Modeling PM Air Quality Impacts of the Proposed OBOT Facility

> H. Andrew Gray Gray Sky Solutions San Rafael, CA

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I. INTRODUCTION

A. Scope of Work

I have been retained by counsel for the defendant in Oakland Bulk & Oversized Terminal, LLC, vs. City of Oakland (Case No. 16-CV-7014) to address, from the perspective of an atmospheric scientist, the issue of whether particulate matter (PM) emitted from the proposed Oakland Bulk and Oversized Terminal (OBOT) facility will substantially contribute to elevated levels of air pollution in the neighborhoods surrounding the proposed facility. I understand that the OBOT facility has been proposed to be constructed and operated in the Gateway Development Area at the location of the former Oakland Army Base adjacent to the Bay Bridge entrance in northwest Oakland.

I address in this report the question of whether fugitive dust emissions from the proposed facility and the associated transportation (rail) operations will substantially contribute to elevated levels of airborne particulate matter (PM) pollution, and if so, to quantify the amount of that contribution. In addition, based on the results of my atmospheric dispersion modeling simulations, I identified and mapped the boundary of the area in which the proposed OBOT's operations contribution to ambient particulate matter pollution will be most significant.

B. Methodology

Based upon my education and professional experience as an atmospheric scientist, I conducted an air dispersion modeling analysis to determine the air quality impacts in the surrounding neighborhoods due to OBOT's proposed operations. I compiled the necessary information to describe the plant's emissions of particulate matter (PM) from each operation at the proposed OBOT facility. I used this information as input to the AERMOD dispersion model which simulated the dispersion of fine particulate matter that would be emitted during OBOT's routine operations into the surrounding community for every hour during the five-year period 2011-2015.

C. Conclusions

Based on the modeling analysis that I conducted, I concluded that emissions from the proposed OBOT operations will, in fact, substantially contribute to elevated levels of fine particulate matter in the ambient air over a large area surrounding the facility. The model estimated that the long-term average $PM_{2.5}$ concentrations¹ will be increased by at least 0.5 μ g/m³ due to OBOT's emissions over an area of 3.5 square kilometers surrounding the facility, if the northerly mainline rail corridor is used. If the southerly mainline rail corridor is used, OBOT's emissions would be responsible for an

¹ PM_{2.5} refers to particles that are smaller than 2.5 microns in diameter.

increase in long-term average PM_{2.5} concentrations that exceeds 0.5 μ g/m³ over an area of 5.4 square kilometers. The area in which PM_{2.5} concentrations from the proposed OBOT facility would exceed 0.5 μ g/m³ is shown in Figure 1, below, for the northerly mainline rail route.² Figure 2 shows the area in which PM_{2.5} concentrations from the proposed OBOT facility would exceed 0.5 μ g/m³ for the southerly mainline rail scenario.



Figure 1. Modeled long-term $PM_{2.5}$ concentrations exceeding 0.5 μ g/m³, north rail scenario

 $^{^2}$ Modeled annual average $PM_{2.5}$ concentrations exceeded 0.5 $\mu g/m^3$ within the brown shaded region in Figures 1 and 2.



Figure 2. Modeled long-term PM_{2.5} concentrations exceeding 0.5 μg/m³, south rail scenario

The model results also demonstrated that short-term PM_{2.5} concentrations would increase substantially in the vicinity of the proposed OBOT facility. According to the model predictions, OBOT's proposed operations would increase the peak 24-hour average PM_{2.5} concentrations by more than 1.0 μ g/m³ at numerous schools and parks within Oakland and Emeryville. At many of the closest sensitive receptors, such as the Bay Bridge toll plaza, the Alexander Zuckerman Bicycle and Pedestrian Path, Gateway Park, Raimondi Park, and Memorial Park, the peak 24-hour average PM_{2.5} concentrations would be increased by more than 2.5 μ g/m³, up to 8.4 μ g/m³ (on the nearby multi-use bike path).

D. Qualifications

I am an environmental engineer and atmospheric scientist with 39 years of professional experience performing air quality dispersion modeling and related analyses. I received my Bachelor of Science (BS) in civil engineering / engineering and public policy from Carnegie-Mellon University in 1979. I earned a Master of Science (MS) and a Ph.D. in environmental engineering science from the California Institute of Technology (Caltech), with a minor emphasis in numerical methods. My doctoral thesis, on the control of atmospheric carbon particles in the Los Angeles region, includes a number of analyses that have been relied upon and cited repeatedly by atmospheric modelers, researchers, and government planners during the last thirty years.

I have developed, evaluated, and applied air pollution dispersion models in academic, regulatory and consulting environments. I developed and applied the methodologies for assessing particulate matter and visibility that were used by the South Coast Air Quality Management District (Southern California) for their air quality management plans during the 1980s and 1990s. I managed a team of researchers that evaluated the MESOPUFF model (the precursor to CALPUFF) for the US Interagency Workgroup on Air Quality Modeling (IWAQM).

As a consultant, I have modeled the air quality impacts of thousands of emission sources, using a variety of air quality models (including AERMOD, CALPUFF, CAMx, CMB, etc.) for various clients, including industry (e.g., diesel engine manufacturers and the off-shore container shipping industry), government (e.g., US EPA and US Dept. of Justice), and environmental organizations (including Sierra Club and National Parks Conservancy Association).

I have authored hundreds of technical reports, many of which have been published in peer-reviewed journals and symposia. I have provided expert testimony regarding air dispersion modeling analyses at numerous hearings, depositions, and at trial. In April 2014, I was invited by the Royal Institute of International Affairs to participate in the "Balancing Global Energy Policy Objectives: A High-Level Roundtable" meeting.

I have expertise in air quality monitoring, statistical analyses, atmospheric chemistry, meteorology, particle processes, atmospheric transport and deposition, numerical methods, computer modeling, air quality control strategy design, and environmental public policy. An integral part of my research has involved developing, applying, and evaluating computer modeling tools to determine the air quality impacts of emission sources in the areas surrounding those sources. My experience and qualifications are described in detail in the attached resume (Attachment A).

E. Compensation

I am compensated for my work on this engagement at a rate of \$160 per hour. The opinions I render in this matter are not contingent upon my compensation.

F. Supporting Documentation

I relied on various documents and data in the process of performing my analysis and reaching my opinions in this matter, including facility maps, engineering diagrams, and other documents that characterize the proposed OBOT facility and its operation, including the report by ESA Associates ("ESA Report")³ and the Basis of Design documents⁴. Land use and topographic data were obtained from the US Geological Survey (USGS), and meteorological data were obtained from the National Oceanic and Atmospheric Administration (NOAA). I also consulted US EPA modeling guidelines and user's guides for the AERMOD model and its associated preprocessing programs. A list of the specific materials that I relied upon in preparing the analysis, opinions, and findings set forth in this report can be found in Appendix A.

G. Previous Testimony

The following is a list of cases in which I have provided expert testimony at deposition or trial during the previous 4 years:

- Natural Resources Defense Council, Inc., Sierra Club, Inc., Environmental Law and Policy Center, and Respiratory Health Association (Plaintiffs) vs. Illinois Power Resources, LLC and Illinois Power Resources Generating, LLC (Defendants). United States District Court for the Central District of Illinois, Peoria Division, Case No. 1-13-cv-01181. Expert reports and deposition provided on behalf of plaintiffs.
- (2) Sierra Club (Plaintiff) vs. Energy Future Holdings Corporation and Luminant Generation Company LLC (Defendants). United States District Court for the Western District of Texas, Waco Division, Civil Action No. 6:12-cv-00108-WSS. Expert reports, deposition, and testimony at trial, provided on behalf of plaintiffs.

³ ESA Associates, Report on the Health and/or Safety Impacts Associated with the Transport, Storage, and/or Handling of Coal and/or Coke In Oakland, Including at the Proposed Oakland Bulk and Oversized Terminal in the West Gateway Area of the Former Oakland Army Base. June 2016.

⁴ HDR, Basis of Design (BoD), Oakland Bulk and Oversized Terminal, Preliminary Engineering, Prepared for California Capital Investment Group, Sections 1 -19c and Appendix. (July 2015) (OAK054818 thru OAK054832).

II. PROPOSED OBOT FACILITY

There has been a proposal to construct and operate a bulk and oversized commodity export terminal, the Oakland Bulk and Oversized Terminal (OBOT), at the Gateway Development Area of the former Oakland Army Base in West Oakland, as shown in Figure 3, below. It has further been proposed that coal be considered as a commodity that would be handled, stored, and transported through the OBOT facility.



Figure 3. Location of proposed OBOT facility

The handling of coal at the OBOT facility, including transport by train, unloading, storage, transfer, and loading the coal onto ships (transloading), will result in "fugitive emissions⁵ of coal dust, in the form of fine particulate matter (PM). The emitted fine coal dust gets carried by the winds into the nearby communities (and beyond).

⁵ The term "fugitive emissions", refers to PM emissions that do not originate from a specific location such as a stack or flue (point sources), and are often emitted across a defined area or volume.

Coal dust contains numerous environmental pollutants, including sulfur, arsenic, chromium, cadmium, mercury, and other toxic metals, many of which have been found to be carcinogenic. As stated in the ESA report⁶, the Union of Concerned Scientists have noted that, "Scientific research points to potential health hazards related to coal dust. Inhalation of fugitive coal dust could result in heart and lung issues, cancers, childhood growth and development problems." Numerous scientific studies have clearly demonstrated that there is a causal relationship between both short-term (a day or multiple days) and longer-term (several months to years) exposure to PM_{2.5} and a wide range of adverse health outcomes, including respiratory impairment, asthma exacerbation, non-fatal heart attacks, adverse birth outcomes (premature births, low birth weight), and cardiovascular disease related mortality.

The US EPA has long recognized the inherent dangers associated with the inhalation of fine particulate matter. Airborne fine particles are regulated by the US EPA as a provision of the Clean Air Act. The primary national ambient air quality standards (NAAQS) require that annual average and 24-hour average PM_{2.5} levels be maintained below prescribed values in order to protect public health.

Fugitive coal dust emissions from the proposed OBOT facility have the potential to increase ambient PM_{2.5} concentrations in the neighborhoods adjacent to the facility, including West Oakland. Much of the area adjacent to the main rail lines that are proposed to be used to transport coal to the OBOT facility, as well as adjacent to the proposed OBOT facility itself, have been designated as "California EPA Disadvantaged Communities", which is an indication that concentrations of air pollutants are particularly high in these areas, and the resident populations are most vulnerable to air quality related health impacts. Examination of ambient air quality data confirms that the communities surrounding the OBOT facility currently experience some of the worst air quality in the region.

I used a computer model to simulate the dispersion of coal dust particulate matter that would be emitted from each of the proposed OBOT operations (emission sources). The objective of the modeling was to determine the potential impacts to the surrounding community's PM air quality due to OBOT's proposed operations involving the transportation of coal through the facility. The air quality impact was quantified as the increase in ambient $PM_{2.5}$ concentrations⁷ due to OBOT's emissions.

⁶ ESA report, pg 5-9

⁷ The ambient $PM_{2.5}$ concentration (μ g/m³) equals the mass of particles (smaller than 2.5 microns in diameter) in the air near ground level divided by the volume of air.

III. MODEL APPLICATION

A. Model Selection

The AERMOD air quality model was used to determine the increase in ambient PM_{2.5} concentrations in the area surrounding the OBOT facility due to fugitive dust emissions within the facility and during transport of coal to the facility. AERMOD^{8,9,10} is a steady-state plume model that considers atmospheric dispersion based on the planetary boundary layer turbulence structure and scaling concepts. AERMOD has been adopted by the US Environmental Protection Agency (EPA) in Appendix W to its Guideline on Air Quality Models¹¹ as the preferred near-field dispersion model for regulatory assessments of industrial point sources, including determinations of compliance with the National Ambient Air Quality Standards (NAAQS) and evaluations of proposed new emission sources.

In addition to the AERMOD dispersion module, the AERMOD modeling system includes AERMET, a meteorological data preprocessor, and AERMAP, a terrain data preprocessor for treatment of complex terrain. The protocol that I used for this modeling analysis follows the guidance for AERMOD application established in US EPA's modeling guidelines¹² and the AERMOD implementation guide.¹³

This report describes the modeling exercise that I conducted using the AERMOD model to evaluate the impact of fugitive dust emissions from the proposed OBOT facility on ambient $PM_{2.5}$ concentrations in the area surrounding the facility. The necessary input data including source characteristics, receptor and meteorological data, and modeling options are described below, followed by a summary of the model results.

⁸ U.S. Environmental Protection Agency. AERMOD: Description of Model Formulation. EPA-454/R-03-004. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. September 2004.

⁹ U.S. Environmental Protection Agency. Addendum: User's Guide for the AMS/EPA Regulatory Model – AERMOD. EPA-454/B-03-001. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711, March 2011.

¹⁰ U.S. Environmental Protection Agency. User's Guide for the AMS/EPA Regulatory Model – AERMOD. EPA-454/B-16-011. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. December 2016.

 ¹¹ U.S. Environmental Protection Agency. Guideline on Air Quality Models, 40 CFR Part 51, Appendix W.
 Published in the Federal Register, Vol. 70, No. 216, November 9, 2005.
 ¹² Ibid

¹³ U.S. Environmental Protection Agency. AERMOD Implementation Guide. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. 2009.

http://www.epa.gov/ttn/scram/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf

B. Source Data

Routine operations at the proposed OBOT facility were divided into various different operations, each defined as a separate emission source for modeling purposes. Each emission source was associated with a specific location, physical size, and emission rate. The emission sources associated with the handling, storage, and transloading of coal at the proposed OBOT facility were:

- Mainline Rail Transport
- Staging at the Port Railyard and OBOT Spur
- Unloading of Coal
- Coal Storage
- Transfer to Storage and Shiploaders via Conveyors
- Transloading to Ships

The approximate locations where each of the emission sources would occur were determined using "basis of design" conceptual design maps for the OBOT facility^{14,15} and Google Earth. Mainline rail shipments were considered to approach the port railyard and OBOT spur from either from the north or the south along the Union Pacific RR mainline rail corridor, each terminating at the location of the proposed TLS terminal facility. The location of the three rail sources (northerly route, southerly route, and spur to the OBOT facility) are shown in Figure 4, below.¹⁶

 ¹⁴ HDR, Basis of Design (BoD), Oakland Bulk and Oversized Terminal, Preliminary Engineering, Prepared for California Capital Investment Group, Sections 1 -19c and Appendix. (OAK054818 thru OAK054832).
 ¹⁵ ESA report, and OBOT Master Plan (OAK 054822), and OBOT Plan Diagrams OAK054829.

¹⁶ The southerly route is under construction north of Adeline St. and was assumed to follow tracks along a westerly route through the new rail yards past the intermodal terminal.



Figure 4. Location of rail emission sources

The modeled locations for the unloading, storage, transfer, and transloading operations at the OBOT facility are shown in Figure 5. The transfer operations were positioned to approximate the path of the conveyors from the unloading hoppers to the storage and transloading sites.



Figure 5. Location of OBOT emission sources

In addition to each source's location, the AERMOD model requires, for fugitive dust sources, specification of the height (above ground) of release, the initial lateral and vertical dimension of the emitted dust plume, and the pollutant emission rate.¹⁷

The physical dimensions of the rail cars, unloading hoppers, conveyors, storage units, and ship loaders were obtained from "basis of design" diagrams and maps.^{18,19} These data were used to estimate the Initial lateral and vertical volume source spreading parameters required by AERMOD, following guidance in the AERMOD User's Guide.²⁰

The rail lines were modeled within AERMOD as strings of individual volume sources, located every 40 meters, which resulted in 92 modeled rail segments along the north route, 150 rail segments along the southern route, and 64 rail segments for the spur from the port rail yard to the proposed OBOT facility. The conveyor operations

¹⁷ "Pollutant emission rate" is the mass of pollutant (PM_{2.5}) released into the atmosphere per unit time (lb/hr).

 ¹⁸ HDR, Basis of Design (BoD), Oakland Bulk and Oversized Terminal, Preliminary Engineering, Prepared for California Capital Investment Group, Sections 1 -19c and Appendix. (OAK054818 thru OAK054832).
 ¹⁹ ESA report, and OBOT Master Plan (OAK 054822), and OBOT Plan Diagrams OAK054829.

²⁰ U.S. Environmental Protection Agency. User's Guide for the AMS/EPA Regulatory Model – AERMOD. EPA-454/B-16-011. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. December 2016.

were also split along the length of the conveyors from the unloading hoppers to the storage facilities, accounting for 16 separately located segments.

ESA²¹ estimated fugitive coal dust emission rates for each of the operations of the proposed OBOT facility, based on a number of assumptions regarding the length of trains, number of trips, effectiveness of proposed control measures, etc. Dr. Sahu has revised the estimated particulate matter emission rates for each emission source,²² which are shown in Table 1. Dr. Sahu estimated annual average emission rates based on expected routine operations, and also maximum 24-hour average emission rates, which were used to model the peak 24-hour impacts.

Annual Average (Ib/day)	Max 24-hr Average (Ib/day)
22.61	33.95
36.86	55.35
63.95	66.69
2.29	4.73
1.26	1.27
20.07	20.24
4.69	4.73
111 00	121 61
114.00	131.01
129.13	153.01
	Annual Average (lb/day) 22.61 36.86 63.95 2.29 1.26 20.07 4.69 114.88 129.13

Table 1. Modeled Fugitive PM_{2.5} Emissions for the Proposed OBOT Facility

I modeled two different scenarios using Dr. Sahu's estimated emission rates, as shown in Table 1. The first scenario ("North rail") includes transport of coal along the northerly route, and then along the spur to OBOT, plus operation of the hoppers (loading was assumed to be split evenly between Hopper A and Hopper B), conveyors, storage (activity is split evenly between all three storage units), and transloading onto ships. The second scenario ("South rail") includes transport of coal along the southerly route rather than the northerly route, followed by the same operations as the "North rail" scenario (spur, unloading, transfer, storage, and transloading).

 ²¹ ESA report.
 ²² Expert report of Dr. Ranajit Sahu.

²³ The north rail and south rail PM_{2.5} emissions were computed using Dr. Sahu's estimates of 9.89 lb/day per track mile for the annual average, and 14.85 lb/day track mile for peak 24-hour average.

C. Receptor Data

The AERMOD model is designed to estimate pollutant concentrations at a specified set of locations within the modeling domain, which are referred to as the modeled "receptors". For the current AERMOD application, I defined a set of gridded modeled receptors on a 6 km x 6 km grid surrounding the proposed OBOT facility using 50 m grid spacing, accounting for 14,641 virtual receptors (121 E/W x 121 N/S). The modeling domain is shown in Figure 6, below. Receptor elevations were determined using the AERMAP program (v11103), for which the 1/3 arc-second National Elevation Dataset (NED) data²⁴ were input.



Figure 6. AERMOD modeling domain (6 km x 6 km)

²⁴ Multi-Resolution Land Characteristics Consortium (MRLC). https://www.mrlc.gov/

In addition to the gridded receptors, a set of sensitive receptors were identified, which includes nearby parks (and playgrounds), schools (and day-care centers), the multi-use bicycle path²⁵, and the toll plaza for the Bay Bridge, as shown in Table 2, below.

Sensitive Receptor Location Latikud UTMs (m) UTM								Distance	e (km) to
Toti Plaza Bay Bindge Toll Flaza 172.48466 122.13607 562384.00 448602.00 0.42 1.40 0.27 1.40 2.61 Bilk Pabk Lexander Zuckermann Bicycle and Pedestrian Path (1) 37.82194 122.32509 55900.11 446663.20 40 1.60 2.23 Alexander Zuckermann Bicycle and Pedestrian Path (1) 37.82308 122.31512 500185.10 416662.21 3.4 0.30 1.55 Alexander Zuckermann Bicycle and Pedestrian Path (1) 37.82378 122.31612 50115.51 416662.21 3.4 0.30 1.55 Alexander Zuckermann Bicycle and Pedestrian Path (1) 37.82014 122.3175 5022.55 1.48564.83 3.0 0.92 0.97 Alexander Zuckermann Bicycle and Pedestrian Path (1) 37.82174 122.3187 522.837.5 418675.53 4.1 1.93 1.66 1.71 1.33 Alexander Zuckermann Bicycle and Pedestrian Path (1) 37.82174 122.3171 5022.050 41571.93.2 1.10 1.93 1.66 1.71 1.33 Oakland Park (1) 37.83027 122.38171		Sensitive Receptor Location	Latitude	Longitude	UTMx (m)	UTMy (m)	Elevation (m)	Hopper A	Spur/Yard
Bike Path Alexander Zuckernam Bicyclar and Pedistrian Path (1) 27.82145 122.23292 5902.07.2 418023.60 2.2 1.08 2.23 Alexander Zuckernam Bicyclar and Pedistrian Path (1) 37.82230 122.3058 5907.65 418023.67 3.8 0.09 1.85 Alexander Zuckernam Bicyclar and Pedistrian Path (1) 37.82370 122.3156 5007.14 418642.81 3.6 0.030 1.55 Alexander Zuckernam Bicyclar and Pedistrian Path (1) 37.82370 122.31164 5007.14 418642.81 3.6 0.032 0.72 Alexander Zuckernam Bicyclar and Pedistrian Path (1) 37.82376 4.5 1.71 1.33 Alexander Zuckernam Bicyclar and Pedistrian Path (1) 37.82378 1.22.23425 56210.87 418695.01 1.71 1.33 Alexander Zuckernam Bicyclar and Pedistrian Path (1) 37.82378 4.12 1.61 1.65 Oadam Park Steward Path (1) 37.82378 1.22.2442 5621.67 41865.31 7.2 4.6 1.61 Alexander Zuckernam Bicycla and Pedistrian Path (1) 37.83378 1.22.244 1.61 <td< th=""><th>Toll Plaza</th><th>Bay Bridge Toll Plaza</th><th>37.824816</th><th>-122.313867</th><th>560384.00</th><th>4186600.00</th><th>4.4</th><th>0.27</th><th>1.49</th></td<>	Toll Plaza	Bay Bridge Toll Plaza	37.824816	-122.313867	560384.00	4186600.00	4.4	0.27	1.49
Alexander Zuckernann Bicyclan dredictrian Path () 9728104 128203 922005 92200 922005 92200 922005 92200 922005 92200 922005 92200 922005 92200 922005 92200 922005 92200 922005 92200 92000	Bike Path	Alexander Zuckermann Bicycle and Pedestrian Path (1)	37.821541	-122.329592	559002.72	4186226.60	2.2	1.49	2.61
Alexander Zuckernann Bioyde and Pedistrian Path (1) 3.282308 122.3028 122.3028 125.302 1		Alexander Zuckermann Bicycle and Pedestrian Path (2)	37.821845	-122.325059	559401.43	4186263.20	4.0	1.08	2.23
Alexander Zuckermann Bioycle and Pedestrian Path (b) 37.82307 -122.1312 60056.1 418642.8 2.6 0.6 1.26 Alexander Zuckermann Bioycle and Pedestrian Path (b) 37.82304 122.30736 50071.54 418542.8 2.6 0.6 1.26 Alexander Zuckermann Bioycle and Pedestrian Path (b) 37.82304 122.23808 51355.2 41875.53 2.4 1.33 Alexander Zuckermann Bioycle and Pedestrian Path (b) 37.82303 122.23817 52205.60 41571.52 3.7 1.88 0.66 Osland Patrix (c) 37.83531 122.23817 52205.50 41571.52 3.7 1.89 0.66 Memorial Park (c) 37.83573 122.23817 52206.23 41551.22 3.7 1.89 0.66 Memorial Park (c) 37.83276 122.23817 52206.23 41551.22 3.7 1.89 0.66 Memorial Park (c) 37.83276 122.23817 52206.23 41551.22 3.7 1.88 0.66 Memorial Park (c) 37.83276 122.23815 5252.50 41551.22 1.16 0.55 1.26 0.55 2.210 0.55<		Alexander Zuckermann Bicycle and Pedestrian Path (3)	37.822390	-122.320568	559796.25	4186326.54	3.8	0.69	1.88
Alexander Zuckermann Bioycle and Pedestrian Path (f) 37.82374 122.311894 80076.14 418684.65 3.6 0.61 1.64 Alexander Zuckermann Bioycle and Pedestrian Path (f) 37.82364 122.30280 51355.16 418654.85 3.6 0.52 0.97 Alexander Zuckermann Bioycle and Pedestrian Path (f) 37.82364 122.20485 50352.52 418721.55 4.1 1.93 Alexander Zuckermann Bioycle and Pedestrian Path (f) 37.82378 122.21762 50962.18 41871.55 4.1 1.93 0.66 Oasland Parks Gatewary Park (new) 37.82378 122.23172 520562.12 3.7 1.98 0.66 Bilmondi Park (f) 37.82374 122.23075 520562.52 3.8 2.00 1.88 Mernorial Park (f) 37.82374 122.38085 52252.05 41853.07 3.3 2.00 1.02 Mernorial Park (f) 37.82374 122.8808 54857.56 41853.02 3.8 2.18 0.95 Mernorial Park (f) 37.81374 122.230805 54259.02 41833.62 2.24 1.01 Mernorial Park (f) 37.81308		Alexander Zuckermann Bicycle and Pedestrian Path (4)	37.823078	-122.316132	560186.10	4186405.72	3.4	0.30	1.55
Alexander Zuckermann Bioycle and Pedestrian Path (f) 37.82105 12.200786 60071.54 4186846.83 3.0 0.92 0.97 Alexander Zuckermann Bioycle and Pedestrian Path (g) 37.82105 11.22.20886 61375.52 418675.02 4.5 1.72 1.83 Alexander Zuckermann Bioycle and Pedestrian Path (g) 37.82131 11.22.20816 6120.87 41889180.31 2.4 0.81 1.93 Baimond Park (G) 77.81573 11.22.20817 6202.87 4189180.31 2.4 0.81 0.66 Memorial Park (G) 37.81573 11.22.20816 6207.852 4189180.31 2.4 0.81 0.66 Memorial Park (G) 37.81373 11.22.20816 6207.852 41893.01.14 3.9 2.09 1.18 Memorial Park (G) 37.81383 11.22.20816 6405.752 41893.02 3.6 2.14 0.98 Memorial Park (G) 37.81383 11.22.20816 6430.812.01 3.8 2.14 0.98 Memorial Park (G) 37.800873 11.82.20816 6430.82.01 2.14 0.98 Memorial Park (G) 37.800873 11.22.20816 <td></td> <td>Alexander Zuckermann Bicycle and Pedestrian Path (5)</td> <td>37.823747</td> <td>-122.311694</td> <td>560576.14</td> <td>4186482.81</td> <td>2.6</td> <td>0.16</td> <td>1.26</td>		Alexander Zuckermann Bicycle and Pedestrian Path (5)	37.823747	-122.311694	560576.14	4186482.81	2.6	0.16	1.26
Alexander Zuckermann Bioyce and Pedestrian Path (1) 37.82506 -122.02080 51555.16 418675.96 4.5 1.28 Alexander Zuckermann Bioyce and Pedestrian Path (9) 37.82736 122.24945 52018.77 418880.72 4.5 1.71 1.38 Oakland Parks Gateway Park (new) 37.82736 122.21762 53067.12 41871.5 2.4 1.74 1.66 Oakland Parks Gateway Park (new) 37.82133 122.23175 5205.05 418571.74 2.4 1.74 0.66 Nemorial Park (1) 37.82133 122.23175 5205.05 418571.74 2.4 1.74 0.66 Memorial Park (1) 37.82136 122.239312 5205.05 418530.07 3.3 2.09 1.10 Memorial Park (1) 37.82136 122.28931 5205.05 418530.07 3.3 2.08 1.10 Memorial Park (1) 37.81308 122.23912 5225.02 418331.62 2.21 1.01 Memorial Park (1) 37.81308 122.23926 5235.027 418331.62 2.23 1.02 Memorial Park (10) 37.81063 122.23926 </td <td></td> <td>Alexander Zuckermann Bicycle and Pedestrian Path (6)</td> <td>37.824314</td> <td>-122.307196</td> <td>560971.54</td> <td>4186548.65</td> <td>3.5</td> <td>0.53</td> <td>1.04</td>		Alexander Zuckermann Bicycle and Pedestrian Path (6)	37.824314	-122.307196	560971.54	4186548.65	3.5	0.53	1.04
Alexander Zuckermann Bicycle and Pedestrian Path (B) 37.82381 1:22.224845 55:02 45.50 4.55 1.12 1.18 Alexander Zuckermann Bicycle and Pedestrian Path (D) 37.82027 1:22.23415 55:02.06 415:02.33 4.1 1.33 1.66 Osaland Patra (Rev) 37.82113 1:22.23417 55:02.06 415:02.33 4.1 1.93 1.66 Baimondi Patr (Rev) 37.81173 1:22.23417 55:02.07.2 415:05.12.2 4.1 1.48 0.66 Menonial Patr (1) 37.82133 4:22.23403 55:05.07 415:01.14 2.00 1.18 Menonial Patr (2) 37.81233 4:22.23803 55:05.07 415:01.34 2.20 1.10 Menonial Patr (3) 37.81233 4:22.23803 55:05.05 415:01.37 3.3 2.09 1.18 Menonial Patr (1) 37.81233 4:22.23803 55:05.05 415:07.07 3.1 2.44 0.91 Menonial Patr (1) 37.81233 4:22.20803 56:35.02 445:07.05 4.5 4.21 1.01 Menonial Patr (1) 37.81203 1:22.20465 56:35.0		Alexander Zuckermann Bicycle and Pedestrian Path (7)	37.825065	-122.302830	561355.16	4186634.83	3.0	0.92	0.97
Alexander Zuckermann Bicycle and Pedestrian Path (9) 37.83277 1.22.29425 552.002 4.5 1.71 1.33 Oskland Parke Gateway Park (new) 37.831271 22.23115 552.05 4157.123.33 1.22 1.72 1.31 Raimondi Park E 37.815764 1.22.234275 550.02 3.455.77.42 2.4 1.74 0.55 Raimondi Park E 37.815764 1.22.294375 550.75.6 41860.87 3.4 2.00 1.17 Memonal Park (1) 37.81374 1.22.29485 5505.75.6 41861.367 3.1 2.02 1.10 Memonal Park (1) 37.81374 1.22.29895 5505.05 41861.367 3.1 2.14 0.98 Memonal Park (1) 37.81306 1.22.29897 5504.05.4 41861.36 4.4 2.21 1.01 Memonal Park (1) 37.81306 1.22.29897 5604.05.4 41861.36 4.4 2.21 1.02 Memonal Park (1) 37.81306 1.22.29897 5604.85.4 41850.35 6.7 2.36 1.12 Memonal Park (10) 37.80363 1.22.291.15 5623.45.4 <t< td=""><td></td><td>Alexander Zuckermann Bicycle and Pedestrian Path (8)</td><td>37.826131</td><td>-122.298498</td><td>561735.52</td><td>4186755.96</td><td>4.5</td><td>1.32</td><td>1.08</td></t<>		Alexander Zuckermann Bicycle and Pedestrian Path (8)	37.826131	-122.298498	561735.52	4186755.96	4.5	1.32	1.08
Alexander Zuckermann Biotycle and Pedestrian Path (10) 37.82277 122.23917 552205.00 4152133 4.1 1.66 Oakland Park Raimondi Park (mew) 37.81133 122.239175 552005.21 4156185.31 2.4 0.61 0.55 Memorial Park (1) 37.81139 122.239125 55205.23 415600.37 3.4 2.00 1.18 Memorial Park (2) 37.82139 122.239035 55255.55 416630.37 3.4 2.00 1.18 Memorial Park (3) 37.81236 122.239315 55256.05 416530.27 3.3 2.00 1.10 Memorial Park (3) 37.81206 122.239315 55256.05 416530.27 3.5 4.212 0.55 Memorial Park (1) 37.81003 322.23965 55246.54 418531.65 4.4 2.21 0.55 Memorial Park (1) 37.81003 322.23965 55205.27 418977.67 3.1 2.14 0.36 Memorial Park (1) 37.80033 122.23965 55205.27 <th418975.83< th=""> 6.4 2.36<td></td><td>Alexander Zuckermann Bicycle and Pedestrian Path (9)</td><td>37.827368</td><td>-122.294245</td><td>562108.77</td><td>4186896.02</td><td>4.5</td><td>1.71</td><td>1.33</td></th418975.83<>		Alexander Zuckermann Bicycle and Pedestrian Path (9)	37.827368	-122.294245	562108.77	4186896.02	4.5	1.71	1.33
Oakland Parks Gateway Park (new) 37.81233 1.22.21278 5509218 48.8113 2.4 0.81 1.93 Raimondi Park W 37.81574 2.22.9437 5501202 4.85717.42 2.4 1.48 0.66 Memorial Park (1) 37.82334 1.22.9846 556275.54 418640.87 3.4 2.09 1.10 Memorial Park (2) 37.82334 1.22.28945 5555.00 418613.07 3.2 2.09 1.10 Memorial Park (5) 37.81754 1.22.28945 5555.00 418513.626 4.4 2.48 0.95 Memorial Park (5) 37.81754 1.22.28945 5553.00 418531.626 4.4 2.48 1.02 0.95 Memorial Park (1) 37.81060 1.22.29945 5523.027 418037.66 6.0 2.28 1.02 Memorial Park (10) 37.80968 1.22.29945 5523.027 41807.62 6.4 1.24 1.03 Memorial Park (10) 37.80961 1.22.29945 5524.57 418530.22 1.22 1.04		Alexander Zuckermann Bicycle and Pedestrian Path (10)	37.830277	-122.293117	562205.60	4187219.53	4.1	1.93	1.66
Raimondi Park W 37.81576 1.22.29312 520162.3 418512.52 3.7 1.89 0.66 Memoral Park (1) 37.82334 1.22.29312 55278.52 4185012.5 3.7 1.99 0.66 Memoral Park (2) 37.82195 5228055 55278.54 418501.2 3.9 2.09 1.18 Memoral Park (2) 37.82195 5228005 418501.2 3.6 2.12 101 Memoral Park (4) 37.83103 122.29804 55250.55 418502.0 3.6 2.12 105 Memoral Park (6) 37.81503 122.29804 55250.57 418551.6 4.4 2.21 0.95 Memoral Park (7) 37.81503 122.29804 55280.27 418551.6 4.4 2.21 0.95 Memoral Park (17) 37.80806 122.29105 55280.27 4184553.6 6.0 2.28 1.02 Memoral Park (19) 37.80806 122.29105 55280.27 4184553.6 6.0 2.89 1.12 Memoral Park (10) 37.80963 122.29105 55382.00 4184553.6 6.0 2.89 1.12<	Oakland Parks	Gateway Park (new)	37.821133	-122.321762	559692.18	4186186.31	2.4	0.81	1.93
Raimondi Park E 37,81793 122,81793 52217.0 418640.87 3.4 1.00 1.27 Memoral Park (1) 37,82334 122,28894 55278.5 418640.87 3.4 2.09 1.18 Memoral Park (3) 37,82056 122,28935 55250.5 4186130.14 3.9 2.09 1.00 Memoral Park (3) 37,82056 122,28931 55250.5 4185377.07 3.1 2.14 0.95 Memoral Park (6) 37,81030 122,28943 56248.8 41855.92 3.8 2.18 0.95 Memoral Park (6) 37,81030 122,28161 56248.5 4485.592 3.8 1.02 Memoral Park (10) 37,80503 122,28140 55308.49 41852.08 5.5 1.21 Memoral Park (10) 37,80525 122,28140 55332.04 418470.0 5.5 1.21 Memoral Park (11) 37,80526 122,28245 5247.54 418470.0 5.5 2.500 1.31 Metoral Park (10) 78,8056 122,28945		Raimondi Park W	37.816746	-122.294375	562106.23	4185717.42	2.4	1.74	0.55
Memoral Park (1) 37.82374 122.28894 55278.52 48650.27 3.4860.27 3.9 2.09 1.18 Memoral Park (2) 37.821975 122.28934 55262.50 48650.11 3.9 2.09 1.10 Memoral Park (4) 37.81503 122.28934 55259.55 485570.07 3.1 2.14 0.98 Memoral Park (5) 37.81503 122.289347 56248.54 485512.6 3.8 2.18 0.95 Memoral Park (7) 37.81503 122.29045 56230.57 4185516.2 4.4 2.21 1.05 Memoral Park (10) 37.81063 122.29165 55230.57 418455.3 6.0 2.28 1.02 Memoral Park (11) 37.800761 122.29145 55280.57 418455.3 6.7 2.36 1.12 Memoral Park (11) 37.800761 122.29145 543850.82 3.2 1.61 0.38 Millow Park 37.81306 122.29145 56383.0 418551.6 41850.02 2.60 1.61 Millow		Raimondi Park E	37.815793	-122.293121	562217.40	4185612.52	3.7	1.89	0.66
Memorial Park (2) 37.821975 122.289038 56255.50 418530.14 3.9 2.09 1.18 Memorial Park (3) 37.82056 122.28913 56255.50 418570.27 3.1 2.04 1.00 Memorial Park (4) 37.81308 122.28937 56239.55 418577.07 3.1 2.14 0.98 Memorial Park (5) 37.81308 122.29057 562436.54 4185316.26 4.4 2.21 0.95 Memorial Park (8) 37.81008 122.29067 562436.54 4185316.26 4.4 2.21 0.65 Memorial Park (10) 37.800768 122.29160 56220.57 418045.28 6.67 2.36 1.12 Memorial Park (11) 37.80526 122.293861 56175.67 418520.23 5.5 2.50 1.31 Memorial Park (11) 37.80526 122.293861 56175.67 418520.43 1.88 0.89 McClymonds Mini-Park 37.81220 122.292661 56198.81 148217.67 6.6 2.47 1.22 Mc		Memorial Park (1)	37.823324	-122.288946	562578.52	4186450.87	3.4	2.10	1.27
Memorial Park (3) 37.82056 142.289155 56255.05 418518.07 3.3 2.09 1.10 Memorial Park (4) 37.81363 122.289147 56259.05 418507.07 3.1 2.14 0.98 Memorial Park (6) 37.81503 122.28937 56289.30 418579.21 3.8 2.18 0.95 Memorial Park (7) 37.81104 122.29060 56248.54 41853.62 4.4 2.21 0.95 Memorial Park (9) 37.80063 122.29160 56230.49 418697.65 6.0 2.28 1.02 Memorial Park (10) 37.80061 122.29209 56227.57 41870.52 6.4 2.43 1.11 Memorial Park (11) 37.80356 122.29209 56227.57 418475.78 6.6 2.49 1.32 Memorial Park (11) 37.80356 122.292045 56198.81 418521.23 4.8 1.80 0.59 2.89 1.78 Mullow Park 37.80268 122.292818 56193.81 418217.07 6.6 2.47		Memorial Park (2)	37.821975	-122.289038	562571.56	4186301.14	3.9	2.09	1.18
Memorial Park (4) 37.81363 12.22.89317 552305 418590.20 3.6 2.12 1.01 Memorial Park (5) 37.815023 122.299067 562486.54 418531.65 4.4 0.95 Memorial Park (7) 37.81308 122.290667 562486.54 418531.65 4.4 2.21 0.95 Memorial Park (8) 37.81006 122.29106 56230.27 418507.65 6.0 2.28 1.02 Memorial Park (10) 37.80708 1.22.29107 56236.57 418407.08 6.4 2.43 1.21 Memorial Park (11) 37.807316 122.292405 56237.57 418407.08 6.4 2.43 1.21 Memorial Park (11) 37.807305 122.29317 56238.43 41857.08 3.2 1.61 0.38 Millow Park 37.81204 122.29346 56398.81 41857.07 5.6 2.47 1.22 Defremery Recreation Center 37.81296 1.22.29345 56398.44 418432.05 6.6 2.47 1.22 Defre		Memorial Park (3)	37.820506	-122.289155	562562.50	4186138.07	3.3	2.09	1.10
Memorial Park (6) 37.81724 1.22.289447 562385.3 418577.07 3.1 2.14 0.98 Memorial Park (6) 37.81026 122.299567 562485.0 4185316.26 4.4 2.21 0.05 Memorial Park (7) 37.81068 122.290567 562436.27 418503.76 6.0 2.28 1.12 Memorial Park (10) 37.80069 122.29265 562257.5 418455.38 6.7 2.36 1.12 Memorial Park (10) 37.80058 122.29265 562350.27 418455.38 6.1 2.36 1.12 Memorial Park (11) 37.80355 122.29317 56224.82 418457.03 5.2 2.50 1.31 14th Street Pocket Park 37.81356 122.29346 56303.04 418377.07 5.6 2.47 1.22 South Prescott Park 37.81267 122.29346 563467.26 418487.57 6.6 2.47 1.32 Unde Infonson Park 37.80268 122.29346 563467.26 418487.57 6.6 2.46 1.32 <td></td> <td>Memorial Park (4)</td> <td>37.818363</td> <td>-122.289317</td> <td>562550.05</td> <td>4185900.20</td> <td>3.6</td> <td>2.12</td> <td>1.01</td>		Memorial Park (4)	37.818363	-122.289317	562550.05	4185900.20	3.6	2.12	1.01
Memorial Park (6) 37.81503 122.289937 562486.54 4185529.21 3.8 2.18 0.95 Memorial Park (7) 37.81503 122.299165 562350.27 4185037.65 6.00 2.28 1.02 Memorial Park (8) 37.80603 122.292165 562350.27 4185037.65 6.00 2.28 1.12 Memorial Park (10) 37.807686 122.292612 55225.75 4184705.80 3.2 1.61 0.38 Memorial Park (11) 37.807635 122.298048 56135.00 3.5 2.50 1.31 14th Street Pocket Park 37.81200 122.280436 56332.00 4.85 4.85 2.49 1.52 South Prescott Park 37.80136 122.280436 564347.00 5.9 2.49 1.52 Defremery Recreation Center 37.81250 122.280436 564342.0 418437.57 6.6 2.47 1.22 Defremery Recreation Center 37.82586 1.22.280435 56393.00 418437.57 6.6 2.66 1.26 Defr		Memorial Park (5)	37.817254	-122.289447	562539.55	4185777.07	3.1	2.14	0.98
Memorial Park (7) 37.81108 -122.20057 55.235.27 4185312.65 4.4 2.21 0.95 Memorial Park (8) 37.80063 -122.29140 55230.27 418475.28 6.0 2.28 1.02 Memorial Park (10) 37.807618 -122.292140 55230.27 418475.28 6.4 2.43 1.11 Memorial Park (11) 37.807618 -122.292142 55224.82 418475.20 5.5 2.50 1.31 14th Street Pocket Park 37.81356 -122.280436 56333.00 418875.77 6.6 2.49 1.52 McClymonds Mini-Park 37.81206 -122.280436 56333.00 418875.77 6.6 2.47 1.52 Wade Johnson Park 37.80289 -122.28046 56334.00 418875.77 6.6 2.47 1.52 Useel Park 37.80289 -122.28046 56338.00 418825.77 6.5 2.47 1.52 Useel Park 37.80289 -122.28046 56338.00 418825.78 6.6 2.66 1.80 Useel Park 37.80289 -122.28917 561881.00 418875.71		Memorial Park (6)	37.815023	-122.289937	562498.30	4185529.21	3.8	2.18	0.95
Memorial Park (9) 37.810603 -122.291661 552302.7 418937.85 6.0 2.28 1.02 Memorial Park (10) 37.80063 -122.292140 562309.47 418957.88 6.7 2.36 1.12 Memorial Park (11) 37.800761 +122.29217 56220-57 418970.82 6.4 2.43 1.11 Memorial Park (11) 37.800751 +122.29217 56220-57 418970.82 5.5 2.50 1.31 Mith Park 37.81086 +122.29217 55220-82 82310.41 418570.82 3.2 1.61 0.38 Willow Park 37.81046 +122.29661 561908.81 418570.82 4.6 2.49 1.52 Wade Johnson Park 37.800761 +122.29046 56247.26 418475.78 4.6 2.47 1.52 Uswell Park 37.80071 +122.28728 56281.60 41857.89 6.0 2.46 1.00 Lowell Park 37.80071 +122.28728 562918.44 418471.78 4.6 2.47 1.52 Marston Campbell Park 37.80070 +122.287245 56318.16 4186		Memorial Park (7)	37.813108	-122.290657	562436.54	4185316.26	4.4	2.21	0.95
Memorial Park (9) 37 808963 -122 28240 58289.49 4184855 38 6.7 2.80 1.12 Memorial Park (10) 37 807618 -122 293127 562267.57 4183705.82 6.4 2.43 1.21 Memorial Park (11) 37 80635 -122 293127 56224.82 418452.03 5.5 2.50 1.31 14th Street Pocket Park 37 81056 -122 293128 561908.18 4185212.63 4.8 1.83 0.59 MCUymonds Mini-Park 37 81086 -122 20346 562467.26 4184975.77 6.6 2.47 1.22 Wade Johnson Park 37 80289 -122 28728 56281.60 4184975.77 6.6 2.47 1.22 DeFremery Recreation Center 37 80298 -122 28728 56281.60 4184975.77 6.6 2.66 1.80 Marston Campbell Park 37 80298 -122 28728 56281.61 4184975.70 7.2 7.0 1.82 Oution Plaza Park 37 82298 -122 28728 56314.61 418673.59 4.6 2.66		Memorial Park (8)	37.810603	-122.291661	562350.27	4185037.65	6.0	2.28	1.02
Memorial Park (10) 37 807618 -122 232625 526267.57 4184705.82 6.4 2.43 1.21 Memorial Park (11) 37 806325 -122 239312 562267.57 4185360.83 5.5 2.50 1.31 14th Street Pocket Park 37 81256 -122 29868 56175.57 4185360.82 3.2 1.61 0.38 Willow Park 37 81206 -122 29868 56333.20 418571.08 4.6 2.49 1.52 Wade Johnson Park 37 80076 -122 20936 56333.20 418575.7 6.6 2.47 1.22 DeFremery Recreation Center 37 807613 -122 287375 562681.60 418525.5 6.0 2.66 1.80 Marston Campbell Park 37 807633 -122 287455 562981.64 418641.35 4.7 2.50 1.60 Union Plaza Park 37 820561 -122 287455 562981.64 418641.35 4.7 2.50 1.60 Union Plaza Park 37 820561 -122 287455 561362.14 4186413.5 4.7 2.50 <		Memorial Park (9)	37.808963	-122.292140	562309.49	4184855.38	6.7	2.36	1.12
Memorial Park (11) 37,80235 122,23927 56224.82 418452.03 5.5 2.50 1.11 14th Street Pocket Park 37,813556 122,29808 561755.67 4185300.82 3.2 1.61 0.38 Willow Park 37,81200 122,29808 56332.00 418571.00 5.9 2.89 1.78 South Prescott Park 37,80086 122,299197 561693.34 4184176.78 4.6 2.49 1.52 Wade Johnson Park 37,80289 122,299197 561693.34 4184176.78 4.6 2.47 1.22 DeFremery Recreation Center 37,802757 122,287328 56281.60 4182528.98 6.0 2.46 1.30 Marston Campbell Park 37,80298 122,247813 56333.96 4184944.66 9.7 3.23 1.98 Poplar Playground 37,822986 122,24824 56311.61 4186732.52 6.6 6.6 1.87 Fitzgerald Park 37,82396 122,24824 56311.61 4186531.21 1.96 3.83 2.87 <td></td> <td>Memorial Park (10)</td> <td>37.807618</td> <td>-122.292629</td> <td>562267.57</td> <td>4184705.82</td> <td>6.4</td> <td>2.43</td> <td>1.21</td>		Memorial Park (10)	37.807618	-122.292629	562267.57	4184705.82	6.4	2.43	1.21
14th Street Pocket Park 37.81356 122.293663 561756.7 418330.0.22 3.2 1.61 0.38 Willow Park 37.81204 122.296663 561908.81 4185212.63 4.8 1.83 0.99 McClymonds Mini-Park 37.812046 122.290346 563302.00 418871.77 6.6 2.47 1.52 Wade Johnson Park 37.809136 122.290346 562467.26 418475.77 6.6 2.47 1.22 Defremery Recreation Center 37.812675 122.278178 562681.60 418525.98 6.0 2.46 1.20 Lowell Park 37.800731 122.278183 56339.95 4184944.66 9.7 3.23 1.98 Poplar Playground 37.82258 122.278183 56339.95 418944.66 9.7 2.50 1.60 Union Plaza Park 37.82566 122.2824.85 562182.16 418673.52 6.6 2.66 1.87 Fitzgerald Park 37.82396 122.2824.85 56437.99 418653.21 119.6 3.83 2.87 Mosswood Park 37.82396 122.287281 56407.90 4		Memorial Park (11)	37.806325	-122.293127	562224.82	4184562.03	5.5	2.50	1.31
Willow Park 37.812210 -122.296661 561908.81 4185212.63 4.8 1.83 0.59 McClymonds Mini-Park 37.818046 -122.28045 56333.00 4185871.00 5.9 2.89 1.78 South Prescott Park 37.80288 122.299197 561603.34 418475.77 6.6 2.47 1.22 Defremery Recreation Center 37.80278 122.299346 562467.26 418452.59 6.0 2.46 1.20 Lowell Park 37.80278 122.287813 56383.96 418525.98 6.0 2.46 1.20 Marston Campbell Park 37.80278 122.287813 563383.96 418494.66 9.7 3.23 1.98 Poplar Playground 37.82258 122.28245 56315.16 4186735.92 6.6 2.66 1.87 Fitzgerald Park 37.82366 122.28629 56346.14 4186770.00 7.0 2.70 1.92 Grove Shafter Park 37.82386 122.276679 56497.99 4186582.66 2.0 4.50 3.53 Lafayette Square Park 37.80063 122.276179 56492.02 <t< td=""><td></td><td>14th Street Pocket Park</td><td>37.813556</td><td>-122.298388</td><td>561755.67</td><td>4185360.82</td><td>3.2</td><td>1.61</td><td>0.38</td></t<>		14th Street Pocket Park	37.813556	-122.298388	561755.67	4185360.82	3.2	1.61	0.38
McClymonds Mini-Park 37.818046 122.280436 563332.00 4185871.00 5.9 2.89 1.78 South Prescott Park 37.802889 122.29014 55647.24 4184176.78 4.6 2.49 1.52 Wade Johnson Park 37.80215 122.29714 562681.60 418525.89 6.0 2.46 1.20 Lowell Park 37.80275 122.287878 562681.60 418525.98 6.0 2.46 1.20 Marston Campbell Park 37.80275 122.287813 563339.96 4184446 9.7 3.23 1.98 Poplar Playground 37.82258 122.28425 562982.88 4186413.35 4.7 2.50 1.60 Union Plaza Park 37.82586 122.28246 563115.16 418677000 7.0 2.70 1.92 Grove Shafter Park 37.823936 122.279205 56320.2 4184700 3.83 2.87 Mosswood Park 37.80283 122.279205 56302.20 4184845.6 3.3 2.59 Frank H. Ogawa Plaza		Willow Park	37.812210	-122.296661	561908.81	4185212.63	4.8	1.83	0.59
South Prescott Park 37.802889 122.299197 561693.34 4184176.78 4.6 2.49 1.52 Wade Johnson Park 37.80136 122.299197 561693.34 4184475.77 6.6 2.47 1.22 DeFremery Recreation Center 37.812575 122.287878 562681.60 418475.77 6.6 2.46 1.20 Lowell Park 37.800757 122.287878 562918.14 4184832.05 6.3 2.87 1.61 Marston Campbell Park 37.800693 122.278787 562918.14 418475.00 7.0 3.23 1.98 Poplar Playground 37.822586 122.282824 563115.16 4186735.92 6.6 2.66 1.87 Fitzgerald Park 37.820561 122.282824 563145.14 4186770.00 7.0 2.70 1.92 Grow Shafter Park 37.820581 122.20289 564307.91 4186532.12 19.6 3.83 2.87 Mosswood Park 37.800583 122.27869 56430.20 4186425.66 2.0 4.50 3.53		McClymonds Mini-Park	37.818046	-122.280436	563332.00	4185871.00	5.9	2.89	1.78
Wade Johnson Park 37.809136 122.290346 562467.26 4184875.77 6.6 2.47 1.22 DeFremery Recreation Center 37.812575 122.28528 562681.60 4185255.98 6.0 2.46 1.20 Loweil Park 37.809693 122.275813 56393.94 418494.66 9.7 3.23 1.98 Poplar Playground 37.82258 122.282824 56315.16 4186735.92 6.6 2.66 1.87 Fitzgeral Park 37.82356 122.28284 56314.14 4186735.92 6.6 2.66 1.87 Grove Shafter Park 37.82356 122.28249 56430.79 4186532.12 19.6 3.83 2.87 Mosswood Park 37.82336 122.27170 56427.00 7.0 2.70 1.92 Iafsyette Square Park 37.80088 122.27170 56423.02 418472.92 11.7 3.77 2.50 Jefferson Square Playground 37.80088 122.27131 56449.13 4183866.7 10.0 4.84 3.58 <		South Prescott Park	37.802889	-122.299197	561693.34	4184176.78	4.6	2.49	1.52
DeFremery Recreation Center 37.812575 -122.287878 562681.60 418528.98 6.0 2.46 1.20 Lowell Park 37.808711 -122.285228 562918.14 418432.05 6.3 2.87 1.61 Marston Campbell Park 37.809693 -122.285228 562918.14 4186431.35 4.7 2.50 1.60 Union Plaze Park 37.82586 -122.282845 56314.61.4 418673.00 7.0 2.70 1.92 Grove Shafter Park 37.82586 -122.28249 563116.14 418677.00 7.0 2.70 1.92 Grove Shafter Park 37.82366 -122.28249 564307.99 4186532.12 19.6 3.83 2.87 Mosswood Park 37.80363 -122.27720 56350.20 4183296.63 8.4 3.85 2.59 Frank H. Ogawa Plaza 37.80510 -122.27121 564092.20 4183266.6 2.6 2.72 Lincoln Square Park 37.805711 -122.27131.3 564143.00 418441.56 13.0 4.64 3.37 <td></td> <td>Wade Johnson Park</td> <td>37.809136</td> <td>-122.290346</td> <td>562467.26</td> <td>4184875.77</td> <td>6.6</td> <td>2.47</td> <td>1.22</td>		Wade Johnson Park	37.809136	-122.290346	562467.26	4184875.77	6.6	2.47	1.22
Lowell Park 37.808711 -122.285228 562918.14 4184832.05 6.3 2.87 1.61 Marston Campbell Park 37.800693 -122.279813 553939.36 4184944.66 9.7 3.23 1.98 Poplar Playground 37.825856 -122.284355 552982.88 4186413.35 4.7 2.50 1.60 Union Plaza Park 37.825856 -122.282405 563146.14 4186770.00 7.0 2.70 1.92 Grove Shafter Park 37.823936 -122.269289 564307.90 4186532.12 19.6 3.83 2.87 Mosswood Park 37.803623 -122.27720 563623.02 418477.92 11.7 3.77 2.50 Jefferson Square Playground 37.800783 -122.27710 563623.02 418495.66 9.3 3.96 2.72 Lincoln Square Playground 37.800783 -122.27131 564409.13 418485.66 9.3 3.96 2.72 Lincoln Square Park 37.800743 -122.27131 564409.13 4183845.66 9.3 3.96 <td></td> <td>DeFremery Recreation Center</td> <td>37.812575</td> <td>-122.287878</td> <td>562681.60</td> <td>4185258.98</td> <td>6.0</td> <td>2.46</td> <td>1.20</td>		DeFremery Recreation Center	37.812575	-122.287878	562681.60	4185258.98	6.0	2.46	1.20
Marston Campbell Park 37.809693 -122.279813 563393.96 4184944.66 9.7 3.23 1.98 Poplar Playground 37.822958 -122.284355 556982.88 4186413.35 4.7 2.50 1.60 Union Plaza Park 37.82585 -122.284282 563115.16 418673.592 6.6 2.66 1.87 Fitzgerald Park 37.82586 -122.284282 564307.99 4186582.66 2.00 4.50 3.53 Mosswood Park 37.823936 -122.26173 564977.90 4186582.66 2.00 4.50 3.53 Lafayette Square Park 37.803623 -122.27127 563623.02 4183927.69 1.17 3.77 2.50 Jefferson Square Playground 37.803623 -122.27131 564194.01 418485.06 9.3 3.96 2.72 Henry J. Kaiser Memorial Park 37.80674 -122.27131 56419.01 418485.06 9.3 3.96 2.72 Lincoln Square Park 37.80908 -122.27031 56490.59 4183666.77 1.0.0 <td< td=""><td></td><td>Lowell Park</td><td>37.808711</td><td>-122.285228</td><td>562918.14</td><td>4184832.05</td><td>6.3</td><td>2.87</td><td>1.61</td></td<>		Lowell Park	37.808711	-122.285228	562918.14	4184832.05	6.3	2.87	1.61
Poplar Playground 37.822958 -122.284355 562982.88 4186413.35 4.7 2.50 1.60 Union Plaza Park 37.822956 -122.282845 563115.16 4186735.92 6.6 2.66 1.87 Fitzgerald Park 37.822966 -122.282845 563146.14 4186770.00 7.0 2.70 1.92 Grove Shafter Park 37.82396 -122.28289 564307.99 4186532.12 19.6 3.83 2.87 Mosswood Park 37.820361 -122.270298 56330.20 418072.92 11.7 3.77 2.50 Jefferson Square Playground 37.80083 -122.271921 564092.62 418441.56 13.0 4.08 2.82 Henry J. Kaiser Memorial Park 37.800102 -122.271921 56409.13 418386.67 10.0 4.84 3.58 Lincoln Square Park 37.800102 -122.26785 564409.13 418386.67 10.0 4.84 3.58 Lincoln Square Park 37.800531 -122.26785 564508.59 4183661.71 10.0 4		Marston Campbell Park	37.809693	-122.279813	563393.96	4184944.66	9.7	3.23	1.98
Union Plaza Park 37.825856 -122.282824 563115.16 4186735.92 6.6 2.66 1.87 Fitzgerald Park 37.8258161 -122.282469 563146.14 4186770.00 7.0 2.70 1.92 Grove Shafter Park 37.825361 -122.282469 564307.99 4186582.12 19.6 3.83 2.87 Mosswood Park 37.823344 -122.261673 56497.790 4186582.66 22.0 4.50 3.53 Lafayette Square Park 37.803623 -122.27720 563623.02 4184272.92 11.7 3.77 2.50 Jefferson Square Playground 37.803743 -122.271921 564092.62 418441.56 13.0 4.08 2.82 Henry J. Kaiser Memorial Park 37.803743 -122.27131 56449.13 4188786.01 8.7 4.67 3.41 Madison Park 37.903731 -122.27045 56479.71 0.0 4.84 3.58 Snow Park 37.90393 -122.67635 544368.51 15.3 4.58 3.34 Dove		Poplar Playground	37.822958	-122.284355	562982.88	4186413.35	4.7	2.50	1.60
Fitzgerald Park 37.826161 -122.282469 563146.14 4186770.00 7.0 2.70 1.92 Grove Shafter Park 37.823936 -122.269289 564307.99 4186532.12 19.6 3.83 2.87 Mosswood Park 37.824344 -122.261737 564977.90 4186532.12 19.6 4.50 3.53 Lafayette Square Park 37.803623 -122.27720 563623.02 4183296.63 8.4 3.85 2.59 Frank H. Ogawa Playground 37.800743 -122.27120 564092.62 418441.56 13.0 4.08 2.82 Henry J. Kaiser Memorial Park 37.800710 -122.27131 564143.00 41838845.06 9.3 3.966 2.72 Lincoln Square Park 37.800102 -122.270314 564240.79 41835840.10 8.7 4.647 3.41 Madison Park 37.80088 -122.27034 564240.79 4183584.01 8.7 4.67 3.41 Madison Park 37.80098 -122.264581 56475.07 4183684.01 8.7 4.67 3.41 Madison Park 37.806953 -122.264581 <td< td=""><td></td><td>Union Plaza Park</td><td>37.825856</td><td>-122.282824</td><td>563115.16</td><td>4186735.92</td><td>6.6</td><td>2.66</td><td>1.87</td></td<>		Union Plaza Park	37.825856	-122.282824	563115.16	4186735.92	6.6	2.66	1.87
Grove Shafter Park 37.823936 -122.269289 564307.99 4186532.12 19.6 3.83 2.87 Mosswood Park 37.824344 -122.261673 564977.90 4186582.66 22.0 4.50 3.53 Lafayette Square Park 37.803623 -122.277270 556362.02 4184272.92 11.7 3.77 2.50 Jefferson Square Playground 37.80988 -122.278669 563502.20 4183969.63 8.4 3.85 2.59 Frank H. Ogawa Plaza 37.80510 -122.27131 564143.00 4184845.06 9.3 3.96 2.72 Lincoln Square Park 37.800102 -122.268375 564409.13 418388.35 12.5 4.64 3.37 Chinese Garden Park / Harrison Square 37.797371 -122.267265 564308.59 4183666.77 10.0 4.84 3.58 Snow Park 37.80953 -122.267851 564707.07 418865.10 5.3 4.58 3.34 Dover Park 37.80953 -122.267851 56470.67 4184651.01 5.3 4.58 3.34 Dover Park 37.84207 -122.267851		Fitzgerald Park	37.826161	-122.282469	563146.14	4186770.00	7.0	2.70	1.92
Mosswood Park 37.824344 -122.261673 564977.90 4186582.66 22.0 4.50 3.53 Lafayette Square Park 37.803623 -122.277270 563623.02 4184272.92 11.7 3.77 2.50 Jefferson Square Playground 37.800388 -122.277270 563623.02 418396.63 8.4 3.85 2.59 Frank H. Ogawa Plaza 37.805110 -122.271921 564092.62 4184441.56 13.0 4.08 2.82 Henry J. Kaiser Memorial Park 37.805743 -122.271921 564092.62 418441.56 3.3 3.96 2.72 Lincoln Square Park 37.805743 -122.271921 564409.13 418388.35 12.5 4.64 3.37 Chinese Garden Park / Harrison Square 37.797371 -122.270314 564240.79 4183584.01 8.7 4.67 3.41 Madison Park Madison Park 37.806953 -122.267265 564508.59 4183661.70 10.0 4.84 3.58 Snow Park 37.806953 -122.26431 564737.16 4184651.10 5.3 4.50 4.60 3.45 Jack L		Grove Shafter Park	37.823936	-122.269289	564307.99	4186532.12	19.6	3.83	2.87
Lafayette Square Park 37.803623 -122.277270 563623.02 4184272.92 11.7 3.77 2.50 Jefferson Square Playground 37.800898 -122.278669 563502.20 4183969.63 8.4 3.85 2.59 Frank H. Ogawa Plaza 37.800743 -122.271921 564092.62 4184441.56 13.0 4.08 2.82 Henry J. Kaiser Memorial Park 37.800102 -122.271313 564143.00 4184885.06 9.3 3.96 2.72 Lincoln Square Park 37.800102 -122.270875 564409.13 418388.35 12.5 4.64 3.37 Chinese Garden Park / Harrison Square 37.797371 -122.267265 564204.79 4183566.77 10.0 4.84 3.58 Snow Park 37.80053 -122.267265 564508.59 4183664.70 0.00 4.84 3.58 Dover Park 37.80027 -122.26831 56477.16 4184651.10 5.3 4.58 3.34 Lack London Square 37.794742 -122.26931 56357.68 418895.19 36.7 4.90 4.47 Jack London Square 37.794742		Mosswood Park	37.824344	-122.261673	564977.90	4186582.66	22.0	4.50	3.53
Jefferson Square Playground 37.800898 -122.278669 563502.20 4183969.63 8.4 3.85 2.59 Frank H. Ogawa Plaza 37.805110 -122.271921 564092.62 418441.56 13.0 4.08 2.82 Henry J. Kaiser Memorial Park 37.805743 -122.271313 564143.00 4184845.06 9.3 3.96 2.72 Lincoln Square Park 37.800102 -122.268375 564409.13 4183888.35 12.5 4.64 3.37 Chinese Garden Park / Harrison Square 37.77371 -122.270314 564240.79 4183584.01 8.7 4.67 3.41 Madison Park 37.800693 -122.264581 5647508.59 4183666.77 10.0 4.84 3.58 Snow Park 37.800593 -122.264581 564376.07 4188604.80 30.3 4.50 4.05 Bushrod Recreation Center 37.84207 -122.264581 564576.63 4188604.80 30.3 4.50 4.05 Jack London Square 37.794742 -122.264591 564674.63 418893.90 12.2 3.54 3.46 Temescal Creek Park 37.84777		Lafavette Square Park	37.803623	-122.277270	563623.02	4184272.92	11.7	3.77	2.50
Frank H. Ogawa Plaza 37.805110 -122.271921 564092.62 418441.56 13.0 4.08 2.82 Henry J. Kaiser Memorial Park 37.808743 -122.271313 564143.00 418485.06 9.3 3.96 2.72 Lincoln Square Park 37.800102 -122.268375 564409.13 4183888.35 12.5 4.64 3.37 Chinese Garden Park / Harrison Square 37.797371 -122.270314 564240.79 4183584.01 8.7 4.67 3.41 Madison Park 37.89098 -122.264515 564508.59 4183666.77 10.0 4.84 3.58 Snow Park 37.802953 -122.264511 564376.07 4188604.80 30.3 4.50 4.05 Bushrod Recreation Center 37.84207 -122.264912 564674.63 418895.19 36.7 4.90 4.47 Jack London Square 37.84207 -122.277190 563637.68 418383.90 12.2 3.54 3.46 Temescal Creek Park 37.84771 -122.28380 562013.08 418883.90 12.2 </td <td></td> <td>Jefferson Square Playground</td> <td>37.800898</td> <td>-122.278669</td> <td>563502.20</td> <td>4183969.63</td> <td>8.4</td> <td>3.85</td> <td>2.59</td>		Jefferson Square Playground	37.800898	-122.278669	563502.20	4183969.63	8.4	3.85	2.59
Henry J. Kaiser Memorial Park 37.808743 -122.271313 564143.00 4184845.06 9.3 3.96 2.72 Lincoln Square Park 37.800102 -122.268375 564409.13 4183888.35 12.5 4.64 3.37 Chinese Garden Park / Harrison Square 37.797371 -122.270314 564240.79 4183584.01 8.7 4.67 3.41 Madison Park 37.798098 -122.267255 564508.59 4183666.77 10.0 4.84 3.58 Snow Park 37.806953 -122.267831 56473.16 4184651.10 5.3 4.58 3.34 Dover Park 37.84201 -122.268331 56476.07 4188604.80 30.3 4.50 4.05 Jack London Square 37.794742 -122.271912 56437.68 4188833.90 12.2 4.40 3.18 Emeryville Parks Golden Gate Playground 37.847207 -122.27190 56337.68 4188833.90 12.2 3.52 3.07 Emeryville Parks Golden Gate Playground 37.847207 -122.277216		Frank H. Ogawa Plaza	37.805110	-122.271921	564092.62	4184441.56	13.0	4.08	2.82
Lincoln Square Park 37.800102 -122.268375 564409.13 4183888.35 12.5 4.64 3.37 Chinese Garden Park / Harrison Square 37.797371 -122.270314 564240.79 4183584.01 8.7 4.67 3.41 Madison Park 37.798098 -122.267255 564508.59 4183666.77 10.0 4.84 3.58 Snow Park 37.800953 -122.264581 564737.16 4184651.10 5.3 4.58 3.34 Dover Park 37.842611 -122.264381 564737.16 4188695.19 30.3 4.50 4.05 Bushrod Recreation Center 37.845207 -122.264912 564674.63 418895.19 36.7 4.90 4.47 Jack London Square 37.794742 -122.27190 56367.68 4183287.62 3.2 4.40 3.18 Emeryville Parks Golden Gate Playground 37.84771 -122.27190 56307.68 4188283.90 12.2 3.54 3.46 Temescal Creek Park 37.84771 -122.277216 56359.06 4187985.04 18.2 3.52 3.07 Doyle Hollis Park 37.84728		Henry J. Kaiser Memorial Park	37.808743	-122.271313	564143.00	4184845.06	9.3	3.96	2.72
Chinese Garden Park / Harrison Square 37.797371 -122.270314 564240.79 4183584.01 8.7 4.67 3.41 Madison Park 37.798098 -122.267265 564508.59 4183666.77 10.0 4.84 3.58 Snow Park 37.806953 -122.264581 564737.16 4184651.10 5.3 4.58 3.34 Dover Park 37.842611 -122.26831 564737.16 4188604.80 30.3 4.50 4.05 Bushrod Recreation Center 37.845207 -122.264912 564674.63 4188895.19 36.7 4.90 4.47 Jack London Square 37.794742 -122.277190 563637.68 4183287.62 3.2 4.40 3.18 Emeryville Parks Golden Gate Playground 37.844271 -122.277190 563637.68 4183287.62 3.2 4.40 3.18 Emeryville Parks Golden Gate Playground 37.844771 -122.277190 563637.68 4183287.62 3.2 4.40 3.18 Doyle Hollis Park 37.847201 -122.287216 563599.06 4187985.04 18.2 3.52 3.07 Doy		Lincoln Square Park	37.800102	-122.268375	564409.13	4183888.35	12.5	4.64	3.37
Madison Park 37.798098 -122.267265 564508.59 4183666.77 10.0 4.84 3.58 Snow Park 37.806953 -122.264581 564737.16 4184651.10 5.3 4.58 3.34 Dover Park 37.842611 -122.264581 564737.16 4184651.10 5.3 4.58 3.34 Bushrod Recreation Center 37.842611 -122.264912 564674.63 4188895.19 36.7 4.90 4.47 Jack London Square 37.794742 -122.277190 563637.68 4183287.62 3.2 4.40 3.18 Emeryville Parks Golden Gate Playground 37.844771 -122.277190 563637.68 4183287.62 3.2 4.40 3.18 Emeryville Parks Golden Gate Playground 37.844771 -122.277126 563599.06 4187985.04 18.2 3.52 3.07 Emeryville Community Organic Garden Park 37.84778 -122.277216 563599.06 4187985.04 18.2 3.03 3.00 Doyle Hollis Park 37.84296 -122.28929 562619.90 4188493.25 7.6 3.03 3.00 Do		Chinese Garden Park / Harrison Square	37.797371	-122.270314	564240.79	4183584.01	8.7	4.67	3.41
Snow Park 37.806953 -122.264581 564737.16 4184651.10 5.3 4.58 3.34 Dover Park 37.842611 -122.264581 564376.07 4188604.80 30.3 4.50 4.05 Bushrod Recreation Center 37.845207 -122.264912 564674.63 418895.19 36.7 4.90 4.47 Jack London Square 37.794742 -122.277190 563637.68 4183287.62 3.2 4.40 3.18 Emeryville Parks Golden Gate Playground 37.844771 -122.278190 563637.68 418323.00 12.2 3.54 3.46 Temescal Creek Park 37.844771 -122.283801 562619.00 418893.30 12.2 3.54 3.60 Doyle Hollis Park Orghe Hollis Park 37.844771 -122.288295 562619.00 4188493.25 7.6 3.03 3.00 Doyle Hollis Park 37.844721 -122.288295 562619.00 4188493.25 7.6 3.05 3.09 Park Ave Playground 37.84296 -122.288295 562619.00		Madison Park	37,798098	-122.267265	564508.59	4183666.77	10.0	4.84	3.58
Dover Park 37.842611 -122.268331 564376.07 4188604.80 30.3 4.50 4.05 Bushrod Recreation Center 37.845207 -122.264912 564674.63 418895.19 36.7 4.90 4.47 Jack London Square 37.794742 -122.277190 563637.68 4183287.62 3.2 4.40 3.18 Emeryville Parks Golden Gate Playground 37.844771 -122.283801 563013.08 418883.90 12.2 3.54 3.46 Temescal Creek Park 37.84772 -122.283801 563013.08 418893.25 7.6 3.03 3.00 Doyle Hollis Park Orghe Hollis Community Organic Garden Park 37.84728 -122.28829 562619.90 4188493.25 7.6 3.05 3.00 Doyle Hollis Park 37.84472 -122.28829 562619.90 418863.07 5.9 3.05 3.00 Park Ave Playground 37.84296 -122.288378 562611.63 418866.73 6.7 3.15 3.16 Christie Park 37.842086 -122.294897 <td< td=""><td></td><td>Snow Park</td><td>37.806953</td><td>-122.264581</td><td>564737.16</td><td>4184651.10</td><td>5.3</td><td>4.58</td><td>3.34</td></td<>		Snow Park	37.806953	-122.264581	564737.16	4184651.10	5.3	4.58	3.34
Bushrod Recreation Center 37.845207 -122.264912 564674.63 4188895.19 36.7 4.90 4.47 Jack London Square 37.794742 -122.277190 563637.68 4188895.19 36.7 4.90 4.47 Image: Solid Condon Square 37.794742 -122.277190 563637.68 4188833.90 12.2 3.54 3.46 Image: Solid Condon Square 37.844771 -122.283801 563013.08 4188833.90 12.2 3.54 3.46 Image: Solid Condon Square 37.84771 -122.288201 563013.08 4188833.90 12.2 3.52 3.07 Image: Solid Condon Square 37.84778 -122.28829 562619.90 4188493.25 7.6 3.03 3.00 Image: Solid Condon Square 37.84296 -122.28829 562619.90 4188493.25 7.6 3.03 3.00 Image: Solid Condon Square 37.84296 -122.288378 562611.63 418866.73 6.7 3.15 3.16 Image: Solid Condon Square 37.842086 -122.294897 56203.90.6		Dover Park	37.842611	-122.268331	564376.07	4188604.80	30.3	4.50	4.05
Jack London Square 37.794742 -122.277190 563637.68 4183287.62 3.2 4.40 3.18 Emeryville Parks Golden Gate Playground 37.844771 -122.283801 563637.68 4183287.62 3.2 4.40 3.18 Emeryville Parks Golden Gate Playground 37.844771 -122.283801 563637.68 418383.90 12.2 3.54 3.46 Temescal Creek Park 37.837080 -122.277216 563599.06 4187985.04 18.2 3.52 3.07 Emeryville Community Organic Garden Park 37.841728 -122.288299 562619.90 4188493.25 7.6 3.03 3.00 Doyle Hollis Park 37.84296 -122.288298 562611.63 418863.07 5.9 3.05 3.09 Park Ave Playground 37.84296 -122.288378 562611.63 4188566.73 6.7 3.15 3.16 Christie Park 37.842086 -122.284378 562039.06 4188542.57 3.7 2.68 2.88 Marina Park 37.838722 -122.284375 <t< td=""><td></td><td>Bushrod Recreation Center</td><td>37.845207</td><td>-122.264912</td><td>564674.63</td><td>4188895.19</td><td>36.7</td><td>4.90</td><td>4.47</td></t<>		Bushrod Recreation Center	37.845207	-122.264912	564674.63	4188895.19	36.7	4.90	4.47
Emeryville Parks Golden Gate Playground 37.844771 -122.283801 563013.08 4188833.90 12.2 3.36 3.46 Temescal Creek Park 37.837080 -122.277216 56359.06 4187985.04 18.2 3.52 3.07 Emeryville Community Organic Garden Park 37.84778 -122.28829 562619.90 4188493.25 7.6 3.03 3.00 Doyle Hollis Park 37.84296 -122.289586 562505.59 4188633.07 5.9 3.05 3.09 Park Ave Playground 37.84292 -122.289387 562611.63 4188666.73 6.7 3.15 3.16 Christie Park 37.842086 -122.294897 562039.06 4188542.57 3.7 2.68 2.88 Marina Park 37.838722 -122.315173 560257.78 4188142.05 3.5 1.80 2.78 Locard EmeryPark 37.838727 -122.315173 560257.78 4188142.05 3.5 1.80 2.78		Jack London Square	37,794742	-122.277190	563637.68	4183287.62	3.2	4.40	3.18
Temescal Creek Park 37.837080 -122.277216 563599.06 4187985.04 18.2 3.05 3.07 Emeryville Community Organic Garden Park 37.84728 -122.277216 563599.06 4187985.04 18.2 3.03 3.00 Doyle Hollis Park 37.842996 -122.288298 562619.90 4188493.25 7.6 3.03 3.00 Park Ave Playground 37.842996 -122.288378 562611.63 4188666.73 6.7 3.15 3.16 Christie Park 37.842086 -122.294897 562039.06 4188542.57 3.7 2.68 2.88 Marina Park 37.838722 -122.315173 560257.78 4188142.05 3.5 1.80 2.78 Locaph EmeryPark 37.838722 -122.315173 560257.78 4188745.82 12.90 2.50	Emeryville Parks	Golden Gate Playground	37,844771	-122,283801	563013.08	4188833.90	12.2	3.54	3,46
Emeryville Community Organic Garden Park 37.841728 -122.288299 562619.90 4188493.25 7.6 3.03 3.00 Doyle Hollis Park 37.842996 -122.288298 562619.90 4188493.25 7.6 3.03 3.09 Park Ave Playground 37.842996 -122.288378 562611.63 4188666.73 6.7 3.15 3.16 Christie Park 37.842086 -122.294897 56203.06 4188528.57 3.7 2.68 2.88 Marina Park 37.838722 -122.315173 560257.78 418874.82 3.5 1.80 2.78 Joseph Emery Park 37.838724 -122.315173 560257.78 418874.52 3.5 1.80 2.78		Temescal Creek Park	37,837080	-122,277216	563599.06	4187985.04	18.2	3.52	3,07
Doyle Hollis Park 37.842996 -122.289586 562015.59 418653.07 5.9 3.05 3.09 Park Ave Playground 37.843292 -122.288378 562615.63 4188666.73 6.7 3.15 3.16 Christie Park 37.842096 -122.294897 562015.64 4188528.57 3.7 2.68 2.88 Marina Park 37.838722 -122.315173 560257.78 4188142.05 3.5 1.80 2.78 Joseph EmeryPark 37.83172 -122.31116 563323.85 418745.82 12.9 2.00 2.50		Emeryville Community Organic Garden Park	37 841729	-122 288200	562619 90	4188493 25	7.6	3 03	3.00
Park Ave Playground 37.843292 -122.208378 562611.63 4188666.73 6.7 3.15 3.16 Christie Park 37.84208 -122.294897 562611.63 4188528.57 3.7 2.68 2.88 Marina Park 37.838722 -122.215173 560257.78 4188142.05 3.5 1.80 2.78 Joseph Emery Park 37.83872 -122.31116 563232.85 418745.82 12.9 2.00 2.50		Dovle Hollis Park	37 842996	-122 289586	562505 50	4188633.07	59	3.05	3.00
Christie Park 37.84208 -122.294897 5603105 42600475 6.7 5.15 5.15 Marina Park 37.842086 -122.294897 560257.78 4188142.05 3.5 1.80 2.78 Joseph Emery Park 37.83172 -122.31173 560257.78 4188142.05 3.5 1.80 2.78		Park Ave Playground	37 843292	-122 288378	562611.63	4188666 73	67	3 15	3 16
Marina Park 37.838722 -122.27677 366037.00 410526.37 5.7 2.06 2.08 Joseph Emery Park 37.838722 -122.315173 560257.78 4188142.05 3.5 1.80 2.78		Christie Park	37 842086	-122 2005/0	562039.06	4188528 57	37	2.68	2 88
Incenter on 27 934115 (5222) 54145 (5222) 55 (100 2.70 2.70 2.70 2.70 2.70 2.70 2.70 2.		Marina Park	37 828777	-122 215172	560257.79	41881/12 05	3.7	1 2.00	2.00
		Joseph Emery Park	37.833147	-122,281416	563232.85	4187545.82	12.8	3.00	2.50

Table 2.	Locations of	modeled	sensitive	receptors
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²⁵ The East Bay Regional Park District's (EBRPD) Alexander Zuckermann Bicycle and Pedestrian Path runs along the southern edge of the eastern span of the San Francisco-Oakland Bay Bridge,

Table 2, continued²⁶

						Distance (km) to	
Sensitive Receptor Location	Latitude	Longitude	UTMx (m)	UTMy (m)	Elevation (m)	Hopper A	Spur/Yard
Oakland Schools Prescott Elementary School	37.808655	-122.297482	561839.51	4184817.65	6.1	2.05	0.92
Ralph J. Bunche High School	37.813548	-122.287732	562693.63	4185367.03	4.4	2.42	1.18
Lafayette Elementary School	37.810224	-122.279760	563398.18	4185003.61	8.6	3.21	1.96
McClymonds High School	37.819091	-122.280755	563303.02	4185986.74	6.2	2.84	1.77
New Day Pre School	37.811982	-122.268286	564406.65	4185206.51	6.5	4.09	2.89
West Oakland Middle School	37.808324	-122.282640	563146.28	4184790.85	8.0	3.09	1.82
Cole Elementary School	37.807842	-122.289818	562514.83	4184732.55	6.8	2.60	1.35
Martin Luther King Jr Elementary School	37.806610	-122.283033	563113.15	4184600.42	8.6	3.16	1.90
Saint Vincent's Day Home - Preschool	37.804877	-122.286556	562804.49	4184405.77	8.0	3.03	1.79
City of Oakland Head Start	37.815601	-122.282085	563188.93	4185598.62	3.8	2.81	1.63
YMCA Preschool	37.811976	-122.275834	563742.26	4185200.67	7.5	3.46	2.24
Oakland School For the Arts	37.808060	-122.271391	564136.73	4184769.22	9.9	3.98	2.74
Starlite Child Development Center - Day Care Center	37.802587	-122.265983	564617.55	4184165.72	11.7	4.68	3.42
Oakland Charter High School	37.801670	-122.269508	564308.02	4184061.54	13.1	4.46	3.19
Lake Merritt Child Care Center	37.801517	-122.268879	564363.53	4184045.00	13.0	4.51	3.25
Lincoln Elementary School	37.800225	-122.268276	564417.74	4183902.07	12.5	4.64	3.37
American Indian Public Charter School	37.800121	-122.265521	564660.37	4183892.43	10.7	4.85	3.58
Little Stars Pre-School	37.801559	-122.264614	564738.96	4184052.61	10.4	4.84	3.58
Bright Future Early Learning	37.806364	-122.273757	563929.92	4184579.43	12.3	3.88	2.62
Laney College	37.796364	-122.262828	564900.74	4183477.46	6.5	5.27	4.01
Street Academy Alternative School	37.817417	-122.265570	564640.98	4185811.40	20.1	4.19	3.08
Westlake Middle School	37.814744	-122.261984	564958.95	4185517.32	12.9	4.55	3.40
St Mary's Center Preschool	37.822857	-122.277044	563626.41	4186407.10	9.5	3.14	2.19
Hoover Elementary School	37.823385	-122.275101	563796.96	4186467.01	12.2	3.32	2.37
Oakland Military Institute / Longfellow School	37.829227	-122.273332	563947.60	4187116.39	18.7	3.55	2.78
North Oakland Community Charter School	37.833187	-122.276563	563659.86	4187553.55	18.2	3.40	2.81
Emery Secondary School	37.837743	-122.274271	563857.63	4188060.61	22.2	3.78	3.30
Aspire Berkley Maynard Academy	37.845610	-122.283640	563026.53	4188927.10	13.5	3.62	3.55
Grace Children's Academy - Day Care Center	37.837391	-122.277277	563593.42	4188019.50	18.5	3.53	3.09
Emeryvile Schools Anna Yates Elementary	37.832448	-122.278604	563480.89	4187470.17	15.6	3.20	2.62
Pacific Rim International School - Montessori School	37.838721	-122.287395	562701.99	4188160.23	7.7	2.86	2.72
Emeryville Child Development Center - Preschool	37.836741	-122.285239	562893.38	4187941.99	8.1	2.89	2.62
Emery High School	37.836173	-122.283554	563042.13	4187880.11	10.6	2.98	2.64

The distance from each sensitive receptor location to the Commodity Hopper A unloading structure within the OBOT facility (see Figure 5), and to a second location near the end of the spur rail line at the new port rail yard²⁷, is shown in Table 2. The locations of the sensitive receptor parks and schools are also shown in Figures 7 and 8, below.

²⁶ The UTM (Universal Transverse Mercator) coordinates shown in Table 2 are located in UTM Zone 10S. ²⁷ The Spur/Yard location on the spur rail line is at UTM coordinates: 561560.0, 4185690.0.



Figure 7. Location of sensitive receptors: Parks



Figure 8. Location of sensitive receptors: Schools

D. Meteorological Data

I assembled meteorological data for 2011-2015 for input to the AERMOD model. The model requires continuous records of surface and upper air meteorological data (including wind speeds and directions, temperatures, ambient air pressures, etc.). These data were all obtained from measurements taken at the Oakland Airport. The surface data includes (1) hourly Integrated Surface Data (ISD) from the Oakland International Airport (OAK),²⁸ located about 14 km SE of the proposed OBOT facility, and (2) 1-minute Automated Surface Observing System (ASOS) wind data from OAK.²⁹ The upper air data consisted of morning radiosonde measurements (soundings) recorded each day at 1200 GMT at the Oakland Airport.³⁰

AERMOD ignores hours with variable wind (i.e., undefined wind direction) or calm (low wind speed) conditions, resulting in zero concentrations for those hours, which can lead to an underestimation of long-term average concentrations. To address the issue of calm and variable winds associated with the hourly averaged surface wind data that is typically input to AERMOD, US EPA developed the AERMINUTE preprocessor.³¹ AERMINUTE processes 1-minute ASOS wind data, resulting in significantly fewer hours with calm and missing winds. I used AERMINUTE (Version 15272) to reduce the number of calm wind conditions (zero wind speed) within the hourly Oakland surface data for 2011-2015 from 7,134 to 541 (out of 43,824 total modeled hours).

AERSURFACE,³² a non-regulatory component of the AERMOD modeling system, was used to develop the surface characteristics at OAK, as required by AERMET. I obtained land cover/land use data from the US Geological Survey (USGS) National Land Cover Database (NLCD)³³ and processed the data using AERSURFACE (Version 13016) in order to determine the required micrometeorological parameters (noon-time albedo, daytime Bowen ratio, and surface roughness length) at OAK using twelve 30-degree sectors for each month. Average surface moisture was assumed for the Oakland Airport location.³⁴

ftp://ftp.ncdc.noaa.gov/pub/data/noaa/readme.txt

²⁸ National Climatic Data Center, Integrated Surface Data (ISD) for OAK (WBAN: 23230) 2011-2015, National Oceanic and Atmospheric Administration (NOAA).

²⁹ National Centers for Environmental Information (NCEI), Automated Surface Observing System (ASOS) Data for OAK (WBAN: 23230) 2011-2015. National Oceanic and Atmospheric Administration (NOAA). https://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/automated-surface-observing-system-asos

³⁰ Earth System Research Laboratory (ESRL), ESRL Radiosonde Database, FSL Data for OAK (WBAN: 23230) 2011-2015. National Oceanic and Atmospheric Administration (NOAA). https://ruc.noaa.gov/raobs/General Information.html

³¹ U.S. Environmental Protection Agency. AERMINUTE User's Guide. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. 2011.

http://www.epa.gov/ttn/scram/7thconf/aermod/aerminute_v11059.zip

³² U.S. Environmental Protection Agency. AERSURFACE User's Guide. EPA-454/B-08-001. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. 2008.

⁽http://www.epa.gov/ttn/scram/7thconf/aermod/aersurface_userguide.pdf)

³³ Multi-Resolution Land Characteristics Consortium (MRLC). https://www.mrlc.gov/

³⁴ According to Climate Data for US Cities (http://www.usclimatedata.com/climate/oakland/california/ united-states/usca2500), the average annual precipitation for Oakland, CA is 24 inches. AERSURFACE guidelines recommend using the wet surface moisture option for locations in the top 30 percent of annual precipitation (greater than about 45 inches).

I used the AERMET meteorological preprocessor (Version 16216)³⁵ to merge the hourly surface and upper air data, and to estimate a number of required boundary layer parameters using the meteorological data and surface characteristics.

Figure 9 shows a "wind rose" frequency diagram for the 5-year meteorological data set that I used for modeling the impacts of the proposed OBOT facility. The wind rose diagram displays the frequency of hourly averaged wind speeds and directions (indicating the direction of wind origin). As can be seen from Figure 9, stronger winds are usually associated with wind directions from the W and WNW, whereas near-calm and light wind conditions, which are typically responsible for higher concentration impacts, are more often from the E through NE.



Figure 9. Wind rose frequency plot for the Oakland Airport, 2011-2015

³⁵ U.S. Environmental Protection Agency. User's Guide to the AERMOD Meteorological Preprocessor (AERMET). EPA-454/R-03-003. U.S. Environmental Protection Agency, Research Triangle Park, NC 27711. 2004. http://www.epa.gov/ttn/scram/7thconf/aermod/aermet_userguide.zip

E. Modeling Options

A number of control options must be specified in order to execute the AERMOD model. For this application, regulatory default options were used, which includes the use of elevated (non-flat) terrain effects, and the calms and missing data processing as set forth in US EPA's modeling guidelines.³⁶ The model's averaging time was set to one hour and default flagpole receptor heights were assumed to be 1.5 m. The proposed OBOT facility is located in Oakland, California, an urban area (estimated population: 600,000³⁷), and therefore the "URBAN" modeling option was selected within AERMOD.³⁸

I used the most recent version of AERMOD (v16216r) to estimate the $PM_{2.5}$ concentration impacts due to emissions from the proposed OBOT facility. No background concentrations were added to the modeled impacts, therefore the modeled $PM_{2.5}$ concentrations represent the incremental impact to the surrounding community from the proposed OBOT facility.

The AERMOD modeling assumed constant PM_{2.5} emissions rates for each modeled source for every modeled hour. The actual emissions for each operation may vary somewhat (with zero emissions during those hours when the source is not operating). Such variability would potentially result in somewhat higher short-term peak concentrations at numerous locations. However, the long-term average concentrations will be well represented by the annual average model results shown below, for which a constant average emission rate was used. Peak (98th percentile) 24-hour average concentrations were estimated using maximum 24-hour emission rates (see Table 1) to account for the potential variability in emission rates.

³⁶ U.S. Environmental Protection Agency. Guideline on Air Quality Models, 40 CFR Part 51, Appendix W. Published in the Federal Register, Vol. 70, No. 216, November 9, 2005.

³⁷ According to the US Census, the population of Oakland, CA was approximately 420,000 in 2016 (https://www.census.gov/quickfacts/fact/table/oaklandcitycalifornia,US/PST045216). ³⁸ The "UPPAN" modeling applies in a second second

³⁸ The "URBAN" modeling option incorporates the effects of increased surface heating from an urban area on pollutant dispersion under stable nighttime atmospheric conditions.

IV. MODEL RESULTS

I ran the AERMOD model using the estimated $PM_{2.5}$ emission rates for the north rail and south rail scenarios, as shown in Table 1, above. Long-term average $PM_{2.5}$ concentrations were predicted using the annual average emission rates. The average modeled concentrations using five years of meteorological data (2011-2015) represent the long-term average $PM_{2.5}$ concentration impacts to the surrounding area due to emissions from the proposed OBOT facility. Peak (98th percentile) 24-hour average $PM_{2.5}$ concentrations were predicted using the maximum 24-hour average emission rates (also shown in Table 1). The predicted peak 24-hour average $PM_{2.5}$ concentrations represent a worst-case daily impact.

The AERMOD model estimated the average $PM_{2.5}$ concentration due to emissions from the proposed OBOT facility for every hour of the five-year modeling period at every gridded receptor location, and also at every modeled sensitive receptor (see Table 2). Long-term averages of the individual hourly modeled concentrations were computed at each modeled receptor location. Figures 10 and 11 show the modeled five-year average $PM_{2.5}$ concentration impacts for the north rail and south rail scenarios, respectively.

The AERMOD model predicted that elevated $PM_{2.5}$ concentrations would occur over a large area surrounding the proposed OBOT facility under both emission scenarios. For example, the model indicated that the long-term (five-year) average $PM_{2.5}$ concentration increase due to routine OBOT operations under the north rail scenario would exceed 0.5 µg/m³ over an area of approximately 3.5 square kilometers, as shown in Figure 10.³⁹ Similarly, Figure 11 shows an area of approximately 5.4 square kilometers in which long-term $PM_{2.5}$ concentrations from the OBOT operations under the south rail scenario would exceed 0.5 µg/m³.

³⁹ The area inside the orange shading in Figures 10 and 11 represents the area in which the modeled annual average PM_{2.5} concentrations from OBOT's proposed operations exceed 0.5 ug/m3.



0.00-0.50 0.50-1.00 1.00-1.50 1.50-2.00

Figure 10. Modeled long-term $PM_{2.5}$ concentrations (μ g/m³), north rail scenario⁴⁰

 $^{^{40}}$ PM_{2.5} contours are shown in Figures 10 and 11 for concentrations up to 2.0 μ g/m³. The area inside the gold ring in the center of the contours represents long-term PM_{2.5} concentrations that exceed 2.0 μ g/m³.



Figure 11. Modeled long-term $PM_{2.5}$ concentrations (μ g/m³), south rail scenario

The model results show that coal dust emissions from the proposed OBOT facility would have a significant impact on $PM_{2.5}$ concentrations in neighboring areas that are already experiencing some of the worst AQ in the region. Much of the area in West Oakland and southern Emeryville, in which the long-term modeled $PM_{2.5}$ concentration impacts are the greatest (see Figures 10 and 11), have been classified as ""disadvantaged communities". These areas are "disproportionately burdened by and vulnerable to existing multiple sources of pollution."⁴¹

Air quality measurements taken at the West Oakland monitor have shown very high $PM_{2.5}$ concentrations in recent years, with numerous observed exceedances of the 24-hr NAAQS level ($35 \mu g/m^3$). According to BAAQMD data, the West Oakland monitoring location has violated both the 24-hour and annual average $PM_{2.5}$ NAAQS.⁴² A short-term special monitoring study⁴³ conducted by DRI, on behalf of the BAAQMD, showed that there are a number of locations close to the 880 freeway, in the area of peak modeled contributions from the proposed OBOT facility, in which $PM_{2.5}$ concentrations were observed to be much higher than measured at the BAAQMD West Oakland monitor (due largely to enrichment from vehicular traffic).

The contribution of significant additional amounts of $PM_{2.5}$ from the proposed OBOT facility could potentially cause more violations of the 24-hour $PM_{2.5}$ NAAQS. (even a small to moderate increase in long-term PM2.5 concentrations would cause many days that are currently just under the standard level to exceed the standard).

The modeling was also used to determine the peak 24-hour impacts to $PM_{2.5}$ concentrations in the area surrounding the proposed OBOT facility. The model results indicate that many of the modeled sensitive receptor locations will be significantly impacted from coal dust emissions from the proposed OBOT facility. Table 3, below, shows the modeled peak (98th percentile) 24-hour average and the annual average $PM_{2.5}$ concentration impacts at each of the sensitive receptor locations for the two emission scenarios.

Short-term (24-hour average) PM2.5 concentrations are predicted to increase by more than 2.5 μ g/m³, and by as much as 8 μ g/m³, at a number of nearby sensitive receptors, including the Bay Bridge toll plaza, Gateway Park, the Alexander Zuckerman Bicycle and Pedestrian Path, Raimondi Park, and Memorial Park. Many of the sensitive receptors, including a number of Oakland and Emeryville schools, would experience peak short-term PM_{2.5} concentration impacts that exceed 1 μ g/m³.

⁴¹ ESA report.

⁴² The annual average ambient air quality standard for $PM_{2.5}$ is 12 µg /m³.

⁴³ West Oakland Monitoring Study (WOMS), Desert Research Institute. 2010.

Table 3. Modeled $PM_{2.5}$ Concentration (μ g/m³) at Sensitive Receptors

		Scenario: North Rail PM conc (ug/m3)		Scenario PM con	: South Rail
	Sensitive Receptor Location	Annual Average	24-hr Avg 98th %-ile	Annual Average	24-hr Δvg 98th %-ile
		All-IS		All-IS	ALL-MS
Toll Plaza	Bay Bridge Toll Plaza	1.236	4.005	1.226	4.088
Bike Path	Alexander Zuckermann Bicycle and Pedestrian Path (1)	0.226	1.161	0.234	1.155
	Alexander Zuckermann Bicycle and Pedestrian Path (2)	0.347	1.756	0.355	1.721
	Alexander Zuckermann Bicycle and Pedestrian Path (3)	0.672	2.992	0.678	3.009
	Alexander Zuckermann Bicycle and Pedestrian Path (4)	2.052	6.945	2.052	6.926
	Alexander Zuckermann Bicycle and Pedestrian Path (5)	2.952	8.381	2.939	8.386
	Alexander Zuckermann Bicycle and Pedestrian Path (6)	2.993	7.615	2.958	7.586
	Alexander Zuckermann Bicycle and Pedestrian Path (7)	3.183	8.164	3.111	7.915
	Alexander Zuckermann Bicycle and Pedestrian Path (8)	1.526	3.824	1.391	3.466
	Alexander Zuckermann Bicycle and Pedestrian Path (9)	1.007	2.649	0.695	1.872
	Alexander Zuckermann Bicycle and Pedestrian Path (10)	0.794	2.366	0.374	1.126
Oakland Parks	Gateway Park (new)	0.607	2.889	0.617	2.877
	Raimondi Park W	1.768	4.008	1.597	3.306
	Raimondi Park E	1.243	3.070	1.162	2.561
	Memorial Park (1)	1.317	3.112	0.933	2.399
	Memorial Park (2)	1.412	3.183	1.088	2.553
	Memorial Park (3)	1.441	3.215	1.185	2.646
	Memorial Park (4)	1.227	2.702	1.068	2.260
	Memorial Park (5)	1.084	2.499	0.968	2.056
	Memorial Park (6)	0.839	2.135	0.797	1.786
	Memorial Park (7)	0.669	1.894	0.680	1.632
	Memorial Park (8)	0.484	1.522	0.553	1.428
	Memorial Park (9)	0.402	1.362	0.489	1.315
	Memorial Park (10)	0.344	1.204	0.458	1.216
	Memorial Park (11)	0.297	1.042	0.439	1.129
	14th Street Pocket Park	0.877	2.618	1.048	2.592
	Willow Park	0.656	2.044	0.776	1.988
	McClymonds Mini-Park	0.483	1.284	0.431	1.156
	South Prescott Park	0.203	0.703	0.477	1.196
	Wade Johnson Park	0.398	1.300	0.471	1.249
	DeFremery Recreation Center	0.545	1.578	0.556	1.351
	Lowell Park	0.335	1.071	0.394	0.989
	Marston Campbell Park	0.311	1.061	0.330	0.942
	Poplar Playground	0.708	1.854	0.547	1.519
	Union Plaza Park	0.531	1.481	0.380	1.157
	Fitzgerald Park	0.495	1.457	0.350	1.129
	Grove Shafter Park	0.220	0.817	0.180	0.684
	Mosswood Park	0.156	0.610	0.133	0.523
	Lafayette Square Park	0.196	0.745	0.280	0.748
	Jefferson Square Playground	0.1/1	0.663	0.351	0.869
	Frank H. Ogawa Plaza	0.190	0.714	0.237	0.687
	Henry J. Kaiser Memorial Park	0.218	0.769	0.238	0.719
	Lincoln Square Park	0.139	0.540	0.233	0.596
	Chinese Garden Park / Harrison Square	0.125	0.496	0.314	0.782
	Madison Park	0.124	0.484	0.247	0.609
	Show Park	0.102	0.544	0.196	0.319
	Dover Faik	0.079	0.360	0.030	0.298
	Jack London Square	0.001	0.512	1 162	3 20/
Emenwille Parks	Golden Gate Playground	0.110	0.423	0.066	0.294
Lineryvine FdIKS	Temescal Creek Park	0.140	0.575	0.005	0.540
	Emerwille Community Organic Garden Park	0.242	1 001	0.095	0.405
	Dovle Hollis Park	0 419	1 103	0.100	0 373
	Park Ave Playground	0.317	0.902	0.093	0.370
	Christie Park	0.532	1.908	0 114	0.422
	Marina Park	0,160	0.628	0 139	0.569
	Joseph Emery Park	0.277	0.917	0.148	0.636

Table 3, continued.

		Scenario:	North Rail	Scenario	South Rail	
		PM con	c (ug/m3)	PM conc (ug/m3)		
	Sensitive Receptor Location	Annual Average	24-hr Avg 98th %-ile	Annual Average	24-hr Avg 98th %-ile	
		ALL-JS	ALL-KS	ALL-LS	ALL-MS	
Oakland Schools	Prescott Elementary School	0.375	1.231	0.537	1.404	
	Ralph J. Bunche High School	0.602	1.631	0.596	1.401	
	Lafayette Elementary School	0.321	1.069	0.337	0.954	
	McClymonds High School	0.505	1.387	0.439	1.185	
	New Day Pre School	0.209	0.656	0.220	0.598	
	West Oakland Middle School	0.308	1.069	0.351	0.954	
	Cole Elementary School	0.345	1.164	0.429	1.146	
	Martin Luther King Jr Elementary School	0.273	0.986	0.338	0.933	
	Saint Vincent's Day Home - Preschool	0.257	0.983	0.366	0.977	
	City of Oakland Head Start	0.500	1.334	0.470	1.163	
	YMCA Preschool	0.297	0.958	0.300	0.873	
	Oakland School For the Arts	0.213	0.766	0.237	0.715	
	Starlite Child Development Center - Day Care Center	0.148	0.587	0.204	0.588	
	Oakland Charter High School	0.152	0.595	0.230	0.605	
	Lake Merritt Child Care Center	0.150	0.587	0.227	0.597	
	Lincoln Elementary School	0.139	0.539	0.231	0.593	
	American Indian Public Charter School	0.132	0.521	0.213	0.554	
	Little Stars Pre-School	0.138	0.544	0.200	0.554	
	Bright Future Early Learning	0.212	0.787	0.251	0.740	
	Laney College	0.105	0.387	0.226	0.526	
	Street Academy Alternative School	0.187	0.660	0.171	0.603	
	Westlake Middle School	0.164	0.588	0.159	0.541	
	St Mary's Center Preschool	0.365	1.199	0.292	1.002	
	Hoover Elementary School	0.315	1.067	0.252	0.892	
	Oakland Military Institute / Longfellow School	0.217	0.827	0.156	0.663	
	North Oakland Community Charter School	0.203	0.766	0.127	0.565	
	Emery Secondary School	0.134	0.548	0.083	0.403	
	Aspire Berkley Maynard Academy	0.124	0.546	0.062	0.328	
	Grace Children's Academy - Day Care Center	0.163	0.646	0.093	0.461	
Emeryvile Schools	Anna Yates Elementary	0.240	0.858	0.144	0.633	
	Pacific Rim International School - Montessori School	0.380	1.082	0.113	0.509	
	Emeryville Child Development Center - Preschool	0.330	1.024	0.128	0.578	
	Emery High School	0.283	0.962	0.125	0.582	

V. MODELING OF FIRES

In addition to the modeling of fugitive dust emissions from routine operations at the proposed OBOT facility. I also modeled two scenarios representing unplanned fires at the proposed OBOT facility. Two hypothetical fire scenarios were developed: (1) Fire A: a medium-size fire located at the Commodity A Hopper unloading structure, and (2) Fire B: a large-size fire located at the ship transloading location. The modeled physical dimensions of the two fires and the assumed PM emission rates were obtained from Dr. Pello's expert report.⁴⁴

The medium-size fire (Fire A) was assumed to burn across the top surface area of a rail car (73 m²) with a $PM_{2.5}$ emission rate of 1.05 g/s.⁴⁵ The large-size fire was assumed to burn across ten percent of a ship's coal surface (135 m²) with a PM₂₅ emission rate of 2.1 g/s.46

I used the AERMOD model, with the same five-year meteorological data and the same set of receptors locations as described above, that was used for modeling routine operations at the proposed OBOT facility, to estimate the short-term (24-hour) impacts to the surrounding community that would be expected to occur in the event of a fire at the proposed OBOT facility. Figures 12 and 13 show the modeled peak (98th percentile) 24-hour average PM_{2.5} concentrations that would result from each of the two fires at the OBOT facility.

The model predicts that both fires would be responsible for significant short-term PM_{2.5} concentration impacts over a large area surrounding the proposed OBOT facility. As shown in Figures 12 and 13, the peak (98th percentile) 24-hour average PM_{2.5} concentration would exceed 0.5 μ g/m³ across almost all of the 6x6 km modeling domain for both fire scenarios. Peak 24-hour average PM_{2.5} concentrations would exceed 5.0 μ g/m³ across an area of more than 2.5 square kilometers under both fire scenarios.

The modeled peak (98th percentile) short-term average concentrations due to the two fire scenarios at each of the modeled sensitive receptors are shown in Table 4. As can be seen from these model results, a fire has the potential to create very high 24hour average PM2.5 concentration levels at many nearby receptor locations.

 ⁴⁴ Expert report of Dr. Pello. Environmental Effects of Coal Fires.
 ⁴⁵ Dr. Pello estimated the total PM emission rate for a medium fire to be 15 g/s. It was assumed that about 7 percent of the total emitted PM would be $PM_{2.5}$ (using AP-42 size factors for coal burning). ⁴⁶ Dr. Pello estimated the total PM emission rate for a large fire to be 30 g/s.



Figure 12. Peak modeled 24-hour average $PM_{2.5}$ concentrations (μ g/m³), Fire A



Figure 13. Peak modeled 24-hour average $PM_{2.5}$ concentrations (μ g/m³), Fire B

Table 4. Peak Modeled 24-hour Average PM_{2.5} Concentrations at Sensitive Receptors due to Fires

		Scenario: Medium Fire at Hopper A	Scenario: Large Fire at Transloading
		PM conc (ug/m3)	PM conc (ug/m3)
	Sensitive Receptor Location	24-hr Avg 98th %-ile	24-hr Avg 98th %-ile
		FA NS	FB NS
Toll Plaza	Bay Bridge Toll Plaza	13.705	5.026
Bike Path	Alexander Zuckermann Bicycle and Pedestrian Path (1)	3.174	3.607
	Alexander Zuckermann Bicycle and Pedestrian Path (2)	4.260	3.730
	Alexander Zuckermann Bicycle and Pedestrian Path (3)	6.268	11.673
	Alexander Zuckermann Bicycle and Pedestrian Path (4)	7.485	9.382
	Alexander Zuckermann Bicycle and Pedestrian Path (5)	20.548	7.754
	Alexander Zuckermann Bicycle and Pedestrian Path (6)	11.893	5.870
	Alexander Zuckermann Bicycle and Pedestrian Path (7)	6.337	4.276
	Alexander Zuckermann Bicycle and Pedestrian Path (8)	3.860	3.291
	Alexander Zuckermann Bicycle and Pedestrian Path (9)	2.575	2.600
	Alexander Zuckermann Bicycle and Pedestrian Path (10)	1.944	2.104
Oakland Parks	Gateway Park (new)	6.108	3.414
	Raimondi Park W	3.071	3.391
	Raimondi Park E	2.858	3.115
	Memorial Park (1)	2.339	2.816
	Memorial Park (2)	2.358	2.943
	Memorial Park (3)	2.279	2.915
	Memorial Park (4)	2.243	2.799
	Memorial Park (5)	2.187	2.763
	Memorial Park (6)	2.316	2.676
	Memorial Park (7)	2.403	2.608
	Memorial Park (8)	2.156	2.784
	Memorial Park (9)	2.027	2.875
	Memorial Park (10)	1.866	2.740
	Memorial Park (11)	1.741	2.641
	14th Street Pocket Park	3.401	3.963
	Willow Park	2.838	3.628
	McClymonds Mini-Park	1.401	1.896
	South Prescott Park	1.893	2.237
	Wade Johnson Park	1.919	2.616
	DeFremery Recreation Center	2.036	2.339
	Lowell Park	1.640	2.167
	Marston Campbell Park	1.390	1.662
	Poplar Playground	1.796	2.367
		1.611	1.957
	Fitzgerald Park	1.554	1.889
	Grove Shafter Park	0.969	1.420
	Mosswood Park	0.762	1.162
	Lafayette Square Park	1.085	1.572
	Frank H. Organia Plaza	0.995	1.339
	Henry L Kaiser Memorial Park	0.978	1.301
	Lincoln Square Park	0.937	1 213
	Chinese Garden Park / Harrison Square	0.768	1 258
	Madison Park	0.748	1 184
	Snow Park	0.757	1.056
	Dover Park	0.496	0.735
	Bushrod Recreation Center	0.429	0.637
	Jack London Square	0.767	1.281
Emeryville Parks	Golden Gate Playground	0.616	0.825
,	Temescal Creek Park	0.760	1.046
	Emeryville Community Organic Garden Park	0.800	1.013
	Doyle Hollis Park	0.788	0.976
	Park Ave Playground	0.729	0.926
	Christie Park	0.920	1.111
	Marina Park	1.178	1.277
	Joseph Emery Park	1.051	1.287

Table 4, continued.

Sensitive Receptor Location	Scenario: Medium Fire at Hopper A PM conc (ug/m3) 24-hr Avg 98th %-ile FA_NS	Scenario: Large Fire at Transloading PM conc (ug/m3) 24-hr Avg 98th %-ile FB_NS
Oakland Schools Prescott Elementary School	2.143	3.162
Ralph J. Bunche High School	2.036	2.368
Lafayette Elementary School	1.386	1.683
McClymonds High School	1.454	1.974
New Day Pre School	0.839	1.253
West Oakland Middle School	1.510	1.913
Cole Elementary School	1.762	2.593
Martin Luther King Jr Elementary School	1.392	1.973
Saint Vincent's Day Home - Preschool	1.450	2.116
City of Oakland Head Start	1.492	1.996
YMCA Preschool	1.062	1.564
Oakland School For the Arts	0.999	1.297
Starlite Child Development Center - Day Care Center	0.805	1.147
Oakland Charter High School	0.887	1.306
Lake Merritt Child Care Center	0.883	1.294
Lincoln Elementary School	0.824	1.222
American Indian Public Charter School	0.791	1.185
Little Stars Pre-School	0.775	1.144
Bright Future Early Learning	1.071	1.396
Laney College	0.669	1.051
Street Academy Alternative School	0.796	1.168
Westlake Middle School	0.713	1.086
St Mary's Center Preschool	1.295	1.844
Hoover Elementary School	1.201	1.708
Oakland Military Institute / Longfellow School	0.982	1.283
North Oakland Community Charter School	0.912	1.191
Emery Secondary School	0.689	0.936
Aspire Berkley Maynard Academy	0.596	0.803
Grace Children's Academy - Day Care Center	0.762	1.025
Emeryvile Schools Anna Yates Elementary	0.998	1.288
Pacific Rim International School - Montessori School	1.003	1.307
Emeryville Child Development Center - Preschool	1.049	1.350
Emery High School	0.996	1.286

VI. SUMMARY AND CONCLUSIONS

I compiled the necessary information in order to characterize the proposed OBOT facility, specifically related to the emissions of particulate matter (PM) from the transfer and handling of coal. I also constructed the required meteorological data, representing a five-year period from 2011 to 2015, necessary to evaluate long-term transport patterns and the resulting long-term air quality impacts.

The source and meteorological data were input to the AERMOD dispersion model which was used to estimate the air quality impacts in the surrounding community due to routine operations at the proposed OBOT facility. The model results indicate that coal dust emissions from the proposed OBOT facility would have a significant effect on $PM_{2.5}$ air quality in a large area surrounding the facility. For example, the model estimated that emissions from the proposed OBOT facility, under the north rail scenario, would be responsible for an increase in long-term average $PM_{2.5}$ levels of at least 0.5 μ g/m³ over an area of 3.5 square kilometers (km²), which is equivalent to the area of a circle with a diameter of 2.1 km. For the south rail scenario, the model estimated that routine OBOT operations would cause an increase in long-term PM_{2.5} concentrations of at least 0.5 μ g/m³ over an area of 5.4 square kilometers (km²), equivalent to a circular area with a diameter of 2.6 km.

The model also showed that coal dust emissions from the OBOT facility would contribute to short-term concentration impacts in the vicinity of the proposed facility and rail lines. Peak (98th percentile) 24-hour average $PM_{2.5}$ concentrations from the proposed OBOT facility would exceed 2.5 μ g/m³, and could be as high as 8 μ g/m³, at many nearby locations including the Alexander Zuckerman Bicycle and Pedestrian Path.

I also evaluated the air quality impacts that would be expected to occur due to an unplanned fire at the proposed OBOT facility using the same modeling platform. The model results demonstrated that either a medium-size fire at the unloading hopper location or a larger fire at the ship transloading location would result in a widespread increase in short-term (24-hour average) PM_{2.5} concentrations in the neighborhoods surrounding the proposed OBOT facility.

These conclusions were reached based upon the information I have reviewed todate, including the materials identified in Appendix A (Materials Considered). I reserve the right to alter this report and its conclusions based on new or revised information.

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I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Executed on October 6, 2017, at San Rafael, California.

Undrew per

H. Andrew Gray