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memorandum

date	March 28, 2023
to	Kelly Bayer and Krystle McBride; AECOM
cc	Justin Taschek; Port of Oakland
	Eric Jolliffe; U.S. Army Corps of Engineers
from	Tim Sturtz, Kurt Richman, and Jyothi Iyer; ESA
subject	Oakland Harbor Turning Basins Widening – Construction Health Risk Assessment

Introduction

Construction of the Oakland Harbor Turning Basins Widening (project) would result in criteria air pollutant emissions and potential risks to human health from the emissions of toxic air contaminants (TACs). Criteria pollutants regulated under the National Environmental Policy Act (NEPA) include volatile organic compounds (VOC), oxides of nitrogen (NO_X), particulate matter ($PM_{2.5}$ and PM_{10}) and carbon monoxide (CO), and are included in the General Conformity Memorandum prepared for this project. This technical memorandum estimates the potential cancer risk and non-cancer health impacts from the project alternatives involving widening either or both of the Inner Harbor Turning Basin and Outer Harbor Turning Basin as well as the No Project/No Action Alternative. The cancer risk and non-cancer health impacts from project alternatives would result from the exposure of receptors to emissions of diesel particulate matter (DPM)[1] and fine particulate matter ($PM_{2.5}$) from the exhaust of diesel-powered construction equipment, haul and vendor truck use, and fugitive dust from on-road vehicle travel. Results presented include incremental lifetime cancer risk, non-cancer chronic Hazard Index (HI), and annual average $PM_{2.5}$ concentrations that are attributable to each of the project alternatives. The United States Environmental Protection Agency (USEPA) does not provide standards or thresholds for the evaluation of health risk assessment results under NEPA. Therefore, estimated project risks are presented for informational purposes and will be further evaluated in the California Environmental Quality Act document. Risks to both off-site residential and off-site worker receptors are analyzed.

[1] The USEPA does not formally recognize DPM as a hazardous air pollutant, unlike states where DPM is identified as an air toxic (e.g., California, Washington). The composition of DPM includes compounds found within the USEPA list of hazardous air pollutants.

Methodology

This Health Risk Assessment (HRA) was prepared to evaluate the increase in health risks to nearby receptors from exposure to construction emissions from the project alternatives. The HRA was prepared using technical documentation, HRA guidance, and protocols from the BAAQMD[2], California Air Resources Board (CARB)[3], and the California Office of Environmental Health Hazard Assessment (OEHHA)[4]. The HRA evaluates the estimated incremental increase in lifetime cancer risks from exposure to emissions of DPM associated with combustion (i.e., exhaust), non-cancer chronic HI, and the annual average $PM_{2.5}$ concentrations associated with combustion and fugitive sources, including tire wear, brake wear, and road dust, that would be emitted by project-related construction sources. Although DPM is a complex mixture of gases and fine particles that includes over 40 substances listed by the USEPA as hazardous air pollutants and by the CARB as TACs, the DPM analysis used PM_{10} emissions as a surrogate for DPM emissions.[5,6] Since the PM_{10} in diesel exhaust contains many of the carcinogenic components of diesel exhaust adsorbed onto the surfaces of the particulate matter, relying on this fraction as a surrogate for DPM emissions as a reasonable assumption. The USEPA does not include DPM in its list of hazardous air pollutants (HAPs), but regulates diesel exhaust from various sources through emission standards on on-road and off-road engines. Individual compounds (typically polycyclic aromatic hydrocarbons) that are components of diesel exhaust are considered HAPs and constitute the mixture that CARB classifies as DPM. Rather than use USEPA's approach using individual HAPs in the HRA, DPM is used as it is familiar and more commonly used in HRAs in California. Pollutant concentrations were estimated using the American Meteorological Society/ Environmental Protection Agency Regulatory Model Improvement Committee's regulatory air dispersion model (AERMOD Version 22112).[7]

Inputs to the model include general modeling parameters that account for atmospheric conditions, terrain, emission rates for each contaminant from the project sources, source parameters that characterize the activities generating emissions, variable phase durations to characterize the construction schedule, and sensitive receptor characteristics (e.g., resident child, adult worker).

Meteorology and Terrain Data

Meteorological data were processed using two on-site meteorological stations that operate under the auspice of the National Oceanic and Atmospheric Administration's (NOAA) Center for Operational

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2 BAAQMD. 2020. *BAAQMD Health Risk Assessment Modeling Protocol,* December 2020. Available online at: https://www.baaqmd.gov/~/media/files/ab617-community-health/facility-risk-reduction/documents/baaqmd_hra_modeling_protocol-pdf.pdf?la=en.

3 CARB. 2020. *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values*, last updated October 2, 2020. Available online at: https://ww2.arb.ca.gov/sites/default/files/classic//toxics/healthval/contable.pdf.

4 OEHHA. 2015. *Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments,* February 2015. Available online at: http://oehha.ca.gov/air/hot_spots/hotspots2015.html.

5 OEHHA (Office of Environmental Health Hazard Assessment). 1998. *For the "Proposed Identification of Diesel Exhaust as a Toxic Air Contaminant" Part B: Health Risk Assessment for Diesel Exhaust*. May 1998. Available online at: https://www.arb.ca.gov/toxics/dieseltac/part_b.pdf.

6 BAAQMD. 2016. *Regulation 2 Permits Rule 5 New Source Review of Toxic Air Contaminants*, December 7, 2016. Available online at: http://www.baaqmd.gov/~/media/dotgov/files/rules/reg-2-rule-5-new-source-review-of-toxic-air-contaminants/documents/rg0205_120716-pdf.pdf?la=en.

7 USEPA. 2021. AERMOD Implementation Guide, July 2021. Available online at: https://gaftp.epa.gov/Air/aqmg/SCRAM/models/preferred/aermod/aermod_implementation_guide.pdf.

Oceanographic Products and Services (CO-OPS): Berth 34 (CO-OPS site ID: 9414776) and Berth 67 (CO-OPS site ID: 9414763).[8] The meteorological data at Berth 34 were used for AERMOD modeling of all emission sources operating in the Outer Harbor and the Berth 67 meteorological data was applied for all Inner Harbor emissions. The wind roses for the two stations are shown in **Figure 1**. The locations of the two meteorological stations relative to the Inner Harbor Turning Basin (IHTB) and Outer Harbor Turning Basin (OHTB) are shown in **Figure 2**. The model results from each meteorological scenario were produced for identical receptor data sets and aggregated in post-processing to characterize overall project concentrations. Terrain and elevation data were imported from the United States Geological Survey's National Elevation Dataset[9], with ⅓ arc-second resolution and a horizon datum of the North American Datum of 1983.

Emission Rates

Emission rates of DPM and exhaust $PM_{2.5}$ by construction year from the various emission sources (e.g., construction equipment, vehicles on roadways, marine sources) were based on the number of construction workdays in the year and the anticipated hours of activity for each source.

Each source was modeled with a unitized emission rate of 1 gram/ per second (g/s). The modeled concentration at each receptor (micrograms per cubic meter [$\mu g/m^3$]) divided by the emission rate (in g/s) represents a "dispersion factor" which is a numerical unitless value. The dispersion factor from each source was then multiplied by its annual average emission rate (g/s) to determine the annual average ambient pollutant concentrations ($\mu g/m^3$) at all modeled receptors.

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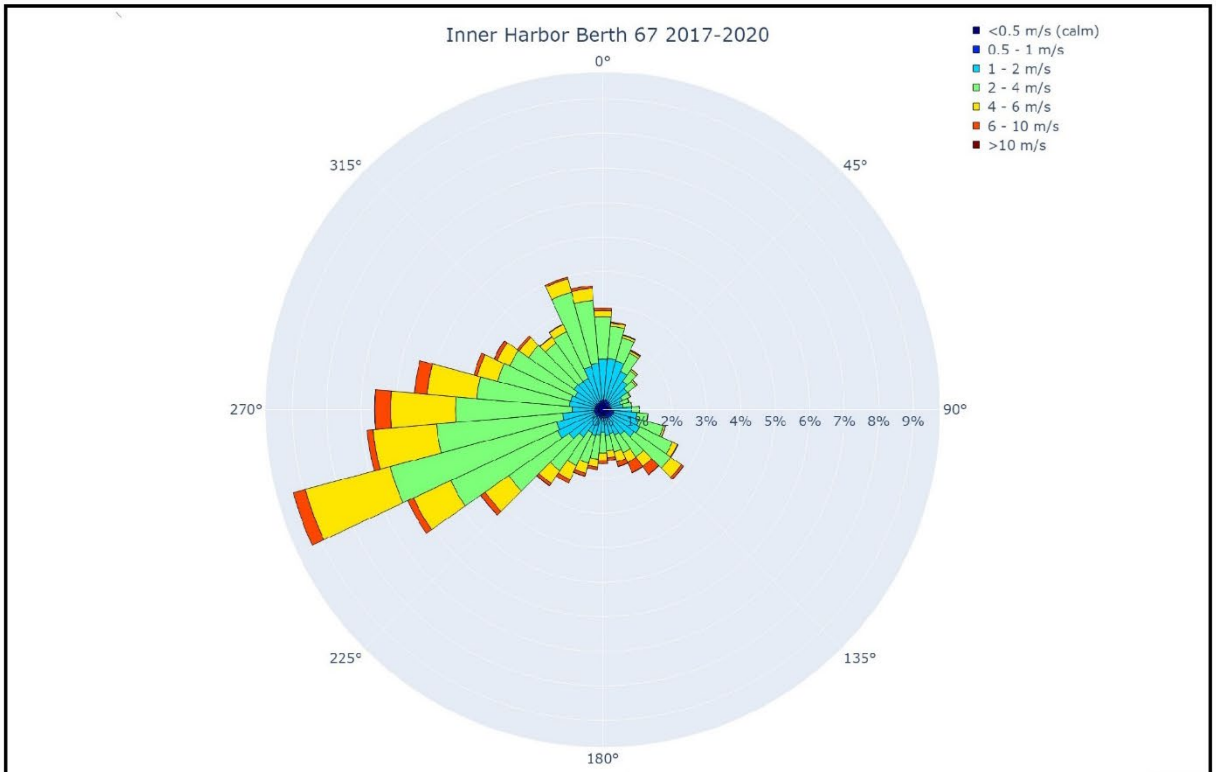
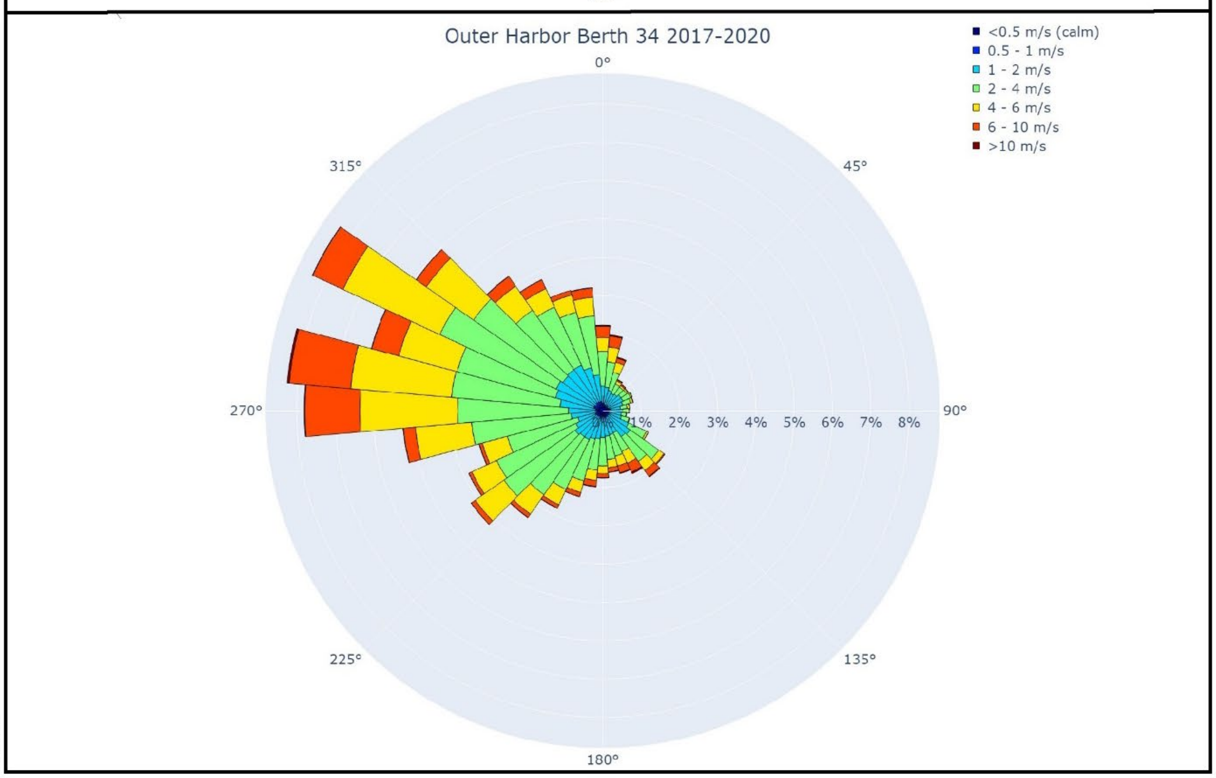
8 The CO-OPS sensor specifications call for installation of anemometers at 10 meters above sea level (sites are located at the water due to the oceanographic nature of the sensors and observations). Specifications for site design are available at https://tidesandcurrents.noaa.gov/publications/CO-OPS_Measurement_Spec.pdf.

9 USGS (United States Geological Survey). 2016. *National Elevation Dataset*. Available online at: www.mrlc.gov/viewerjs/.

Preliminary Draft

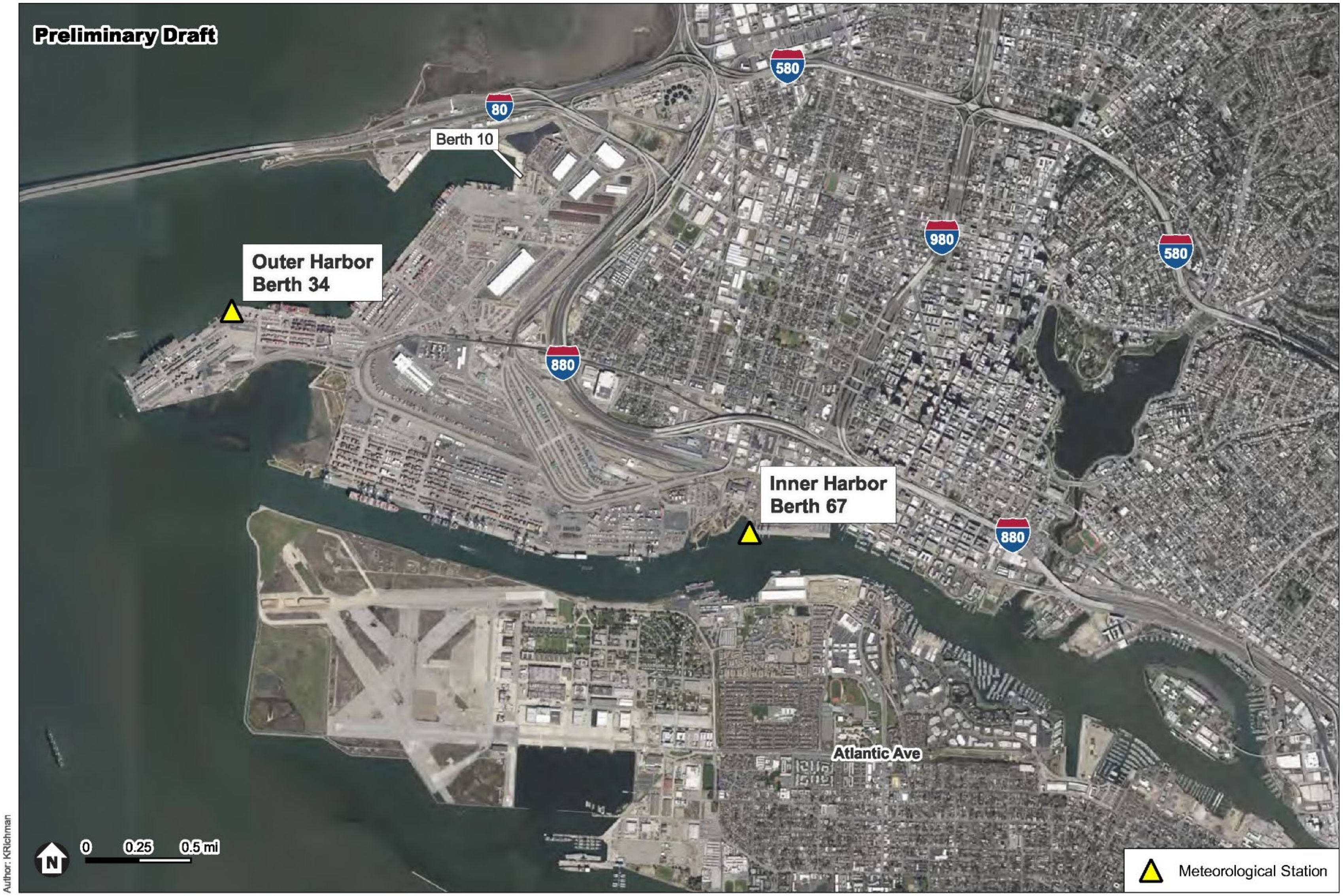




SOURCE: ESA, 2023; Meteorological Data from NOAA, 2023

Port of Oakland Turning Basins Widening Project

Figure 1
Surface Meteorological Station Windroses
Oakland, California



SOURCE: ESA, 2023; Basemap from Bing Maps;

Port of Oakland Turning Basins Widening Project

Figure 2
Surface Meteorological Station Locations
Oakland, California

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Sources and Source Parameters

In general, emissions sources can be modeled as point, area or volume sources in AERMOD. A line source is represented as a series of area sources. Construction sources around Howard Terminal, Alameda, Berth 10, and the Inner Harbor and Outer Harbors were each modeled as separate area source groups in AERMOD. The land-based construction area sources use the same release parameters, including a release height of 5 meters and an initial vertical dimension[10] of 1.4 meters. The area sources representing marine emissions from the Inner Harbor, Outer Harbor, and tug transiting routes use a release height of 6 meters and an initial vertical dimension of 4.744 meters based on the harbor craft parameters used in the West Oakland Community Action Plan (WOCAP) analysis.[11]

In addition, haul truck, vendor truck, and worker vehicle trips associated with construction were also modeled as area sources. From the Howard Terminal construction area, haul routes were modeled north and south along Highways 880 and 980. From the Alameda construction area, haul routes were modeled on Main Street to Atlantic Avenue and split between continuing south along Atlantic Avenue or heading north through the Webster Street Tube and Posey Tube before connecting to Highways 880 and 980. Haul trips from the Berth 10 construction site were modeled along Maritime Street out to Highways 80 and 880. The area sources were modeled with a release height of 3.4 meters above road and an initial vertical dimension of 3.16 meters, consistent with WOCAP haul route parameters.[12] Road dust generated from the truck trips was modeled with a release height of 2.55 meters above road and an initial vertical dimension of 2.37 meters. Roadway elevations for surface streets and elevated highways were determined using the USGS 1/3rd arc-second National Elevation Dataset (NED) and 2010 American Recovery and Reinvestment Act (ARRA) San Francisco Coast LIDAR data, respectively.

The area sources are shown in **Figure 3**. The modeling parameters for the sources modeled in AERMOD are summarized in **Table 1**.

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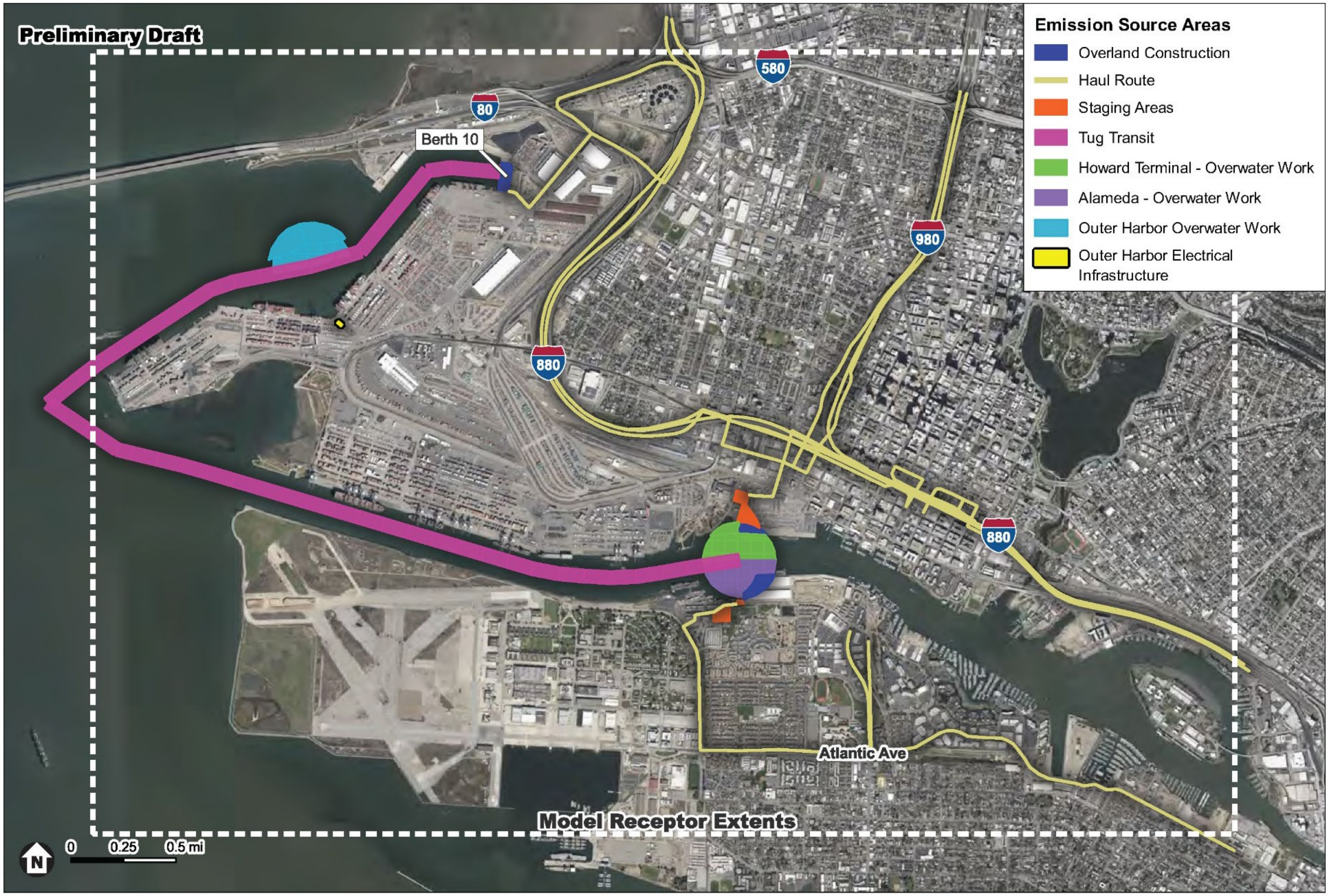
10 For some sources, the emissions may be turbulently mixed near the source by the process that is generating the emissions, therefore occupying some initial depth. The initial vertical dimension to the plume represents that depth and is used when the area source algorithm is used to model mechanically generated emission sources, such as mobile sources. For more passive area source emissions, such as evaporation or wind erosion, the initial vertical dimension would be equal to zero.

11 BAAQMD and West Oakland Environmental Indicators Project. 2019. *Final Environmental Impact Report: The West Oakland Community Action Plan*, September 2019, Appendix C: AB 617 Owning Our Air: The West Oakland Community Action Plan Technical Support Document Base Year Emissions Inventory and Air Pollutant Dispersion Modeling. Available online at: https://www.baaqmd.gov/~/media/files/ab617-community-health/west-oakland/100219-files/wocap-final-eir-100219-pdf.pdf?la=en.

12 BAAQMD and West Oakland Environmental Indicators Project. 2019. *Final Environmental Impact Report: The West Oakland Community Action Plan*, September 2019, Appendix C: AB 617 Owning Our Air: The West Oakland Community Action Plan Technical Support Document Base Year Emissions Inventory and Air Pollutant Dispersion Modeling. Available online at: https://www.baaqmd.gov/~/media/files/ab617-community-health/west-oakland/100219-files/wocap-final-eir-100219-pdf.pdf?la=en.



SOURCE: ESA, 2023; Basemap from Bing Maps;

Port of Oakland Turning Basins Widening Project

Figure 3
Modeled Area Source Layout
Oakland, California

ESA

Receptor Grid

Consistent with BAAQMD recommendations, cancer risk and non-cancer health impacts from DPM and annual average $PM_{2.5}$ concentrations were estimated throughout the Oakland and Alameda communities. The BAAQMD considers 1,000 feet around emission sources as the “zone of influence” with respect to HRAs with the exception that one should enlarge the 1,000-foot radius on a case-by-case basis if an unusually large source or sources of risk or hazard emissions that may affect a proposed project are beyond the recommended radius. Therefore, due to the proximity of the project to the disproportionately impacted West Oakland community and the size and scope of the Port and other West Oakland sources, the receptor grid was expanded well beyond the 1,000 feet distance. A 20-meter receptor spacing was used across all of West Oakland (consistent with the WOCAP analysis) and throughout near-project portions of Alameda. A 50-meter resolution receptor grid was applied over the Port of Oakland Seaport area and the Schnitzer Steel facility to assess potential for elevated concentrations for workers. To capture the broader influence of the project, a 250-meter resolution grid was applied across the full modeling domain (shown as model receptor extents in Figure 3). Discrete sensitive receptors within 1,000 feet of the IHTB expansion on both the Oakland and Alameda side were also included in the modeling effort and primarily include residential areas and the live-aboards at Jack London Square Marina. There are no sensitive receptors within 1,000 feet of the OHTB boundaries. In all, 31,260 receptors were modeled. Receptors were placed at a height of 1.8 meters above terrain height, which represents the default breathing height for ground-floor receptors (i.e., human residents). The modeled receptor grid is shown in **Figure 4**. It should be noted that the discrete receptors are not visible in the figure because they are not distinguishable from the fine 20-meter grid.

Pollutants Modeled

The pollutants modeled in this health risk assessment include DPM and $PM_{2.5}$ exhaust from off-road equipment, diesel truck travel, and marine vessel operations; and $PM_{2.5}$ from brake wear and tire wear. TACs in fugitive dust generated from land-based construction activities was not included and would be addressed through the implementation of best management practices for dust control. Details regarding the emission inventory methodology are provided in the *Oakland Harbor Turning Basins Widening - General Conformity Analysis* memorandum.

It should be noted that amendments to California Commercial Harbor Craft Regulation, section 2299.5, title 13, division 3, chapter 5.1 and section 93118.5, title 17, chapter 1, subchapter 7.5 of the California Code of Regulations went into effect on January 1, 2023. The amended Commercial Harbor Craft Regulation will reduce emissions from harbor craft operated near California’s coast. Based on the requirements of this regulation, ocean tugs, towboats/pushboats, and workboats used during construction could have higher tier classes than were assumed for this analysis (i.e., have cleaner engines). Because these amendments were only recently approved on December 30, 2022, they were not factored into this analysis; however, they may be factored into subsequent analysis under the California Environmental Quality Act.

Exposure Parameters

Maximum incremental lifetime cancer risk and annual average $PM_{2.5}$ concentrations were modeled for the construction period from 2027 through 2029. The analysis was organized by construction activity in each calendar year at each location. OEHHA and BAAQMD guidance recommend evaluating the lifetime excess cancer risk from exposure to pollutants over a 30-year exposure duration. The exposure duration modeled was 28 months, representing the total construction period, with exposure starting when construction commences.

All exposure assumptions are presented in **Table 2**; these assumptions are based on risk assessment guidelines from OEHHA and BAAQMD.

TABLE 1
AERMOD SOURCE MODELING PARAMETERS

Parameter	Off-Road Construction Equipment	Marine Equipment	On-Road Trucks Exhaust	On-Road Trucks Dust
Source Type[1]	Area	Area	Line-Area	Line-Area
Release Height[2] (m)	5	6	3.4	2.55
Initial Vertical Dimension[2] (m)	1.4	4.744	3.16	2.37
Hours per Day	12	24	12	12
Days per Week	5	5	5	5

NOTES:

1. All sources, including construction areas around Howard Terminal, Schnitzer Steel, Alameda, the Inner Harbor, the Outer Harbor, Berth 10, and all haul roads were modeled as area sources.
2. Release heights and initial vertical dimensions for off-road construction equipment, marine equipment, on-road truck exhaust, and on-road truck dust are from the source parameters used in the WOCAP health risk analysis (BAAQMD 2019). The release height for on-road exhaust and dust from elevated roadways were added to the height of the roadway surface, evaluated using Alameda 2010 LIDAR scans (USGS 2010).
3. Emissions for dredging equipment were estimated assuming 24 hours per day and 7 days per week of operation; for dispersion modeling, the emissions were consolidated to occur 24 hours per day, 5 days a week.

m = meters

SOURCE: BAAQMD and WOEIP. 2019. Final Environmental Impact Report: The West Oakland Community Action Plan, September 2019, Appendix C: AB 617 Owning Our Air: The West Oakland Community Action Plan Technical Support Document Base Year Emissions Inventory and Air Pollutant Dispersion Modeling.

TABLE 2
EXPOSURE PARAMETERS FOR RISK ASSESSMENT

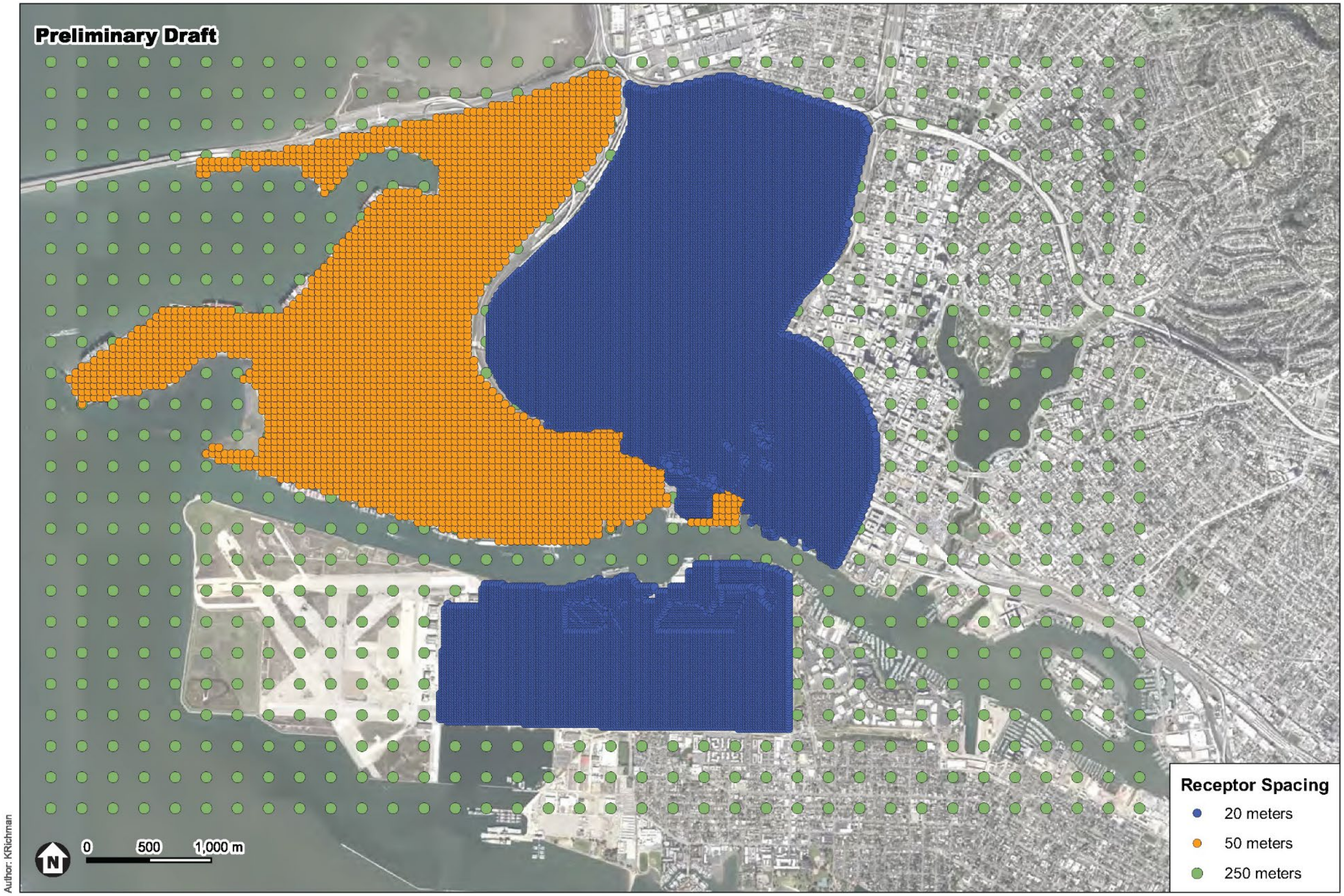
Receptor Type	Age Group	Daily Breathing Rate[1] (L/Kg day or L/Kg 8 hrs)	Exposure Duration[2] (years)	Fraction of Time at Home[3] or Modeling Adjustment Factor[4] (unitless)	Exposure Frequency[5] (days/year)	Averaging Time[6] (days)	Age Sensitivity Factor[7] (unitless)
Off-site Resident	Third Trimester	361	0.25	1	350	25,550	10
	Age 0 to 2 Years	1,090	2	1	350	25,550	10
	Age 2 to 9 Years	631	0.03	1	350	25,550	3
Off-site Worker	Age 16 to 70 years	230	2.28	1.17	350	25,550	1

NOTES:

1. Daily breathing rates are from OEHHA (2015) based on BAAQMD guidance (2016) as follows: for residents, 95th percentile 24-hour breathing rates (OEHHA Table 5.6) for third trimester and age 0 to 2 years and 80th percentile 24-hour breathing rates (OEHHA Table 5.7) for age 2 to 9 years, age 2 to 16 years, and age 16 to 30 years.
2. The exposure duration represents 2.28 years of exposure to construction emissions (the entire construction period for the project).
3. Fraction of time based on OEHHA Table 8.4 since there are no schools within cancer risk isopleths of one in a million or greater, per BAAQMD guidance (2016).
4. A Modeling Adjustment Factor of 1.17 is used to account the level of exposure to workers. This adjustment is based on guidance from OEHHA (2015) and accounts for the modeled hours per worker shift and the expected worker days. Modeling was conducted to account for hours per day of activity depending on type of operation and the days worked per week were expected to be roughly 6 to account for the distinction between the offroad/on-road equipment activity and the marine activity, which operate on different schedules.
5. Exposure frequency represents default exposure frequency for residential receptors from BAAQMD guidance (2016).
6. Averaging time represents 70 years for lifetime cancer risk, per OEHHA (2015).
7. Age sensitivity factors from OEHHA (2015) Table 8.3.

kg = kilogram
L = liter

SOURCES: OEHHA. 2015. *Air Toxics Hot Spots Program Guidance Manual for the Preparation of Health Risk Assessments,* February 2015.; BAAQMD. 2016. *Air Toxics NSR Program Health Risk Assessment (HRA) Guidelines*, January 2016. Available online at: http://www.baaqmd.gov/~/media/files/planning-and-research/rules-and-regs/workshops/2016/reg-2-5/hra-guidelines_clean_jan_2016-pdf.pdf?la=en.



SOURCE: ESA, 2023; Basemap from Bing Maps;

Port of Oakland Turning Basins Widening Project

Figure 4
Model Receptor Grid Locations
Oakland, California

ESA

A toxicity value representing the cancer potency factor of 1.1 milligrams DPM per kilogram of body weight was used in the analysis for DPM. This toxicity value is for carcinogenic (cancer) effects; for DPM, the primary pathway for exposure is assumed to be inhalation. The incremental risks were determined for each TAC emission source and summed to obtain an estimated total incremental cancer health risk. $PM_{2.5}$ toxicity is correlated directly to ambient air concentrations.

Calculation of Intake

The dose estimated for each exposure pathway is a function of the concentration of a chemical and the intake of that chemical. The intake factor for inhalation was calculated as follows using **Equation 1**. The values used in this equation are presented in Table .

$$\textbf{Equation 1}: IF_{inh} = \frac{DBR * FAH * EF * ED * MAF * ASF * CF}{AT}$$

Where:

IF_{inh} = Intake Factor for Inhalation (m^3/kg-day)
DBR = Daily Breathing Rate (L/kg-day)
FAH = Frequency of Time at Home (unitless)
EF = Exposure Frequency (days/year)
ED = Exposure Duration (years)
AT = Averaging Time (days)
MAF = Model Adjustment Factor (unitless)
ASF = Age Sensitivity Factor (unitless)
CF = Conversion Factor, 0.001 (m^3/L)

Calculation of Cancer Risk

Excess lifetime cancer risk is estimated as the upper-bound incremental probability that an individual will develop cancer over a lifetime as a direct result of exposure to carcinogens. Excess lifetime cancer risk is expressed as a unitless probability, and is calculated as the number of cancer incidences per one million individuals. The cancer risk for each chemical is calculated by multiplying the chemical intake or dose at the human exchange boundaries (e.g., lungs) by the chemical-specific cancer potency factor. Excess lifetime cancer risk occurs exclusively through the inhalation pathway and is calculated according to **Equation 2**.

$$\textbf{Equation 2}: Risk_{inh} = C_i * IF_{inh} * CPF_i * CF_1 * CF_2$$

Where:

$Risk_{inh}$ = Cancer risk; the incremental probability of an individual developing cancer as a result of inhalation exposure to a particular carcinogen (per one million)
C_i = Average annual air concentration of chemical, from AERMOD (µg/m^3)
IF_{inh} = Intake Factor for Inhalation (m^3/kg-day)
CPF_i = Cancer potency factor for chemical (mg chemical/kg body weight-day)$^{-1}$
CF_1 = Conversion factor, micrograms to milligrams (mg/µg)
CF_2 = Risk per one million individuals

i = Chemical

Calculation of Hazard Index

Chronic noncancer health impacts to receptors are determined by dividing an airborne concentration at the receptor by the appropriate Reference Exposure Level (REL). This is termed the Hazard Index (HI). A REL is used as an indicator of potential noncancer health impacts and is defined as the concentration at which no adverse noncancer health effects are anticipated. Potential noncancer health effects from chronic exposure of DPM is evaluated using the chronic inhalation REL of 5 μg/m^3 using **Equation 3**.

$$\textbf{Equation 3}: HI_{inh} = C_i / REL_{inh}$$

Where:

HI_{inh} = Chronic Hazard Index from inhalation exposure to a particular carcinogen (unitless)

C_i = Average annual air concentration of chemical, from AERMOD (μg/m^3)

REL_{inh} = Inhalation Reference Exposure Level (μg/m^3)

Results

Expansion of Inner Harbor Turning Basin (NEPA Alternative B)

Table 3 presents the maximum cancer risk and non-cancer health impacts from exposure to unmitigated (uncontrolled) DPM and $PM_{2.5}$ emissions from construction activities associated with the expansion of the IHTB. This alternative assumes the use of diesel dredges. The table includes lifetime excess cancer risk (chances per one million), chronic HI, and average annual $PM_{2.5}$ concentrations (μg/m^3) at the Maximally Exposed Individual Residence (MEIR) and the Maximally Exposed Individual Worker (MEIW). **Figures 5 and 6** shows the cancer risk contours and the locations of the MEIR and MEIW, respectively.

TABLE 3
UNMITIGATED HRA RESULTS FROM THE EXPANSION OF THE INNER HARBOR TURNING BASIN - DIESEL DREDGING

Receptor Type	Lifetime Excess Cancer Risk, chances per one million	Chronic Hazard Index, unitless	Annual Average $PM_{2.5}$ Concentration, μg/m^3
Resident (MEIR)[1]	**32.1**	0.059	**1.4**
BAAQMD Thresholds	10	1.0	0.3
Worker (MEIW)[2]	2.6	0.166	3.92
BAAQMD Thresholds	10	1.0	--

NOTES:

Bold values show exceedance of thresholds.

1. The Expansion of Inner Harbor Turning Basin (NEPA Alternative B) MEIR for cancer risk would be located at Universal Transverse Mercator (UTM) (562894.19, 4183407.24) within the proposed Waterfront Ballpark at Howard terminal.
2. The Expansion of Inner Harbor Turning Basin (NEPA Alternative B) MEIW for cancer risk would be located at UTM (562874.19, 4183347.24) adjacent to the proposed IHTB excavation area at Howard Terminal.

-- = no applicable threshold for workers

BAAQMD = Bay Area Air Quality Management District
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
μg/m^3 = micrograms per cubic meter

SOURCE: Table compiled by ESA in 2023.

As shown in Table 3, the increase in lifetime cancer risk and $PM_{2.5}$ annual average concentration from exposure to unmitigated project construction emissions from expansion of the IHTB using diesel dredging (NEPA Alternative B) may result in exceedances of local cancer risk and $PM_{2.5}$ thresholds at the MEIR. The unmitigated non-cancer chronic HI would be less than local thresholds. All cancer risk and non-cancer impacts would be below local thresholds for the MEIW.

SOURCE: ESA, 2023; Basemap adjusted from Bing Maps;
Inset MEIR Overlay Basemap from Oakland A's Marine Reservation Scenario (2021);

Port of Oakland Turning Basins Widening Project

Figure 5
Expansion of Inner Harbor Turning Basin Diesel Dredging (Alternative B): Unmitigated Residential Cancer Risk
Oakland, California

ESA

SOURCE: ESA, 2023; Basemap adjusted from Bing Maps;

Port of Oakland Turning Basins Widening Project

Figure 6
Expansion of Inner Harbor Turning Basin Diesel Dredging (Alternative B): Unmitigated Worker Cancer Risk
Oakland, California

ESA

Expansion of Outer Harbor Turning Basin (NEPA Alternative C)

Table 3 presents the maximum cancer risk and non-cancer health impacts from exposure to unmitigated DPM and $PM_{2.5}$ emissions from construction activities associated with the expansion of the OHTB. This alternative assumes the use of diesel dredges. The table includes lifetime excess cancer risk (chances per one million), chronic HI, and average annual $PM_{2.5}$ concentrations at the MEIR and MEIW. **Figures 7 and 8** shows the incremental cancer risk contours and the locations of the MEIR and MEIW, respectively.

TABLE 4
UNMITIGATED HRA RESULTS FROM THE EXPANSION OF THE OUTER HARBOR TURNING BASIN – DIESEL DREDGING

Receptor Type	Lifetime Excess Cancer Risk, chances per one million	Chronic Hazard Index, unitless	Annual Average $PM_{2.5}$ Concentration, $\mu g/m^3$
Resident (MEIR)[1]	2.8	0.008	0.04
BAAQMD Thresholds	10	1.0	0.3
Worker (MEIW)[2]	0.7	0.073	0.37
BAAQMD Thresholds	10	1.0	--

NOTES:

Bold values show exceedance of thresholds.

1. The Expansion of Outer Harbor Turning Basin (NEPA Alternative C) MEIR for cancer risk would be located at UTM (561300, 4185020) at an undeveloped parcel in West Oakland adjacent to Highway 880. It is conservatively assumed that this location could be developed with future residential uses by the start of project construction.
2. The Expansion of Outer Harbor Turning Basin (NEPA Alternative C) MEIW for cancer risk would be located at UTM (559850, 4185250) on Port property near Berth 25.

-- = no applicable threshold for workers

BAAQMD = Bay Area Air Quality Management District
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
$\mu g/m^3$ = micrograms per cubic meter

SOURCE: Table compiled by ESA in 2023.

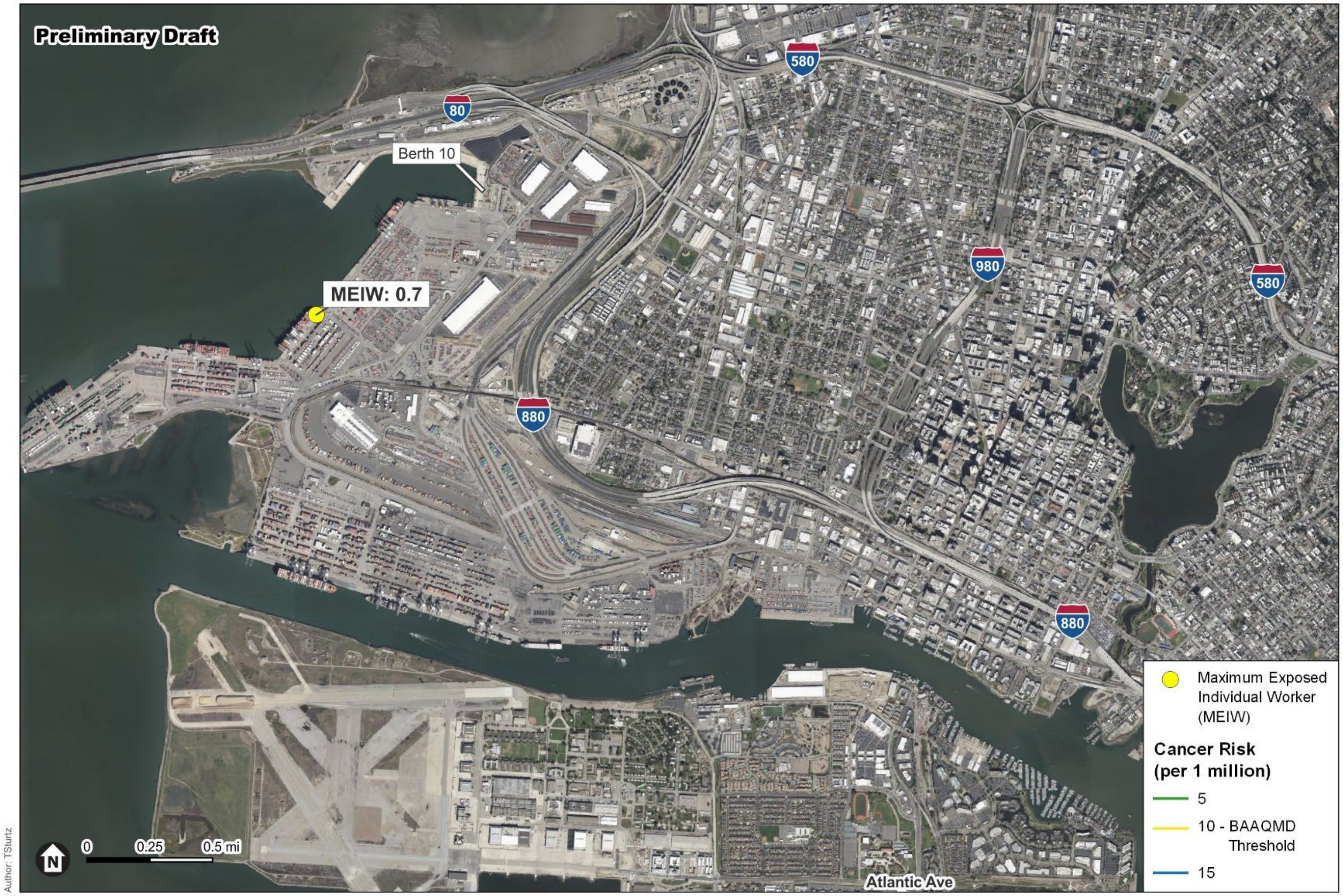
As shown in Table 34, the increase in lifetime cancer risk from exposure to unmitigated project construction emissions from expansion of the OHTB using diesel dredging (NEPA Alternative C) would not result in an exceedance of local health risk assessment thresholds at the MEIR and MEIW.

SOURCE: ESA, 2023; Basemap adjusted from Bing Maps;

Port of Oakland Turning Basins Widening Project

Figure 7
Expansion of Outer Harbor Turning Basin Diesel Dredging (Alternative C): Unmitigated Residential Cancer Risk
Oakland, California

ESA



SOURCE: ESA, 2023; Basemap adjusted from Bing Maps;

Port of Oakland Turning Basins Widening Project

Figure 8
Expansion of Outer Harbor Turning Basin Diesel Dredging (Alternative C): Unmitigated Worker Cancer Risk
Oakland, California

ESA

Expansion of Inner Harbor and Outer Harbor Turning Basins

Diesel Dredging (NEPA Alternative D-1)

Table 35 presents the maximum cancer risk and non-cancer health impacts from exposure to unmitigated DPM and $PM_{2.5}$ emissions from construction activities associated with the expansion of both the Inner and Outer Harbor Turning Basins using diesel dredges. The table includes lifetime excess cancer risk (chances per one million), chronic HI, and average annual $PM_{2.5}$ concentrations at the MEIR and MEIW. **Figures 9 and 10** shows the incremental cancer risk contours and the locations of the MEIR and MEIW, respectively.

TABLE 5
UNMITIGATED HRA RESULTS FROM THE EXPANSION OF BOTH THE INNER HARBOR TURNING BASIN AND OUTER HARBOR TURNING BASINS – DIESEL DREDGING

Receptor Type	Lifetime Excess Cancer Risk, chances per one million	Chronic Hazard Index, unitless	Annual Average $PM_{2.5}$ Concentration, μg/m^3
Resident (MEIR)[1]	**33.0**	0.059	**1.4**
BAAQMD Thresholds	10	1.0	0.3
Worker (MEIW)[2]	2.6	0.17	3.92
BAAQMD Thresholds	10	1.0	--

NOTES:

Bold values show exceedance of thresholds.

1. The Expansion of Inner Harbor and Outer Harbor Turning Basins with Diesel Dredging (NEPA Alternative D-1) MEIR for cancer risk would be located at UTM (562894.19, 4183407.24) within the proposed Waterfront Ballpark at Howard terminal.
2. The Expansion of Inner Harbor and Outer Harbor Turning Basins with Diesel Dredging (NEPA Alternative D-1) MEIW for cancer risk would be located at UTM (562874.19, 4183347.24) adjacent to the proposed IHTB excavation area at Howard Terminal.

-- = no applicable threshold for workers

BAAQMD = Bay Area Air Quality Management District
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
μg/m^3 = micrograms per cubic meter

SOURCE: Table compiled by ESA in 2023.

As shown in Table 35, the increase in lifetime cancer risk and annual $PM_{2.5}$ concentration from exposure to unmitigated project construction emissions from expansion of the IHTB and OHTB using diesel dredging (NEPA Alternative D-1) may result in exceedances of the local cancer risk and $PM_{2.5}$ thresholds at the MEIR. The non-cancer chronic HI at the MEIR would be less than local thresholds. All cancer risk and non-cancer health impacts would be below the local thresholds for the MEIW.

SOURCE: ESA, 2023; Basemap adjusted from Bing Maps;
Inset MEIR Overlay Basemap from Oakland A's Marine Reservation Scenario (2021);

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Figure 9
Expansion of Inner and Outer Harbor Turning Basins Diesel Dredging (Alternative D-1): Unmitigated Residential Cancer Risk
Oakland, California

ESA

SOURCE: ESA, 2023; Basemap from Bing Maps;

Port of Oakland Turning Basins Widening Project

Figure 10
Expansion of Inner and Outer Harbor Turning Basins Diesel Dredging (Alternative D-1): Unmitigated Worker Cancer Risk
Oakland, California

Electric Dredging (NEPA Alternative D-2)

The expansion of both the Inner and Outer Harbor Turning Basins using electric dredges would result in maximum cancer risk and non-cancer health impacts as shown in **Table 6**. Results presented in Table 6 also incorporate reductions from the use of off-road construction equipment greater than 25 horsepower equipped with the most effective Verified Diesel Emissions Control Strategies (VDECS) available for the engine type. In this case, the best available VDECS would be the use of engines that meet the Tier 4 Final (Tier 4F) standards as certified by CARB and USEPA.[13]

TABLE 6
MITIGATED HRA RESULTS FROM THE EXPANSION OF THE INNER HARBOR TURNING BASIN AND OUTER HARBOR TURNING BASINS – ELECTRIC DREDGING

Receptor Type	Lifetime Excess Cancer Risk, chances per one million	Chronic Hazard Index, unitless	Annual Average $PM_{2.5}$ Concentration, $\mu g/m^3$
Resident (MEIR)[1]	8.1	0.013	**1.19**
BAAQMD Thresholds	10	1.0	0.3
Worker (MEIW)[2]	0.46	0.029	3.33
BAAQMD Thresholds	10	1.0	--

NOTES:

Bold values show exceedance of thresholds.

1. The Expansion of Inner Harbor and Outer Harbor Turning Basins with Electric Dredging (NEPA Alternative D-2) MEIR for cancer risk would be located at UTM (563142.35, 4182964.1) in the Landing at Bay 37 development that is currently under construction in Alameda.
2. The Expansion of Inner Harbor and Outer Harbor Turning Basins with Electric Dredging (NEPA Alternative D-2) MEIW for cancer risk would be located at UTM (562874.19, 4183347.24) adjacent to the proposed IHTB excavation area at Howard Terminal.

-- = no applicable threshold for workers

BAAQMD = Bay Area Air Quality Management District
$PM_{2.5}$ = particulate matter less than 2.5 microns in diameter
$\mu g/m^3$ = micrograms per cubic meter

SOURCE: Table compiled by ESA in 2023.

As shown in Table 36, the increase in lifetime cancer risk from exposure to mitigated project construction emissions from expansion of the IHTB and OHTB using electric dredging (NEPA Alternative D-2) may still result in an exceedance of local $PM_{2.5}$ non-cancer health impact thresholds at the MEIR. The existing background $PM_{2.5}$ annual design values indicate that the area is well within attainment. Therefore, the modeled concentrations when combined with the annual design values would not likely result in concentrations beyond the national or state $PM_{2.5}$ annual ambient air quality standards. Use of Tier 4F engines in construction equipment and electric dredges would reduce the incremental cancer risk to below local cancer risk thresholds. All cancer risk and non-cancer health impacts would also be below applicable thresholds for the MEIW.

13 This analysis assumed use of Tier 4 Final engines for all land-based construction equipment. Equipment meeting Tier 4 Final standards would be used to the extent such technology is available for equipment used for project construction; however, if Tier 4 Final equipment is not available for all equipment, the mitigated risk could change depending on the specific equipment not available at Tier 4, the extent of its use during construction, and the level of emissions from alternative best available control technology for that equipment.

SOURCE: ESA, 2023; Basemap adjusted from Bing Maps;
Inset MEIR Overlay Basemap from Bay37 Homesite Map (Accessed January 25, 2023);

Port of Oakland Turning Basins Widening Project

Figure 11
Expansion of Inner and Outer Harbor Turning Basins Electric Dredging (Alternative D-2): Mitigated Residential Cancer Risk
Oakland, California

ESA

SOURCE: ESA, 2023; Basemap adjusted from Bing Maps;

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Figure 12
Expansion of Inner and Outer Harbor Turning Basins Electric Dredging (Alternative D-2): Mitigated Worker Cancer Risk
Oakland, California

ESA

No Project/No Action Alternative

Under the No Action/No Project Alternative, there would be no construction activities within the IHTB or the OHTB. Therefore, there would be no construction-related cancer risk nor non-cancer health impacts associated with the No Action/No Project Alternative.