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HEALTH RISK ASSESSMENT

Health Risk Assessment

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Acronyms and Abbreviations

AMP	alternative maritime power
BPIP	Building Profile Input Program
CARB	California Air Resources Board
CEIDARS	*California Emission Inventory and Reporting System*
CEQA	California Environmental Quality Act
GVWR	gross vehicle weight rating
HARP	Hot Spot and Analysis Reporting Program
HRA	health risk assessment
ICEs	internal combustion engines
km	kilometers
m	meters
MEI	Maximally exposed individual
NEPA	National Environmental Policy Act
OEHHA	Office of Environmental Health Hazard Assessment
PM	particulate matter
proposed Project	San Pedro Waterfront Project
REL	reference exposure level
SCAQMD	South Coast Air Quality Management District
TAC	toxic air contaminant
TOG	total organic gas
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
VOC	volatile organic compound

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HEALTH RISK ASSESSMENT FOR THE PORT OF LOS ANGELES SAN PEDRO WATERFRONT PROJECT

D3.1 Introduction

This document describes the methods and results of a health risk assessment (HRA) that evaluates potential public health effects from toxic air contaminant (TAC) emissions generated by the operation of the San Pedro Waterfront Project (proposed Project). TACs are compounds that are known or suspected to cause adverse health effects after short-term (acute) or long-term (chronic) exposure.

The HRA evaluated health risks associated with the following scenarios:

- California Environmental Quality Act (CEQA) baseline.
- National Environmental Policy Act (NEPA) baseline.[1]
- Proposed Project, with and without mitigation.
- Alternative 1 (Alternative Development Scenario 1), with and without mitigation.
- Alternative 2 (Alternative Development Scenario 2), with and without mitigation.
- Alternative 3 (Alternative Development Scenario 3—Reduced Project), with and without mitigation.
- Alternative 4 (Alternative Development Scenario 4), with and without mitigation.
- Alternative 5 (No Federal Action), with and without mitigation.[2]
- Alternative 6 (No Project).[3]

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[1] The NEPA Baseline is equivalent to Alternative 5 with mitigation.
[2] Alternative 5 has no federal action and therefore only needs a CEQA finding.

The HRA analyzed proposed project emissions and human exposure to the emissions during the 70-year period from 2009 to 2078. The HRA included both proposed project construction and operational emissions that would occur within this exposure period.

This HRA was prepared in accordance with the *Protocol for Conducting an Air Quality Impact Analysis and Human Health Risk Assessment for the San Pedro Waterfront EIR/EIS* (LAHD 2008a). The protocol is a living document, developed by LAHD in consultation with the South Coast Air Quality Management District (SCAQMD), California Air Resources Board (CARB), and Office of Environmental Health Hazard Assessment (OEHHA). In general, the protocol follows the methodology for preparing Tier 1 risk assessments described in *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* (OEHHA 2003), *Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics "Hot Spots" Information and Assessment Act (AB2588)* (SCAQMD 2005a), and *Health Risk Assessment Guidance for Analyzing Cancer Risks from Mobile Source Diesel Emissions* (SCAQMD 2002).

The HRA process requires four general steps to estimate health impact results: (1) quantify proposed Project-generated emissions; (2) identify ground-level receptor locations that may be affected by the emissions (including both a regular grid of receptors and any special sensitive receptor locations such as schools, hospitals, convalescent homes, and/or daycare centers); (3) perform dispersion modeling analyses to estimate ambient toxic air contaminant concentrations at each receptor location; and (4) use a risk characterization model to estimate the potential health risk at each receptor location. The following section describes in detail the methods used to develop each step of the HRA.

D3.2 Development of Emission Scenarios Used in the HRA

D3.2.1 Emission Sources

The following emission sources were included in the health risk assessment:

- **Cruise ships transiting** to and from berth. Ship transit in SCAQMD waters consists of the following transit segments, starting with the segment farthest from the berth:

[3] The No Project alternative has no federal action and therefore only needs a CEQA finding. Mitigation is not applicable to the no-project alternative; therefore, this alternative was only modeled without mitigation.

- Fairway transit—between the SCAQMD overwater boundary (about 44 nautical miles [nm] from the Berth 87–93 terminal) and the Precautionary area boundary (about 21 nm from the terminal).
- Precautionary area transit—between the precautionary area outer boundary and the Port breakwater. This segment length is about 11 nm.
- Harbor transit—between the Port breakwater and the berth, including turning and docking. This segment length is about 10 nm to the Inner Harbor Berths 87–93 and 9 nm to the Outer Harbor Berths 45–50.

The total one-way transit distance included in this HRA is about 44 nm. Emission sources include the ship main propulsion engine, auxiliary engines, and boiler.

- **Ships hoteling** while at berth. Sources of hoteling emissions include the ship auxiliary engines and boiler; the main propulsion engine is turned off. When a ship uses alternative maritime power (AMP) while hoteling, the auxiliary engines also are turned off, leaving the boiler as the only emission source.
- **On-road vehicles** associated with onsite employees, cruise ship passengers, and other visitors to the proposed project facilities. As indicated in the Traffic Study (Fehrs & Peers 2008), the geographic distribution of trips generated by the proposed Project is dependent on the characteristics of the street system serving the site, the level of accessibility of routes to and from the proposed project site, the locations of employment and commercial centers to which residents of the proposed Project would be drawn, and the geographic distribution of population from which employees and potential patrons of the proposed commercial elements of the proposed Project would be drawn. The traffic study indicated that approximately 80% of the proposed project-related traffic would occur from the Interstate 110 and State Route 47 freeways and 20% would be from the local streets. Since the trip length (e.g., travel distance) for the proposed project-related motor vehicles is not known, the regional vehicle emissions were calculated based on the default urban trip length of 13.3 miles used in the URBEMIS2007 model for the SCAB region. For the purpose of modeling onsite vehicle emissions, it was assumed that 5% of vehicle emissions were apportioned to on site (i.e., vehicles entering and exiting from the onsite roads, driveways, and parking lots), and 45% were apportioned off site immediately adjacent to the proposed project site (i.e., vehicles traveling along freeway off-ramps/on-ramps, bridge, John S. Gibson Boulevard, Front Street, Harbor Boulevard, 22nd Street, Outer Harbor Cruise Terminal, and terminal entrance. The other 50% of the vehicle emissions will occur off site and are not included in the dispersion modeling analysis.
- **Onsite terminal equipment**, including forklifts and fuel trucks.
- **Harbor craft,** including assist tugboats while in transit to and from ship assists, assist tug hoteling, tugboats moving barges during construction, ferry vessels, commercial fishing fleet, trip excursion boats, crew boats, and government boats (e.g., police and fire boats).

- **Construction equipment,** which includes off-road diesel equipment, such as excavators, front end loaders, dredging equipment, dump trucks, cranes, and on-road delivery and haul trucks. In accordance with SCAQMD guidance, only onsite construction emissions were included in the HRA.

D3.2.2 Toxic Air Contaminant Emission Calculation Approach

The determination of health risks in this HRA required the calculation of 70-year average, maximum annual, and maximum 1-hour emission rates. The 70-year-average emission rates were used to determine individual lifetime cancer risks. For the NEPA baseline and proposed project alternatives, the 70-year averaging period was assumed to be 2009 through 2078. For the CEQA baseline, the 70-year averaging period was from 2006–2075. Maximum annual emission rates during this exposure period were conservatively used to determine the chronic hazard index because the chronic exposure period for noncancer effects is assumed to be up to 8 years rather than 70 years (OEHHA 2003). Maximum 1-hour emission rates were used to determine the acute hazard index because the acute exposure period is 1 hour for most TACs.

This extended period of analysis (up to 70 years for cancer risk) required wide-ranging predictions of the future operational characteristics of the proposed emission sources. Two of the more important factors that would affect future emissions from proposed project sources are:

- reductions in emission factors due to (a) the incidental phase-in of cleaner vehicles or equipment due to normal fleet turnover; (b) the future phase-in of cleaner fuels as required by existing regulations or agreements; and (c) the future phase-in of cleaner engines as required by existing regulations or agreements; and
- increased vehicle and equipment activity levels due to anticipated increases in cruise ship passengers and proposed project visitors.

Based on the future trends in these factors, this HRA developed annualized 70-year TAC emission rates for each emission source category by using the methods described in Sections D3.2.3 through D3.2.5. The approaches for estimating maximum annual and 1-hour emissions are described in Sections D3.2.6 and D3.2.7, respectively.

The year-by-year particulate matter (PM) and volatile organic compound (VOC) emission calculations by source are attached to this appendix.

D3.2.3 Emission Factor Trends

The following methods were used in this HRA to develop the 70-year trends in annual emission factors for unmitigated emissions.

1. **Ships**. Unmitigated PM and VOC emission factors for main engines, auxiliary engines, and boilers on ocean-going marine vessels were held constant at existing levels for the entire 70-year period.
2. **Harbor craft.** Unmitigated PM and VOC emission factors for main engines and auxiliary engines for the harbor craft were based on engine categories and projected engine counts. Emission factors were based on ship category and engine size.
3. **Terminal equipment.** Emission factors for diesel- and propane-powered terminal equipment were calculated using the CARB OFFROAD2007 Emissions Model (CARB 2007) and a terminal equipment population at the Berth 87–93 Inner Harbor Cruise Terminal in 2006. With each future analysis year, the equipment population was allowed to age in the OFFROAD 2007 model until reaching its CARB-defined useful lifetime, at which point the equipment would be assumed to be replaced by new equipment meeting current emission standards. The OFFROAD2007 emission factors would gradually decline over time due to fleet turnover and engine technology improvements to the exhaust emission controls.
4. **On-road vehicles**. Emissions associated with vehicle trips were calculated with the URBEMIS2007 emissions model (Rimpo and Associates 2008) for each analysis year. Trip generation rates for each land use were obtained from the Traffic Study (Fehrs & Peers 2008) and used as inputs to the URBEMIS2007 model. The URBEMIS2007 model calculated emissions using vehicle fleet characteristics and average trip lengths representative of the South Coast Air Basin. On a per-vehicle basis, emissions gradually decline over time due to vehicle fleet turnover.
5. **Construction equipment**. Emissions from diesel-powered construction equipment were calculated using emission factors derived from OFFROAD2007. Using South Coast Air Basin fleet information, the OFFROAD model was run for each of the construction years from 2009 through 2014. Emission factors were calculated based on each type of equipment and horsepower rating of the equipment.

D3.2.4 Activity Level Trends

The second parameter needed to develop source category emission rates is the annual source activity levels expected each year over the 70-year period. Examples of activity levels include the number of ship visits, ship hoteling times, terminal equipment usage, and vehicle trips generated.

For the CEQA baseline scenario, activity levels in the 2006 baseline period were held constant over the entire 70-year period. The emission factors, however, were allowed to change year-by-year as described in Section D3.2.3.

For the NEPA baseline and all proposed project alternatives, the yearly activity levels from 2009 to 2037 were interpolated from the 2006, 2011, 2015, 2022, and 2037 analysis year projections. Actual ship visit data were used for year 2006. Due to the lack of activity projections beyond 2037, activity levels after 2037 were held constant at 2037 levels.

D3.2.5 70-Year-Average Emission Rates

For emission source types which use diesel internal combustion engines (ICEs), which represent the majority of emission sources at the Port, DPM is the only pollutant needed for the cancer risk analysis (which uses 70-year-average emission rates). The unit risk factor established by OEHHA for the assessment of DPM cancer risk includes consideration of all of the individual toxic species that could be adsorbed onto the DPM particles.

For all other source types (ship boilers, gasoline vehicles, and alternative-fueled engines), however, TOG and PM speciation of combustion emissions into individual TAC compounds was necessary. Speciation profiles are used to estimate the amounts of various organic compounds that make up TOG and various metals and particulate compounds that make up PM. A speciation profile contains a list of organic compounds, particulate compounds, and the weight fraction that each compound composes of the TOG and PM emissions from a particular source type. In accordance with a CARB recommendation (CARB 2005a), speciation profiles developed for the *California Emission Inventory and Reporting System* (CEIDARS) were used in this study (CARB 2002b, 2003b) for ship boilers and propane terminal equipment. Table D3.2-1 presents the speciation profiles that were used to convert TOG and PM combustion emissions into individual TAC emissions.[4] TACs cumulatively contributing less than 0.1% to the speciation profiles in terms of cancer risk were screened out of the HRA and are not shown in the table.

For on-road vehicles, speciation was performed using the EMFAC2007 emission factor model. For off-road equipment, speciation was performed using the OFFROAD2007 emission factor model.

For each emission source category, PM and VOC emissions were calculated for each analysis year by multiplying the source activity level by the emission factors for that particular year. Emissions were interpolated for the remaining years during the 70-year analysis period. The resulting 70 annual emission rates for each pollutant were then averaged to produce the 70-year average PM and VOC emission rates needed for the HRA or speciation. Tables D3.2-2 through D3.2-6 present the 70-year average TAC emission rates used in this HRA for the CEQA baseline, NEPA baseline, proposed Project, mitigated project, and no-project scenarios, respectively.

[4] In this study, TOG emissions were derived from volatile organic compound (VOC) emissions using conversion factors provided with the TOG speciation profiles.

Table D3.2-1. Speciation Profiles for Diesel and Alternative Fuel Combustion Sources

Pollutant	CAS Number	Weight Percent									
		TOG Profile No. 401	TOG Profile No. 504	TOG Profile No. 719	TOG Profile No. 818	PM_{10} Profile No. 112	PM_{10} Profile No. 114	PM_{10} Profile No. 119	PM_{10} Profile No. 123	PM_{10} Profile No. 400	PM_{10} Profile No. 425
Acetaldehyde	75070	0.75	—	0.029	7.4	—	—	—	—	—	—
Acrolein	107208	0.18	—	—	—	—	—	—	—	—	—
Benzene	71432	3.4	1.9	0.11	2.0	—	—	—	—	—	—
1,3 butadiene	106990	0.83	—	—	—	—	—	—	—	—	—
Formaldehyde	50000	3.1	0.088	0.80	15	—	—	—	—	—	—
Xylenes	1210	—	0.97	0.039	1.0	—	—	—	—	—	—
Naphthalene	91203	—	0.062	—	0.085	—	—	—	—	—	—
n-Hexane	110543	—	1.4	0.020	0.16	—	—	—	—	—	—
Propylene	115071	—	4.0	1.7	2.6	—	—	—	—	—	—
Toluene	108883	—	1.9	0.039	1.5	—	—	—	—	—	—
Ammonia	7664417	—	—	—	—	—	—	—	—	—	0.34
Arsenic	7440382	—	—	—	—	0.54	0.54	—	—	—	0.0005
Bromine	7726956	—	—	—	—	—	—	—	0.05	—	0.0018
Cadmium	7440439	—	—	—	—	0.05	0.05	—	—	—	0.004
Copper	7440508	—	—	—	—	—	—	—	0.05	—	0.0025
Lead	7439921	—	—	—	—	0.55	0.55	—	—	0.003	0.0042
Manganese	7439965	—	—	—	—	—	—	—	0.05	0.05	0.004
Mercury	7439976	—	—	—	—	—	—	—	—	0.0026	0.003
Nickel	7440020	—	—	—	—	0.05	0.05	—	0.05	0.05	0.0019
Styrene	100425	0.13	—	—	—	—	—	—	—	—	—
Sulfates	9960	—	—	—	—	25	25	15	45	—	1.74

Pollutant	*CAS Number*	*Weight Percent*									
		TOG Profile No. 401	*TOG Profile No. 504*	*TOG Profile No. 719*	*TOG Profile No. 818*	*PM_{10} Profile No. 112*	*PM_{10} Profile No. 114*	*PM_{10} Profile No. 119*	*PM_{10} Profile No. 123*	*PM_{10} Profile No. 400*	*PM_{10} Profile No. 425*
Vanadium	7440622	—	—	—	—	—	—	0.55	—	—	0.0029
Antimony	7440360	—	—	—	—	—	—	—	—	—	0.0036
Chlorine	7782505	—	—	—	—	—	—	—	—	—	—
Hexavalent Chromium	18540299	—	—	—	—	0.027	0.027	—	0.0025	0.0025	0.00006
Phosphorous	7723140	—	—	—	—	—	—	—	—	—	0.0127
Zinc	7440666	—	—	—	—	0.55	0.55	—	0.05	—	0.0438
Applicable Emission Sources:		Motor Vehicles—crew vehicles gasoline	Ship boilers—residual or distillate oil	Propane terminal equipment	Ship main and aux. engines, tugboats, terminal equipment, construction equipment-diesel fuel	Ship boilers—distillate oil	Ship aux. Engines—residual or distillate fuel	Tugboats—main engine and aux. engines, construction equipment – diesel fuel	Propane terminal equipment	Motor Vehicles—crew vehicles - gasoline	Ship main engine, terminal equipment – diesel fuel

Notes:

[a] TACs cumulatively contributing less than 0.1% to the total cancer risk, chronic hazard index, or acute hazard index were screened out of each speciation profile.

[b] TOG – total organic gas.

For Profile No. 401, TOG is 92.7% VOC.

[c] For Profile No. 504, TOG is 83.47% VOC.

[d] For Profile No. 719, TOG is 9.14% VOC.

[e] For Profile No. 818, TOG is 87.85% VOC.

[f] PM_{10} Profile No. 112, for ship boilers using distillate oil, yields higher health risk values than the speciation profile for ship boilers using residual fuel. Therefore, PM_{10} Profile No. 112 was conservatively used for all boilers, whether using residual or distillate fuel.

[g] Hexavalent chromium is assumed to be 5% of total chromium, in accordance with the CARB *AB2588 Technical Support Document* (1989), page 57.

Source: CARB (2002b; 2003b).

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Table D3.2-2. Toxic Air Contaminant Emissions by Source – CEQA Baseline

	70-Year-Average Emissions (lb/yr) [b,e,g]				*Maximum Annual Emissions (lb/yr)* [c,e]			*Maximum 1-Hour Emissions (lb/hr)* [d,f]			
Emission Source	*DPM*	*Benzene*	*Butadiene*	*Formal-dehyde*	*DPM*	*Acrolein*	*Formal-dehyde*	*Arsenic*	*Acrolein*	*Benzene*	*Formal-dehyde*
Ships—Hoteling	69,352	0	0	0	69,352	0	0	4.66E-02	0	4.25E-01	3.19E+00
Ships—Transit	101,356	0	0	0	101,356	0	0	3.69E-04	0	3.49E-01	2.61E+00
Harbor Craft	27,933	0	0	0	27,933	0	0	1.27E-04	0	3.59E-01	2.69E+00
Terminal Equipment	77	0	0	0	228	0	0	3.35E-06	0	2.74E-02	2.06E-01
Stationary	0	331	0.02	0.54	0	0	0.54	1.14E-07	0	3.78E-02	6.20E-05
Onsite Motor Vehicle	104	2	0.47	1.5	336	0.31	4.3	0	7.00E-05	1.29E-03	9.73E-04
Offsite Motor Vehicle	65	367	85	276	212	56	781	0	1.26E-02	2.33E-01	1.75E-01
Total	198,887	701	86	278	199,417	56	786	4.71E-02	1.27E-02	1.43E+00	8.88E+00

Notes:

[a] This HRA evaluated emissions of 27 toxic air contaminants (all 27 TACs are listed in Table D3.2-1). However, for brevity, only those TACs contributing at least 2 percent to the estimated health risk results are presented in this table.

[b] Seventy-year-average emissions were used to determine individual lifetime cancer risk.

[c] Maximum annual emissions were used to determine noncancer chronic hazard indexes.

[d] Maximum 1-hour emissions were used to determine noncancer acute hazard indices.

[e] For 70-year average and maximum annual emissions, only non-diesel ICE emissions (i.e., alternative fueled engines) are shown for formaldehyde, arsenic, and sulfates. Diesel ICE emissions are modeled only with DPM emissions.

[f] Because worst-case 1-hour health risk impacts involve ships docking and hoteling near the terminal, no Fairway or Precautionary Area transit emissions would occur during the worst-case hour. Therefore, maximum 1-hour emissions for ship transit include only harbor transit and docking emissions.

[g] Seventy-year-average and maximum annual ship transit emissions presented in this table include transit to the edge of the SCAQMD overwater boundary (a 44 nm distance).

Table D3.2-3. Toxic Air Contaminant Emissions by Source – NEPA Baseline

	70-Year-Average Emissions (lb/yr) [b,e,g]				*Maximum Annual Emissions (lb/yr)* [c,e]			*Maximum 1-Hour Emissions (lb/hr)* [d,f]			
Emission Source	*DPM*	*Benzene*	*Butadiene*	*Formal-dehyde*	*DPM*	*Acrolein*	*Formal-dehyde*	*Arsenic*	*Acrolein*	*Benzene*	*Formal-dehyde*
Ships—Hoteling	11,645	0	0	0	8,723	0	0	2.94E-02	0	2.66E-01	1.99E+00
Ships—Transit	45,433	0	0	0	42,008	0	0	2.91E-04	0	2.03E-01	1.52E+00
Harbor Craft	16,216	0	0	0	22,541	0	0	6.40E-05	0	3.28E-01	2.46E+00
Terminal Equipment	4	0	0	0	11	0	0	7.12E-08	0	7.47E-04	5.60E-03
Stationary	0	331	0.02	0.54	0	0	0.54	1.14E-07	0	3.78E-02	6.20E-05
Onsite Motor Vehicle	32	2	0.46	1.4	34	0.19	2.5	0	4.23E-05	7.86E-04	5.52E-04
Offsite Motor Vehicle	287	373	83	250	308	35	451	0	7.61E-03	1.41E-01	9.93E-02
Total	73,616	707	84	252	73,625	35	454	2.97E-02	7.65E-03	9.77E-01	6.08E+00

Notes:

[a] This HRA evaluated emissions of 27 toxic air contaminants (all 27 TACs are listed in Table D3.2-1). However, for brevity, only those TACs contributing at least 2 percent to the estimated health risk results are presented in this table.

[b] Seventy-year-average emissions were used to determine individual lifetime cancer risk.

[c] Maximum annual emissions were used to determine noncancer chronic hazard indexes.

[d] Maximum 1-hour emissions were used to determine noncancer acute hazard indices.

[e] For 70-year average and maximum annual emissions, only non-diesel ICE emissions (i.e., alternative fueled engines) are shown for formaldehyde, arsenic, and sulfates. Diesel ICE emissions are modeled only with DPM emissions.

[f] Because worst-case 1-hour health risk impacts involve ships docking and hoteling near the terminal, no Fairway or Precautionary Area transit emissions would occur during the worst-case hour. Therefore, maximum 1-hour emissions for ship transit include only harbor transit and docking emissions.

[g] Seventy-year-average and maximum annual ship transit emissions presented in this table include transit to the edge of the SCAQMD overwater boundary (a 44 nm distance).

Table D3.2-4. Toxic Air Contaminant Emissions by Source – Proposed Project without Mitigation

	70-Year-Average Emissions (lb/yr) [b,e,g]				*Maximum Annual Emissions (lb/yr)* [c,e]			*Maximum 1-Hour Emissions (lb/hr)* [d,f]			
Emission Source	*DPM*	*Benzene*	*Butadiene*	*Formal-dehyde*	*DPM*	*Acrolein*	*Formal-dehyde*	*Arsenic*	*Acrolein*	*Benzene*	*Formal-dehyde*
Ships—Hoteling	88,770	0	0	0	83,991	0	0	6.22E-02	0	6.28E-01	4.71E+00
Ships—Transit	148,690	0	0	0	150,489	0	0	3.90E-04	0	3.68E-01	2.76E+00
Harbor Craft	18,777	0	0	0	22,539	0	0	1.14E-04	0	3.32E-01	2.49E+00
Terminal Equipment	39	0	0	0	113	0	0	7.16E-07	0	6.16E-03	4.62E-02
Stationary	0	331	0.02	0.54	0	0	0.54	1.14E-07	0	3.78E-02	6.20E-05
Onsite Motor Vehicle	39	3	0.60	1.8	40	0.24	3.1	0	5.29E-05	9.84E-04	6.91E-04
Offsite Motor Vehicle	353	482	108	322	361	43	564	0	9.53E-03	1.77E-01	1.24E-01
Total	256,668	816	108	324	257,533	43	568	6.27E-02	9.58E-03	1.55E+00	1.01E+01

Notes:

[a] This HRA evaluated emissions of 27 toxic air contaminants (all 27 TACs are listed in Table D3.2-1). However, for brevity, only those TACs contributing at least 2 percent to the estimated health risk results are presented in this table.

[b] Seventy-year-average emissions were used to determine individual lifetime cancer risk.

[c] Maximum annual emissions were used to determine noncancer chronic hazard indexes.

[d] Maximum 1-hour emissions were used to determine noncancer acute hazard indices.

[e] For 70-year average and maximum annual emissions, only non-diesel ICE emissions (i.e., alternative fueled engines) are shown for formaldehyde, arsenic, and sulfates. Diesel ICE emissions are modeled only with DPM emissions.

[f] Because worst-case 1-hour health risk impacts involve ships docking and hoteling near the terminal, no Fairway or Precautionary Area transit emissions would occur during the worst-case hour. Therefore, maximum 1-hour emissions for ship transit include only harbor transit and docking emissions.

[g] Seventy-year-average and maximum annual ship transit emissions presented in this table include transit to the edge of the SCAQMD overwater boundary (a 44 nm distance).

Table D3.2-5. Toxic Air Contaminant Emissions by Source— Mitigated Project

Emission Source	*70-Year-Average Emissions (lb/yr)* [b,e,g]				*Maximum Annual Emissions (lb/yr)* [c,e]			*Maximum 1-Hour Emissions (lb/hr)* [d,f]			
	DPM	*Benzene*	*Butadiene*	*Formal-dehyde*	*DPM*	*Acrolein*	*Formal-dehyde*	*Arsenic*	*Acrolein*	*Benzene*	*Formal-dehyde*
Ships—Hoteling	12,444	0	0	0	13,144	0	0	3.92E-02	0	3.48E-01	2.61E+00
Ships—Transit	47,894	0	0	0	78,018	0	0	2.57E-04	0	3.68E-01	2.76E+00
Harbor Craft	16,216	0	0	0	22,541	0	0	6.40E-05	0	3.28E-01	2.46E+00
Terminal Equipment	10	0	0	0	11	0	0	7.12E-08	0	7.47E-04	5.60E-03
Stationary	0	331	0.02	0.54	0	0	0.54	1.14E-07	0	3.78E-02	6.20E-05
Onsite Motor Vehicle	39	3	0.60	1.8	40	0.24	3.1	0	5.29E-05	9.84E-04	6.91E-04
Offsite Motor Vehicle	353	482	108	322	361	43	564	0	9.53E-03	1.77E-01	1.24E-01
Total	76,956	816	108	324	114,115	43	568	3.95E-02	9.58E-03	1.26E+00	7.96E+00

Notes:

[a] This HRA evaluated emissions of 27 toxic air contaminants (all 27 TACs are listed in Table D3.2-1). However, for brevity, only those TACs contributing at least 2 percent to the estimated health risk results are presented in this table.

[b] Seventy-year-average emissions were used to determine individual lifetime cancer risk.

[c] Maximum annual emissions were used to determine noncancer chronic hazard indexes.

[d] Maximum 1-hour emissions were used to determine noncancer acute hazard indices.

[e] For 70-year average and maximum annual emissions, only non-diesel ICE emissions (i.e., alternative fueled engines) are shown for formaldehyde, arsenic, and sulfates. Diesel ICE emissions are modeled only with DPM emissions.

[f] Because worst-case 1-hour health risk impacts involve ships docking and hoteling near the terminal, no Fairway or Precautionary Area transit emissions would occur during the worst-case hour. Therefore, maximum 1-hour emissions for ship transit include only harbor transit and docking emissions.

[g] Seventy-year-average and maximum annual ship transit emissions presented in this table include transit to the edge of the SCAQMD overwater boundary (a 44 nm distance).

Table D3.2-6. Toxic Air Contaminant Emissions by Source – Alternative 6 (No Project)

	70-Year-Average Emissions (lb/yr) [b,e,g]				*Maximum Annual Emissions (lb/yr)* [c,e]			*Maximum 1-Hour Emissions (lb/hr)* [d,f]			
Emission Source	*DPM*	*Benzene*	*Butadiene*	*Formal-dehyde*	*DPM*	*Acrolein*	*Formal-dehyde*	*Arsenic*	*Acrolein*	*Benzene*	*Formal-dehyde*
Ships—Hoteling	77,005	0	0	0	77,148.0	0	0	4.66E-02	0	4.80E-01	3.60E+00
Ships—Transit	137,660	0	0	0	141,751.5	0	0	4.42E-04	0	4.16E-01	3.12E+00
Harbor Craft	21,666	0	0	0	22,565.5	0	0	9.73E-05	0	3.28E-01	2.46E+00
Terminal Equipment	29	0	0	0	94.4	0	0	5.99E-07	0	5.16E-03	3.87E-02
Stationary	0	331	0.02	0.54	0	0	0.54	1.14E-07	0	3.78E-02	6.20E-05
Onsite Motor Vehicle	20	2	0.35	1.0	21	0.13	1.6	0	2.79E-05	5.18E-04	3.64E-04
Offsite Motor Vehicle	181	279	63	188	186	23	296	0	5.02E-03	9.32E-02	6.55E-02
Total	236,562	612	63	190	241767	23	298	4.72E-02	5.04E-03	1.36E+00	9.29E+00

Notes:

[a] This HRA evaluated emissions of 27 toxic air contaminants (all 27 TACs are listed in Table D3.2-1). However, for brevity, only those TACs contributing at least 2 percent to the estimated health risk results are presented in this table.

[b] Seventy-year-average emissions were used to determine individual lifetime cancer risk.

[c] Maximum annual emissions were used to determine noncancer chronic hazard indexes.

[d] Maximum 1-hour emissions were used to determine noncancer acute hazard indices.

[e] For 70-year average and maximum annual emissions, only non-diesel ICE emissions (i.e., alternative fueled engines) are shown for formaldehyde, arsenic, and sulfates. Diesel ICE emissions are modeled only with DPM emissions.

[f] Because worst-case 1-hour health risk impacts involve ships docking and hoteling near the terminal, no Fairway or Precautionary Area transit emissions would occur during the worst-case hour. Therefore, maximum 1-hour emissions for ship transit include only harbor transit and docking emissions.

[g] Seventy-year-average and maximum annual ship transit emissions presented in this table include transit to the edge of the SCAQMD overwater boundary (a 44 nm distance).

D3.2.6 Maximum Year Emission Rates

Similar to the cancer risk analysis, diesel ICEs need only DPM emissions to be included in the chronic hazard index analysis (which uses maximum annual emission rates). The reference exposure level (REL) established by OEHHA for the assessment of DPM for chronic noncancer effects includes consideration of all of the individual toxic species that may be adsorbed onto the DPM particles.

For all other source types (ship boilers and alternative-fueled engines), it was necessary to speciate combustion emissions into individual TAC components using the total organic gas (TOG) and PM speciation profiles shown in Table D3.2-1. TACs cumulatively contributing less than 0.1% to the speciation profiles in terms of chronic hazard index were screened out of the HRA and are not shown in the table.

For the NEPA baseline and proposed project alternatives, maximum year emissions were selected from the analysis years 2011, 2015, 2022, and 2037. The year with the most emissions by far was 2011, due primarily to construction-related emissions adding to the operational emissions. The annual emissions for 2011 for each source grouping were modeled together in the HRA. The source groupings included (1) ships in transit, (2) ships hoteling, (3) trucks and crew vehicles (4) terminal equipment, (5) harbor craft, and (6) construction equipment, including crane and dredging operations. For CEQA baseline conditions, 2006 emissions were used in the HRA for the chronic hazard index.

Tables D3.2-2 through D3.2-6 present the maximum annual TAC emission rates used in this HRA for the CEQA baseline, NEPA baseline, proposed Project, mitigated project, and no-project scenarios, respectively.

D3.2.7 Maximum 1-Hour Emission Rates

For the acute hazard index analysis, which uses maximum 1-hour emission rates, speciating combustion emissions into individual TAC components was necessary for all source types because OEHHA has not assigned an acute toxicity factor to DPM. Therefore, combustion emissions were speciated into individual TAC components using the TOG and PM speciation profiles shown in Table D3.2-1. TACs cumulatively contributing less than 0.1% to the speciation profiles in terms of acute hazard index were screened out of the HRA and are not shown in the table.

For the NEPA baseline and proposed project alternatives, maximum 1-hour emissions were calculated assuming theoretical worst-case hourly activity levels for each source category for each project analysis year (2011, 2015, 2022, and 2037). To ensure the capture of maximum impacts, the highest 1-hour emissions from each source grouping for each project analysis year were conservatively modeled together in the HRA.

CEQA baseline emissions represent worst-case activity levels for 2006.

For marine vessels, the worst-case hourly activity scenarios were considered as three ships hoteling at adjacent berths during the same hour (Alternative 4, 5, and 6). For those scenarios where only two adjacent berths would be active (such as the proposed Project and Alternatives 1, 2, and 3), the scenarios assumed two ships hoteling. The analysis assumed the largest ship sizes (and, therefore, the greatest emissions) anticipated in the fleet that could be accommodated simultaneously at the terminal. As an additional conservative measure, each ship was assumed to use residual fuel with 4.5% sulfur content during the unmitigated worst case 1-hour scenario. (By contrast, the calculations of cancer risk and chronic hazard index, which are based on long-term exposures, assume residual fuel with 2.7% sulfur content for unmitigated emissions, which represents the worldwide average sulfur content used by ships [Entec 2002]).

For construction equipment, maximum 1-hour emissions were estimated by first calculating daily emissions from individual construction activities (for example, parking facility construction, Downtown Harbor, or Ports O'Call Promenade). Maximum daily emissions then were determined by summing emissions from overlapping construction activities as indicated in the proposed construction schedule (Table 2-6) of the EIS/EIR. Maximum 1-hour emission rates were derived from the peak daily emissions assuming uniform distribution of emissions over an 8-hour workday, except for ship hoteling emissions, which were spread over 12 hours.

Tables D3.2-2 through D3.2-6 present the maximum 1-hour speciated emissions by source for the CEQA baseline, NEPA baseline, proposed Project, mitigated project, and no-project scenarios, respectively.

D3.3 Receptor Locations Used in the HRA

This HRA analyzes the health risks associated with TAC emissions from proposed Project-related sources at a variety of locations (receptors) throughout the proposed project area, including at the locations of exposure to residents, offsite workers, recreational users, students, and sensitive members of the public. The analysis utilized a regular coarse grid of 1,189 receptor points spaced every 250 meters (m) apart around Berth 87–93 terminal. The regular receptor grid extended roughly 7 kilometers (km) east-west by 10 km north-south around the terminal area. In addition, 72 discrete receptors were placed at sensitive receptor locations of special concern, such as schools, day care centers, convalescent homes, and hospitals within a 5-km radius of the terminal.

Subsequent to the initial modeling analysis and preliminary identification of maximum impact locations, the HRA was refined by modeling with five additional fine grids for an additional total of 740 receptors. The fine grids consisted of high-density receptors surrounding the maximum impact locations with receptors spaced every 50 m apart. Figure D3.3-1 presents the coarse and fine receptor grids used in the AERMOD modeling analysis. Figure D3.3-2 shows the locations of the sensitive receptors included in the modeling analysis.

AERMAP, version 06341, was used to calculate receptor elevations and the controlling hill height for each receptor.

Maximally exposed individual (MEI) locations were selected from the modeled receptor grids for five different receptor types: residential, occupational, sensitive, student, and recreational. The selection methodology for the MEI locations was:

- The residential MEI was selected from all receptors in residential or zoned residential areas, including the public marinas (for possible live-aboards) located in the Outer Harbor.
- The occupational MEI was selected from all receptors not over water. Receptors located on adjacent Port terminals were considered valid for selection.
- The sensitive MEI was selected from all identified schools, day care centers, convalescent homes, and hospitals in the surrounding area.
- The student MEI was selected from all identified schools in the surrounding area.
- The recreational MEI was selected from all receptors where the public may have access (e.g., the Outer Harbor Park) including those on Port property. Receptors not considered recreational included those where the general public does not have access on Port property and those located over water.

D3.4 Dispersion Model Selection and Inputs

The air dispersion modeling for the HRA was performed using the EPA AERMOD dispersion model, version 07026, based on the *Guideline on Air Quality Models* (40 CFR, Part 51, Appendix W; April 15, 2003). The AERMOD model is a steady-state, multiple-source, Gaussian dispersion model designed for use with emission sources situated in terrain where ground elevations can exceed the stack heights of the emission sources. The AERMOD model requires hourly meteorological data consisting of wind vector, wind speed, temperature, stability class, and mixing height. The AERMOD model allows input of multiple sources and source groupings, eliminating the need for multiple model runs. The selection of the AERMOD model is well suited based on (1) the general acceptance by the modeling community and regulatory agencies of its ability to provide reasonable results for large industrial complexes with multiple emission sources, (2) a consideration of the availability of annual sets of hourly meteorological data for use by AERMOD, and (3) the ability of the model to handle the various physical characteristics of proposed project emission sources, including, “point,” “area,” and “volume” source types. AERMOD is an EPA-approved dispersion model, and CARB and SCAQMD approves of its use for near source impact analysis.

This HRA used the functional equivalent of the Hot Spot and Analysis Reporting Program (HARP) model to calculate cancer risk and chronic hazard index values based on the ambient air concentrations predicted by the AERMOD dispersion model. Because HARP is not yet directly compatible with AERMOD, AERMOD was run using unit emission rates and then post-processed to determine actual concentrations for each scenario. Software was developed to perform this calculation in one step, thereby increasing the efficiency of the analysis and making it unnecessary to apply the HARP model.

An additional modification in our approach was made for the calculation of the acute hazard index calculations. HARP's refined calculation methodology requires the use of a binary concentration output file from AERMOD, which is prohibitively large when used with the HARP framework for a proposed project with hundreds of sources and over 1,000 receptors. Furthermore, HARP's screening methodology for the acute hazard index, which does not require binary output from AERMOD, is extremely conservative because it sums the maximum hazard index from each source, even if the maximums do not occur simultaneously. Therefore, for this HRA, acute hazard indices were calculated directly in AERMOD by modeling toxicity-weighted 1-hour emission rates. Specifically, for each source, the 1-hour emission rate of each TAC was divided by the acute REL for that TAC, and all the quotients were subsequently added together to form a single, toxicity-weighted emission rate for use in AERMOD. Using this approach, the maximum 1-hour concentrations produced by AERMOD are actually the acute hazard indices. Although this approach is less conservative than HARP's screening methodology, it is still conservative for the following reasons: (1) the hazard indices include the contributions from all TACs, regardless of their respective target organs; and (2) the hazard index exposure period for some TACs is longer than 1-hour, in which case AERMOD will over-predict the maximum concentration. For this HRA, the TACs with acute exposure periods longer than 1 hour include arsenic (4 hours) and benzene (6 hours).

D3.4.1 Emission Source Representation

The AERMOD modeling analysis evaluated proposed Project-related construction and operational emission sources, including construction (e.g., cranes, barges, and front-end loaders) and dredging equipment, tugboats, other harbor craft, cruise ships, terminal equipment, and on-road vehicles. The HRA realistically simulated the proposed Project-related emission sources, taking into consideration physical characteristics, activity levels, and operational locations of the sources. Emissions from the movement of vessels in the shipping lanes and harbor craft (tugboats, ferry, commercial fishing, crew, excursion, and government boats) were simulated and modeled as a series of separated volume sources. Volume source emissions were simulated by AERMOD as being released and mixed vertically and horizontally within a volume of air prior to being dispersed downwind.

Mobile source operations confined within specific geographic locations, such as the Berth 87–93 Outer Harbor terminal or the Berth 45–50 Inner Harbor terminal, were modeled as area polygons covering the area over which the activity occurred. Area sources were simulated by AERMOD with a release height characteristic of the dominant equipment activity within each area source.

Finally, stationary emissions from hoteling ships (both in the Inner and Outer Harbor) were modeled as point (stack) sources with upward plume velocity and buoyancy.

Three size categories of hoteling ships were considered in the analysis. The AERMOD modeling included the effects of building downwash for point sources.

A total of 707 emission sources were simulated in AERMOD. The specific methodology for defining the sources is discussed below.

1. **Ship transit lanes (fairway and open sea, precautionary area, and harbor transit)**. Emissions from marine vessels that transit between the offshore ship transit lanes and the berth were simulated as a series of separated volume sources beginning at the SCAQMD overwater boundary (about 50 nm from the Outer Harbor Berth and extending to either the wharf at the Outer Harbor (Beth 45–50) or to the Inner Harbor (Berth 87–93). Total transit emissions were calculated and divided equally among the volume sources for each of Inner and Outer Harbor-bound ships along the fairway and open sea, the precautionary area, and the harbor transit segments.

   Vessel transit sources were modeled as occurring from elevated-release volume sources separated by a distance not more than twice the width of each volume source, as recommended for the simulation of line sources in the *ISCST User's Guide* (USEPA 1995). For the fairway and precautionary area segments, the volume source width was set to 1,000 meters, reflecting the variability in the transit lane path. Hence, the center-to-center spacing of the fairway and precautionary area transit sources was 1,000 meters. For harbor transit sources, the volume source width was set to 100 meters because the narrower shipping lane and proximity to receptors require a smaller source width and closer source spacing. The center-to-center spacing of the harbor transit sources was 200 m.

   Based on a series of visual observations of oceangoing exhaust plumes at the Port, the plume height for ship transit sources was conservatively assumed to be 25% above stack height for fairway and open sea as well as in the precautionary zone, and 50% above stack height for harbor transit (SAIC 2006). The lower apparent wind speeds at slower ship speeds result in a higher plume rise.

   The transit sources were positioned along the centerline of the vessel inbound/outbound traffic lanes through the fairway and precautionary area, along a line from the edge of the precautionary area to Angels Gate, and then up the center of the Main Channel to either the Outer Harbor or Inner Harbor berths.

2. **Vessel berth maneuvering area (turning basin and docking)**. Ship turning and docking represent activities with concentrated emissions that occur in designated locations near the berth. As a result, dedicated volume sources were created to simulate these activities. For the Inner Harbor, a turning-basin volume source was located in the center of the turning basin nearest the wharf at Berth 87–93. The volume-source width was set to 228 m, which is the approximate size of the turning basin. For the Outer Harbor, a slightly larger turning-basin volume source was used set to a width of 274 m, reflective of the larger ships docking in the Outer Harbor. Based on a series of visual observations of container ship exhaust plumes at the Port, the plume height was assumed to be 100% above stack height (i.e., twice the stack height) for ship turning and docking (SAIC 2006).

3. **Vessel hoteling locations**. Because they are stationary, hoteling-vessel emission sources were modeled as stack-type point sources located adjacent to Berths 87–93 in the Inner Harbor and adjacent to Berths 45–50 in the Outer Harbor. Three sets of stack parameters for hoteling auxiliary engines were developed reflective of the three categories of ship sizes. This was based on information for Voyager class ships from the Norwegian Star chief engineer (Malmestrom pers. comm.). The larger ships have higher exit velocities and higher flow rates. In addition, each of the three ship types included adjustments for building downwash effects because of the relatively short stacks. Building downwash was performed using EPA's Building Profile Input Program (BPIP) model. The BPIP model calculates direction-specific structure widths and heights for use with AERMOD model in downwash analyses for the three ship types, which had structure heights ranging from 32 to 37 meters, lengths from 260 to 320 meters, and width from 40 to 50 meters.

4. **Terminal equipment.** Each berth operates equipment for the loading and unloading of supplies from the ships as well as refueling trucks. This equipment mainly consists of forklifts and was modeled as an area source polygon located at the terminal berth with a release height of 15 feet. Fuel delivery trucks were also modeled for the same area with a 15-foot release height, which approximates average height of exhaust port plus a nominal amount of plume rise.

5. **Construction equipment.** A variety of construction equipment would be used to develop the cruise ship facilities, the Ports O'Call redevelopment, new roadways, parks, harbors, and the promenade. This equipment mainly consists of cranes, front end loaders, dump trucks, heavy-duty trucks, and barges. This equipment was modeled as an area source polygon for each construction element with an assumed release height of 15 feet. Fugitive dust emissions associated with earth-movement activities were modeled with a 4-foot release height, which approximates average height of resuspended material.

6. **Roadways.** Truck movements on roadways were modeled as a series of area polygon sources. Roadways were divided into links over which emissions were uniform. Therefore, the emission density (i.e., emissions per unit area) is identical for all area sources along a given roadway.

   Emissions were modeled separately for heavy-duty class of vehicles (trucks) with a release height of 15 feet, which is the approximate average height of the exhaust port plus a nominal amount of plume rise, while light duty vehicles were modeled with a 4-foot release height.

7. **Harbor craft.** A variety of harbor craft operate at the San Pedro Waterfront. Under the proposed Project and alternatives, some of the harbor craft change location where they are harbored compared to the CEQA baseline, thus requiring their analysis in the proposed Project. The harbor craft were modeled as a unique set of volume sources for each craft type: assist tugs (both in transit and hoteling), ferry vessels, commercial fishing boats, crew boats, excursion boats, and government boats (e.g., police and fire). The tugboats were modeled with a 50-foot source height, which accounts for the stack plus a nominal amount of plume rise, and a 100-meter volume source width consistent with the spacing used for the passenger ships within the harbor. Outside the harbor, a volume

source width of 1,000 meters was used consistent with the passenger ship modeling.

The HRA positioned the emission sources by using the Universal Transverse Mercator (UTM) coordinate system (NAD-83) referenced to topographic data obtained from the United States Geological Survey (USGS).

Table D3.4-1 lists the source release parameters used in the AERMOD model. Figure D3.4-1 shows the sizes and locations of the emission sources over a base map of the proposed project vicinity.

D3.4.2 Meteorological Data

Due to the blocking effect of the Palos Verdes Hills, wide variations in wind conditions often occur within the Port of Los Angeles. For example, during typical sea-breeze conditions, the hills can create a relatively light wind zone in the Inner Harbor, while the Outer Harbor experiences stronger winds in a different direction. The monthly and hourly streamlines developed for the South Coast Air Basin in *California South Coast Air Basin Hourly Wind Flow Patterns* show a clear difference in wind speed and direction between the Inner and Outer Harbor regions (SCAQMD 1977).

LAHD is currently operating a monitoring program that includes the collection of meteorological data from several locations within Port boundaries (LAHD 2004). Recently, meteorological data sets containing a full year of consecutive hourly observations, from September 1, 2006, through August 31, 2007, became available. The data sets contain 8,760 hourly observations of wind speed, wind direction, temperature, atmospheric stability, and mixing height recorded at each of the monitoring stations in the network.

The two most representative meteorological data sets selected for this analysis were collected at Liberty Hill Plaza (LH) in San Pedro, located at the Liberty Hill Plaza Building, adjacent to the Port Administrative Property on Palos Verdes Street. This location is near the western edge of Port operational emission sources and adjacent to residential areas in San Pedro. The other meteorological site at Berth 47 lies within the proposed project site (Outer Harbor terminal area). The LH station is representative of Inner Harbor wind patterns, while the Berth 47 station is representative of Outer Harbor wind patterns.

1 **Table D3.4-1.** AERMOD Source Release Parameters for the HRA

Source Type	*Source Description*	*Source ID*	*AERMOD Source Type*	*No. of Sources*	*Release Height (m)*	*Source Width[a] (m)*	*Initial Sigma-z (m)*	*Area Size (sq meters)*	*Exit Velocity (m/s)*	*Exit Temp Deg (K)*	*Stack Diam. (m)*
Ships	Hoteling auxiliary diesel engines—Type 1	B87, B91, B93	Point	1–3	45.7	–	–	–	3.1	473	1.12
	Hoteling auxiliary diesel engines —Type 2	B87, B91, B93	Point	1–3	53.4	–	–	–	3.2	473	1.12
	Hoteling auxiliary diesel engines—Type 3	B45, B47, B87, B91, B93	Point	1–2	61.0	–	–	–	5.7	473	1.12
	Inner Harbor docking	IH01	Volume	1	91.4–121.9[b]	228	42.5–56.7[c]	–	–	–	–
	Inner Harbor transit (Liberty Hill Met)	IH02–IH11	Volume	10	68.6–91.4[b]	200	21.3–28.4[c]	–	–	–	–
	Inner Harbor bound (Berth 47 Met)	IH12–IH28	Volume	17	68.6–91.4[b]	200	21.3–28.4[c]	–	–	–	–
	Inner Harbor bound (precautionary)	IH29–IH42	Volume	14	57.2–76.2[b]	1000	10.6–14.2[c]	–	–	–	–
	Inner Harbor bound (fairway and open sea)	IH43–IH108	Volume	66	57.2–76.2[b]	1000	10.6–14.2[c]	–	–	–	–
	Outer Harbor docking (Berth 47 Met)	OH01	Volume	1	91.4–121.9[b]	274	42.5–56.7[c]	–	–	–	–
	Outer Harbor bound (Berth 47 Met)	OH02–OH13	Volume	12	68.6–91.4[b]	200	21.3–28.4[c]	–	–	–	–
	Outer Harbor bound (precautionary)	OH14–OH27	Volume	14	57.2–76.2[b]	1000	10.6–14.2[c]	–	–	–	–
	Outer Harbor bound (fairway and open sea)	OH28–OH93	Volume	66	57.2–76.2[b]	1000	10.6–14.2[c]	–	–	–	–

Source Type	*Source Description*	*Source ID*	*AERMOD Source Type*	*No. of Sources*	*Release Height (m)*	*Source Width[a] (m)*	*Initial Sigma-z (m)*	*Area Size (sq meters)*	*Exit Velocity (m/s)*	*Exit Temp Deg (K)*	*Stack Diam. (m)*
	Mike's fueling station	IHSS1	Volume	1	3.0	1.2	1.5[c]	–	–	–	–
	Jankovich & Son fueling station	IHSS2	Volume	1	3.0	1.2	1.5[c]	–	–	–	–
Terminal Equipment	Terminal equipment—forklift	TE	Areapolygon	1	1.2	–	–	208,041 (outer) 236,798 (inner)	–	–	–
	Terminal equipment—trucks	TETRUCK	Areapolygon	1	4.6	–	–	208,041 (outer) 236,798 (inner)	–	–	–
	Westway terminal	WBT	Areapolygon	1	10.0	–	–	–	–	–	–
	Catalina Express and Island Express terminal	C01[d]	Areapolygon	1	4.6	–	–	30825	–	–	–
Construction Equipment	Cruise ship terminal Berth 91–93	C02	Areapolygon	1	4.6	–	–	188400	–	–	–
	Cruise ship terminal parking facilities	C03	Areapolygon	1	4.6	–	–	71375	–	–	–
	North Harbor	C05[d]	Areapolygon	1	4.6	–	–	57146	–	–	–
	Maritime Office Building—Millennium Maritime	C06	Areapolygon	1	4.6	–	–	501	–	–	–
	Maritime Office Building—Crowley	C07	Areapolygon	1	4.6	–	–	425	–	–	–
	Maritime Office Building—Lane Victory	C08	Areapolygon	1	4.6	–	–	861	–	–	–
	Downtown Harbor	C09[d]	Areapolygon	1	4.6	–	–	22518	–	–	–

Source Type	Source Description	Source ID	AERMOD Source Type	No. of Sources	Release Height (m)	Source Width[a] (m)	Initial Sigma-z (m)	Area Size (sq meters)	Exit Velocity (m/s)	Exit Temp Deg (K)	Stack Diam. (m)
	Ralph J. Scott Fireboat Museum	C10[d]	Areapolygon	1	4.6	–	–	1006	–	–	–
	John S. Gibson Park	C11	Areapolygon	1	4.6	–	–	842	–	–	–
	Maritime Office Building	C12	Areapolygon	1	4.6	–	–	8883	–	–	–
	Maritime Office Building—L.A. Maritime Institute	C13	Areapolygon	1	4.6	–	–	1828	–	–	–
	City Dock No. 1 Promenade	C14[d]	Areapolygon	1	4.6	–	–	205	–	–	–
	7th Street Harbor	C15[d]	Areapolygon	1	4.6	–	–	14249	–	–	–
	Downtown Square	C16	Areapolygon	1	4.6	–	–	1197	–	–	–
	7th Street Pier	C17[d]	Areapolygon	1	4.6	–	–	1121	–	–	–
	Ports O'Call Promenade—Phase 2	C18[d]	Areapolygon	1	4.6	–	–	85028	–	–	–
	Downtown water feature	C19	Areapolygon	1	4.6	–	–	174	–	–	–
	Ports O'Call Redevelopment Phase 1	C20	Areapolygon	1	4.6	–	–	149370	–	–	–
	Ports O'Call Redevelopment Phase 2	C21	Areapolygon	1	4.6	–	–	20572	–	–	–
	Waterfront Red Car Maintenance Facility	C22	Areapolygon	1	4.6	–	–	1551	–	–	–
	Ports O'Call Promenade—Phase 1	C23[d]	Areapolygon	1	4.6	–	–	46152	–	–	–
	Fishermen's Park	C24	Areapolygon	1	4.6	–	–	3526	–	–	–
	Demolish Jankovich &	C25	Areapolygon	1	4.6	–	–	1793	–	–	–

Source Type	Source Description	Source ID	AERMOD Source Type	No. of Sources	Release Height (m)	Source Width[a] (m)	Initial Sigma-z (m)	Area Size (sq meters)	Exit Velocity (m/s)	Exit Temp Deg (K)	Stack Diam. (m)
	Son fueling station										
	Sampson Way roadway improvements	C26	Areapolygon	1	4.6	–	–	178030	–	–	–
	Berth 240 fueling station	C27	Areapolygon	1	4.6	–	–	58805	–	–	–
	Westway Terminal demolition	C28	Areapolygon	1	4.6	–	–	94890	–	–	–
	Outer Harbor Cruise Ship Terminal—Berth 45–50	C29[d]	Areapolygon	1	4.6	–	–	169204	–	–	–
	Outer Harbor Park and Promenade	C30	Areapolygon	1	4.6	–	–	48324	–	–	–
	Outer Harbor parking lot	C31	Areapolygon	1	4.6	–	–	13374	–	–	–
	Salinas De San Pedro Park/Youth Camp Promenade	C32[d]	Areapolygon	1	4.6	–	–	25124	–	–	–
	Ports O'Call Promenade—Phase 3	C33[d]	Areapolygon	1	4.6	–	–	4259	–	–	–
	Maritime Museum Renovation	C34	Areapolygon	1	4.6	–	–	600	–	–	–
	Waterfront Red Car Line Extension (Swinford to 22nd Street)	T01–T11	Areapolygon	11	4.6	–	–	vary from 2,101 to 29,195	–	–	–
	Waterfront Red Car Line Extension (22nd Street to Cabrillo Beach)	T12–T20	Areapolygon	9	4.6	–	–	vary from 5,869 to 44,745	–	–	–
	Red Car Line Extension (22nd Street to Cruise	T21–T23	Areapolygon	3	4.6	–	–	vary from	–	–	–

Source Type	*Source Description*	*Source ID*	*AERMOD Source Type*	*No. of Sources*	*Release Height (m)*	*Source Width[a] (m)*	*Initial Sigma-z (m)*	*Area Size (sq meters)*	*Exit Velocity (m/s)*	*Exit Temp Deg (K)*	*Stack Diam. (m)*
	Terminal)							2,101 to 29,195			
Onroad Mobile (non-heavy duty trucks)	Outer Harbor Cruise Terminal	R01–R02	Areapolygon	2	1.2	–	–	10,762 8,209	–	–	–
	Harbor Boulevard	R03–R08, R26	Areapolygon	7	1.2	–	–	vary from 2,225 to 17,245	–	–	–
	Freeway ramps	R09–R21	Areapolygon	13	1.2	–	–	vary from 722 to 4,369	–	–	–
	Terminal entrance	R22–R23	Areapolygon	2	1.2	–	–	4,201 3,445	–	–	–
	Bridge	R24–R25	Areapolygon	2	1.2	–	–	7,399 15,917	–	–	–
Operation (non-heavy duty trucks)	S.S. Lane Victory (non trucks)	O01	Areapolygon	1	1.2	–	–	31433	–	–	–
	Cruise ship terminal, Berths 91–92 and 93 A–B	O02	Areapolygon	1	1.2	–	–	189039	–	–	–
	Downtown Harbor docking slips	O03	Areapolygon	1	1.2	–	–	57977	–	–	–
	Crowley Tugboats office	O04	Areapolygon	1	1.2	–	–	425	–	–	–
	Los Angeles Maritime Institute	O05	Areapolygon	1	1.2	–	–	861	–	–	–
	Waterfront Promenade and Town Square	O06	Areapolygon	1	1.2	–	–	1197	–	–	–

Source Type	*Source Description*	*Source ID*	*AERMOD Source Type*	*No. of Sources*	*Release Height (m)*	*Source Width[a] (m)*	*Initial Sigma-z (m)*	*Area Size (sq meters)*	*Exit Velocity (m/s)*	*Exit Temp Deg (K)*	*Stack Diam. (m)*
	Ports O'Call Promenade—Phase 2	O07	Areapolygon	1	1.2	–	–	81292	–	–	–
	Ports O'Call restaurant development	O08	Areapolygon	1	1.2	–	–	142671	–	–	–
	Ports O'Call Redevelopment Phase 2	O09	Areapolygon	1	1.2	–	–	20572	–	–	–
	Waterfront Red Car Maintenance Facility	O10	Areapolygon	1	1.2	–	–	1551	–	–	–
	Fishermen's Park	O11	Areapolygon	1	1.2	–	–	3526	–	–	–
	San Pedro Park	O12	Areapolygon	1	1.2	–	–	177544	–	–	–
	Research and Development Campus at Westway	O14	Areapolygon	1	1.2	–	–	96912	–	–	–
	Cruise ship terminal—Berth 45–50	O15	Areapolygon	1	1.2	–	–	170941	–	–	–
	Outer Harbor parking lot	O16	Areapolygon	1	1.2	–	–	13374	–	–	–
	Warehouses 9 & 10	O17	Areapolygon	1	1.2	–	–	22098	–	–	–
	Ports O'Call retail development	O19	Areapolygon	1	1.2	–	–	3526	–	–	–
Onroad Mobile (heavy duty trucks)	Outer Harbor cruise terminal	R01–R02	Areapolygon	2	4.6	–	–	10,762 8,209	–	–	–
	Harbor Boulevard	R03–R08, R26	Areapolygon	7	4.6	–	–	vary from 2,225 to 17,245	–	–	–

Source Type	*Source Description*	*Source ID*	*AERMOD Source Type*	*No. of Sources*	*Release Height (m)*	*Source Width[a] (m)*	*Initial Sigma-z (m)*	*Area Size (sq meters)*	*Exit Velocity (m/s)*	*Exit Temp Deg (K)*	*Stack Diam. (m)*
	Freeway ramps	R09–R21	Areapolygon	13	4.6	–	–	vary from 722 to 4,369	–	–	–
	Terminal entrance	R22–R23	Areapolygon	2	4.6	–	–	4,201 3,445	–	–	–
	Bridge	R24–R25	Areapolygon	2	4.6	–	–	7,399 15,917	–	–	–
Operation (heavy duty trucks)	S.S. Lane Victory (non trucks)	O01	Areapolygon	1	4.6	–	–	31433	–	–	–
	Cruise ship terminal, Berths 91–92 and 93 A–B	O02	Areapolygon	1	4.6	–	–	189039	–	–	–
	Downtown Harbor docking slips	O03	Areapolygon	1	4.6	–	–	57977	–	–	–
	Crowley Tugboats office	O04	Areapolygon	1	4.6	–	–	425	–	–	–
	Los Angeles Maritime Institute	O05	Areapolygon	1	4.6	–	–	861	–	–	–
	Waterfront Promenade and Town Square	O06	Areapolygon	1	4.6	–	–	1197	–	–	–
	Ports O'Call Promenade—Phase 2	O07	Areapolygon	1	4.6	–	–	81292	–	–	–
	Ports O'Call restaurant development	O08	Areapolygon	1	4.6	–	–	142671	–	–	–
	Ports O'Call Redevelopment Phase 2	O09	Areapolygon	1	4.6	–	–	20572	–	–	–
	Waterfront Red Car Maintenance Facility	O10	Areapolygon	1	4.6	–	–	1551	–	–	–

Source Type	*Source Description*	*Source ID*	*AERMOD Source Type*	*No. of Sources*	*Release Height (m)*	*Source Width[a] (m)*	*Initial Sigma-z (m)*	*Area Size (sq meters)*	*Exit Velocity (m/s)*	*Exit Temp Deg (K)*	*Stack Diam. (m)*
	Fishermen's Park	O11	Areapolygon	1	4.6	–	–	3526	–	–	–
	San Pedro Park	O12	Areapolygon	1	4.6	–	–	177544	–	–	–
	Research and Development Campus at Westway	O14	Areapolygon	1	4.6	–	–	96912	–	–	–
	Cruise ship terminal—Berth 45–50	O15	Areapolygon	1	4.6	–	–	170941	–	–	–
	Outer Harbor parking lot	O16	Areapolygon	1	4.6	–	–	13374	–	–	–
	Warehouses 9 & 10	O17	Areapolygon	1	4.6	–	–	22098	–	–	–
	Ports O'Call retail development	O19	Areapolygon	1	4.6	–	–	3526	–	–	–
Operation Harbor Craft	Assist tugs (hoteling)	ATBH, ATPH	Volume	1–2	15.2	200.0	3.54	–	–	–	–
	Assist tugs (transit)	ATB, ATP	Volume	25–42	15.2	200; 1000	3.54	–	–	–	–
	Catalina ferry vessels	FB, FP	Volume	71–72	6.0	200; 1000	2.79	–	–	–	–
	Commercial fishing	FC	Volume	99	6.0	200; 1000	2.79	–	–	–	–
	Crew boats	CB	Volume	37	6.0	200; 1000	2.79	–	–	–	–
	Excursion boats	FE	Volume	51	6.0	200; 1000	2.79	–	–	–	–
	Government boats	G	Volume	90	6.0	200; 1000	2.79	–	–	–	–

Source Type	Source Description	Source ID	AERMOD Source Type	No. of Sources	Release Height (m)	Source Width[a] (m)	Initial Sigma-z (m)	Area Size (sq meters)	Exit Velocity (m/s)	Exit Temp Deg (K)	Stack Diam. (m)

[a] Source width is converted to a sigma-y value for AERMOD by dividing by 2.15 for line or contiguous area sources (all volume sources).

[b] The volume source release height varied depending upon the passenger ship type (1–3); based on visual observations of ocean-going ships exhaust plumes at the Port of Los Angeles, the plume height was observed to be 25% above stack height for fairway and precautionary area transit, 50% above stack height for harbor transit, and 100% above stack height for docking. The lower apparent wind speeds at slower ship speeds result in a higher plume rise.

[c] Sigma-z values were determined for AERMOD using twice the plume rise increment and then dividing by 2.15 for elevated releases on a platform (ships) as well as for ground-based releases (terminal equipment).

[d] The portion of the emissions associated with tugboats was modeled as a set of 80 volume sources with a 15.2 meter release height and sigma-z of 3.54 meters.

To account for the unique wind patterns in the proposed project area, the modeling domain for this analysis was split into Inner and Outer Harbor regions. The division between the Inner Harbor (to the north) and the Outer Harbor (to the south) is roughly a line extending east and west of the 22nd Street landing at the Port. Emission sources located in the Inner Harbor region, which includes construction sources and Inner Harbor operational sources, were modeled with the LH meteorological data. Emission sources located in the Outer Harbor region, which includes the cruise ships hoteling in the Outer Harbor plus transit tugboats and other harbor craft in the Outer Harbor, were modeled with the Berth 47 meteorological data. The modeling results were then summed at each common receptor point.

The meteorological data were processed using EPA-approved AERMET (version 06341) meteorological data preprocessor for the AERMOD dispersion model. AERMET uses three steps to preprocess and combine the surface and upper-air soundings to output the data in a format that is compatible with the AERMOD model. The first step extracts the data and performs a brief quality assurance check of the data. The second step merges the meteorological data sets. The third step outputs the data in the AERMOD compatible format while also incorporating surface characteristics surrounding the collection or application site.

The output from the AERMET model consists of two separate files: the surface conditions file and a vertical profile dataset. AERMOD utilizes these two files in the dispersion modeling algorithm to predict pollutant concentrations resulting from a source's emissions.

D3.4.3 Model Options

Technical options selected for the AERMOD model were regulatory default. Use of these options follows the USEPA modeling guidance (40 CFR, Appendix W; April 15, 2003). Sources within the Inner Harbor were modeled as urban sources, while sources over the Outer Harbor and open water were not considered urban.

Temporal distributions are based on estimates of current ship activities and intended construction operations along with estimates of future ship activity operations. The following temporal distribution of emissions were used in the modeling of the annual average concentrations (for cancer risk and chronic hazard index):

Terminal equipment	12.5% of emissions 9 a.m.–10 a.m. 75% of emissions 11 a.m.–2 p.m. 12.5% of emissions 2 p.m.–3 p.m.
Fueling stations (Mike's and Jankovich)	Uniform distribution 24 hours/day
Crew boats, commercial fishing, excursion boats, ferry, government boats	8.3% of emissions midnight–5 a.m. 80% of emissions 5 a.m.–5 p.m. 11.7% of emissions 5 p.m.–midnight
On-road motor vehicles	51% of emissions 8 a.m.–5 p.m.

	37% of emissions 5 p.m.–3 a.m. 12 % of emissions 3 a.m.–8 a.m.
Construction motor vehicle activity	Uniform distribution of emissions 8 hr/day; 7 a.m.–3 p.m.
Ships in transit	50% 5 a.m.–6 a.m.; 50% 6 p.m.–7p.m.
Hoteling ships	Uniform distribution of emissions 12 hr/day; 6 a.m.–6 p.m.

D3.5 Calculation of Health Risks

For long-term health risk values, the results of the AERMOD dispersion modeling analysis represent an intermediate product in the HRA process. Post-AERMOD calculations were used to determine cancer risk and chronic hazard indices from exposure to proposed project emissions by factoring pollutant concentrations by pollutant-specific cancer potency values and chronic RELs obtained from OEHHA (CARB 2005b).

D3.5.1 Toxicity Factors

The inhalation cancer potency factor is the probability that a person will contract cancer from the continuous inhalation of 1 milligram (mg) of a chemical per kilogram (kg) of body weight per day over a period of 70 years. The inhalation potency factor is used to calculate a potential inhalation cancer risk using the new risk assessment algorithms defined by the OEHHA (2003).

To assess the potential for noncancer health effects resulting from chronic and acute inhalation exposure, OEHHA has established RELs to which ambient TAC concentrations are compared. An REL is an estimate of the continuous inhalation exposure concentration to which the human population (including sensitive subgroups) is likely to be without appreciable risk of experiencing deleterious noncancer effects.

In addition to the inhalation exposure pathway, several noninhalation exposure pathways also were incorporated in the HRA, including dermal adsorption, soil ingestion, home-grown produce ingestion (residential and sensitive receptors only), and mother's milk ingestion (residential and sensitive receptors only). For these noninhalation routes, the most conservative factor (the residential factor)[5] was used to simplify calculations and was considered conservative because the pollutants with

[5] For the multi-pathway analysis, factors from Table 8a of Rule 1401 and 212 (SCAQMD 2005b) were applied depending upon residential or worker receptor. The factors are simple multiplication factors to increase risk. Separate factors are reported for chronic and cancer risk.

noninhalation factors (e.g., arsenic and lead for cancer risk) were not the major pollutants contributing to cancer risk. The various exposure parameters and settings used in this approach are equivalent to the HARP methodology and are consistent with SCAQMD guidelines (SCAQMD 2005a). A similar approach was used for the chronic hazard index where the SCAQMD factors were also applied for noninhalation exposures for arsenic, cadmium, and mercury. For this study, the contributions of the noninhalation exposure pathways to the HRA results are negligible compared to the inhalation pathway.

Table D3.5-1 presents the cancer, chronic noncancer, and acute noncancer toxicity factors used to assess health risks in this study.

Table D3.5-1. Toxicity Factors Used in the HRA

Pollutant	*CAS Number*	*Inhalation Cancer Potency Factor (mg/kg-d)$^{-1}$*	*Chronic Inhalation REL (µg/m^3)*	*Target Organ for Chronic Exposure*	*Acute Inhalation REL (µg/m^3)*	*Target Organ for Acute Exposure*
DPM [a]	9901	1.1	5	I	—	—
Acetaldehyde	75070	0.01	9	I	—	—
Benzene [b]	71432	0.1	60	C,E,G	1,300	C,E,F,H
Acrolein	107028	---	0.06	D,I	0.19	D,I
1,3-Butadiene	106990	---	20	H	---	---
Formaldehyde	50000	0.021	3	D,I	94	D,F,I
Xylenes	1210	—	700	G,I	22,000	D,I
Naphthalene	91203	0.12	9	I	—	—
n-Hexane	110543	—	7,000	G	—	—
Propylene	115071	—	3,000	I	—	—
Toluene	108883	—	300	C,G,I	37,000	C,D,G,H,I
Ammonia	7664417	—	200	I	3,200	D,I
Arsenic [b, c]	7440382	12	0.03	B,C,G,J	0.19	C,H
Bromine	7726956	—	1.7	I	—	—
Cadmium [c]	7440439	15	0.02	I,M	—	—
Copper	7440508	—	2.4	I	100	I
Lead [c]	7439921	0.042	—	—	—	—
Manganese	7439965	—	0.2	G	—	—
Mercury [c]	7439976	—	0.09	F,G,M	1.8	C,H
Nickel [c]	7440020	0.91	0.05	A,E,I	6.0	F,I
Sulfates	9960	—	25	I	120	I

Pollutant	*CAS Number*	*Inhalation Cancer Potency Factor (mg/kg-d)$^{-1}$*	*Chronic Inhalation REL (µg/m^3)*	*Target Organ for Chronic Exposure*	*Acute Inhalation REL (µg/m^3)*	*Target Organ for Acute Exposure*
Vanadium	7440622	—	—	—	30	D,I
Antimony	7440360	—	0.2	I	—	—
Chlorine	7782505	—	0.2	I	210	D,I
Hexavalent Chromium	18540299	510	0.2	E,I	—	—
Phosphorous	7723140	—	0.07	C,H	—	—
Zinc	7440666	—	35	B,E,I	—	—

Notes:

[a] For diesel ICEs, only DPM emissions were evaluated for cancer risk and chronic hazard indices, because DPM is a surrogate for the combined health effects associated with exposure to diesel exhaust emissions. For all other emission sources (external combustion boilers, alternative fuel engines, tire and brake wear), emissions of the 24 other toxic air contaminants were evaluated for cancer risk and chronic hazard indices. For the acute hazard indices, DPM was not evaluated; rather, emissions of the 24 other toxic air contaminants were evaluated for all emission sources (including diesel ICEs).

[b] The acute exposure period is 1 hour for all compounds except benzene (6 hours) and arsenic (4 hours).

[c] Arsenic, cadmium, lead, mercury, nickel, and hexavalent chromium were also evaluated for noninhalation exposure pathways. For arsenic, the cancer risk oral slope factor is 1.5 (mg/kg/day)$^{-1}$, and the noncancer chronic oral REL is 0.0003 mg/kg/day. For cadmium, the noncancer chronic oral REL is 0.0005 mg/kg/day. For lead, the cancer risk oral slope factor is 0.0085 (mg/kg/day)$^{-1}$. For mercury, the noncancer chronic oral REL is 0.0003 mg/kg/day. For nickel, the noncancer chronic oral REL is 0.05 mg/kg/day. For hexavalent chromium, the noncancer chronic oral REL is 0.02 mg/kg/day.

Key to noncancer acute and chronic exposure target organs:

A. Alimentary Tract	D. Eye	G. Nervous System	J. Skin
B. Cardiovascular System	E. Hematologic System	H. Reproductive System	K. Bone
C. Developmental System	F. Immune System	I. Respiratory System	L. Endocrine System
			M. Kidney

Source: CARB 2005b

D3.5.2 Exposure Scenarios for Individual Lifetime Cancer Risk

For the cancer risk evaluation, the frequency and duration of exposure to TACs are assumed to be directly proportional to the risk. Therefore, this HRA used specific exposure assumptions for each receptor type, as described below.

1. **Residential and Sensitive Receptors.** Cancer risks for residential and sensitive receptors were estimated using the breathing rates described in the *CARB Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk (October 2003)* (CARB 2004a). For risk assessments based on multiple exposure pathways, where a single cancer risk value is required for a risk management decision, the CARB policy recommends that the potential

cancer risk be based on the derived cancer risk method outlined in the OEHHA HRA Guidance Manual (OEHHA 2003) together with the 80th percentile breathing rate of 302 liters per kilogram of body weight per day (L/kg-day). The HRA, therefore, determined maximum residential and sensitive receptor cancer risk impacts by using the 80th percentile point estimate analysis method and an exposure duration of 24 hours per day, 350 days per year over 70 years (i.e., the "Derived [Adjusted]" risk calculation method).

2. **Occupational impacts**. Workers generally do not spend as much time within a project region as residents of the region. The SCAQMD, therefore, allows an exposure adjustment for workers (SCAQMD 2005a). Lifetime occupational exposure is based on a worker presence of 8 hours per day, 245 days per year for 40 years (as recommended by OEHHA [2003]). The breathing rate for workers is equal to 447 L/kg-day, which equates to 149 L/kg-day over an 8-hour workday (OEHHA 2003).

   Student impacts. Risks for students were scaled from the results for workers (students and workers have the same noninhalation exposure pathways of dermal adsorption and soil ingestion). The SCAQMD policy is to evaluate student cancer risk based upon a full 70 years of exposure. However, students actually spend a limited time at a given school. Based on an assumed maximum presence of 6 hours per day, 180 days per year for 6 years, this exposure time produces an adjustment factor of (6 x 180 x 6) / (8 x 245 x 40) = 0.083 relative to worker exposures. This factor is further modified to account for differences in the breathing rate of children compared to the worker-breathing rate. The high-end breathing rate for children is equal to 581 L/kg-day (OEHHA 2003). The risk values predicted at school sites, therefore, were multiplied by (0.083 x 581) / 447 = 0.11 to produce the maximum student risks actually expected from the proposed Project.

3. **Recreational user impacts**. Risks for recreational receptors were scaled from the results for workers (recreational users and workers have the same noninhalation exposure pathways of dermal adsorption and soil ingestion). Based upon an assumed maximum recreational presence of 2 hours per day, 350 days per year for 70 years, this exposure time produces an adjustment factor of (2 × 350 × 70) / (8 × 245 × 40) = 0.625. This factor is further modified to account for differences in the breathing rate of a person engaged in recreation compared to the worker breathing rate. The breathing rate during recreation is assumed to be a heavy-activity rate equal to 1,097 L/kg-day, which was obtained from the USEPA *Exposure Factors Handbook* (USEPA 1997). The risk values predicted in recreation areas, therefore, were multiplied by (0.63 × 1,097) / 447 = 1.5 to produce the maximum recreational user risks expected from the proposed Project.

Table D3.5-2 summarizes the primary exposure assumptions used to calculate individual lifetime cancer risk by receptor type. In accordance with OEHHA and SCAQMD guidelines, no exposure adjustments were made to the chronic and acute hazard index calculations other than the normal adjustment for worker exposure for the chronic hazard index, which is applied only to the noninhalation exposure pathways.

Table D3.5-2. Exposure Assumptions for Individual Lifetime Cancer Risk

Receptor Type	*Exposure Frequency*		*Exposure Duration (Years)*	*Breathing Rate (L/kg-day)*
	Hours/Day	*Days/Year*		
Residential	24	350	70	302
Occupational	8	245	40	447
Sensitive	24	350	70	302
Student	6	180	6	581
Recreational	2	350	70	1,097

Notes:

[a] The residential breathing rate of 302 L/kg BW-day represents the 80th percentile breathing rate. (OEHHA 2003).

[b] The occupational exposure frequency of 245 days/year represents 5 days/week, 49 weeks/year. The occupational breathing rate of 447 L/kg BW-day equates to 149 L/kg BW-day over an 8-hour work day (OEHHA 2003).

[c] The student breathing rate of 581 L/kg BW-day represents the high-end child breathing rate (OEHHA 2003).

[d] The recreational breathing rate of 1,097 L/kg BW-day represents a heavy-activity breathing rate, which is derived from a breathing rate of 3.2 m^3/hr (and assuming a 70-kg adult) as reported in the USEPA *Exposure Factors Handbook* (USEPA 1997). This recreational breathing rate is conservative because it assumes that an individual could sustain the maximum hourly breathing rate for 2 consecutive hours.

D3.6 Significance Criteria for Proposed Project Health Risks

LAHD has adopted the threshold of less than 10 in a million as being an acceptable risk level for receptors. Based on this threshold, a project would produce less than-significant cancer risk impacts if the maximum incremental cancer risk due to the project is less than 10 chances in 1 million (10×10^{-6}).

For chronic and acute noncancer exposures, maximum predicted annual and 1-hour TAC concentrations are compared with the RELs developed by OEHHA. A hazard index (defined as the summation of predicted TAC concentrations divided by their respective RELs) less than 1.0 indicates that the exposure would present an acceptable or insignificant health risk (i.e., no adverse noncancer health impact). Hazard indexes above 1.0 represent the potential for an unacceptable or significant health risk.

For the determination of significance from a CEQA standpoint, this HRA determined the incremental increase in health effects values due to the proposed Project by estimating the net change in impacts between the proposed Project and CEQA baseline conditions. For the determination of significance from a NEPA standpoint, this HRA determined the incremental increase in health effects values due to the proposed Project by estimating the net change in impacts between the proposed Project and NEPA baseline. Both of these incremental health effects values (proposed Project minus CEQA baseline, and proposed Project minus NEPA baseline) were compared to the significance thresholds described above.

D3.7 Predicted Health Impacts

D3.7.1 Unmitigated Proposed Project Health Impacts

Table D3.7-1 presents a summary of the maximum health impacts that would occur for each receptor type with construction and operation of the proposed Project without mitigation. The table also shows the maximum health impacts from the CEQA baseline and NEPA baseline scenarios, as well as the CEQA increment (proposed Project minus CEQA baseline) and NEPA increment (proposed Project minus NEPA baseline). Because the results in Table D3.7-1 represent the maximum impacts predicted for each receptor type, the impacts at all other receptors would be less than these values.

Table D3.7-1 shows that the maximum CEQA cancer risk increment is predicted to be 270 in a million (270×10^{-6}), at a recreational receptor. The maximum CEQA cancer risk increment at a residential receptor is predicted to be 112 in a million (112×10^{-6}). These risk values exceed the significance threshold of 10 in a million. The CEQA increments would also exceed the significance threshold at the maximum occupational and sensitive receptors.

The maximum NEPA cancer risk increment is predicted to be 385 in a million (385×10^{-6}) at a recreational receptor. The maximum NEPA cancer risk increment at a residential receptor is predicted to be 202 in a million (202×10^{-6}). These risk values exceed the significance threshold of 10 in a million. The NEPA increments would also exceed the significance threshold at the maximum occupational and sensitive receptors.

The receptor location for the maximum CEQA residential cancer risk increment is in the marina about 400 meters north-northwest of Berth 45. The receptor location for the maximum NEPA residential cancer risk increment is near the intersection of Harbor Boulevard and 3rd Street.

Table D3.7-1. Maximum Health Impacts Associated with the Proposed Project without Mitigation

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Proposed Project	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
Cancer Risk	Residential	341×10^{-6} (341 in a million)	379×10^{-6} (379 in a million)	**112×10^{-6} (112 in a million)**	139×10^{-6} (139 in a million)	**202×10^{-6} (202 in a million)**	10×10^{-6} (10 in a million)
	Occupational	387×10^{-6} (387 in a million)	992×10^{-6} (992 in a million)	**176×10^{-6} (176 in a million)**	171×10^{-6} (171 in a million)	**251×10^{-6} (251 in a million)**	

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Proposed Project	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
	Recreational	594×10^{-6} (594 in a million)	$1{,}522 \times 10^{-6}$ (1,522 in a million)	**270×10^{-6} (270 in a million)**	263×10^{-6} (263 in a million)	**385×10^{-6} (385 in a million)**	
	Sensitive	97×10^{-6} (97 in a million)	120×10^{-6} (120 in a million)	**12×10^{-6} (12 in a million)**	52×10^{-6} (52 in a million)	**58×10^{-6} (58 in a million)**	
	Student	6×10^{-6} (6 in a million)	8×10^{-6} (8 in a million)	1×10^{-6} (1 in a million)	2×10^{-6} (2 in a million)	4×10^{-6} (4 in a million)	
Chronic Hazard Index	Residential	0.53	0.69	0.09	0.44	0.13	1.0
	Occupational	1.16	1.72	0.38	1.04	0.42	
	Recreational	1.16	1.72	0.38	1.04	0.42	
	Sensitive	0.13	0.13	0.02	0.11	0.03	
	Student	0.13	0.11	0.02	0.10	0.03	
Acute Hazard Index	Residential	1.64	2.40	**1.42**	1.36	**1.26**	1.0
	Occupational	2.56	3.07	**2.51**	1.76	**1.46**	
	Recreational	2.56	3.07	**2.51**	1.76	**1.46**	
	Sensitive	0.86	0.51	0.73	0.44	0.68	
	Student	0.54	0.42	0.41	0.29	0.34	

Notes:

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA and NEPA increments only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact.

The CEQA increment represents the proposed Project minus the CEQA baseline. The NEPA increment represents the proposed Project minus the NEPA baseline.

Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values.

The cancer risk values reported in this table for the residential receptor are based on the 80th percentile breathing rate.

For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half were assumed to use the average residual fuel oil of 2.7% sulfur content

The maximum chronic hazard index increments are predicted to be less than the significance threshold of 1.0 at all receptors for both CEQA and NEPA.

The maximum acute hazard index increments are predicted to be greater than the significance threshold of 1.0 for residential, occupational, and recreational receptors for both CEQA and NEPA.

Figures D3.7-1, D3.7-2, and D3.7-3 show the maximum receptor locations for the CEQA baseline, NEPA baseline, and unmitigated proposed project scenarios, respectively. The residential, occupational, and recreational MEI's are not necessarily located directly on existing homes, workplaces, or recreational facilities; rather, they are located in areas that could contain these land use types.

Table D3.7-2 presents the contributions from each emission source to the maximum health effects values for the proposed Project without mitigation. At the maximum residential receptor, the greatest contributor to the cancer risk is harbor craft; for the chronic hazard index, the greatest contributor is ship hoteling. The proximity of the receptor to the Crowley tugboat operation as well as close proximity of harbor craft transit operations are two important factors for why harbor craft are important contributors to these health risk values. By contrast, the greatest contributor to the acute hazard index at the maximum residential receptor is from construction activity. During construction of the proposed Project, a 1-hour period would produce relatively high emissions, enough to cause construction to contribute more than harbor craft or hoteling ships for a short-term period.

Table D3.7-2. Source Contributions at the Residential and Occupational MEIs for the Proposed Project without Mitigation

	Maximum Residential Receptor			*Maximum Occupational Receptor*		
Emission Source	*Cancer Risk*	*Chronic Hazard Index*	*Acute Hazard Index*	*Cancer Risk*	*Chronic Hazard Index*	*Acute Hazard Index*
Construction	0.6%	0.9%	65.2%	0.6%	0.2%	75.0%
Harbor Craft	54.7%	37.3%	0.6%	6.0%	6.8%	0.2%
Hoteling Cruise Ships	37.8%	38.9%	12.6%	91.5%	25.9%	10.3%
Onsite—Light-Duty Vehicles	0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Onsite—Heavy-Duty Vehicles	<0.1%	<0.1%	0.1%	<0.1%	<0.1%	0.1%
On-Road Light-Duty Vehicles—Passenger	3.8%	2.6%	2.2%	0.7%	3.8%	1.2%
On-Road—Heavy-Duty Vehicles	1.3%	19.0%	16.3%	0.2%	62.6%	10.4%
Ships in Transit	1.7%	1.2%	3.0%	0.8%	0.6%	2.6%
Stationary Sources	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Terminal Equipment	<0.1%	0.1%	<0.1%	0.1%	0.1%	<0.1%

Notes:

Stationary Sources include fuel operations from Mike's Marina and Jankovich and Son's.

At the maximum occupational receptor, the greatest contributor to the cancer risk is hoteling emissions from cruise ships. The greatest contributor to the chronic hazard index is the operation of heavy-duty vehicles. The greatest contributor to the acute hazard index is construction.

Table D3.7-3 presents the contributions from each TAC to the maximum health effects values for the proposed Project without mitigation. Because DPM is a surrogate for all diesel ICE emissions for cancer risk and chronic hazard index calculations, DPM is the maximum contributor (well over 90%) to these health risk values. The acute hazard index, however, was calculated by using speciated TAC emissions from all sources. The table shows that the greatest acute hazard index contributor is formaldehyde at both the maximum residential and occupational receptors. Formaldehyde is emitted from both gasoline and diesel fueled engines.

Table D3.7-3. TAC Contributions at the Residential and Occupational MEIs for the Proposed Project without Mitigation

	Maximum Residential Receptor			*Maximum Occupational Receptor*		
Pollutant	*Cancer Risk*	*Chronic Hazard Index*	*Acute Hazard Index*	*Cancer Risk*	*Chronic Hazard Index*	*Acute Hazard Index*
DPM*	96.1%	97.4%	N/A	99.1%	96.1%	N/A
Acrolein	<0.1%	1.9%	2.3%	<0.1%	2.9%	1.2%
Acetaldehyde	<0.1%	<0.1%	<0.1%	<0.1%	0.1%	<0.1%
Benzene	1.5%	<0.1%	0.8%	0.3%	0.1%	0.8%
1,3-Butadiene	2.1%	<0.1%	<0.1%	0.5%	<0.1%	<0.1%
Formaldehyde	0.2%	0.5%	86.5%	0.1%	0.8%	89.3%
Xylenes	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Naphthalene	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
n-Hexane	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Propylene	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Toluene	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Ammonia	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Arsenic	<0.1%	<0.1%	9.2%	<0.1%	<0.1%	7.7%
Bromine	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Cadmium	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Copper	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Lead	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Manganese	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Mercury	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%

Pollutant	*Maximum Residential Receptor*			*Maximum Occupational Receptor*		
	Cancer Risk	*Chronic Hazard Index*	*Acute Hazard Index*	*Cancer Risk*	*Chronic Hazard Index*	*Acute Hazard Index*
Nickel	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Sulfates	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Vanadium	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Antimony	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Chlorine	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Hexavalent Chromium	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Phosphorus	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Zinc	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%

* For diesel internal combustion engines, only DPM emissions were evaluated for cancer risk and chronic hazard indices, because DPM is a surrogate for the combined health effects associated with exposure to diesel exhaust emissions. For all other emission sources (external combustion boilers, alternative fuel engines, tire and brake wear), emissions of the 26 other toxic air contaminants were evaluated for cancer risk and chronic hazard indices. For the acute hazard indices, DPM was not evaluated; rather, emissions of the 26 other toxic air contaminants were evaluated for all emission sources (including diesel ICEs).

To illustrate the geographical extent of health risk impacts associated with the proposed Project, a series of health risk isopleths (contours) has been prepared. The isopleths show individual lifetime cancer risks over a map of the surrounding community, assuming residential exposure conditions (24 hours per day, 350 days per year, for 70 years) and an 80th percentile breathing rate. The risk isopleths are as follows:

Figure D3.7-4	CEQA Baseline
Figure D3.7-5	NEPA Baseline
Figure D3.7-6	Proposed Project Minus CEQA Baseline
Figure D3.7-7	Proposed Project Minus NEPA Baseline

D3.7.2 Mitigated Project Health Impacts

This HRA evaluated the effect on health risks resulting from the implementation of the air quality mitigation measures identified in Section 3.2 of the EIS/EIR. A summary of the mitigation measures quantified in this HRA for proposed project construction and operation is as follows:[6]

D3.9.2.1 Mitigation Measures for Proposed Project Construction Quantified in the HRA

MM AQ-1. Harbor Craft Engine Standards. All harbor craft used during the construction phase of the proposed Project shall, at a minimum, be repowered to meet the cleanest existing marine engine emission standards or EPA Tier 2. Additionally, where available, harbor craft shall meet the proposed EPA Tier 3 (which are proposed to be phased-in beginning 2009) or cleaner marine engine emission standards.

This measure shall be met unless one of the following circumstances exists and the contractor is able to provide proof that any of these circumstances exists:

- A piece of specialized equipment is unavailable in a controlled form within the state of California, including through a leasing agreement;
- A contractor has applied for necessary incentive funds to put controls on a piece of uncontrolled equipment planned for use on the proposed Project, but the application process is not yet approved, or the application has been approved, but funds are not yet available; or
- A contractor has ordered a control device for a piece of equipment planned for use on the proposed Project, or the contractor has ordered a new piece of controlled equipment to replace the uncontrolled equipment, but that order has not been completed by the manufacturer or dealer. In addition, for this exemption to apply, the contractor must attempt to lease controlled equipment to avoid using uncontrolled equipment, but no dealer within 200 miles of the proposed Project has the controlled equipment available for lease.

MM AQ-2. Dredging Equipment Electrification. The proposed Project shall use electric dredging equipment.

MM AQ-3. Fleet Modernization for Onroad Trucks.

1. Trucks hauling materials such as debris or fill shall be fully covered while operating off Port property.
2. Idling shall be restricted to a maximum of 5 minutes when not in use.
3. Tier Specifications:
   - <u>January 1, 2009 to December 31, 2011</u>: All onroad heavy-duty diesel trucks with a gross vehicle weight rating (GVWR) of 19,500 pounds or greater used

[6] Not all of the mitigation measures prescribed in Section 3.2 have their effects quantified. Only those mitigation measures affecting the risk calculations are shown in this report.

on site or to transport materials to and from the site shall comply with EPA 2004 onroad PM emission standards and be the cleanest available with respect to NO_X (0.10g/bhp-hr PM10 and 2.0 g/bhp-hr NO_X). In addition, all onroad trucks shall be outfitted with the BACT devices certified by CARB. Any emissions control device used by the contractor shall achieve emissions reductions that are no less than what could be achieved by a Level 3 diesel emissions control strategy for a similarly sized engine as defined by CARB regulations.

- Post-January 2011: All onroad heavy-duty diesel trucks with a GVWR of 19,500 pounds or greater used on site or to transport materials to and from the site shall comply with 2010 emission standards, where available. In addition, all onroad trucks shall be outfitted with BACT devices certified by CARB. Any emissions control device used by the contractor shall achieve emissions reductions that are no less than what could be achieved by a Level 3 diesel emissions control strategy for a similarly sized engine as defined by CARB regulations.
- A copy of each unit's certified EPA rating, BACT documentation, and CARB or SCAQMD operating permit shall be provided at the time of mobilization of each applicable unit of equipment
- The above EPA standards shall be met unless one of the following circumstances exists, with the contractor able to provide proof:
  - A piece of specialized equipment is unavailable in a controlled form within the state of California, including through a leasing agreement;
  - A contractor has applied for necessary incentive funds to put controls on a piece of uncontrolled equipment planned for use on the proposed Project, but the application process is not yet approved, or the application has been approved, but funds are not yet available; or
  - A contractor has ordered a control device for a piece of equipment planned for use on the proposed Project, or the contractor has ordered a new piece of controlled equipment to replace the uncontrolled equipment, but that order has not been completed by the manufacturer or dealer. In addition, for this exemption to apply, the contractor must attempt to lease controlled equipment to avoid using uncontrolled equipment, but no dealer within 200 miles of the proposed Project has the controlled equipment available for lease.

MM AQ-4. Fleet Modernization for Construction Equipment.

1. Construction equipment shall incorporate, where feasible, emissions savings technology such as hybrid drives and specific fuel economy standards.
2. Idling shall be restricted to a maximum of 5 minutes when not in use.
3. Tier Specifications:
   - January 1, 2009, to December 31, 2011: All offroad diesel-powered construction equipment greater than 50 hp, except derrick barges and marine

vessels, shall meet Tier 2 offroad emissions standards. In addition, all construction equipment shall be outfitted with the BACT devices certified by CARB. Any emissions control device used by the contractor shall achieve emissions reductions that are no less than what could be achieved by a Level 2 or Level 3 diesel emissions control strategy for a similarly sized engine as defined by CARB regulations.

- January 1, 2012, to December 31, 2014: All offroad diesel-powered construction equipment greater than 50 hp, except derrick barges and marine vessels, shall meet Tier 3 offroad emissions standards. In addition, all construction equipment shall be outfitted with BACT devices certified by CARB. Any emissions control device used by the contractor shall achieve emissions reductions that are no less than what could be achieved by a Level 3 diesel emissions control strategy for a similarly sized engine as defined by CARB regulations.
- Post-January 1, 2015: All offroad diesel-powered construction equipment greater than 50 hp shall meet the Tier 4 emission standards, where available. In addition, all construction equipment shall be outfitted with BACT devices certified by CARB. Any emissions control device used by the contractor shall achieve emissions reductions that are no less than what could be achieved by a Level 3 diesel emissions control strategy for a similarly sized engine as defined by CARB regulations.
- A copy of each unit's certified tier specification, BACT documentation, and CARB or SCAQMD operating permit shall be provided at the time of mobilization of each applicable unit of equipment.
- The above tier specifications shall be met unless one of the following circumstances exists, with the contractor able to provide proof:
  - A piece of specialized equipment is unavailable in a controlled form within the state of California, including through a leasing agreement;
  - A contractor has applied for necessary incentive funds to put controls on a piece of uncontrolled equipment planned for use on the proposed Project, but the application process is not yet approved, or the application has been approved, but funds are not yet available; or
  - A contractor has ordered a control device for a piece of equipment planned for use on the proposed Project, or the contractor has ordered a new piece of controlled equipment to replace the uncontrolled equipment, but that order has not been completed by the manufacturer or dealer. In addition, for this exemption to apply, the contractor must attempt to lease controlled equipment to avoid using uncontrolled equipment, but no dealer within 200 miles of the proposed Project has the controlled equipment available for lease.
- Construction equipment shall incorporate, where feasible, emissions-saving technology such as hybrid drives and specific fuel economy standards.

D3.9.2.2 Mitigation Measures for Proposed Project Operation Quantified in the HRA

Cruise Ships and Cruise Terminal

MM AQ-9. Alternative Maritime Power (AMP) for Cruise Vessels. Cruise vessels calling at the Inner Harbor Cruise Terminal shall use AMP at the following percentages while hoteling in the Port:

- 30% of all calls in 2009, and
- 80% of all calls in 2013 and thereafter to accommodate existing lease agreements and home ported vessels. This portion of the mitigation measure is not quantified.

Ships calling at the Outer Harbor Cruise Terminal shall use AMP while hoteling at the Port as follows (minimum percentage):

- 97% of all calls in 2013 and thereafter.

Additionally, by 2013, all ships retrofitted for AMP shall be required to use AMP while hoteling, with a compliance rate of 100%, with the exception of circumstances when an AMP-capable berth is unavailable due to utilization by another AMP-capable ship.

MM AQ-10. Low-Sulfur Fuel. Ships calling at the Inner Harbor Cruise Terminal shall use low-sulfur fuel (maximum sulfur content of 0.2%) in engines and boilers within 40 nm of Point Fermin (including hoteling for non-AMP ships) at the following annual participation rates:

- 30% of all calls in 2009, and
- 90% of all calls in 2013 and thereafter.

Ships calling at the Outer Harbor Cruise Terminal shall use low-sulfur fuel (maximum sulfur content of 0.2%) in engines and boilers within 40 nm of Point Fermin (including hoteling for non-AMP ships) at the following annual participation rates:

- 90% of all calls in 2013.

Low-sulfur fuel requirements shall apply independently of AMP participation.

MM AQ-11. Vessel Speed-Reduction Program. Ships calling at the Inner Harbor Cruise Terminal shall comply with the expanded VSRP of 12 knots between 40 nm from Point Fermin and the Precautionary Area in the following implementation schedule:

- 30% of all calls in 2009, and
- 100% of all calls in 2013 and thereafter.

Ships calling at the Outer Harbor Cruise Terminal shall comply with the expanded VSRP of 12 knots between 40 nm from Point Fermin and the Precautionary Area in the following implementation schedule:

- 100% of all calls in 2013 and thereafter.

MM AQ-13. Clean Terminal Equipment. All terminal equipment shall be electric, where available.

All terminal equipment other than electric forklifts at the cruise terminal building shall implement the following measures:

- Beginning in 2009, all non-yard tractor purchases shall be either (1) the cleanest available NO_X alternative-fueled engine meeting 0.015 g/bhp-hr for PM or (2) the cleanest available NO_X diesel-fueled engine meeting 0.015 g/bhp-hr for PM. If there are no engines available that meet 0.015 g/bhp-hr for PM, the new engines shall be the cleanest available (either fuel type) and shall have the cleanest VDEC;
- By the end of 2012, all non-yard tractor terminal equipment less than 750 hp shall meet the EPA Tier 4 non-road engine standards; and
- By the end of 2014, all terminal equipment shall meet EPA Tier 4 non-road engine standards.

MM AQ-14. LNG-Powered Shuttle Busses. All shuttle buses shall be LNG powered.

Delivery Trucks

MM AQ-15. Truck Emission Standards. Onroad heavy-duty diesel trucks (above 14,000 pounds) entering the cruise terminal building shall achieve EPA's 2007 Heavy-Duty Highway Diesel Rule emission standards for onroad heavy-duty diesel engines (EPA 2001a) in the following percentages: 20% in 2009, 40% in 2012, and 80% in 2015 and thereafter.

Tug Boat Operations

MM AQ-17. AMP for Tugboats. Crowley and Millennium tugboats calling at the North Harbor cut shall use AMP while hoteling at the Port as follows (minimum percentage):

- 100% compliance in 2014.

MM AQ-18. Engine Standards for Tugboats. Tugboats calling at the North Harbor cut shall be repowered to meet the cleanest existing marine engine emission standards or EPA Tier 2 as follows (minimum percentages):

- 30% in 2010, and
- 100% in 2014.

Tugs calling at the North Harbor cut shall be repowered to meet the cleanest existing marine engine emission standards or EPA Tier 3 as follows (minimum percentages):

- 20% in 2015,
- 50% in 2018, and
- 100% in 2020.

Catalina Express

MM AQ-21. Catalina Express Ferry Engine Standards. Ferries calling at the Catalina Express Terminal shall be repowered to meet the cleanest existing marine engine emission standards or EPA Tier 2 as follows (minimum percentages):

- 30% in 2010, and
- 100% in 2014.

Table D3.7-4 presents a summary of the maximum health impacts that would occur for each receptor type with construction and operation of the proposed Project with mitigation. The mitigation measures would reduce proposed project maximum cancer risks by about 52 to 78%, depending on the receptor type. Chronic hazard indexes would be reduced by about 10 to 23%. Acute hazard indices would be reduced by about 5 to 23%. The reason chronic and acute hazard indices would have lower reductions compared to cancer risks is because the maximum 1-hour and annual emissions for some source categories occur during the construction period, in which many of the mitigation measures do not apply.

Table D3.7-4. Maximum Health Impacts Associated with the Proposed Project with Mitigation

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Proposed Project	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
Cancer Risk	Residential	111×10^{-6} (111 in a million)	379×10^{-6} (379 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	139×10^{-6} (139 in a million)	**15×10^{-6} (15 in a million)**	10×10^{-6} (10 in a million)
	Occupational	86×10^{-6} (86 in a million)	992×10^{-6} (992 in a million)	**16×10^{-6} (16 in a million)**	171×10^{-6} (171 in a million)	**25×10^{-6} (25 in a million)**	

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Proposed Project	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
	Recreational	132×10^{-6} (132 in a million)	$1{,}522 \times 10^{-6}$ (1,522 in a million)	**25×10^{-6} (25 in a million)**	263×10^{-6} (263 in a million)	**38×10^{-6} (38 in a million)**	
	Sensitive	47×10^{-6} (47 in a million)	120×10^{-6} (120 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	52×10^{-6} (52 in a million)	$<0.1 \times 10^{-6}$ (<0.1 in a million)	
	Student	2×10^{-6} (2 in a million)	8×10^{-6} (8 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	2×10^{-6} (2 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	
Chronic Hazard Index	Residential	0.44	0.69	0.04	0.44	0.07	1.0
	Occupational	1.04	1.72	0.20	1.04	0.16	
	Recreational	1.04	1.72	0.20	1.04	0.16	
	Sensitive	0.11	0.13	0.00	0.11	0.00	
	Student	0.10	0.11	0.00	0.10	0.00	
Acute Hazard Index	Residential	1.55	2.40	**1.10**	1.36	0.94	1.0
	Occupational	1.97	3.07	**1.74**	1.76	**1.07**	
	Recreational	1.97	3.07	**1.74**	1.76	**1.07**	
	Sensitive	0.73	0.51	0.60	0.44	0.55	
	Student	0.42	0.42	0.29	0.29	0.23	

Notes:

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA and NEPA increments only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact.

The CEQA increment represents the proposed Project minus the CEQA baseline. The NEPA increment represents the Project minus the NEPA baseline.

Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values.

The cancer risk values reported in this table for the residential receptor are based on the 80th percentile breathing rate.

For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half were assumed to use the average residual fuel oil of 2.7% sulfur content

The data in Table D3.7-4 show that the maximum CEQA cancer risk increment after mitigation is predicted to be 25 in a million (25×10^{-6}), at a recreational receptor. This risk value exceeds the significance threshold of 10 in a million. The CEQA cancer risk increment would also exceed the threshold at an occupational receptor. The maximum residential CEQA cancer risk increment after mitigation is predicted to be less than 1 in a million (<1 × 10^{-6}), which is well below the significance threshold.

The maximum NEPA cancer risk increment is predicted to be 38 in a million (38 × 10^{-6}) at a recreational receptor. The maximum NEPA cancer risk increment at a residential receptor is predicted to be 15 in a million (15 × 10^{-6}). These risk values exceed the significance threshold of 10 in a million. The NEPA increment would also exceed the significance threshold at the maximum occupational receptor.

The maximum chronic hazard index increments after mitigation are predicted to be less than the significance threshold at all receptors for both CEQA and NEPA.

The maximum acute hazard index increments after mitigation are predicted to remain greater than the significance threshold at residential, occupational, and recreational receptors for CEQA, and at occupational and recreational receptors for NEPA.

Figure D3.7-8 shows the maximum receptor locations for the mitigated proposed Project. It should be noted that the residential, occupational, and recreational MEIs are not necessarily located directly on existing homes, workplaces, or recreational facilities; rather, they are located in areas that contain these land use types.

Table D3.7-5 presents the contributions from each emission source to the maximum health effects impacts for the mitigated Project. At the maximum residential receptor, the greatest contributors to cancer risk and chronic hazard index are harbor craft. The greatest contributor to the acute hazard index is on-road heavy-duty truck operations.

Table D3.7-5. Source Contribution at the Residential and Occupational MEIs for the Mitigated Project

	Maximum Residential Receptor			*Maximum Occupational Receptor*		
Emission Source	*Cancer Risk*	*Chronic Hazard Index*	*Acute Hazard Index*	*Cancer Risk*	*Chronic Hazard Index*	*Acute Hazard Index*
Construction	1.6%	0.6%	21.2%	0.6%	0.1%	63.3%
Harbor Craft	66.3%	44.1%	0.4%	53.6%	7.6%	0.3%
Hoteling Cruise Ships	14.7%	28.4%	16.8%	38.1%	17.7%	13.2%
Operations—Passenger	0.2%	<0.1%	<0.1%	1.2%	<0.1%	<0.1%
Operations—Heavy	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	0.1%
On-Road Vehicles—Passenger	11.5%	3.1%	5.4%	3.8%	4.2%	1.5%
On-Road Vehicles—Heavy	4.0%	22.7%	50.6%	1.2%	69.8%	13.3%
Ships in Transit	1.5%	3.0%	3.0%	1.2%	0.5%	3.4%
Stationary Sources	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%	<0.1%
Terminal Equipment	<0.1%	<0.1%	<0.1%	0.2%	<0.1%	<0.1%

Emission Source	*Maximum Residential Receptor*			*Maximum Occupational Receptor*		
	Cancer Risk	*Chronic Hazard Index*	*Acute Hazard Index*	*Cancer Risk*	*Chronic Hazard Index*	*Acute Hazard Index*
Tugs	0.1%	<0.1%	2.6%	<0.1%	<00.1%	4.8%

At the maximum occupational receptor, the greatest contributor to cancer risk is harbor craft. The greatest contributor to the chronic hazard index is on-road heavy-duty vehicles. The greatest contributor to the acute hazard index is construction due to the close proximity of this receptor to construction areas.

Table D3.7-6 presents the contributions from each TAC to the maximum health effects values for the mitigated proposed Project. DPM remains the primary contributor to cancer risk and chronic hazard index (greater than 85%). The greatest acute hazard index contributor is formaldehyde associated with combustion from gasoline and diesel fueled vehicles during construction.

Table D3.7-6. TAC Contributions at the Residential and Occupational MEIs for the Mitigated Project

Pollutant	*Maximum Residential Receptor*			*Maximum Occupational Receptor*		
	Cancer Risk	*Chronic Hazard Index* [a]	*Acute Hazard Index* [a]	*Cancer Risk*	*Chronic Hazard Index* [a]	*Acute Hazard Index*[a]
DPM[b]	88.2%	96.9%	N/A	94.8%	95.8%	N/A
Acrolein	<0.1	2.3%	5.4%	<0.1	3.2%	1.5%
Acetaldehyde	0.1%	0.1%	<0.1	<0.1	0.1%	<0.1
Benzene	4.6%	<0.1	0.7%	2.0%	0.1%	0.8%
Butadiene	6.3%	<0.1	<0.1	2.7%	<0.1	<0.1
Formaldehyde	0.7%	0.6%	81.2%	0.3%	0.9%	87.1%
Xylenes	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Naphthalene	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
n-Hexane	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Propylene	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ammonia	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Arsenic	<0.1	<0.1	11.9%	<0.1	<0.1	9.6%
Bromine	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cadmium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Copper	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

Pollutant	Maximum Residential Receptor			Maximum Occupational Receptor		
	Cancer Risk	Chronic Hazard Index [a]	Acute Hazard Index [a]	Cancer Risk	Chronic Hazard Index [a]	Acute Hazard Index [a]
Lead	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Manganese	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Mercury	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Nickel	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sulfates	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Vanadium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Antimony	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Chlorine	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Hexavalent Chromium	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Phosphorus	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

[a] The chemical contributions for the chronic and acute hazard indices include all chemicals, regardless of the target organs they affect. As a result, the contributions may add to greater than 100% because not all chemicals affect the same target organ.

[b] For diesel internal combustion engines, only DPM emissions were evaluated for cancer risk and chronic hazard indices because DPM is a surrogate for the combined health effects associated with exposure to diesel exhaust emissions. For all other emission sources (external combustion boilers, alternative fuel engines, tire and brake wear), emissions of the 24 other toxic air contaminants were evaluated for cancer risk and chronic hazard indices. For the acute hazard indices, DPM was not evaluated; rather, emissions of the 24 other toxic air contaminants were evaluated for all emission sources (including diesel ICEs).

To illustrate the geographical extent of health risk impacts associated with the mitigated proposed Project, a series of health risk isopleths (contours) has been prepared. The isopleths show individual lifetime cancer risks over a map of the surrounding community, assuming residential exposure conditions (24 hours per day, 350 days per year, for 70 years) and an 80th percentile breathing rate.

The risk isopleths are as follows:

Figure D3.7-9	Mitigated Project Minus CEQA Baseline
Figure D3.7-10	Mitigated Project Minus NEPA Baseline

D3.7.3 Alternative 6 (No Project) Health Impacts

This alternative considers what would reasonably be expected to occur on the site if no LAHD or federal action would occur. LAHD would not issue any permits or discretionary approvals and would take no further action to construct or permit the construction of any portion of the proposed Project. The USACE would not issue any permits or discretionary approvals for dredge or fill actions, transport or ocean disposal of dredged material, or construction of wharves, and there would be no significance determinations under NEPA. This alternative would not allow implementation of the proposed Project or other physical improvements associated with the proposed Project. Under this alternative, no construction impacts would occur. No environmental controls beyond those imposed by local, state, and federal regulatory agencies would be implemented.

Table D3.7-7 presents a summary of the maximum health impacts that would occur for each receptor type with operation of the no-project alternative. The data in Table D3.7-7 show that the maximum CEQA cancer risk increment is predicted to be 27 in a million (27×10^{-6}), at a recreational receptor. The cancer risk would also exceed the significance threshold of 10 in a million for the residential and occupational receptors.

The maximum chronic and acute hazard index CEQA increments are predicted to be less than the significance thresholds for all receptors.

Figure D3.7-11 shows the maximum receptor locations for the no-project alternative. It should be noted that the residential, occupational, and recreational MEIs are not necessarily located directly on existing homes, workplaces, or recreational facilities; rather, they are located in areas that contain these land use types.

Table D3.7-7. Maximum Health Impacts Associated with Alternative 6

Health Impact	*Receptor Type*	*Maximum Predicted Impact*			*Significance Threshold*
		Alternative 6	*CEQA Baseline*	*CEQA Increment*	
Cancer Risk	Residential	396 x 10^{-6} (396 in a million)	379 x 10^{-6} (379 in a million)	**18 x 10^{-6} (18 in a million)**	10×10^{-6} 10 in a million
	Occupational	955 x 10^{-6} (955 in a million)	992 x 10^{-6} (992 in a million)	**18 x 10^{-6} (18 in a million)**	
	Recreational	1,465 x 10^{-6} (1,465 in a million)	1,522 x 10^{-6} (1,522 in a million)	**27 x 10^{-6} (27 in a million)**	
	Sensitive	127 x 10^{-6} (127 in a million)	120 x 10^{-6} (120 in a million)	7 x 10^{-6} (7 in a million)	

Health Impact	*Receptor Type*	*Maximum Predicted Impact*			*Significance Threshold*
		Alternative 6	*CEQA Baseline*	*CEQA Increment*	
	Student	8 x 10^{-6} (8 in a million)	8 x 10^{-6} (8 in a million)	<1 x 10^{-6} (<1 in a million)	
Chronic Hazard Index	Residential	0.31	0.81	<0.01	1.0
	Occupational	0.94	2.58	<0.01	
	Recreational	0.06	0.15	<0.01	
	Sensitive	0.05	0.09	<0.01	
	Student	0.94	2.58	<0.01	
Acute Hazard Index	Residential	0.66	1.67	0.23	1.0
	Occupational	0.85	2.19	0.36	
	Recreational	0.35	1.24	0.20	
	Sensitive	0.35	0.93	0.20	
	Student	0.85	2.19	0.36	

Notes:

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA increment only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the impact for Alternative 6.

The CEQA increment represents the Alternative 6 minus baseline.

Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values.

The cancer risk values reported in this table for the residential receptor are based on the 80th percentile breathing rate.

Figure D3.7-12 shows isopleths of individual lifetime cancer risk associated with the no-project alternative minus the CEQA baseline. The cancer risk isopleths were prepared assuming residential exposure conditions (24 hours per day, 350 days per year, for 70 years) and an 80^{th} percentile breathing rate.

D3.7.4 Health Impacts of Other Alternatives

Tables D3.7-8 through D3.7-17 present summaries of the maximum health impacts that would occur for each receptor type with construction and operation of Alternatives 1 through 5.

Table D3.7-8. Maximum Health Impacts Associated With Alternative 1 Without Mitigation, 2009–2078

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Proposed Project	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
Cancer Risk	Residential	360×10^{-6} (360 in a million)	379×10^{-6} (379 in a million)	**45×10^{-6} (45 in a million)**	139×10^{-6} (139 in a million)	**221×10^{-6} (221 in a million)**	10×10^{-6} (10 in a million)
	Occupational	477×10^{-6} (477 in a million)	992×10^{-6} (992 in a million)	**78×10^{-6} (78 in a million)**	171×10^{-6} (171 in a million)	**306×10^{-6} (306 in a million)**	
	Recreational	732×10^{-6} (732 in a million)	$1{,}522 \times 10^{-6}$ (1,522 in a million)	**120×10^{-6} (120 in a million)**	263×10^{-6} (263 in a million)	**469×10^{-6} (469 in a million)**	
	Sensitive	99×10^{-6} (99 in a million)	120×10^{-6} (120 in a million)	3×10^{-6} (3 in a million)	52×10^{-6} (52 in a million)	**60×10^{-6} (60 in a million)**	
	Student	6×10^{-6} (6 in a million)	8×10^{-6} (8 in a million)	0.2×10^{-6} (0.2 in a million)	2×10^{-6} (2 in a million)	4×10^{-6} (4 in a million)	
Chronic Hazard Index	Residential	0.53	0.69	0.09	0.44	0.11	1.0
	Occupational	1.17	1.72	0.24	1.04	0.43	
	Recreational	1.17	1.72	0.24	1.04	0.43	
	Sensitive	0.13	0.13	0.02	0.11	0.03	
	Student	0.13	0.11	0.02	0.10	0.03	
Acute Hazard Index	Residential	1.64	2.40	**1.42**	1.36	**1.26**	1.0
	Occupational	2.56	3.07	**2.51**	1.76	**1.46**	
	Recreational	2.56	3.07	**2.51**	1.76	**1.46**	
	Sensitive	0.86	0.51	0.73	0.44	0.68	
	Student	0.57	0.42	0.44	0.29	0.37	

Notes:

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA and NEPA increments only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact.

The CEQA increment represents the proposed Project minus the CEQA baseline. The NEPA increment represents the proposed Project minus the NEPA baseline.

Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values.

The cancer risk values reported in this table for the residential receptor are based on the 80th percentile breathing rate.

Health Impact	Receptor Type	Maximum Predicted Impact: Proposed Project	CEQA Baseline	CEQA Increment	NEPA Baseline	NEPA Increment	Significance Threshold
For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half were assumed to use the average residual fuel oil of 2.7% sulfur content							

Table D3.7-9. Maximum Health Impacts Associated With Alternative 1 With Mitigation, 2009–2078

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Proposed Project	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
Cancer Risk	Residential	115 x 10^{-6} (115 in a million)	379 x 10^{-6} (379 in a million)	<1 x 10^{-6} (0 in a million)	139 x 10^{-6} (139 in a million)	**19 x 10^{-6} (19 in a million)**	10 × 10^{-6} (10 in a million)
	Occupational	96 x 10^{-6} (96 in a million)	992 x 10^{-6} (992 in a million)	**21 x 10^{-6} (21 in a million)**	171 x 10^{-6} (171 in a million)	**30 x 10^{-6} (30 in a million)**	
	Recreational	147 x 10^{-6} (147 in a million)	1,522 x 10^{-6} (1,522 in a million)	**32 x 10^{-6} (32 in a million)**	263 x 10^{-6} (263 in a million)	**46 x 10^{-6} (46 in a million)**	
	Sensitive	48 x 10^{-6} (48 in a million)	120 x 10^{-6} (120 in a million)	<1 x 10^{-6} (0 in a million)	52 x 10^{-6} (52 in a million)	1 x 10^{-6} (1 in a million)	
	Student	2 x 10^{-6} (2 in a million)	8 x 10^{-6} (8 in a million)	<1 x 10^{-6} 0 in a million	2 x 10^{-6} 2 in a million	0.1 x 10^{-6} 0.1 in a million	
Chronic Hazard Index	Residential	0.44	0.69	0.04	0.44	0.02	1.0
	Occupational	1.04	1.72	0.17	1.04	0.06	
	Recreational	1.04	1.72	0.17	1.04	0.06	
	Sensitive	0.11	0.13	0.00	0.11	0.00	
	Student	0.10	0.11	0.00	0.10	0.00	
Acute Hazard Index	Residential	1.36	2.40	**1.10**	1.36	0.94	1.0
	Occupational	1.79	3.07	**1.74**	1.76	**1.07**	
	Recreational	1.79	3.07	**1.74**	1.76	**1.07**	
	Sensitive	0.73	0.51	0.60	0.44	0.55	
	Student	0.44	0.42	0.31	0.29	0.24	
Notes:							

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Proposed Project	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA and NEPA increments only. The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact. The CEQA increment represents the proposed Project minus the CEQA baseline. The NEPA increment represents the proposed Project minus the NEPA baseline. Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values. The cancer risk values reported in this table for the residential receptor are based on the 80th percentile breathing rate. For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half were assumed to use the average residual fuel oil of 2.7% sulfur content							

Table D3.7-10. Maximum Health Impacts Associated with Alternative 2 without Mitigation, 2009–2078

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Alternative 2	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
Cancer Risk	Residential	340 x 10^{-6} (340 in a million)	379 x 10^{-6} (379 in a million)	**112 x 10^{-6} (112 in a million)**	139 x 10^{-6} (139 in a million)	**202 x 10^{-6} (202 in a million)**	10 × 10^{-6} (10 in a million)
	Occupational	387 x 10^{-6} (387 in a million)	992 x 10^{-6} (992 in a million)	**176 x 10^{-6} (176 in a million)**	171 x 10^{-6} (171 in a million)	**251 x 10^{-6} (251 in a million)**	
	Recreational	594 x 10^{-6} (594 in a million)	1,522 x 10^{-6} (1,522 in a million)	**270 x 10^{-6} (270 in a million)**	263 x 10^{-6} (263 in a million)	**384 x 10^{-6} (384 in a million)**	
	Sensitive	97 x 10^{-6} (97 in a million)	120 x 10^{-6} (120 in a million)	**12 x 10^{-6} (12 in a million)**	52 x 10^{-6} (52 in a million)	**58 x 10^{-6} (58 in a million)**	
	Student	6 x 10^{-6} (6 in a million)	8 x 10^{-6} (8 in a million)	1 x 10^{-6} (1 in a million)	2 x 10^{-6} (2 in a million)	4 x 10^{-6} (4 in a million)	
Chronic Hazard Index	Residential	0.53	0.69	0.09	0.44	0.12	1.0
	Occupational	1.16	1.72	0.37	1.04	0.42	
	Recreational	1.16	1.72	0.37	1.04	0.42	
	Sensitive	0.13	0.13	0.02	0.11	0.03	

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Alternative 2	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
	Student	0.13	0.11	0.02	0.10	0.03	
Acute Hazard Index	Residential	1.64	2.40	**1.42**	1.36	**1.26**	1.0
	Occupational	2.56	3.07	**2.51**	1.76	**1.46**	
	Recreational	2.56	3.07	**2.51**	1.76	**1.46**	
	Sensitive	0.86	0.51	0.73	0.44	0.68	
	Student	0.54	0.42	0.41	0.29	0.34	

Notes:

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA and NEPA increments only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact.

The CEQA increment represents Alternative 2 minus the CEQA baseline. The NEPA increment represents Alternative 2 minus the NEPA baseline.

Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values.

The cancer risk values reported in this table for the residential receptor are based on the 80th percentile breathing rate.

For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half were assumed to use the average residual fuel oil of 2.7% sulfur content

Table D3.7-11. Maximum Health Impacts Associated with Alternative 2 with Mitigation, 2009–2078

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Alternative 2	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
Cancer Risk	Residential	111×10^{-6} (111 in a million)	379×10^{-6} (379 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	139×10^{-6} (139 in a million)	**15×10^{-6} (15 in a million)**	10×10^{-6} (10 in a million)
	Occupational	86×10^{-6} (86 in a million)	992×10^{-6} (992 in a million)	**16×10^{-6} (16 in a million)**	171×10^{-6} (171 in a million)	**25×10^{-6} (25 in a million)**	
	Recreational	131×10^{-6} (131 in a million)	$1,522 \times 10^{-6}$ (1,522 in a million)	**25×10^{-6} (25 in a million)**	263×10^{-6} (263 in a million)	**38×10^{-6} (38 in a million)**	
	Sensitive	47×10^{-6} (47 in a million)	120×10^{-6} (120 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	52×10^{-6} (52 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	

Health Impact	Receptor Type	Maximum Predicted Impact: Alternative 2	CEQA Baseline	CEQA Increment	NEPA Baseline	NEPA Increment	Significance Threshold
	Student	2 x 10^{-6} (2 in a million)	8 x 10^{-6} (8 in a million)	<1 x 10^{-6} (<1 in a million)	2 x 10^{-6} (2 in a million)	<1 x 10^{-6} (<1 in a million)	
Chronic Hazard Index	Residential	0.44	0.69	0.04	0.44	0.05	1.0
	Occupational	1.04	1.72	0.19	1.04	0.12	
	Recreational	1.04	1.72	0.19	1.04	0.12	
	Sensitive	0.11	0.13	0.00	0.11	0.00	
	Student	0.10	0.11	0.00	0.10	0.00	
Acute Hazard Index	Residential	1.48	2.40	**1.10**	1.36	0.94	1.0
	Occupational	1.88	3.07	**1.74**	1.76	**1.07**	
	Recreational	1.88	3.07	**1.74**	1.76	**1.07**	
	Sensitive	0.73	0.51	0.60	0.44	0.55	
	Student	0.42	0.42	0.29	0.29	0.23	

Notes:

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA and NEPA increments only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact.

The CEQA increment represents Alternative 2 minus the CEQA baseline. The NEPA increment represents Alternative 2 minus the NEPA baseline.

Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values.

The cancer risk values reported in this table for the residential receptor are based on the 80^{th} percentile breathing rate.

For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half were assumed to use the average residual fuel oil of 2.7% sulfur content

Table D3.7-12. Maximum Health Impacts Associated with Alternative 3 without Mitigation, 2009–2078

Health Impact	Receptor Type	Maximum Predicted Impact: Alternative 3	CEQA Baseline	CEQA Increment	NEPA Baseline	NEPA Increment	Significance Threshold
Cancer Risk	Residential	357 x 10^{-6} (357 in a million)	379 x 10^{-6} (379 in a million)	**45 x 10^{-6} (45 in a million)**	139 x 10^{-6} (139 in a million)	**219 x 10^{-6} (219 in a million)**	10 × 10^{-6} (10 in a million)
	Occupational	477 x 10^{-6} (477 in a million)	992 x 10^{-6} (992 in a million)	**78 x 10^{-6} (78 in a million)**	171 x 10^{-6} (171 in a million)	**305 x 10^{-6} (305 in a million)**	

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Alternative 3	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
	Recreational	731 x 10^{-6} (731 in a million)	1,522 x 10^{-6} (1,522 in a million)	119 x 10^{-6} (119 in a million)	263 x 10^{-6} (263 in a million)	**468 x 10^{-6} (468 in a million)**	
	Sensitive	99 x 10^{-6} (99 in a million)	120 x 10^{-6} (120 in a million)	3 x 10^{-6} (3 in a million)	52 x 10^{-6} (52 in a million)	**60 x 10^{-6} (60 in a million)**	
	Student	6 x 10^{-6} (6 in a million)	8 x 10^{-6} (8 in a million)	0.2 x 10^{-6} (0.2 in a million)	2 x 10^{-6} (2 in a million)	4 x 10^{-6} (4 in a million)	
Chronic Hazard Index	Residential	0.53	0.69	0.08	0.44	0.10	1.0
	Occupational	1.16	1.72	0.21	1.04	0.42	
	Recreational	1.16	1.72	0.21	1.04	0.42	
	Sensitive	0.13	0.13	0.02	0.11	0.03	
	Student	0.13	0.11	0.02	0.10	0.03	
Acute Hazard Index	Residential	1.58	2.40	**1.37**	1.36	**1.21**	1.0
	Occupational	2.56	3.07	**2.51**	1.76	**1.46**	
	Recreational	2.56	3.07	**2.51**	1.76	**1.46**	
	Sensitive	0.86	0.51	0.73	0.44	0.68	
	Student	0.52	0.42	0.39	0.29	0.32	

Notes:

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA and NEPA increments only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact.

The CEQA increment represents Alternative 3 minus the CEQA baseline. The NEPA increment represents Alternative 3 minus the NEPA baseline.

Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values.

The cancer risk values reported in this table for the residential receptor are based on the 80th percentile breathing rate.

For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half were assumed to use the average residual fuel oil of 2.7% sulfur content

Table D3.7-13. Maximum Health Impacts Associated with Alternative 3 with Mitigation, 2009–2078

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Alternative 3	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
Cancer Risk	Residential	112 x 10^{-6} (112 in a million)	379 x 10^{-6} (379 in a million)	<1 x 10^{-6} (0 in a million)	139 x 10^{-6} (139 in a million)	**19 x 10^{-6} (19 in a million)**	10 × 10^{-6} (10 in a million)
	Occupational	95 x 10^{-6} (95 in a million)	992 x 10^{-6} (992 in a million)	**21 x 10^{-6} (21 in a million)**	171 x 10^{-6} (171 in a million)	**29 x 10^{-6} (29 in a million)**	
	Recreational	146 x 10^{-6} (146 in a million)	1,522 x 10^{-6} (1,522 in a million)	**32 x 10^{-6} (32 in a million)**	263 x 10^{-6} (263 in a million)	**45 x 10^{-6} (45 in a million)**	
	Sensitive	48 x 10^{-6} (48 in a million)	120 x 10^{-6} (120 in a million)	<1 x 10^{-6} (<1 in a million)	52 x 10^{-6} (52 in a million)	1 x 10^{-6} (1 in a million)	
	Student	2 x 10^{-6} (2 in a million)	8 x 10^{-6} (8 in a million)	<1 x 10^{-6} (<1 in a million)	2 x 10^{-6} (2 in a million)	<1 x 10^{-6} (<1 in a million)	
Chronic Hazard Index	Residential	0.44	0.69	0.01	0.44	0.02	1.0
	Occupational	1.04	1.72	0.15	1.04	0.06	
	Recreational	1.04	1.72	0.15	1.04	0.06	
	Sensitive	0.11	0.13	0.00	0.11	0.00	
	Student	0.10	0.11	0.00	0.10	0.00	
Acute Hazard Index	Residential	1.36	2.40	**1.07**	1.36	0.91	1.0
	Occupational	1.79	3.07	**1.74**	1.76	**1.05**	
	Recreational	1.79	3.07	**1.74**	1.76	**1.05**	
	Sensitive	0.73	0.51	0.60	0.44	0.55	
	Student	0.41	0.42	0.28	0.29	0.22	

Notes:

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA and NEPA increments only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact.

The CEQA increment represents Alternative 3 minus the CEQA baseline. The NEPA increment represents Alternative 3 minus the NEPA baseline.

Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values.

The cancer risk values reported in this table for the residential receptor are based on the 80th percentile breathing rate.

For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half

Health Impact	Receptor Type	Maximum Predicted Impact					Significance Threshold
		Alternative 3	CEQA Baseline	CEQA Increment	NEPA Baseline	NEPA Increment	
were assumed to use the average residual fuel oil of 2.7% sulfur content							

Table D3.7-14. Maximum Health Impacts Associated with Alternative 4 without Mitigation, 2009–2078

Health Impact	Receptor Type	Maximum Predicted Impact					Significance Threshold
		Alternative 4	CEQA Baseline	CEQA Increment	NEPA Baseline	NEPA Increment	
Cancer Risk	Residential	500 x 10^{-6} (500 in a million	379 x 10^{-6} (379 in a million)	**140 x 10^{-6} (140 in a million)**	139 x 10^{-6} (139 in a million)	**362 x 10^{-6} (362 in a million)**	10 × 10^{-6} (10 in a million)
	Occupational	925 x 10^{-6} (925 in a million	992 x 10^{-6} (992 in a million)	**82 x 10^{-6} (82 in a million)**	171 x 10^{-6} (171 in a million)	**754 x 10^{-6} (754 in a million)**	
	Recreational	1,419 x 10^{-6} (1,419 in a million	1,522 x 10^{-6} (1,522 in a million)	**126 x 10^{-6} (126 in a million)**	263 x 10^{-6} (263 in a million)	**1,156 x 10^{-6} (1,156 in a million)**	
	Sensitive	144 x 10^{-6} (144 in a million	120 x 10^{-6} (120 in a million)	**23 x 10^{-6} (23 in a million)**	52 x 10^{-6} (52 in a million)	**105 x 10^{-6} (105 in a million)**	
	Student	9 x 10^{-6} (9 in a million	8 x 10^{-6} (8 in a million)	1 x 10^{-6} (1 in a million)	2 x 10^{-6} (2 in a million)	7 x 10^{-6} (7 in a million)	
Chronic Hazard Index	Residential	0.53	0.69	0.09	0.44	0.21	1.0
	Occupational	1.17	1.72	0.15	1.04	0.91	
	Recreational	1.17	1.72	0.15	1.04	0.91	
	Sensitive	0.13	0.13	0.02	0.11	0.06	
	Student	0.13	0.11	0.02	0.10	0.06	
Acute Hazard Index	Residential	1.64	2.40	**1.42**	1.36	**1.26**	1.0
	Occupational	2.56	3.07	**2.51**	1.76	**1.46**	
	Recreational	2.56	3.07	**2.51**	1.76	**1.46**	
	Sensitive	0.86	0.51	0.73	0.44	0.68	
	Student	0.53	0.42	0.40	0.29	0.33	

Notes:

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA and NEPA increments only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact.

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Alternative 4	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
The CEQA increment represents Alternative 3 minus the CEQA baseline. The NEPA increment represents Alternative 3 minus the NEPA baseline. Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values. The cancer risk values reported in this table for the residential receptor are based on the 80th percentile breathing rate. For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half were assumed to use the average residual fuel oil of 2.7% sulfur content							

Table D3.7-15. Maximum Health Impacts Associated with Alternative 4 with Mitigation, 2009–2078

Health Impact	*Receptor Type*	*Maximum Predicted Impact*					*Significance Threshold*
		Alternative 4	*CEQA Baseline*	*CEQA Increment*	*NEPA Baseline*	*NEPA Increment*	
Cancer Risk	Residential	139×10^{-6} (139 in a million)	379×10^{-6} (379 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	139×10^{-6} (139 in a million)	3×10^{-6} (3 in a million)	10×10^{-6} (10 in a million)
	Occupational	172×10^{-6} (172 in a million)	992×10^{-6} (992 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	171×10^{-6} (171 in a million)	2×10^{-6} (2 in a million)	
	Recreational	263×10^{-6} (263 in a million)	$1,522 \times 10^{-6}$ (1,522 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	263×10^{-6} (263 in a million)	3×10^{-6} (3 in a million)	
	Sensitive	53×10^{-6} (53 in a million)	120×10^{-6} (120 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	52×10^{-6} (52 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	
	Student	2×10^{-6} (2 in a million)	8×10^{-6} (8 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	2×10^{-6} (2 in a million)	$<1 \times 10^{-6}$ (<1 in a million)	
Chronic Hazard Index	Residential	0.44	0.69	0.04	0.44	0.01	1.0
	Occupational	1.04	1.72	0.13	1.04	0.05	
	Recreational	1.04	1.72	0.13	1.04	0.05	
	Sensitive	0.11	0.13	0.00	0.11	0.00	
	Student	0.10	0.11	0.00	0.10	0.00	
Acute Hazard Index	Residential	1.36	2.40	**1.10**	1.36	0.94	1.0
	Occupational	1.79	3.07	**1.74**	1.76	**1.04**	
	Recreational	1.79	3.07	**1.74**	1.76	**1.04**	
	Sensitive	0.73	0.51	0.60	0.44	0.55	

Health Impact	Receptor Type	Maximum Predicted Impact					Significance Threshold
		Alternative 4	CEQA Baseline	CEQA Increment	NEPA Baseline	NEPA Increment	
	Student	0.41	0.42	0.28	0.29	0.22	

Notes:

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA and NEPA increments only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact.

The CEQA increment represents Alternative 3 minus the CEQA baseline. The NEPA increment represents Alternative 3 minus the NEPA baseline.

Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values.

The cancer risk values reported in this table for the residential receptor are based on the 80th percentile breathing rate.

For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half were assumed to use the average residual fuel oil of 2.7% sulfur content

Table D3.7-16. Maximum Health Impacts Associated with Alternative 5 without Mitigation, 2009–2078

Health Impact	*Receptor Type*	*Maximum Predicted Impact*			*Significance Threshold*
		Alternative 5	*CEQA Baseline*	*CEQA Increment*	
Cancer Risk	Residential	500×10^{-6} (500 in a million)	379×10^{-6} (379 in a million)	**139×10^{-6} (139 in a million)**	10×10^{-6} 10 in a million
	Occupational	925×10^{-6} (925 in a million)	992×10^{-6} (992 in a million)	**82×10^{-6} (82 in a million)**	
	Recreational	$1{,}419 \times 10^{-6}$ (1,419 in a million)	1522×10^{-6} (1522 in a million)	**126×10^{-6} (126 in a million)**	
	Sensitive	144×10^{-6} (144 in a million)	120×10^{-6} (120 in a million)	**23×10^{-6} (23 in a million)**	
	Student	9×10^{-6} (9 in a million)	8×10^{-6} (8 in a million)	1×10^{-6} (1 in a million)	
Chronic Hazard Index	Residential	0.53	0.69	0.08	1.0
	Occupational	1.17	1.72	0.14	
	Recreational	1.17	1.72	0.14	
	Sensitive	0.13	0.13	0.02	
	Student	0.13	0.11	0.02	
Acute Hazard	Residential	1.36	2.40	0.59	1.0
	Occupational	1.87	3.07	**1.81**	

Health Impact	*Receptor Type*	*Maximum Predicted Impact*			*Significance Threshold*
		Alternative 5	*CEQA Baseline*	*CEQA Increment*	
Index	Recreational	1.87	3.07	**1.81**	
	Sensitive	0.44	0.51	0.28	
	Student	0.29	0.42	0.15	

Notes:

Alternative 5 is the No Federal Action alternative, and therefore is not assessed for NEPA impacts.

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA increment only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact.

The CEQA increment represents Alternative 5 minus the CEQA baseline.

Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values.

The cancer risk values reported in this table for the residential receptor are based on the 80^{th} percentile breathing rate.

For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half were assumed to use the average residual fuel oil of 2.7% sulfur content

Table D3.7-17. Maximum Health Impacts Associated with Alternative 5 with Mitigation, 2009–2078

Health Impact	*Receptor Type*	*Maximum Predicted Impact*			*Significance Threshold*
		Alternative 5	*CEQA Baseline*	*CEQA Increment*	
Cancer Risk	Residential	139 x 10^{-6} (139 in a million)	379 x 10^{-6} (379 in a million)	<1 x 10^{-6} (<1 in a million)	10 × 10^{-6} (10 in a million)
	Occupational	171 x 10^{-6} (171 in a million)	992 x 10^{-6} (992 in a million)	<1 x 10^{-6} (<1 in a million)	
	Recreational	263 x 10^{-6} (263 in a million)	1,522 x 10^{-6} (1,522 in a million)	<1 x 10^{-6} (<1 in a million)	
	Sensitive	52 x 10^{-6} (52 in a million)	120 x 10^{-6} (120 in a million)	<1 x 10^{-6} (<1 in a million)	
	Student	2 x 10^{-6} (2 in a million)	8 x 10^{-6} (8 in a million)	<1 x 10^{-6} (<1 in a million)	
Chronic Hazard Index	Residential	0.44	0.69	0.03	1.0
	Occupational	1.04	1.72	0.13	
	Recreational	1.04	1.72	0.13	
	Sensitive	0.11	0.13	0.00	
	Student	0.10	0.11	0.00	
Acute	Residential	1.36	2.40	0.38	1.0

Health Impact	*Receptor Type*	*Maximum Predicted Impact*			*Significance Threshold*
		Alternative 5	*CEQA Baseline*	*CEQA Increment*	
Hazard Index	Occupational	1.76	3.07	**1.14**	
	Recreational	1.76	3.07	**1.14**	
	Sensitive	0.44	0.51	0.16	
	Student	0.29	0.42	0.09	

Notes:

Alternative 5 is the No Federal Action alternative, and therefore is not assessed for NEPA impacts.

Exceedances of the significance criteria are in bold. The significance thresholds apply to the CEQA increment only.

The maximum increments might not necessarily occur at the same receptor locations as the maximum impacts. This means that the increments cannot necessarily be determined by simply subtracting the baseline impacts from the proposed project impact.

The CEQA increment represents Alternative 5 minus the CEQA baseline.

Data represent the receptor locations with the maximum impacts or increments. The impacts or increments at all other receptors would be less than these values.

The cancer risk values reported in this table for the residential receptor are based on the 80th percentile breathing rate.

For the acute hazard index, half the ships were assumed to use residual fuel oil with a 4.5% sulfur content and the other half were assumed to use the average residual fuel oil of 2.7% sulfur content

E3.8 Risk Uncertainty

By their nature, risk estimates cannot be completely accurate because they are predictions of risk. Scientists, medical experts, regulators, and practitioners do not completely understand how toxic air pollutants harm human cells or how different pollutants might interact with each other in the human body. The exposure assessment often relies on computer models that are based on a multitude of assumptions, both in terms of present and future conditions.

When information is missing or uncertain, risk analysts generally make assumptions that tend to prevent them from underestimating the potential risk. These assumptions provide a margin of safety in the protection of human health. Again, to protect public health, these assumptions are very conservative. For example, most people do not stay in one place for 24 hours a day, 350 days a year for 70 years.

Additionally, no single universal way exists of doing health risk assessments, leading to possible problems in comparing different risks. Assumptions also change over time, and even HRAs completed using the same models can produce different results.

OEHHA has provided a discussion of risk uncertainty, which is reiterated here (OEHHA 2003).

There is a great deal of uncertainty associated with the process of risk assessment. The uncertainty arises from lack of data in many areas necessitating the use of assumptions. The assumptions used in these guidelines are designed to err on the side of health protection in order to avoid underestimation of risk to the public. Sources of uncertainty, which may either overestimate or underestimate risk, include: 1) extrapolation of toxicity data in animals to humans, 2) uncertainty in the estimation of emissions, 3) uncertainty in the air dispersion models, and 4) uncertainty in the exposure estimates. Uncertainty may be defined as what is not known and may be reduced with further scientific studies. In addition to uncertainty, there is a natural range or variability in the human population in such properties as height, weight, and susceptibility to chemical toxicants. Scientific studies with representative individuals and large enough sample size can characterize this variability.

Interactive effects of exposure to more than one carcinogen or toxicant are also not necessarily quantified in the HRA. Cancer risks from all emitted carcinogens are typically added, and hazard quotients for substances impacting the same target organ system are added to determine the hazard index (HI). Many examples of additivity and synergism (interactive effects greater than additive) are known. For substances that act synergistically, the HRA could underestimate the risks. Some substances may have antagonistic effects (lessen the toxic effects produced by another substance). For substances that act antagonistically, the HRA could overestimate the risks.

Other sources of uncertainty, which may underestimate or overestimate risk, can be found in exposure estimates where little or no data are available (e.g., soil half-life and dermal penetration of some substances from a soil matrix).

The differences among species and within human populations usually cannot be easily quantified and incorporated into risk assessments. Factors including metabolism, target site sensitivity, diet, immunological responses, and genetics may influence the response to toxicants. The human population is much more diverse both genetically and culturally (e.g., lifestyle, diet) than inbred experimental animals. The intraspecies variability among humans is expected to be much greater than in laboratory animals. Adjustment for tumors at multiple sites induced by some carcinogens could result in a higher potency. Other uncertainties arise 1) in the assumptions underlying the dose-response model used, and 2) in extrapolating from large experimental doses, where, for example, other toxic effects may compromise the assessment of carcinogenic potential, to usually much smaller environmental doses. Also, only single tumor sites induced by a substance are usually considered. When epidemiological data are used to generate a carcinogenic potency, less uncertainty is involved in the extrapolation from workplace exposures to environmental exposures. However, children, a subpopulation whose hematological, nervous, endocrine, and immune systems, for example, are still developing and who may be more sensitive to the effects of carcinogens on their developing systems, are not included in the worker population and risk estimates based on occupational epidemiological data are more uncertain for children than adults. Finally, the quantification of each uncertainty applied in the estimate of cancer potency is itself uncertain.

Thus, risk estimates generated by an HRA should not be interpreted as the expected rates of disease in the exposed population but rather as estimates of potential risk, based on current knowledge and a number of assumptions. Additionally, the uncertainty factors integrated within the estimates of noncancer RELs are meant to err on the side of public health protection in order to avoid underestimation of risk. Risk assessment is best used as a ruler to compare one source with another and to prioritize concerns. Consistent approaches to risk assessment are necessary to fulfill this function.

E3.9 References

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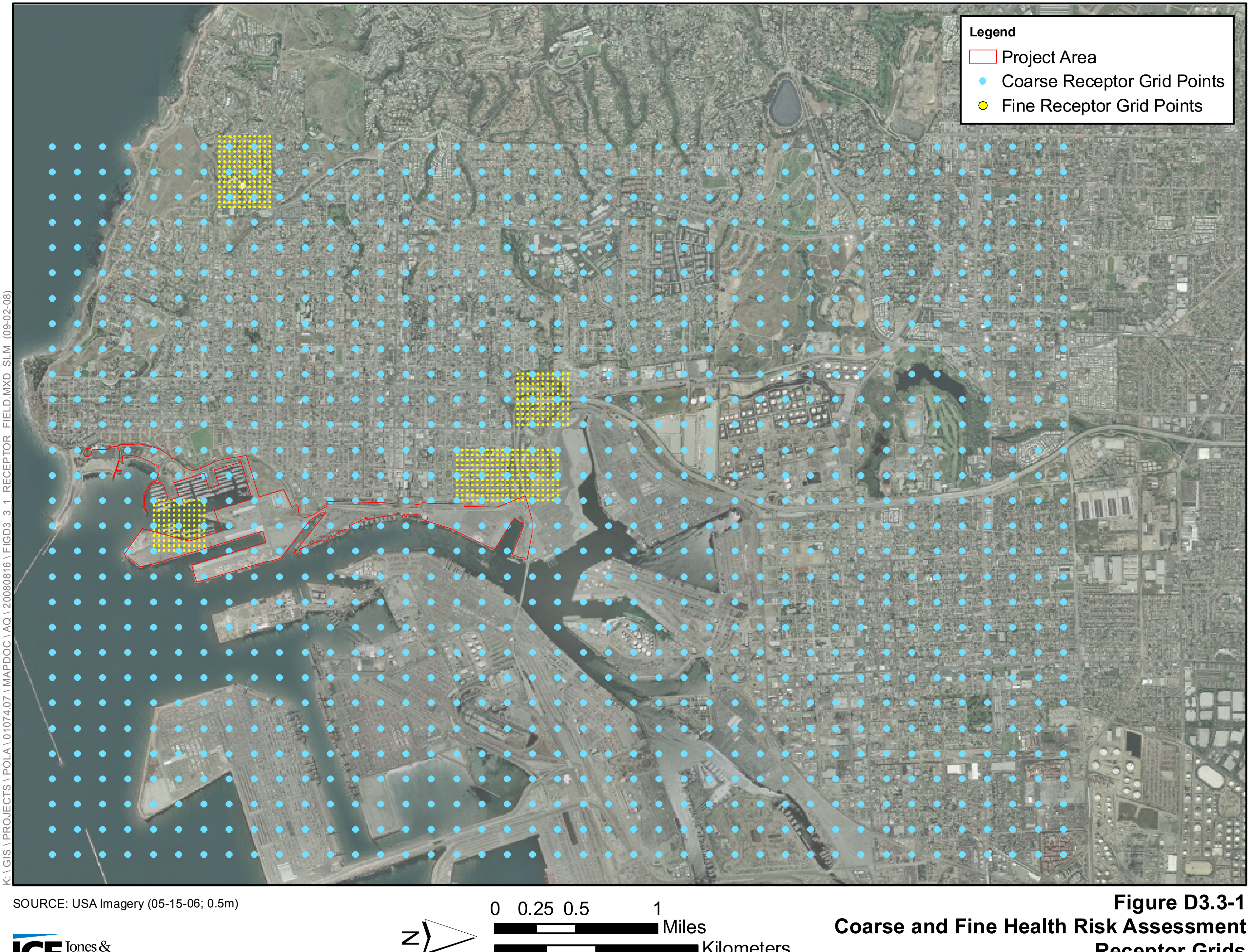
FIGURES



SOURCE: USA Imagery (05-15-06; 0.5m)

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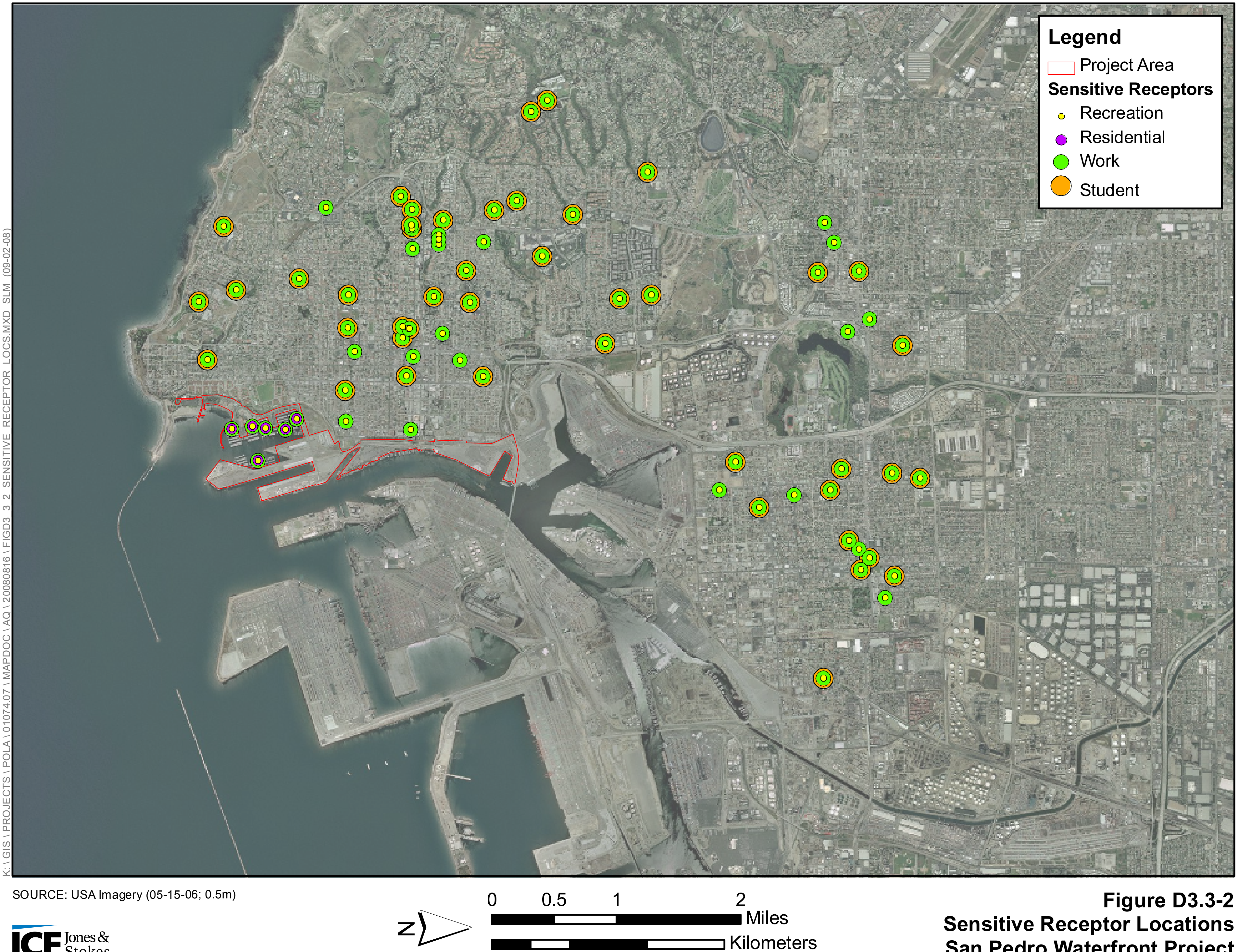
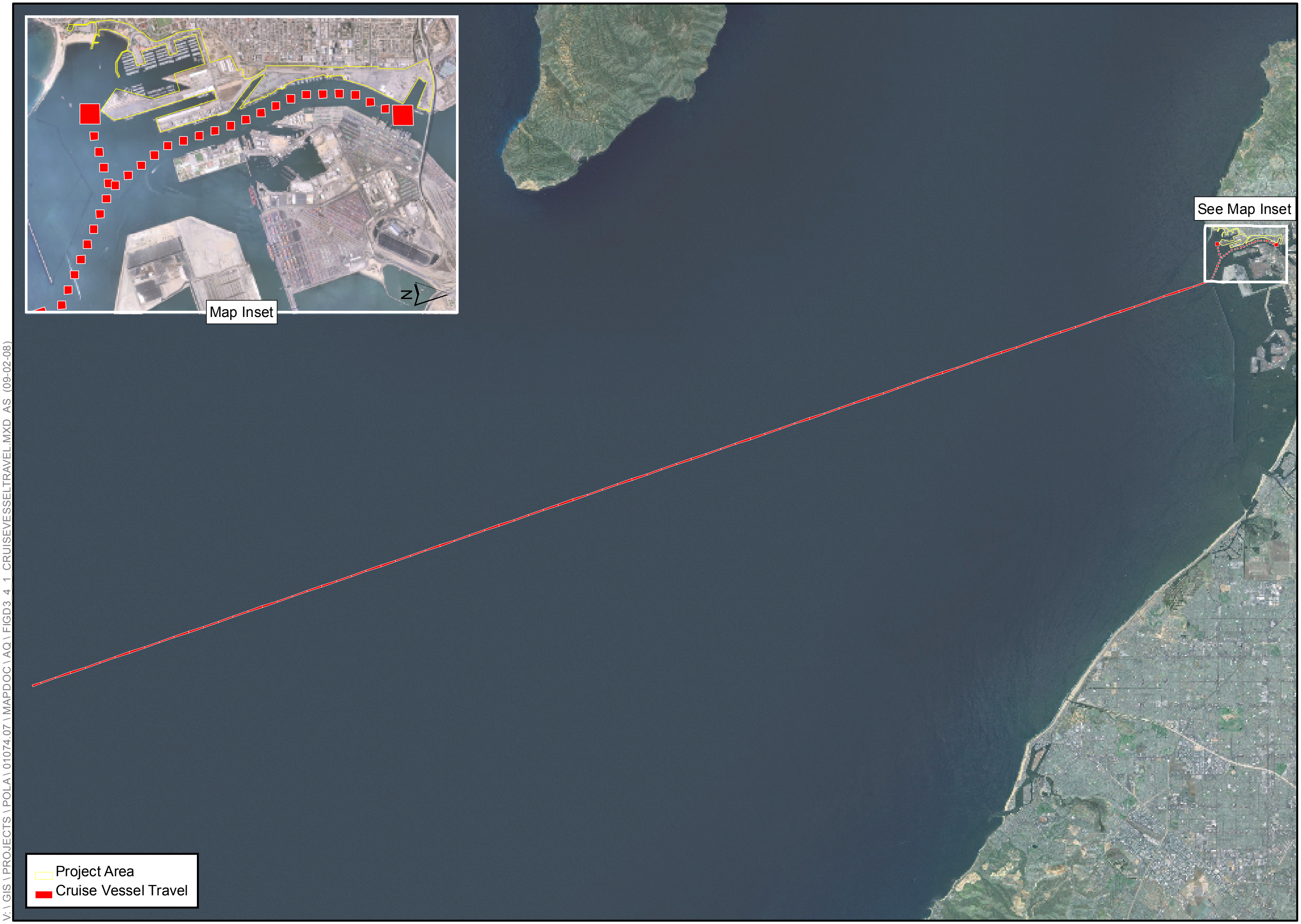
Figure D3.3-1
Coarse and Fine Health Risk Assessment Receptor Grids
San Pedro Waterfront Project



SOURCE: USA Imagery (05-15-06; 0.5m)

Figure D3.3-2
Sensitive Receptor Locations
San Pedro Waterfront Project



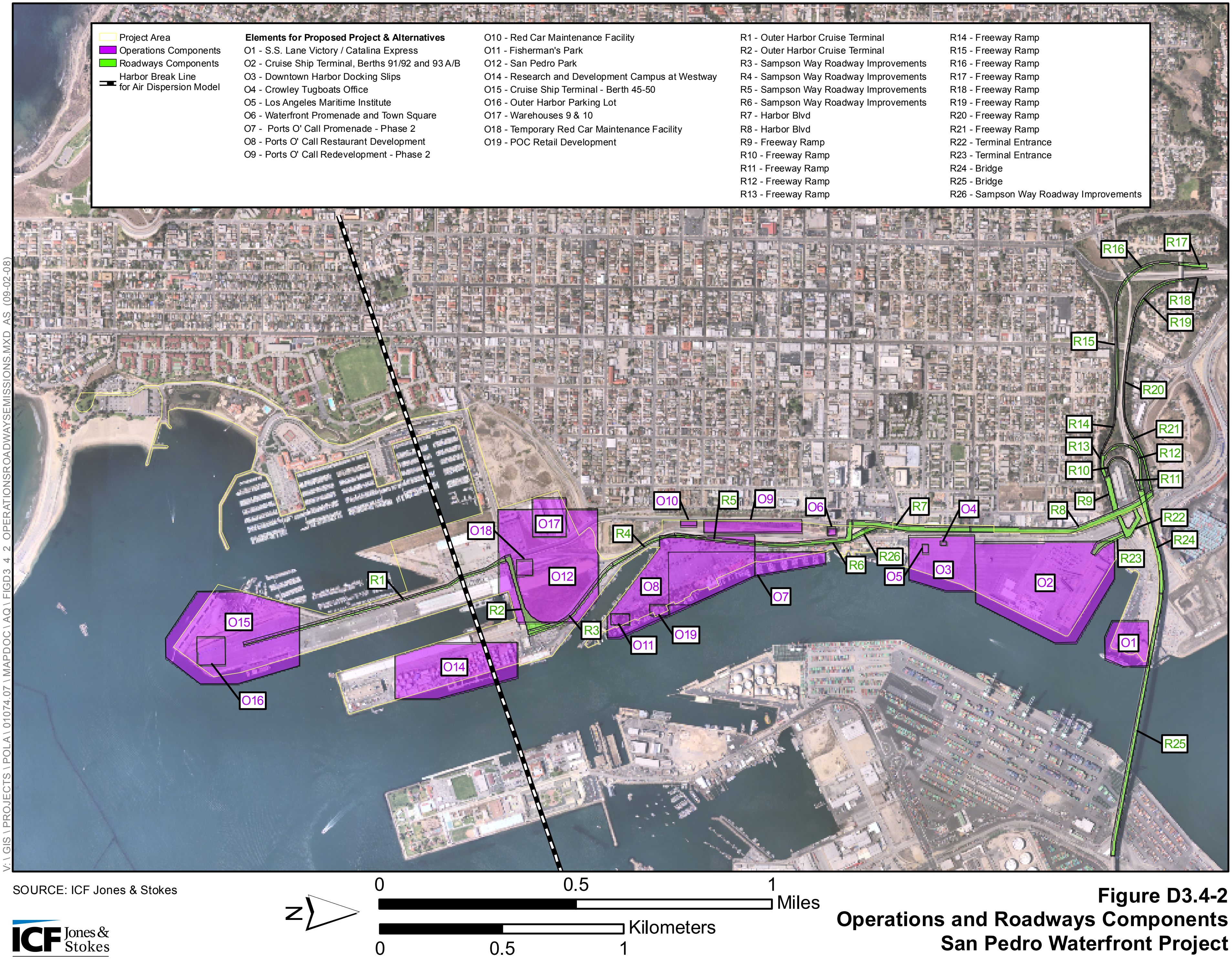
SOURCE: ICF Jones & Stokes

N

0 5 10 Miles

0 5 10 Kilometers

Figure D3.4-1
Cruise Vessel Travel
San Pedro Waterfront Project



SOURCE: ICF Jones & Stokes

Figure D3.4-2
Operations and Roadways Components
San Pedro Waterfront Project

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SOURCE: USA Imagery (02-15-07; 0.3m)

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Figure D3.7-1
Maximum Concentration Locations Associated with CEQA Baseline Conditions
San Pedro Waterfront Project

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SOURCE: USA Imagery (02-15-07; 0.3m)

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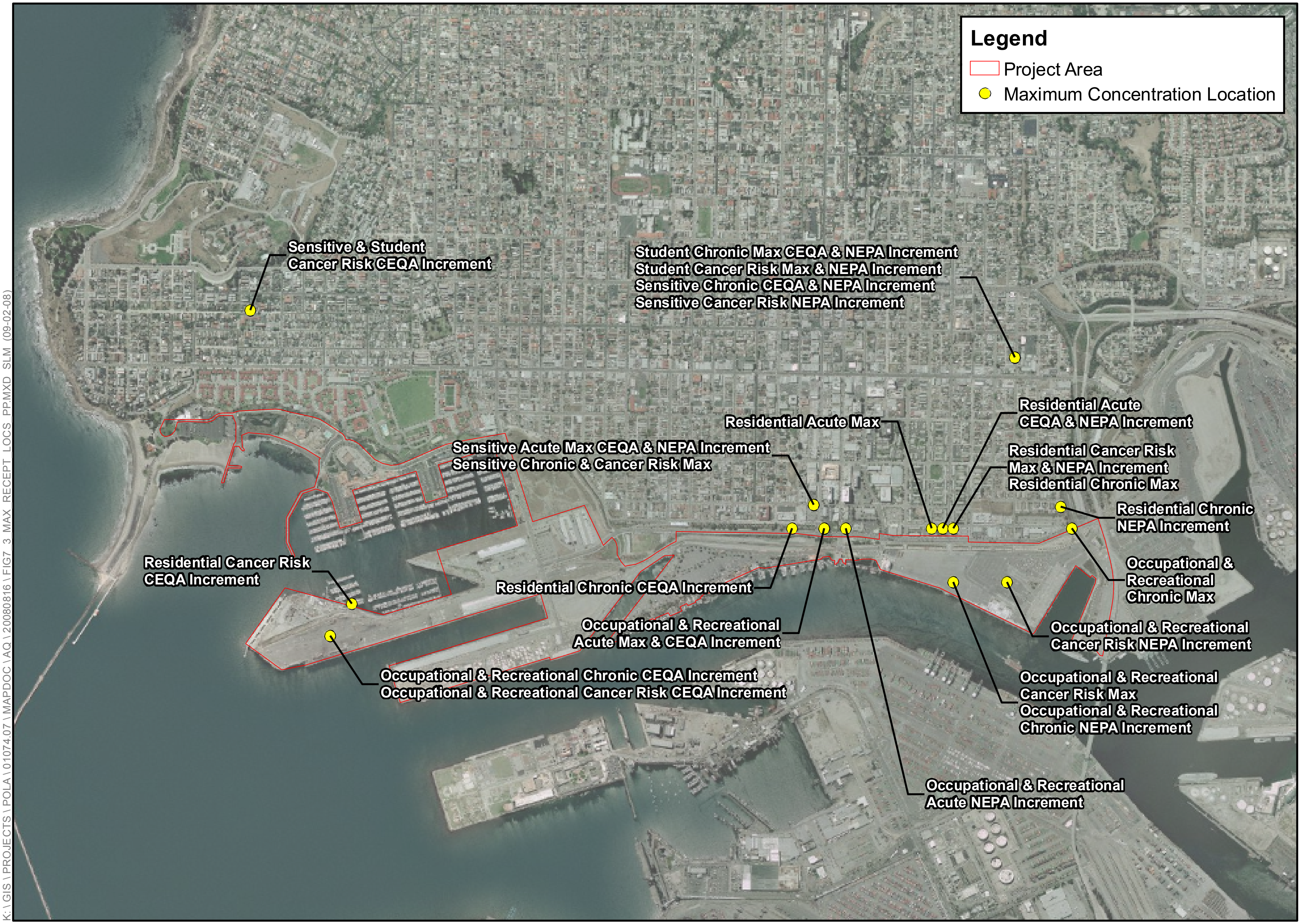
Figure D3.7-2
Maximum Concentration Locations Associated with NEPA Baseline Conditions
San Pedro Waterfront Project



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SOURCE: USA Imagery (02-15-07; 0.3m)

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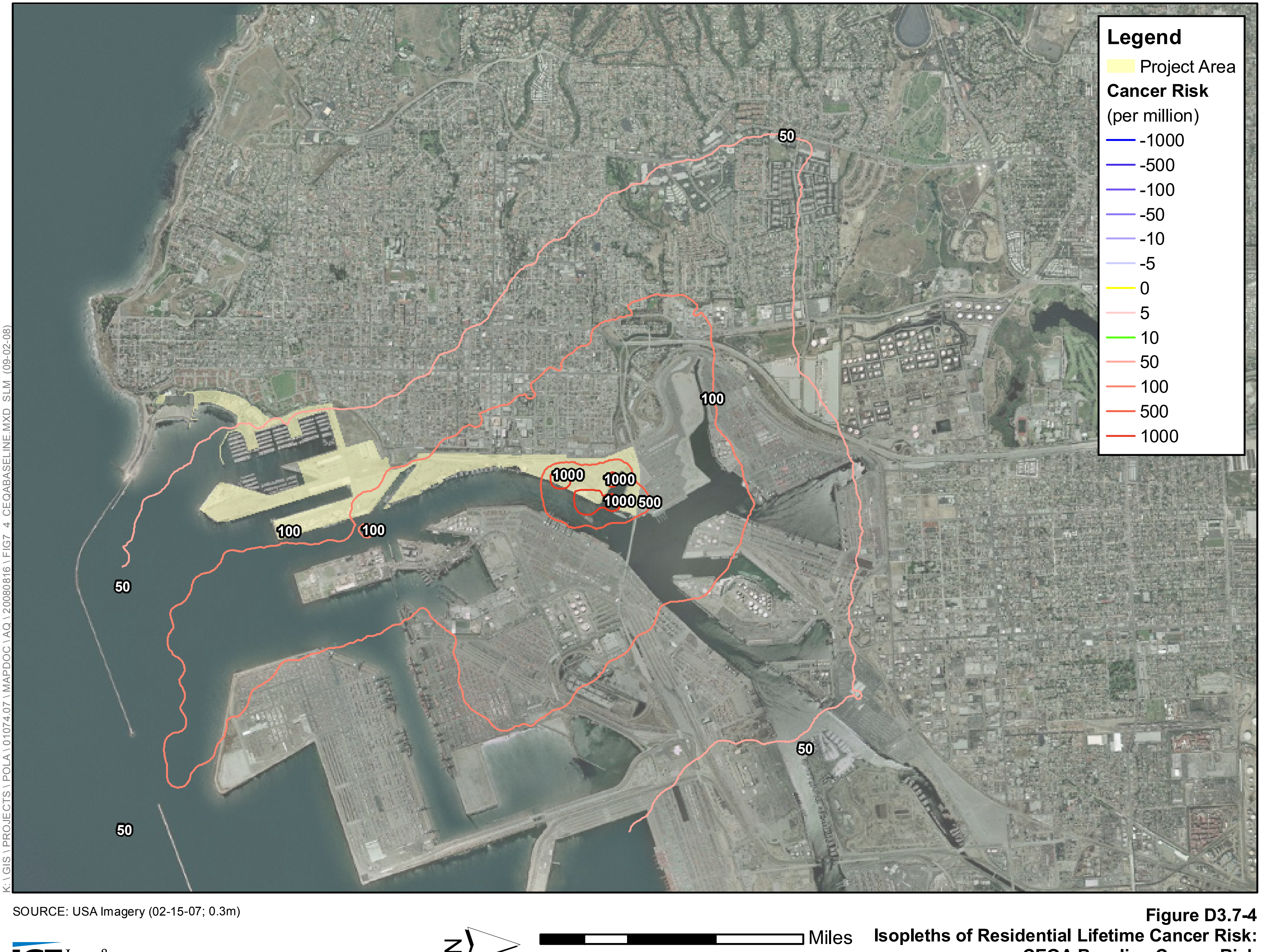
Figure D3.7-3
Maximum Concentration Locations Associated with Proposed Project
San Pedro Waterfront Project



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SOURCE: USA Imagery (02-15-07; 0.3m)

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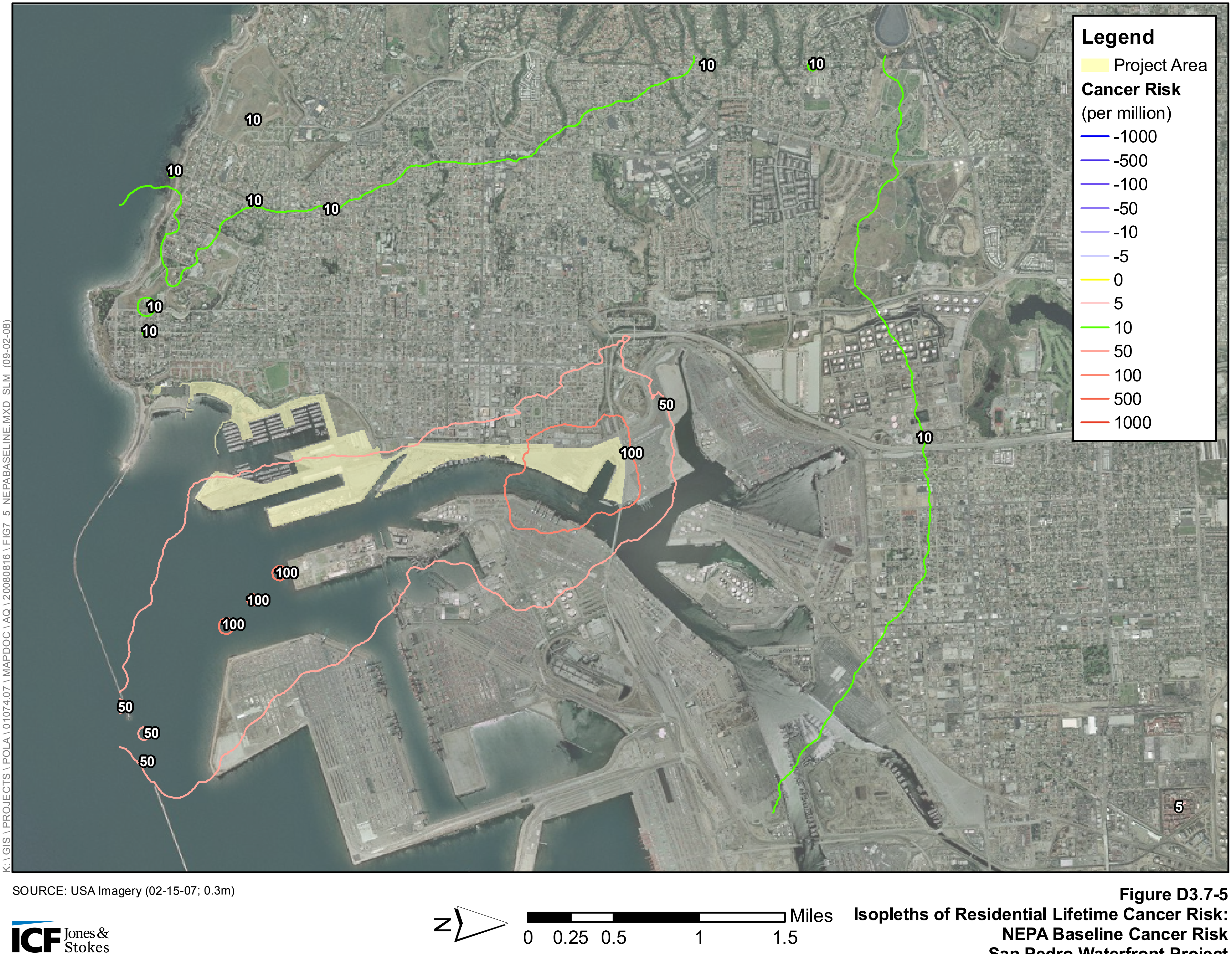
Figure D3.7-4
Isopleths of Residential Lifetime Cancer Risk: CEQA Baseline Cancer Risk
San Pedro Waterfront Project



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SOURCE: USA Imagery (02-15-07; 0.3m)

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Figure D3.7-5
Isopleths of Residential Lifetime Cancer Risk:
NEPA Baseline Cancer Risk
San Pedro Waterfront Project

SOURCE: USA Imagery (02-15-07; 0.3m)

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Figure D3.7-6
Isopleths of Residential Lifetime Cancer Risk:
Unmitigated Proposed Project Minus CEQA Baseline
San Pedro Waterfront Project

K:\GIS\PROJECTS\POLA\01074.07\MAPDOC\AQ\20080816\FIG7_7_PPUNMTG_NEPA.MXD SLM (09-02-08)

SOURCE: USA Imagery (02-15-07; 0.3m)

N
0 0.25 0.5 1 1.5 Miles

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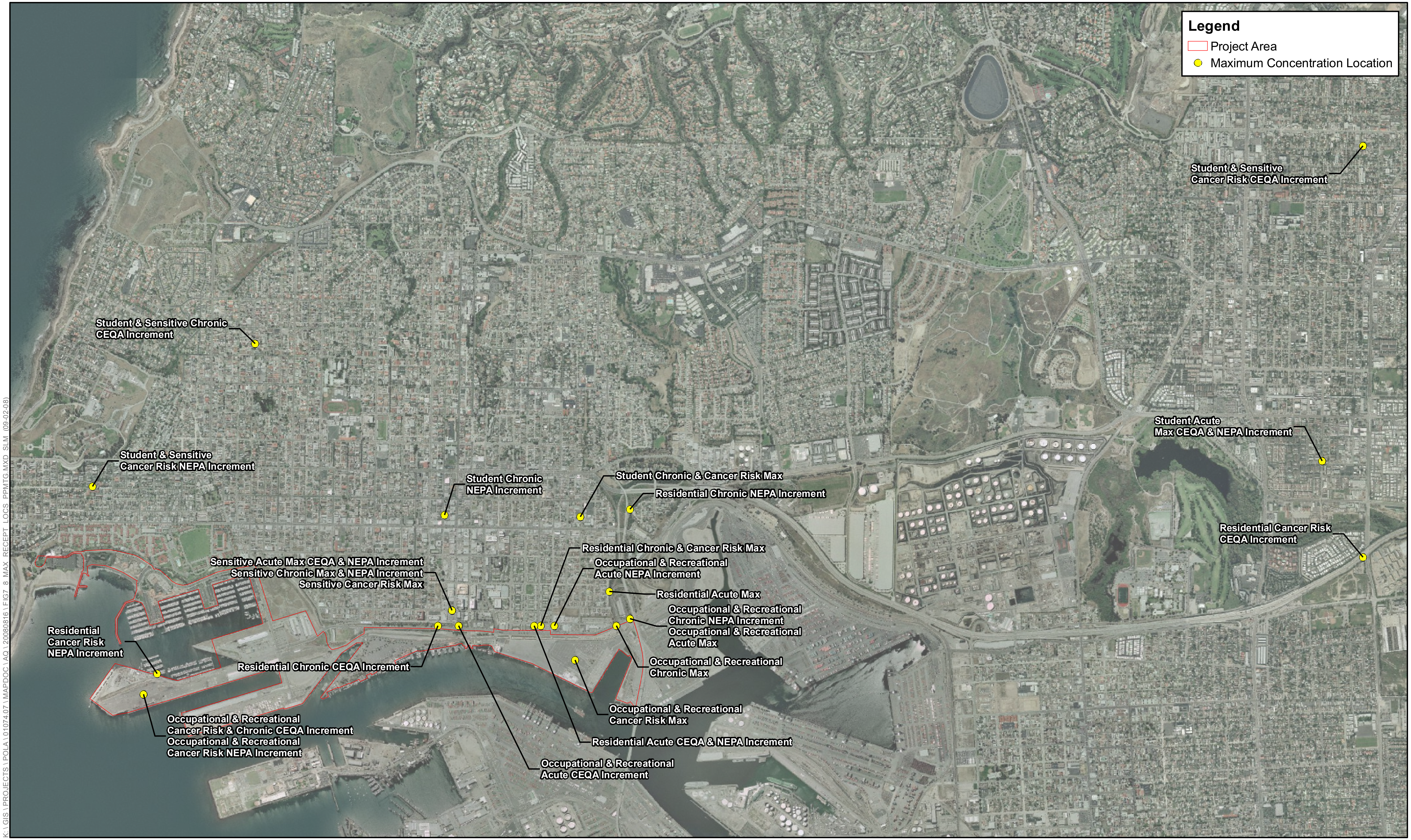
Figure D3.7-7
Isopleths of Residential Lifetime Cancer Risk: Unmitigated Proposed Project Minus NEPA Baseline
San Pedro Waterfront Project



SOURCE: USA Imagery (02-15-07; 0.3m)

N

0 1,000 2,000 3,000 4,000 Feet

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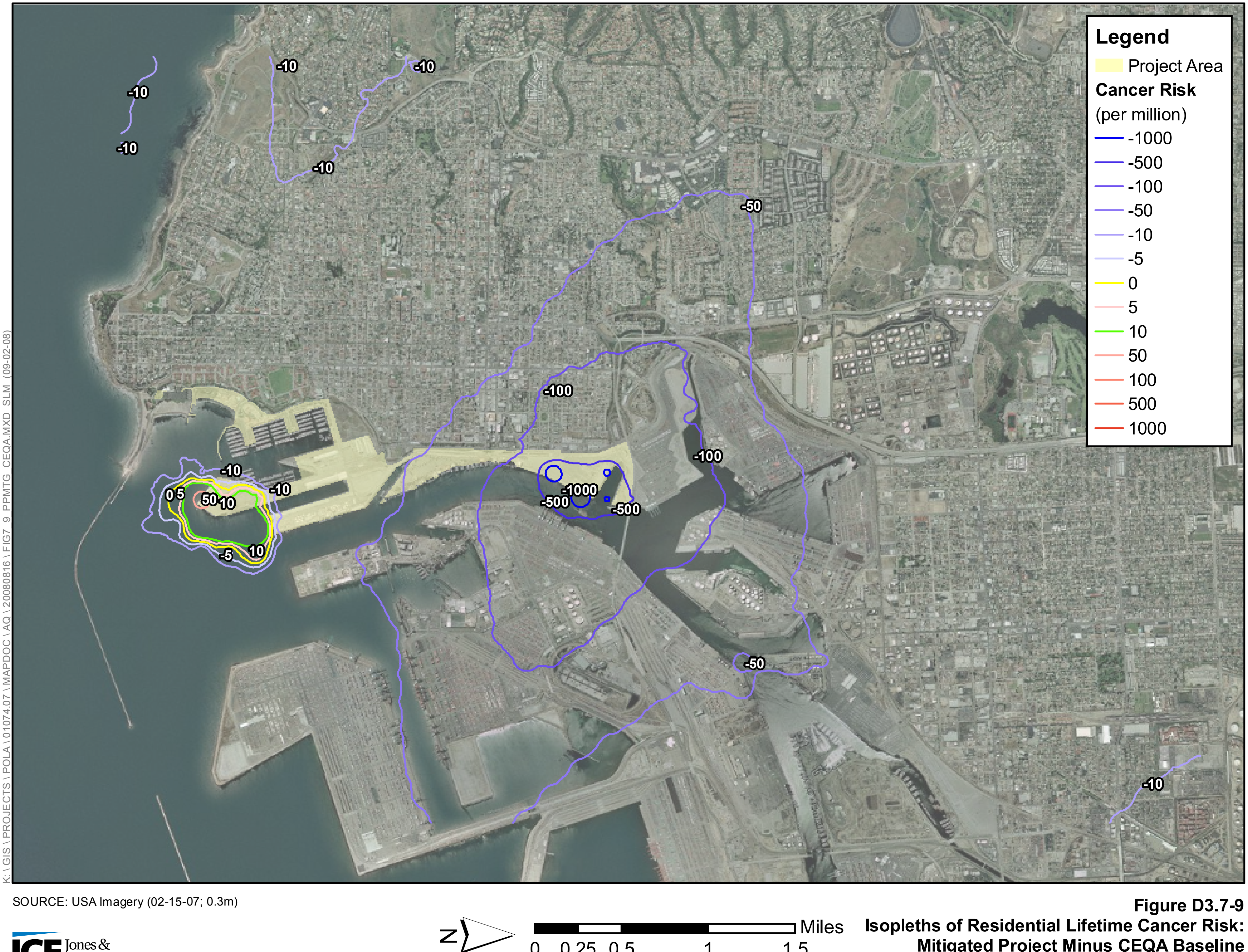
Figure D3.7-8
Maximum Concentration Locations Associated with Mitigated Project
San Pedro Waterfront Project



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SOURCE: USA Imagery (02-15-07; 0.3m)

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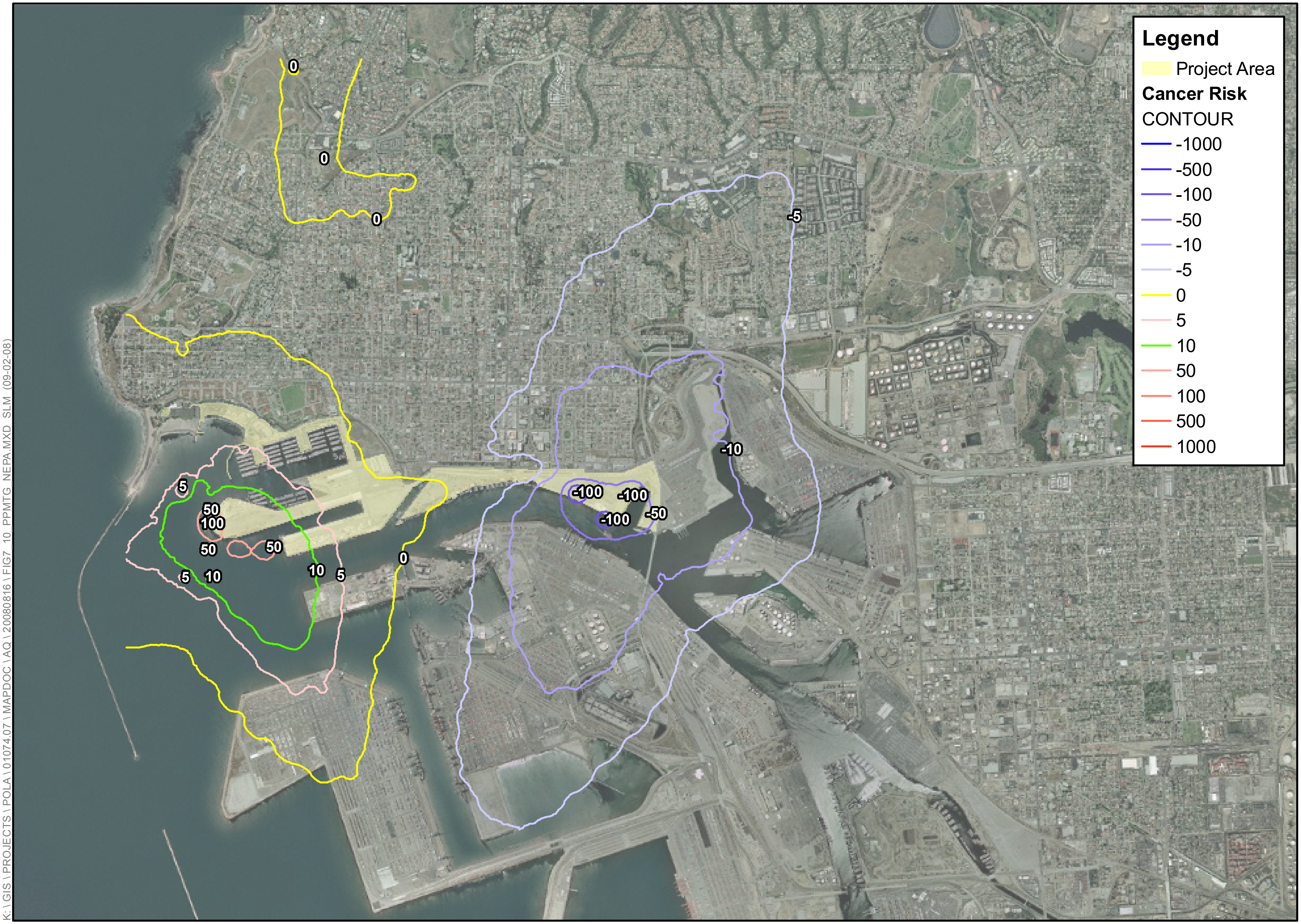
Figure D3.7-9
Isopleths of Residential Lifetime Cancer Risk: Mitigated Project Minus CEQA Baseline
San Pedro Waterfront Project



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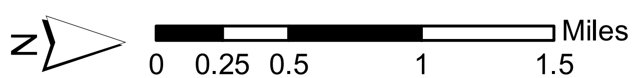

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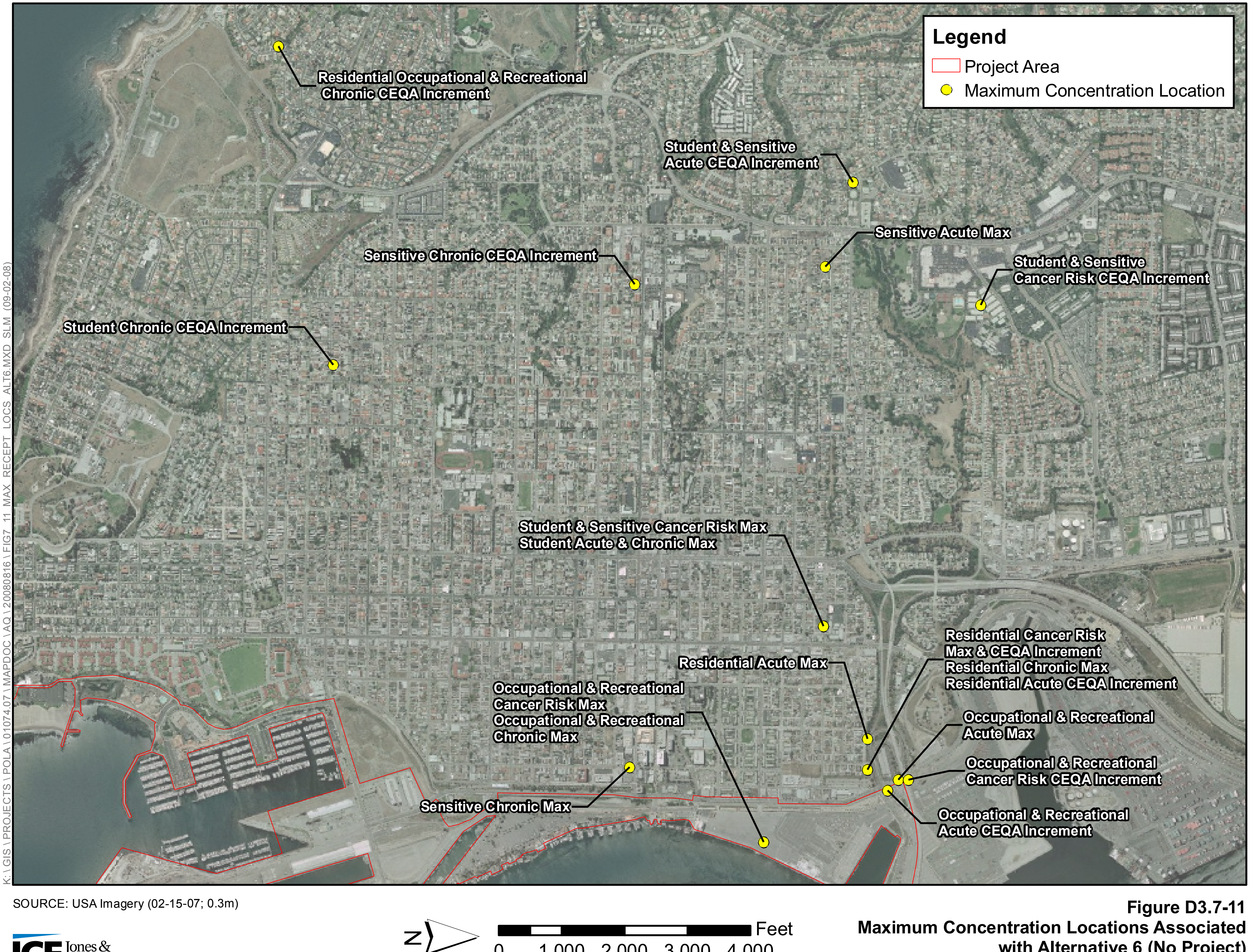
Figure D3.7-10
Isopleths of Residential Lifetime Cancer Risk: Mitigated Project Minus NEPA Baseline
San Pedro Waterfront Project



SOURCE: USA Imagery (02-15-07; 0.3m)

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Figure D3.7-11
Maximum Concentration Locations Associated with Alternative 6 (No Project)
San Pedro Waterfront Project

K:\GIS\PROJECTS\POLA\01074.07\MAPDOC\AQ\20080816\FIG7_12_ALT6_NO_PROJECT.MXD SLM (09-02-08)

SOURCE: USA Imagery (02-15-07; 0.3m)

ICF Jones & Stokes
an ICF International Company

Figure D3.7-12
Isopleths of Residential Lifetime Cancer Risk: Alternative 6 (No Project) Minus CEQA Baseline
San Pedro Waterfront Project