# APPENDIX D3

## Health Risk Assessment Report

# APPENDIX D3

# HEALTH RISK ASSESSMENT FOR THE PORT OF LOS ANGELES BERTHS 136-147 CONTAINER TERMINAL IMPROVEMENTS PROJECT

## 1.0 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 Port of Los Angeles (Port) Berths 136-147 Terminal Improvements Project. TACs are compounds that are known or suspected to cause short-term (acute) and/or long-term (chronic non-carcinogenic or carcinogenic) adverse health effects.

This HRA was prepared in accordance with the *Health Risk Assessment Protocol for Port of Los Angeles Terminal Improvement Projects* (Protocol) (Port 2005a). The Protocol is a living document, developed by the Port 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 methods 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 methods in these guidance documents are incorporated into the new Hotspots Analysis and Reporting Program (HARP) model released by the CARB in December 2003 (CARB 2003a). The HRA used the HARP Express Version 2.07 interface to facilitate inputs into the HARP model (Dillingham Software Engineering 2004).

The HARP model incorporates use of the U.S. Environmental Protection Agency (USEPA) Industrial Source Complex Short-Term, Version 3 model (ISCST3) for dispersion modeling (USEPA 1995). The selection of the ISCST3 model is well suited for this HRA 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 ISCST3, and (3) the ability of the model to handle the various physical characteristics of Project emission sources, including, "point," "area, " and "volume" source types. ISCST3 is a USEPA-approved Gaussian-plume dispersion model that was designated as a USEPA guideline model in August 1985.

The HRA process requires four general steps to estimate health impact results: (1) quantify 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 daycare centers); (3) perform dispersion modeling analyses to estimate ambient TAC concentrations at each receptor location; and (4) use a risk characterization model to estimate the potential health risk at each receptor location. The following describes in detail the methods used to develop each step of the Project HRA.

# 2.0 DEVELOPMENT OF EMISSION SCENARIOS USED IN THE HRA

## 2.1 Emission Sources

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

- **Ships transiting** to and from Berths 136-147. Ship transit in SCAQMD waters consists of the following transit segments, starting with the segment farthest from the berth.

  - Fairway transit – The portion of transit between the SCAQMD overwater boundary (about 50 nautical miles [nm] from the Port breakwater) and the Ports Precautionary Area (about 10 nm from the Port breakwater). A sensitivity analysis performed for the China Shipping Project showed that only the closest 14-nm portion of Fairway transit is sufficient to include in this HRA, as the more distant portion of Fairway transit contributed to less then 1 percent of the total risks at the maximum residential and occupational receptors. Therefore, the HRA did not model vessel emissions beyond this point in the Fairway.

  - Precautionary area transit – The portion of transit between the fairway and the Port breakwater. This segment length is about 10 nm.

  - Harbor transit – The portion of transit between the Port breakwater and the berth. This segment length is about 4 nm.

  - Turning and Docking – Final positioning of the ship near the berth.

  The total one-way transit distance included in this HRA is about 28 nm. Vessel emission sources include main propulsion engines, auxiliary engines, and boilers.

- **Ships hoteling** while at berth. Sources of hoteling emissions include ship auxiliary engines and boilers, as the main propulsion engine is not in operation. When a ship uses alternative maritime power (AMP) while hoteling, only boilers sources are in use.

- **Tugboats** used to assist the container ships between the Port breakwater and the berth (two tugboats per ship assist). Emission sources include tugboat main propulsion and auxiliary engines.

- **Terminal and Railyard Equipment (Cargo Handling Equipment)**, including yard tractors (hostlers), rubber-tired gantry cranes (RTGs), toppicks, sidepicks, forklifts, and yard sweepers.

- **Locomotives** switching and/or idling within both the existing/proposed Pacific Harbor Line, Inc. (PHL) rail yard locations, the proposed Berths 136-147 on-dock rail yard, and trains hauling containers between the Berths 136-147 rail yard and Anaheim Street along the San Pedro Subdivision rail line. A sensitivity analysis performed for the China Shipping Project determined that Project trains traveling north of Anaheim Street along this route contributed no greater than 0.2 percent to the total risks from all Project sources at the maximum residential and occupational receptors. Therefore, the HRA did not model locomotive transit emissions north of this point.

- **Trucks** transporting containers within primary roadways to and from Berths 136-147, including:
    - On-terminal driving and idling
    - Interstate-110 (I-110) between Harry Bridges Boulevard and Anaheim Street
    - I-110/C Street off-/on-ramps
    - Proposed I-110 northbound off-ramp to Harry Bridges Boulevard
    - Harry Bridges Boulevard from Figueroa Street to Alameda Street
    - Alameda Street from Harry Bridges Boulevard to Anaheim Street
    - Fries Avenue from Harry Bridges Boulevard to Pier A Street
    - Proposed Fries Avenue grade separation to Proposed Main Gate
    - Proposed Main Gate
    - Pier A Street from Fries Avenue to Pier A Street Gate
    - Pier A Street Gate

  The HRA also analyzed existing roadways that connect to the current Berths 136-147 as part of the CEQA baseline (Year 2003) and No Project scenarios.

  The HRA evenly distributed truck on-terminal driving and idling emissions throughout Berths 136-147 terminal for all Project scenarios.

  A sensitivity analysis performed for the China Shipping Project examined potential impacts from Project trucks traveling on roadways north of Anaheim Street along I-110 and Alameda Street. This analysis showed that these roadway segments contribute no greater than 0.2 percent to the total risks from all Project sources at the maximum residential and occupational receptors. Therefore, the HRA did not model Project truck emissions north of this point. Additionally, the HRA did not analyze roads other then those identified above, as the traffic analysis determined that the Project would produce a minimal amount of truck trips within these roadways.

- **Construction emission sources**, including onsite construction equipment and haul trucks, general cargo ship (for crane delivery) transit and hoteling, tugboat/barge activities associated with dredging, dike and wharf construction, and dredge material transport.

## 2.2 TAC Emission Calculation Approach

The determination of health risks in this HRA required the calculation of 70-year annual average, maximum annual, and maximum 1-hour emission rates. The HRA used 70-year annual average emission rates to determine individual lifetime cancer risks. The 70-year averaging period coincided with 2007 through 2076, or Project years 1 through 70. The HRA conservatively used maximum annual emission rates to determine the chronic hazard index, as the chronic exposure period for non-cancer 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.

Nearly all Project emission sources are diesel-powered internal combustion engines. Therefore, the analysis of long-term (chronic) health effects focused on DPM emissions, as this is the only pollutant OEHHA considers in the estimation of cancer (lifetime) and chronic (annual) non-cancer effects from these sources. However, to estimate acute health effects (less than 24 hours), the HRA evaluated a more detailed list of pollutants, including criteria pollutants and TACs in the form of volatile organic compounds (VOCs) and particulate matter (PM).

Project vessels have diesel-fired external combustion boilers for the purpose of space and water heating. An accepted method to estimate chronic health effects from this source type is to analyze its individual TAC emissions (16 chemicals). Since this source would produce a small percentage of the total annual Project emissions, the HRA simplified the chronic analysis effort for this source and treated it as an internal combustion engine, meaning that it only analyzed its DPM emissions (1 chemical). This approach produced more conservative results, compared to an analysis of individual TACs.

The extensive Project life analyzed in the HRA (up to 70 years for cancer risk) required wide-ranging predictions of the future operational characteristics of proposed emission sources. Two of the more important factors that would affect future emissions from Project sources are:

1. Reductions in emission factors due to (a) vehicle or equipment fleet turnover to cleaner standards and (b) the future phase-in of cleaner fuels as required by existing regulations.

2. Increased vehicle or equipment activity levels due to anticipated increases in container throughput or infrastructure constraints.

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 2.3, 2.4, and 2.5. The approaches for estimating maximum annual and 1-hour emissions are described in Sections 2.6 and 2.7, respectively.

The HRA included Project construction emissions of DPM in the cancer risk analysis. Typically, short-term construction emissions are not considered in this type of chronic analysis. However, given the magnitude and long duration of Project construction emissions, the HRA took this conservative approach.

## 2.3 Emission Factor Trends

The HRA used the following methods to develop 70-year trends in annual emission factors for unmitigated emissions. The analysis for the most part followed emission estimation methods used in the *Port of Los Angeles Baseline Air Emissions Inventory - 2001* and *The Port of Los Angeles Inventory of Air Emissions for Calendar Year 2005* (*2001 and 2005 PEIs*) (Starcrest Consulting Group 2005 and 2007):

1. **Ships**. 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. This approach is consistent with the European study on vessel emissions because there are no future standards currently promulgated for these source categories that would result in

more restrictive emission factors, and fleet turnover rate is slow and uncertain (Entec 2002).

2. **Tugboats**. Composite emission factors for main and auxiliary engines on assist tugboats were based on an inventory of tugboat engine sizes and model years performed in 2005 (Starcrest 2006). A gradual replacement of older tugboat engines with new engines meeting USEPA Tier 2 standards (USEPA 1999) was assumed, based on default marine engine lifetimes developed by CARB (CARB 2004d). The emission factors assume the use of Port diesel fuel (average sulfur content of 1,900 parts per million [ppm]) before year 2007 and ultra-low-sulfur diesel (ULSD) (15 ppm sulfur) beginning in 2007. (Theses sources began using ULSD beginning in September 2006, due to the California Diesel Fuel Regulations [CARB 2004b]). This use of lower sulfur diesel fuel would produce reductions in $SO_2$ and DPM emissions.

3. **Terminal Equipment**. Composite emission factors were developed for the CEQA baseline terminal equipment fleet (year 2003) (Starcrest 2003). Discussions with operators at the TraPac Terminal determined that the existing terminal equipment have a useful life of about 15 years (personal communication with Scott Axelson 2004). Therefore, based upon (1) the assumption that TraPac would replace existing equipment with new equipment every 15 years and (2) the implementation schedule for new off-road vehicle emission standards as found in the ARB OFFROAD2007 Emissions Model (ARB 2006a), the HRA developed a function to estimate future equipment emission factors for Project years 1 (year 2007) through 70 (year 2076).

   To estimate 2004 composite vehicle fleet emission factors, the analysis replaced 1/15 of the year 2003 Project vehicle fleet with the most current OFFROAD emission factors (in this case, year 2004). The analysis then applied annual emission deterioration rates (DRs) found in OFFROAD to the remaining 14/15ths of the fleet, then averaged the emission factors from the new and old groups of vehicles to produce year 2004 composite factors. The analysis repeated this function for each future Project year until it replaced all vehicles with USEPA/ARB Tier 4 off-road standards. Since the Tier 4 standards become effective in year 2012, the Project vehicle fleet completely turned over to Tier 4 standards in 2027 (year 2012 + 15 years = 2027). Therefore, the composite emission factors for each of the three OFFROAD horsepower (Hp) categories equaled the Tier 4 standards (plus deterioration) from 2027 through 2076. This exercise produced 70 individual years of emission factors for the following three Project terminal equipment Hp categories: (1) 121-175, (2) 176-250, and (3) 251-500. Data and calculations used in this analysis are shown in Tables D1.2.1 through D1.2.30.

   The emission factors assume the use of CARB diesel fuel (maximum 500 ppm sulfur) for the CEQA Baseline year of 2003 and ULSD starting in Project year 1, or 2007. Additionally, unmitigated emission factors for hostlers account for the use of diesel oxidation catalysts (DOCs) starting in 2005, in accordance with an agreement reached between the Port and TraPac (TraPac Inc. 2006).

4. **Locomotives.** Locomotive future-year emission factors are based on the USEPA nationwide locomotive emission standard implementation schedule (USEPA 1998). In general, locomotive emission factors decline in future years as older locomotives

gradually are replaced with newer locomotives meeting the USEPA tiered emission standards. The emission factors for the PHL locomotives that operate at the existing/proposed PHL rail yard and in switching mode within the proposed Berths 136-147 on-dock rail yard were adjusted to account for the replacement of existing engines in these locomotives with new Tier 2 standard engines beginning in year 2008 (Port 2005b). The emission factors assume the use of CARB diesel fuel (maximum 500 ppm sulfur) in yard locomotives in 2003, and ULSD starting in 2007, in accordance with California Diesel Fuel Regulations (CARB 2004b). The analysis also assumed that line-haul locomotives use diesel fuel with an average sulfur content of 1,927 ppm before 2008, 500 ppm starting in 2008, and 15 ppm starting in 2012, in accordance with the USEPA Nonroad Diesel Fuel Rule (USEPA 2004). Emission factors after the year 2040 were held constant at 2040 levels.

5. **Trucks**. Due to the promulgation of future USEPA and CARB emission standards, coupled with normal truck fleet turnover, emission factors for trucks will decrease with time. The emission factors also assume the use of CARB diesel fuel (maximum 500 ppm sulfur) in trucks in 2003 and ULSD starting in 2007, in accordance with California Diesel Fuel Regulations (CARB 2004b). Composite truck emission factors were developed using the EMFAC2007 emission factor model (CARB 2006b). Emission factors were calculated for years 2003, 2007, 2010, 2015, 2025, 2038, and 2040 (the year farthest in the future that EMFAC2007 estimates emission factors). Emission factors for years between the calculated years were estimated by interpolation. Registration information collected for on-road trucks that serviced San Pedro Bay Ports container terminals in the year 2003 and 2005 (Starcrest 2005 and 2007) were used to develop the truck fleet age distribution for the CEQA Baseline year 2003 and future Project years, respectively, for use in EMFAC2007. Given a lack of information on how emission factors would change beyond the year 2040, emission factors after the year 2040 were held constant at 2040 levels.

6. **Construction Sources**. DPM Emissions from Phases 1 and 2 sources, including onsite construction equipment and haul trucks, general cargo ship (for crane delivery) transit and hoteling, tugboat/barge activities associated with dredging, dike and wharf construction, and dredge material transport, were calculated by the methods presented in section 3.2.4.3.1 of the EIS/R.

## 2.4 Activity Level Trends

The second parameter needed to develop Project source emission rates is the annual source activity levels expected over the 70-year period. Examples of activity levels include the number of ship visits and associated energy usage, ship hoteling times, terminal equipment usage, number of departing and arriving trains, truck trips, and truck travel speeds.

For all Project scenarios, the Port identifies yearly activity projections for 2003 (baseline year), 2007, 2010, 2015, 2025, and 2038 (end of terminal lease period). Due to the difficulty of predicting projections beyond 2038, the analysis held activity levels after 2038 constant at 2038 levels. However, for the CEQA baseline scenario, activity levels in the baseline year of 2003 were held constant over the entire 70-year period of 2007 through 2076 (some emission factors for the scenario change annually, as described in Section 2.3).

The analysis performed two additional adjustments to Project source activity levels:

1. For line-haul locomotives, idling times within the proposed Berths 136-147 rail yard were reduced from 1.9 hours to 1.0 hour per outbound train trip starting in 2006 in response to the 2005 CARB/Railroad Statewide Agreement (BNSF 2006).

2. If a Project scenario operated at an annual level that exceeded 8,000 twenty-foot equivalents (TEUs) per acre, the annual terminal equipment horsepower-hour activity for that year was increased by the following amount to simulate an increase in handling and grounded operations: proposed annual TEUs per acre divided by 8,000 TEUs per acre. In other words, if a scenario operated at an annual level of 8,800 TEUs per acre, the terminal equipment activity level for that year was increased by 10 percent from its unadjusted estimate.

### 2.5 70-Year Annual Average Emission Rates

For diesel internal combustion engines, which represent the overwhelming majority of Project emission sources, DPM is the only pollutant analyzed for cancer effects. The cancer unit risk factor established by OEHHA for the assessment of DPM emissions includes consideration of all toxic compounds associated with diesel combustive emissions. For each Project emission source category, the analysis calculated DPM emissions for each of the 70 Project years by multiplying the source activity level by the source DPM emission factor for that particular year. The analysis then averaged the 70 annual source DPM emission rates to produce the 70-year annual average DPM emission rate needed for the cancer analysis.

Project construction activities would occur between 2007 and 2016. The analysis divided total DPM emissions from construction by 70 years to create 70-year annual average DPM emission rates. The analysis then added these emissions to the 70-year annual average operational DPM emissions to estimate total Project cancer effects.

Appendix D4 presents the 70-year average DPM emission rates by source type for the CEQA baseline, NEPA baseline, proposed Project, Mitigated Project, and Project Alternative scenarios.

### 2.6 Peak Annual Emission Rates

Similar to the cancer risk analysis, DPM is the only pollutant analyzed for chronic (annual) non-cancer effects. The reference exposure level (REL) established by OEHHA for the assessment of DPM emissions for chronic non-cancer effects includes consideration of all toxic compounds associated with diesel combustive emissions.

To estimate non-cancer effects, the HRA focused on Project operations in year 2010, as this was determined in consideration of annual emissions and their locations to be the year with the greatest incremental impacts between the Project and baseline conditions. This determination includes consideration of when Project construction emissions would combine and overlap with operational emissions between the years of 2007 through 2009 and in 2015. The analysis estimated annual TAC emissions for year 2010 for the proposed Project, Mitigated Project, and NEPA baseline scenarios. The analysis used annual TAC emissions for the CEQA baseline year of 2003 to determine CEQA significance. Appendix D4 presents the peak annual DPM emission rates used in chronic non-cancer analyses for these Project scenarios.

## 2.7 Peak Hourly TAC Emission Rates

The analysis of acute health effects evaluates peak hourly TAC emission rates, as OEHHA has not assigned acute RELs for DPM. In accordance with a CARB recommendation (CARB 2005a), the HRA used speciation profiles developed for the *California Emission Inventory and Reporting System* (CEIDARS) to convert Project emissions of TOG and PM to individual TACs (CARB 2002b and 2003b). Table D3-1 presents the CARB TOG and PM speciation profiles used in the HRA[1].

The analysis of acute non-cancer health impacts also focused on project year 2010, as this was determined to be the year with the greatest difference in short-term TAC impacts between the Project and baseline conditions. The HRA developed peak hourly emission scenarios that would maximize operational activities during a single hour and would produce the highest ambient TAC impacts. The analysis estimated hourly TAC emissions for year 2010 for the proposed Project, Mitigated Project, and NEPA baseline scenarios. The analysis used hourly TAC emissions for the CEQA baseline year of 2003 to determine CEQA significance. Appendix D4 presents the peak hourly TAC emission rates used in acute non-cancer analyses for these Project scenarios.

The peak hourly scenarios included the following assumptions:

1. Marine vessels – Review of the Project ship visit data determined that it is possible that 3 vessels would be at berth at the same time, either (a) in hoteling mode or (b) 2 in hoteling mode and 1 maneuvering in proximity to the Berths 136-147 facility. Dispersion modeling showed that a ship in harbor transiting, turning, and docking would produce higher short-term TAC concentrations at all maximally exposed receptor locations compared to the same vessel in hoteling mode. Therefore, the analysis assumed that peak hourly vessel emissions would occur from 2 vessels in hoteling mode and 1 vessel maneuvering in proximity to the Berths 136-147 facility.

   Review of the ship visit data for the CEQA and NEPA baselines determined that it is possible that 2 vessels would be at berth at the same time. Therefore, the analysis assumed that peak hourly vessel emissions for these scenarios would occur from 1 vessel in hoteling mode and 1 vessel maneuvering in proximity to the Berths 136-147 facility.

[1] In this study, TOG emissions were derived from VOC emissions using conversion factors provided with the TOG speciation profiles.

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

| Pollutant | CAS Number | Weight Percent of TOG or PM | | | | | |
|---|---|---|---|---|---|---|---|
| | | TOG Profile No. 504 | TOG Profile No. 818 | PM Profile No. 111 | PM Profile No. 112 | PM Profile No. 116 | PM Profile No. 425 |
| Benzene | 71432 | 2.2 | 2.0 | — | — | — | — |
| Formaldehyde | 50000 | 0.1 | 14.7 | — | — | — | — |
| Xylenes | 1210 | 0.3 | | — | — | — | — |
| Methanol | 67561 | | 0.03 | | | | |
| MEK | 78933 | | 1.5 | | | | |
| m-Xylene | 108383 | 0.3 | 0.6 | | | | |
| o-Xylene | 95476 | 0.5 | 0.5 | | | | |
| p-Xylene | 106423 | | 0.1 | | | | |
| Styrene | 100425 | | 0.06 | | | | |
| Toluene | 108883 | 2.2 | 1.5 | — | — | — | — |
| Ammonia | 7664417 | — | — | — | — | — | 0.33 |
| Arsenic | 7440382 | — | — | 0.03 | 0.5 | — | 0.0004 |
| Copper | 7440508 | — | — | 0.05 | — | — | 0.003 |
| Mercury | 7439976 | — | — | — | — | — | 0.0026 |
| Nickel | 7440020 | — | — | 0.55 | 0.05 | — | 0.0016 |
| Sulfates | 9960 | — | — | 44 | 25 | 15 | 1.8 |
| Vanadium | 7440622 | — | — | 0.55 | — | 0.55 | 0.0015 |

Notes:

1. TOG = total organic gas and PM = particulate matter.
2. For TOG species, all ocean-going vessel (OGV) sources use the greater of TOG profiles 504 or 818. All other Project sources use profile 818.
3. For PM species, all OGV sources use the greater of PM profiles 111, 112, 116, or 425. Locomotives use the greater of profiles 116 or 425. Tugboats, trucks, and terminal equipment use profile 425.
4. For Profile No. 504, TOG is 83.47 percent VOC.
5. For Profile No. 818, TOG is 87.85 percent VOC.

Source: CARB (2002b; 2003b).

2. Terminal Equipment – Average hourly terminal equipment emissions for each work shift were increased by 25% to simulate peak activities within the terminal. Table D3-2 includes assumptions used by the HRA to temporally distribute Project emissions over a 24-hour period.

3. Trucks – Ten percent of the Project truck average daily trips (ADT) would occur for each hour during the 0600 to 1800 time period and 5 percent of the ADT would occur for each hour during 1800 to 0600.

4. On-dock rail yard – Assumed 1 hour of outbound train activity, which includes 1 hour of road haul and switching locomotive and rail yard equipment usage.

5. Existing PHL rail yard (current and proposed locations) – Assumed that emissions for each of the 3 train trip types occurred each hour.

## 3.0 RECEPTOR LOCATIONS USED IN THE HRA

The HRA analyzes the health risks associated with TAC emissions from project-related sources at a variety of locations (receptors) throughout the project area, including locations of residents, offsite workers, and sensitive members of the public. The analysis utilized a regular coarse grid of 1,189 receptor points spaced every 250 meters apart around Berths 136-147 terminal, as shown in Figure D3-1. The regular receptor grid extended roughly 7 kilometers (km) east-west by 10 km north-south around the terminal area. Receptor points spaced at 50-meter intervals were positioned along the Berths 136-147 terminal property lines for each project scenario. The modeling analysis also evaluated a receptor field spaced 50 meters apart within the proposed

**Table D3-2. Temporal Distribution of Berths 136-147 Terminal Project Emission Sources**

| *Category* | *Time Period* | *Activity Distribution* | *Hours per Day* |
|---|---|---|---|
| Ocean-Going Vessel | 4 A.M. – 8 P.M.<br>8 P.M. – 4 A.M. | 80%<br>20% | 16<br>8 |
| Hotelling | Midnight-midnight | 100% | 24 |
| Harbor Craft | 6 A.M. – 6 P.M.<br>6 P.M. – 6 A.M. | 80%<br>20% | 12<br>12 |
| Cargo Handling | 8 A.M. – 5 P.M.<br>5 P.M. – 3 A.M.<br>3 A.M. – 8 A.M. | 80%<br>15%<br>5% | 9<br>10<br>5 |
| Trucks | 6 A.M. – 6 P.M.<br>6 P.M. – 6 A.M. | 80%<br>20% | 12<br>12 |
| Locomotives | Midnight-midnight | 100% | 24 |

HBB Buffer area between HBB and C Street to take into consideration Project impacts to this future high use area (Figure D3-1A). In addition, 74 discrete receptors were placed at sensitive receptor locations of special concern, such as schools, day care centers, convalescent homes, and hospitals within the regular receptor grid. Table D3-3 summarizes the locations of these sensitive receptors. The coordinate information and elevation of each receptor location were determined from United States Geological Survey (USGS) topographic data.

The HRA selected maximally exposed individual (MEI) locations from the modeling receptor grids for five different receptor types: (1) residential, (2) occupational, (3) sensitive, (4) student, and (5) recreational. The locations of these receptor types include the following:

- Residential receptors occur within all residential or zoned residential areas, including the public marinas (for possible liveaboards) located in the East Basin and Cerritos Channel.

Occupational receptors occur outside of the Berths 136-147 terminal property, excluding over water. Receptors on the Berths 136-147 property line were considered as valid occupational locations. This approach is conservative, particularly for long-term occupational exposures because it is unlikely that an offsite worker would reside on or very near the Berths 136-147 property line except for intermittent periods.

**Table D3-3. Sensitive Receptors Evaluated in the Berths 136-147 Project HRA.**

| | Street Address | City | E UTM | N UTM |
|---|---|---|---|---|
| **DAYCARE CENTERS** | | | | |
| Armstrong Academy | 1682 Anaheim St | Harbor City | 384877 | 3738389 |
| Coastline Head Start | 1121 Lomita Blvd | Harbor City | 379956 | 3740279 |
| Der Kinder Garden School | 1518 Pacific Coast Highway | Harbor City | 379458 | 3739409 |
| Gateway Christian School | 25420 Vermont Ave | Harbor City | 380509 | 3739569 |
| Lilly's Babies | 1647 248th St | Harbor City | 379032 | 3740490 |
| Normont Terrace Children's Center | 25028 Petroleum Ave | Harbor City | 380116 | 3740258 |
| Volunteers of America- Parent Child Center | 1135 257th St. | Harbor City | 380165 | 3739532 |
| Cabrillo Ave Children's Center | 741 W. 8th Street | San Pedro | 380265 | 3733547 |
| Carmen's Cry Baby Care | 1509 S Palos Verdes St | San Pedro | 381286 | 3732766 |
| Comprehensive Child Development | 769 W 3rd St | San Pedro | 380148 | 3734010 |
| Day-Star Early Learning Center | 631 W 6th St | San Pedro | 380497 | 3733752 |
| Federation / Port of San Pedro | 202 S Beacon | San Pedro | 381485 | 3734127 |
| Federation / Toberman House | 131 N. Grand | San Pedro | 380583 | 3734263 |
| First United Methodist Church | 580 West 6th St | San Pedro | 380574 | 3733740 |
| Merry Go-round Nursery School | 446 W 8th St | San Pedro | 380874 | 3733533 |
| Miss Shannon's Child Care | 325 W 31st St. | San Pedro | 380880 | 3731115 |
| Park Western Place Children's | 1220 Park Wester Place | San Pedro | 379234 | 3735301 |
| Robin's Nest Daycare | 645 W 14th St | San Pedro | 380380 | 3732882 |
| San Pedro /Wilmington Children's Center | 920 W 36th St | San Pedro | 379707 | 3730982 |
| San Pedro Children's Center | | San Pedro | 379772 | 3734405 |
| Schahnin's Int Day Care | | San Pedro | 380133 | 3732170 |
| Wee Tot Nursery School | 1128 W 7th St | San Pedro | 379354 | 3733669 |
| World Tots LA | 100 W 5th St | San Pedro | 381529 | 3733934 |
| YMCA of Metro LA | 301 S. Bandini St | San Pedro | 379750 | 3734044 |
| YWCA | 437 W 9th St | San Pedro | 380869 | 3733433 |
| YWCA Venture Park Preschool | 1921 N Gaffey Street. | San Pedro | 380316 | 3736352 |
| Happy Harbor Preschool | 1530 N Wilmington Blvd | Wilmington | 382021 | 3739838 |
| Munchkin Center | 1348 N Marine Ave | Wilmington | 383025 | 3739406 |
| New Harbor Vista Child Development Center | 909 W D St | Wilmington | 382167 | 3737588 |
| Sanchez Family Child Care | 1443 Deepwater Ave | Wilmington | 383559 | 3739727 |
| Small World Learning Center | 1749 N Avalon Blvd | Wilmington | 383093 | 3740329 |
| Wilmington Park Children's Center | 1419 E Young St | Wilmington | 384700 | 3738996 |
| Yvette's Daycare | 815 W Opp St | Wilmington | 382230 | 3738553 |
| | | | | |

| | | | | |
|---|---|---|---|---|
| **SCHOOLS** | | | | |
| Harbor City Elementary School | 1508 254th St | Harbor City | 379413 | 3739802 |
| Learning Garden Preschool | 1518 Pacific Coast Highway | Harbor City | 379347 | 3739386 |
| Lorenz Hillside School | 1516 W. Anaheim St | Harbor City | 379362 | 3738859 |
| Narbonne High School | 24300 Western Ave | Harbor City | 379287 | 3740937 |
| Normont Elementary School | 1001 253rd St | Harbor City | 380360 | 3740007 |
| The Pines Christian School | 25200 S Western Ave | Harbor City | 380692 | 3739702 |
| President Avenue Elementary School | 1465 243rd St | Harbor City | 379451 | 3740991 |
| Angel's Gate High School | 3200 S Alma St | San Pedro | 379582 | 3731350 |
| Bandini Street Elementary School | 425 N Bandini St | San Pedro | 379735 | 3734601 |
| Barton Hill Elementary School | 423 N Pacific Ave | San Pedro | 380689 | 3734581 |
| Cabrillo Ave. Elementary School | 732 S Cabrillo Ave | San Pedro | 380082 | 3733567 |
| Cooper Community Day School | 2210 N Taper Ave | San Pedro | 379649 | 3736710 |
| Dana Middle School | 1501 S Cabrillo Ave | San Pedro | 380110 | 3732842 |
| Fifteenth Street Elementary School | 1527 S Mesa St | San Pedro | 380902 | 3732772 |
| Harbor OCC Center | 740 N. Pacific Ave. | San Pedro | 380693 | 3733547 |
| Holy Trinity Elementary School | 1226 W Santa Cruz St | San Pedro | 379365 | 3734402 |
| Holy Trinity Elementary School | 1226 W Santa Cruz St | San Pedro | 379337 | 3734320 |
| J. F. Cooper High School | 2201 N. Taper Ave | San Pedro | 379791 | 3736724 |
| Leland Street Elementary School | 2120 S Leland St. | San Pedro | 379593 | 3732169 |
| Mary Star Of The Sea Elementary School | 717 S Cabrillo St. | San Pedro | 380082 | 3733583 |
| Mary Star of the Sea High School | 810 W 8th St. | San Pedro | 379926 | 3733674 |
| Park Western School | 1214 Park Western Pl. | San Pedro | 379274 | 3735321 |
| Point Fermin Elementary School | 3333 Kerckhoff Avenue. | San Pedro | 380485 | 3730978 |
| San Pedro High School | 1001 W 15th St. | San Pedro | 379645 | 3732757 |
| Narbonne Community School | 950 W Santa Cruz St. | San Pedro | 379748 | 3734370 |
| Taper Avenue Elementary School | 1824 N Taper Ave. | San Pedro | 379809 | 3736305 |
| Avalon High School | 1425 N Avalon Blvd | Wilmington | 383045 | 3739524 |
| Banning High School | 1527 Lakme Ave | Wilmington | 383183 | 3739701 |
| Broad Avenue Elementary School | 24815 Broad Ave | Wilmington | 383151 | 3740602 |
| First Baptist Christian School | 1360 Broad Ave | Wilmington | 383200 | 3739416 |
| Fries Ave Elementary School | 1301 N Fries Ave | Wilmington | 382880 | 3739251 |
| G Street School | | Wilmington | 382506 | 3738149 |
| Gulf Ave Elementary School | 828 W L St | Wilmington | 382247 | 3738964 |
| Hawaiian Avenue Elementary School | 540 Hawaiian Ave | Wilmington | 381913 | 3737808 |
| Los Angeles Harbor College | 1111 Figueroa Place | Wilmington | 381309 | 3738644 |
| Pacific Harbor Christian School | 1530 Wilmington Blvd | Wilmington | 381947 | 3739810 |
| Wilmington Middle School | 1700 Gulf Ave | Wilmington | 382253 | 3740243 |
| Wilmington Park Elementary School | 1140 Mahar Ave | Wilmington | 384715 | 3738942 |
| **HOSPITALS** | | | | |
| Bay Harbor Hospital | 1437 W Lomita Blvd | Harbor City | 379467 | 3740421 |
| Kaiser Permanente Foundation Hospital | 25825 Vermont Ave | Harbor City | 380073 | 3739356 |
| San Pedro Peninsula Hospital | 1300 W Seventh St | San Pedro | 379055 | 3733680 |
| Memorial Hospital of Gardena | 1703 N Avalon Blvd | Wilmington | 383016 | 3740228 |

- Sensitive receptors occur at all schools, day care centers, convalescent homes, and hospitals in the surrounding Project area.
- Student receptors occur at all schools in the surrounding area.
- Recreational receptors occur outside of the Ports of Los Angeles or Long Beach properties, excluding water.

## 4.0 DISPERSION MODEL SELECTION AND INPUTS

This HRA used the HARP model to assess air quality impacts and health risks from Project operational emission sources. HARP uses the ISCST3 model for dispersion modeling. The selection of the ISCST3 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 ISCST3; and (3) the ability of the model to handle the various physical characteristics of Project emission sources, including "point," "area," and "volume" source types. ISCST3 is a USEPA-approved Gaussian-plume dispersion model that was designated as a guideline model in August 1995, and the SCAQMD approves of its use for mobile source analyses.

### 4.1 Physical Simulations of Emission Sources

The ISCST3 modeling analysis evaluated Project-related operational and construction emission sources, including container ships, assist tugboats, terminal and rail yard equipment, locomotives, trucks, and construction sources. The HRA realistically simulated the Project-related emission sources, taking into consideration physical characteristics and operational locations of the sources. Emissions from the movement of vessels in the shipping lanes, trains on rail lines, and trucks on roadways are line-source emissions were simulated and modeled as a series of separated volume sources. Mobile source operations confined within specific geographic locations, such as the Berths 136-147 terminal or proposed on-dock rail yard, were modeled as a collection of volume sources covering the area. Volume source emissions were simulated by ISCST3 as being released and mixed vertically and horizontally within a volume of air prior to being dispersed downwind. Finally, stationary emissions from hoteling ships were modeled as point (stack) sources with upward plume velocity and buoyancy. A total of 474 emission sources were simulated in the ISCST3 modeling for the proposed Project scenario. Figures D3-2, D3-3, and D3-4 show the locations of the proposed Project, CEQA Baseline, and Project construction emission sources simulated in the ISCST3 modeling analyses.

The operational characteristics of each source type in terms of area of operation and vertical stack height or source height determined the release parameters of each volume or point source. The following discusses the methodology for defining the physical source characteristics used in the HRA.

1. **Ship transit lanes (Fairway, Precautionary Area, and Harbor Transit)**. Emissions from marine vessels that transit between the offshore shipping lanes and the berth were simulated as a series of elevated volume sources beginning approximately 14 nm beyond Point Fermin and extending to the wharves at Berths 136-147. Total transit emissions were calculated and divided equally among the volume sources for each of

the Fairway, Precautionary Area, and Harbor Transit segments. Tug assist emissions were included in separate Harbor Transit volume sources.

Vessel transit sources were modeled as line sources with the use of multiple volume sources and consistent with the methods found in the *ISCST User's Guide, Section 1.2.2, Volume II* (USEPA 1995). The volume source width for all areas of transit was set to 100 meters. The center-to-center spacing of the Fairway and Precautionary Area transit volume sources was 600 meters. For Harbor Transit sources, the center-to-center spacing of the Harbor Transit volume sources was 200 meters.

The HRA used the following vertical dimensions for vessel transit volume sources, based upon a series of visual observations of container ship exhaust plumes at the Port (SAIC 2006):

- Fairway/Precautionary Area – Center of volume source equal to 25 percent above stack height (39 m), or 49 m, and a volume source depth of 50 percent of stack height, or 19.5 m.
- Harbor Transit – Center of volume source equal to 50 percent above stack height, or 58.5 m, and a volume source depth of 100 percent of stack height, or 39 m.

These assumptions are consistent with air dispersion theory, as lower apparent wind speeds at slower ship speeds results 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 Berths 136-147. Figure D3-5 shows the locations of vessel sources modeled in the HRA.

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, the HRA used one volume source to simulate these activities directly adjacent to the wharves at Berths 136-147. The volume source width was set to 300 meters. Based upon a series of visual observations of container ship exhaust plumes at the Port, the HRA set the center of volume source equal to 100 percent above stack height, or 78 m, and the volume source depth equal to 200 percent of stack height, or 78 m (SAIC 2006).

3. **Vessel hoteling locations**. Because they are stationary, the HRA modeled hoteling-vessel emission sources as stack-type point sources at three to four locations along the Berths 136-147 wharves. Stack parameters of hoteling auxiliary engines needed for the ISCST3 modeling analysis were developed for each vessel size category from data (1) collected during the vessel-boarding program for the Port of Los Angeles 2001 Baseline Air Emissions Inventory (Starcrest 2005) and (2) engine vendors (Caterpillar 2001). The HRA analyzed ship boiler emissions as occurring from the auxiliary engines stacks. The analysis adjusted stack plume exit velocities downward to account for deviations of the stack angles from the vertical.

4. **Terminal and rail yard areas.** The HRA overlaid areas of the Berths 136-147 Terminal, proposed on-dock rail yard, and the PHL rail yard with square boxes of various sizes to

achieve a complete coverage of source operational areas. Each of the boxes represents the base of a volume source. The analysis assumed that emissions spread uniformly over the entire area represented by the volume sources. Emissions, therefore, were assigned to each volume source in proportion to the base area of the source divided by the total area of all sources. Emissions from terminal and construction equipment, on-terminal trucks, and rail yard cargo-handling equipment were assigned a release height of 15 feet, which is the approximate average height of the exhaust port plus a nominal amount of plume rise.

Emissions from yard locomotives and idling line-haul locomotives at the proposed on-dock rail yard and the PHL rail yard were assigned a release height equal to the average stack height of 15 feet plus a minimum vertical plume rise. Based on a screening-level modeling analysis conducted for the Roseville Rail yard Study, a minimum plume rise of 6.8 feet was assumed for slow-moving (Notch 1) or idling locomotives (CARB 2004c). Hence, the rail yard locomotives were modeled as elevated volume sources with a release height of 20 feet.

5. **Roadways and railways.** Truck movements on roadways and train movements on rail lines were modeled as a series of separated volume sources, as recommended for the simulation of line sources in the ISCST User's Guide (USEPA 1995). Roadways were divided into links that have uniform average speeds and widths. Average roadway speeds were estimated using California Department of Transportation (Caltrans) guidelines for peak-hour conditions (Caltrans 1997). The rail line was assumed to have uniform width and average speed over the entire segment from the Berths 136-147 rail yard to the Anaheim Street crossing. Therefore, the source characteristics for each volume source along a given link are identical except for the centerpoint locations. Total link emissions were divided equally among the number of sources in a given link.

   Emissions from trucks within roadways were assigned a release height of 10 feet, which is the approximate average height of the exhaust port. Emissions from trains were assigned a release height equal to the average stack height of 15 feet. Based on a screening-level modeling analysis conducted for the Roseville Railyard Study, a minimum of 5.1 feet in the rise of the plume was assumed for locomotives moving 9 mph (alternating between Notch 1 and Notch 2) (CARB 2004c). The width of the volume sources for roadways and rail lines were set equal to the width of the roadway or rail corridor plus 3 meters on each side.

The HRA positioned emission sources with the use of the Universal Transverse Mercator (UTM) coordinate system (NAD-27) referenced to topographic data obtained from the USGS.

## 4.2 Meteorological Data

Due to the blocking effect of the Palos Verdes Hills, wide variations in wind conditions often occur within the Port. 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 from different directions. The monthly and hourly streamlines developed for the South Coast Air Basin in *California South Coast Air Basin Hourly Wind Flow Patterns* show this difference in wind conditions between the inner and outer harbor regions (SCAQMD 1977).

The Port has operated an air quality monitoring program since February 2005 that includes the collection of meteorological data from four locations within the Port area (Port 2004). Figures D3-6 through D3-9 present annual wind roses generated for each of these monitoring stations. As part of this effort, annual meteorological data sets were developed for purposes of dispersion modeling analyses.

Due to the varying wind conditions within the Port region, the most accurate way to perform the project HRA was to split the modeling domain into distinct Inner/Outer Harbor Port meteorological areas. The boundary between these two areas is roughly a line from the eastern end of 22nd Street to the Pier 300 wharf face. The stations within the Port-wide network that were chosen to simulate meteorological conditions within these areas include (1) the Saints Peter and Paul School, about one mile north of the Berths 136-147 terminal in Wilmington (Inner Harbor) and (2) the Berth 47 location, about 1.3 miles west-northwest of Angel's Gate (Outer Harbor). The modeling results for each meteorological domain were summed at each common receptor point to produce total impacts from a Project scenario.

### 4.3 Model Options

For the most part, the ISCST3 modeling analyses used the USEPA regulatory ISCST3 default options for all modeling runs. As recommended by the SCAQMD, however, the analyses used urban dispersion parameters and the no calms processing routine (SCAQMD 2002).

Table D3-2 displays data used by the HRA to temporally distribute emissions from the Berths 136-147 Terminal Project over a 24-hour period (ARB 2006). The analysis assumed that construction emissions would occur from 0800 to 1200 and 1300 to 1700 local time.

## 5.0 CALCULATION OF HEALTH RISKS

The results of the ISCST3 dispersion modeling analysis represent an intermediate product in the HRA process. The HARP model subsequently was used to determine cancer risk and health effects from acute and chronic exposure from Project emission sources by factoring pollutant concentrations by pollutant-specific cancer potency values and/or acute and chronic reference exposure levels (RELs) obtained from OEHHA (CARB 2005b).

### 5.1 Toxicity Factors

The inhalation cancer potency factor is equal to 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 with the use of the most recent assessment algorithms (OEHHA 2003).

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

Table D3-4 presents the cancer, chronic noncancer, and acute noncancer toxicity factors used to assess health risks in this study.

## 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.** The HRA estimated cancer risks for residential and sensitive receptors with the use of 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 the inhalation pathway only (as appropriate for DPM), where a single cancer risk value is required for a risk management decision, the ARB policy recommends that the potential cancer risk be based on the breathing rate representing the 80$^{th}$ percentile for a 70-year exposure period. The 80$^{th}$ percentile lifetime breathing rate is equal to 302 liters per kilogram of body weight per day (L/kg BW-day) (ARB 2004). Therefore, the HRA determined maximum residential and sensitive receptor cancer risk impacts by using HARP's built-in 80$^{th}$ percentile point estimate analysis method (inhalation only) and an exposure duration of 24 hours per day, 350 days per year, and 70 years (i.e., the "Derived [Adjusted]" risk calculation method). As supplemental information, residential and sensitive receptor cancer risks were also calculated using a 65$^{th}$ percentile ("average") breathing rate of 271 L/kg BW-day and a 95$^{th}$ percentile ("high end") breathing rate of 393 L/kg BW-day.

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 presence of 8 hours per day, 245 days per year (HARP uses a value of 245.7), for 40 years (as recommended by OEHHA [2003]). This exposure time produces an adjustment factor of (8 × 245.7 × 40)/(24 × 350 × 70) = 0.134. This factor is further modified to account for differences in the breathing rate of workers compared to the 80$^{th}$ percentile lifetime breathing rate. The breathing rate for workers is equal to 447 L/kg BW-day, which equates to 149 L/kg BW-day over an 8-hour work day (OEHHA 2003). Therefore, the residential risk values predicted at occupational receptors were multiplied by (0.134 × 447 / 302) = 0.20 to produce the maximum occupational impacts actually expected from the project.

**Table D3-4. Toxicity Factors Used in the HRA**

| Pollutant | CAS Number | Inhalation Cancer Potency Factor $(mg/kg\text{-}d)^{-1}$ | Chronic Inhalation REL ($\mu g/m^3$) | Target Organ for Chronic Exposure | Acute Inhalation REL ($\mu g/m^3$) | Target Organ for Acute Exposure |
|---|---|---|---|---|---|---|
| DPM [1] | 9901 | 1.1 | 5 | I | — | — |
| Benzene [2] | 71432 | — | — | — | 1,300 | C,E,F,H |
| Formaldehyde | 50000 | — | — | — | 94 | D,F,I |
| Xylenes | 1210 | — | — | — | 22,000 | D,I |
| Methanol | 67561 | — | — | — | 28,000 | G |
| MEK | 78933 | — | — | — | 13,000 | D,I |
| Styrene | 100425 | — | — | — | 21,000 | D,I |
| Toluene | 108883 | — | — | — | 37,000 | C,D,G,H,I |
| Ammonia | 7664417 | — | — | — | 3,200 | D,I |
| Arsenic [2] | 7440382 | — | — | — | 0.19 | C,H |
| Copper | 7440508 | — | — | — | 100 | I |
| Mercury [3] | 7439976 | — | — | — | 1.8 | C,H |
| Nickel [3] | 7440020 | — | — | — | 6.0 | F,I |
| Sulfates | 9960 | — | — | — | 120 | I |
| Vanadium | 7440622 | — | — | — | 30 | D,I |

Notes:

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 the acute hazard indices, DPM was not evaluated; rather, emissions of the 14 other toxic air contaminants were evaluated for all emission sources.
2. The acute exposure period is 1 hour for all compounds except benzene (6 hours) and arsenic (4 hours).

Key to noncancer acute and chronic exposure target organs:

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

Source: CARB 2005b.

3. **Student impacts**. Since HARP does not directly compute risks for student receptors, risks to students were scaled from the results for residents. It is the policy of the SCAQMD to evaluate student cancer risk impacts based upon 70 years of exposure. However, students actually spend a limited time at a given school. Based upon 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 × 180 × 6)/(24 × 350 × 70) = 0.011. This factor is further modified to account for differences in the breathing rate of children compared to the 80th percentile lifetime breathing rate. The high-end breathing rate for children is equal to 581 L/kg BW-day (OEHHA 2003). Therefore, the risk values predicted at school sites were multiplied by (0.011 × 581 / 302) = 0.021 to produce the maximum student impacts actually expected from the project. As supplemental information, the risk values assuming a SCAQMD-recommended full 70 years of exposure are also reported in this HRA.

4. **Recreational user impacts**. Because HARP does not directly compute risks for recreational exposure assumptions, risks for recreational receptors were scaled from the results for residents. Based upon an assumed maximum recreational presence of 2 hours per day, 350 days per year, for 70 years, an adjustment factor of (2 × 350 × 70)/(24 × 350 × 70) = 0.0833 is produced. This factor is further modified to account for differences in the breathing rate of a person engaged in recreation compared to the 80th percentile lifetime breathing rate. The breathing rate during recreation is assumed to be a "heavy activity" rate equal to 1,097 L/kg BW-day, which was obtained from the U.S. EPA *Exposure Factors Handbook* (EPA, 1997). Therefore, the risk values predicted in recreation areas were multiplied by (0.0833 × 1,097 / 302) = 0.30 to produce the maximum recreational user impacts expected from the project.

Table D3-5 summarizes the primary exposure assumptions used to calculate individual lifetime cancer risks by receptor type.

## 6.0 SIGNIFICANCE CRITERIA FOR PROJECT HEALTH RISKS

For the determination of significance from a California Environmental Quality Act (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 National Environmental Policy Act (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 (Project minus CEQA baseline and Project minus NEPA baseline) were compared to the significance thresholds described below.

The SCAQMD has established thresholds to determine the significance of health impacts from proposed land use development projects (SCAQMD 2005a). Based on these thresholds, a project would produce less than significant cancer risk impacts if the maximum incremental cancer risk due to the project alone were less than 10 chances in 1 million ($10 \times 10^{-6}$). The Port has adopted this SCAQMD threshold as being an acceptable risk level for new projects. To determine a project's significance, the HRA compared the CEQA and NEPA increments for all receptor types to the 10 in a million threshold.

For chronic and acute noncancer exposures, the HRA compared maximum predicted annual and 1-hour TAC concentrations to applicable 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.

**Table D3-5. 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:

1. The residential breathing rate of 302 L/kg BW-day represents the 80th percentile breathing rate. For informational purposes, residential cancer risks were also calculated for a 65th percentile ("average") breathing rate of 271 L/kg BW-day and a 95th percentile ("high end") breathing rate of 393 L/kg BW-day (OEHHA 2003).
2. 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).
3. The student breathing rate of 581 L/kg BW-day represents the high end child breathing rate (OEHHA 2003).
4. 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.

# 7.0 PREDICTED HEALTH IMPACTS

## 7.1 Unmitigated Proposed Project Health Impacts

Table D3-6 presents a summary of the maximum health impacts that would occur for each receptor type with operation of the unmitigated proposed Project. The table shows the maximum health impacts from the CEQA baseline and NEPA baseline scenarios, as well as the CEQA increment (Project minus CEQA baseline) and NEPA increment (Project minus NEPA baseline). The analysis compares the CEQA and NEPA increments to the significance thresholds established by the SCAQMD. Since the data in Table D3-6 correspond to the maximum incremental impacts predicted for each receptor type, the incremental impacts at all other receptor locations would be less than these values.

Table D3-6 shows that the maximum CEQA increment for residential cancer risk is predicted to be 155 in a million ($155 \times 10^{-6}$). This risk value exceeds the significance criterion of 10 in a million ($10 \times 10^{-6}$) risk; this impact would be significant under CEQA. This impact would occur just northeast of the intersection of C Street and Mar Vista Avenue in Wilmington. The maximum cancer risk increments at an off-site occupational (near the corner of Fries Avenue and La Paloma Street), sensitive, and recreational receptor also would exceed the 10 in a million significance criterion. The maximum cancer risk increment at a student receptor would be less than significant.

The prediction for the maximum CEQA increment for acute non-cancer effects would exceed the 1.0 hazard index significance criterion at residential, occupational, and recreational receptors in proximity to the Project terminal. The maximum occupational and recreational impacts would occur along Fries Avenue south of Pier A Street and in the southwest portion of the HBB Buffer. The maximum CEQA increment for acute non-cancer effects to student receptor types would remain below the 1.0 hazard index significance criterion. The prediction for the maximum CEQA increment for chronic non-cancer effects would remain below the significance criterion of 1.0 at all receptor types.

Table D3-6 shows that the maximum NEPA increment for residential cancer risk predicted for the unmitigated proposed Project is 229 in a million ($229 \times 10^{-6}$), which exceeds the significance criterion of 10 in a million risk; this impact would be significant under NEPA. This impact would occur just northeast of the intersection of C Street and Mar Vista Avenue, in the same location as the CEQA incremental impact. The maximum cancer risk increments at an off-site occupational (also near the corner of Fries Avenue and La Paloma Street), sensitive, and recreational receptor also would exceed the 10 in a million significance criterion.

The prediction for the maximum NEQA increment for acute non-cancer effects would exceed the 1.0 hazard index significance criterion at all receptor types in proximity to the Project terminal. These maximum impacts would occur (1) in the vicinity of C Street and Gulf Avenue (residential), (2) along La Paloma Street (occupational), (3) near Wilmington Boulevard and D Street (sensitive), (4) at Hawaiian Avenue Elementary School (student), and (5) in the southern portion of the HBB Buffer (recreational). The prediction for the maximum NEPA increment for chronic non-cancer effects would remain well below the 1.0 hazard index significance criterion at all receptor types.

Figures D3-10 through D3-14 show the distribution of predicted residential cancer risks within the modeling domain for the following scenarios: (1) CEQA Baseline, (2) NEPA Baseline, (3) unmitigated Project, (4) unmitigated CEQA increment (unmitigated Project minus CEQA Baseline), and (5) unmitigated NEPA increment (unmitigated Project minus NEPA Baseline). As an explanation of the incremental cancer risks presented in these figures, the Project unmitigated CEQA cancer risk increment shown in Figure D3-13 is obtained by subtracting the data in Figure D3-10 (CEQA Baseline cancer risk) from Figure D3-12 (unmitigated Project cancer risk). The residential exposure conditions associated with these figures are 24 hours per day, 350 days per year, for 70 years and an 80th percentile breathing rate.

Table D3-7 identifies how unmitigated Project emission source categories would contribute to the maximum residential and occupational impact locations for their respective CEQA cancer increments. The main contributors of Project emissions to the maximum residential cancer risk location northeast of the intersection of C Street and Mar Vista Avenue include (1) 70 percent by ship hoteling, (2) 12 percent by terminal and rail yard equipment, (3) 9 percent by off-site trucks, and (4) 4 percent by on-terminal trucks. Container vessel emissions that occur outside of the Port within the precautionary area and fairway zones would contribute approximately 1 percent of the total cancer risk at this location. Operational emissions from the relocated PHL rail yard would contribute to less than 0.1 percent of the risk at this location.

**Table D3-6. Maximum Health Impacts due to the Proposed Project Without Mitigation**

| *Health Impact* | *Receptor Type* | MAXIMUM PREDICTED INCREMENTAL IMPACTS[1] | | | | | | *Significance Threshold*[3] |
|---|---|---|---|---|---|---|---|---|
| | | *Proposed Project* | *CEQA Baseline* | *CEQA Increment*[2] | *Proposed Project* | *NEPA Baseline* | *NEPA Increment*[2] | |
| Cancer Risk | Residential | $272 \times 10^{-6}$ | $117 \times 10^{-6}$ | **$155 \times 10^{-6}$** | $272 \times 10^{-6}$ | $43 \times 10^{-6}$ | **$229 \times 10^{-6}$** | $10 \times 10^{-6}$ |
| | Occupational | $146 \times 10^{-6}$ | $49 \times 10^{-6}$ | **$98 \times 10^{-6}$** | $146 \times 10^{-6}$ | $20 \times 10^{-6}$ | **$127 \times 10^{-6}$** | |
| | Sensitive | $183 \times 10^{-6}$ | $70 \times 10^{-6}$ | **$113 \times 10^{-6}$** | $183 \times 10^{-6}$ | $30 \times 10^{-6}$ | **$153 \times 10^{-6}$** | |
| | Student | $3.8 \times 10^{-6}$ | $1.5 \times 10^{-6}$ | $2.4 \times 10^{-6}$ | $3.8 \times 10^{-6}$ | $0.6 \times 10^{-6}$ | $3.2 \times 10^{-6}$ | |
| | Recreational | $109 \times 10^{-6}$ | $48 \times 10^{-6}$ | **$61 \times 10^{-6}$** | $115 \times 10^{-6}$ | $20 \times 10^{-6}$ | **$95 \times 10^{-6}$** | |
| Chronic Hazard Index | Residential | 0.50 | 0.32 | 0.18 | 0.57 | 0.25 | 0.32 | 1.0 |
| | Occupational | 0.89 | 0.57 | 0.32 | 0.86 | 0.39 | 0.47 | |
| | Sensitive | 0.38 | 0.22 | 0.16 | 0.38 | 0.18 | 0.20 | |
| | Student | 0.31 | 0.20 | 0.11 | 0.31 | 0.14 | 0.17 | |
| | Recreational | 0.83 | 0.46 | 0.37 | 0.85 | 0.38 | 0.47 | |
| Acute Hazard Index[4] | Residential | 3.60 | 2.47 | **1.13** | 3.60 | 1.83 | **1.77** | 1.0 |
| | Occupational | 4.01 | 2.62 | **1.39** | 4.57 | 2.38 | **2.19** | |
| | Sensitive | 3.35 | 2.33 | **1.02** | 3.35 | 1.72 | **1.63** | |
| | Student | 2.77 | 1.92 | 0.85 | 2.77 | 1.42 | **1.35** | |
| | Recreational | 4.65 | 3.21 | **1.44** | 4.76 | 2.47 | **2.29** | |

*Notes:*

(1) Data represent project scenario impacts that contribute to maximum CEQA/NEPA incremental impacts.

(2) The CEQA Increment represents proposed Project impact minus CEQA Baseline impact. The NEPA Increment represents proposed Project impact minus NEPA Baseline impact.

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

(4) For the acute hazard index, two possible maximum 1-hour scenarios were modeled: (1) one ship hoteling and one ship harbor transiting, turning, and docking; and (2) two ships hoteling. The scenario that yielded the highest result is reported for each impact type.

**Table D3-7. Unmitigated Project Source Contributions at the Maximum Residential and Occupational CEQA Cancer Increment Locations.**

| Emission Source | Maximum Residential Receptor Cancer Risk | Maximum Occupational Receptor Cancer Risk |
|---|---|---|
| Ships - Fairway Transit | 0.5% | 0.2% |
| Ships - Precautionary Area Transit | 0.2% | 0.1% |
| Ships - Harbor Travel | 3.4% | 2.3% |
| Ships – Hoteling | 69.8% | 80.4% |
| Tugboats - Harbor Travel & Turning and Docking | 0.5% | 0.5% |
| Terminal and rail yard Equipment | 12.2% | 8.4% |
| Trucks – On-Terminal | 3.6% | 2.7% |
| Trucks - Off-Terminal | 9.0% | 1.5% |
| Trains - ICTF | 0.5% | 3.7% |
| Trains - PHL | 0.0% | 0.0% |
| Trains - Haul from ICTF to Anaheim | 0.1% | 0.1% |
| Construction | 0.3% | 0.2% |

## 7.2 Mitigated Proposed Project Health Impacts

This HRA evaluated how **Mitigation Measures AQ-6** through **AQ-18** identified in Section 3.2 of the EIS/EIR would reduce unmitigated public health impacts from the proposed Project. However, given the uncertainty of implementing **Mitigation Measures AQ-13** through **AQ-18**, the mitigated HRA only considered the effects of **Mitigation Measures AQ-6** through **AQ-12.** To be conservative, the mitigated HRA did not apply mitigations to construction sources of DPM.

Figures D3-15 through D3-17 show the distribution of predicted residential cancer risks for the (1) mitigated Project, (2) mitigated CEQA increment (mitigated Project minus CEQA Baseline), and (3) mitigated NEPA increment (mitigated Project minus NEPA Baseline).

Table D3-8 summarizes the maximum health impacts predicted to occur from the operation of the proposed Project with mitigation. An analysis was not performed for mitigated chronic non-cancer effects, due to the minimal unmitigated values of the Project increments. Table D3-8 shows that the maximum CEQA increment for residential cancer risk predicted for the mitigated Project is reduced to 1.4 in a million ($1.4 \times 10^{-6}$), which is less than the significance criterion of 10 in a million. The location of this impact is near Berth 202 within the Consolidated Slip Marina in association with a live aboard. Table D3-8 also shows that the maximum mitigated Project CEQA cancer risk increments at other receptor types would remain below the 10 in a million significance criterion. Review of Figure D3-16 shows that the mitigated Project would produce lower residential cancer risks compared to the CEQA Baseline within the entire modeling domain except for a small area that encompasses the Consolidated Slip that is northeast of the Berths 136-147 terminal.

Table D3-8 shows that the mitigated Project would reduce maximum CEQA increments for acute non-cancer effects to below the 1.0 hazard index significance criterion at all receptor types.

The maximum NEPA increment for residential, occupational, and sensitive cancer risks predicted for the mitigated Project is 20, 10.1, and 13.6 in a million, meaning that the mitigated Project would produce significant cancer risks compared to the NEPA Baseline to these receptor types. The location of the maximum residential impact is just northeast of the intersection of C Street and Mar Vista Avenue, in the same location as the maximum NEPA incremental impact for the unmitigated Project. This location differs from the location of the maximum CEQA incremental residential cancer risk for the mitigated Project. This is due to the differences in the locations and magnitudes of emissions between these four scenarios. As an example, the following main contributors of Project emissions to maximum mitigated NEPA residential cancer risk at this impact location differ from those that produced the maximum mitigated CEQA residential cancer risk: (1) 39 percent by ships hoteling (mainly from boiler emissions), (2) 31 percent by terminal and rail yard equipment, (3) 16 percent by off-site trucks, and (4) 5 percent by on-terminal trucks. Container vessel emissions that occur outside of the Port within the Precautionary area and fairway zones would contribute approximately 0.5 percent of the total cancer risk at this location.

Table D3-8 shows that the mitigated Project would reduce maximum NEPA increments for acute non-cancer effects to below the 1.0 hazard index significance criterion at all receptor locations. As a result, acute non-cancer impacts from the mitigated Project would be less than significant under NEPA.

Table D3-9 identifies how mitigated Project emission source categories would contribute to the maximum residential and occupational impact locations for their respective CEQA cancer increments. The main contributors of Project emissions to the maximum mitigated CEQA residential cancer risk location within the Consolidated Slip Marina include (1) 30 percent by locomotives that haul cargo along the rail line that parallels Alameda Street, (2) 20 percent by ships hoteling (mainly from boiler emissions), (3) 17 percent by locomotives within the relocated PHL rail yard, and (4) 12 percent by off-site trucks. Container vessel emissions that occur outside of the Port within the Precautionary area and fairway zones would contribute approximately 2 percent of the total cancer risk at this location.

**Table D3-8. Maximum Health Impacts due to the Proposed Project After Mitigation**

| *Health Impact* | *Receptor Type* | MAXIMUM PREDICTED IMPACT[1] | | | | | | *Significance Threshold*[3] |
|---|---|---|---|---|---|---|---|---|
| | | *Mitigated Proposed Project* | *CEQA Baseline* | *CEQA Increment*[2] | *Mitigated Proposed Project* | *NEPA Baseline* | *NEPA Increment*[2] | |
| Cancer Risk | Residential | 15.0 × $10^{-6}$ | 13.6 × $10^{-6}$ | 1.4 × $10^{-6}$ | 62.7× $10^{-6}$ | 42.7 × $10^{-6}$ | 20.0 × $10^{-6}$ | 10 × $10^{-6}$ |
| | Occupational | 2.9 × $10^{-6}$ | 1.6 × $10^{-6}$ | 1.3 × $10^{-6}$ | 29.6 × $10^{-6}$ | 19.5 × $10^{-6}$ | 10.1 × $10^{-6}$ | |
| | Sensitive | 4.8 × $10^{-6}$ | 7.3 × $10^{-6}$ | -2.5. × $10^{-6}$ | 43.2 × $10^{-6}$ | 29.6 × $10^{-6}$ | 13.6 × $10^{-6}$ | |
| | Student | .01 × $10^{-6}$ | 0.2 × $10^{-6}$ | -0.1 × $10^{-6}$ | 0.9 × $10^{-6}$ | 0.6 × $10^{-6}$ | 0.3 × $10^{-6}$ | |
| | Recreational | 14.7 × $10^{-6}$ | 16.7 × $10^{-6}$ | -2.0 × $10^{-6}$ | 28.0 × $10^{-6}$ | 19.8 × $10^{-6}$ | 8.2 × $10^{-6}$ | |
| Acute Hazard Index[4] | Residential | 1.85 | 1.72 | 0.13 | 2.51 | 1.87 | 0.64 | 1.0 |
| | Occupational | 2.44 | 2.23 | 0.21 | 3.19 | 2.38 | 0.81 | |
| | Sensitive | 1.12 | 1.05 | 0.07 | 2.32 | 1.72 | 0.60 | |
| | Student | 1.53 | 1.45 | 0.08 | 1.93 | 1.42 | 0.51 | |
| | Recreational | 3.19 | 3.21 | (0.02) | 3.32 | 2.47 | 0.85 | |

*Notes:*

(1) Data represent project scenario impacts that contribute to maximum CEQA/NEPA incremental impacts.

(2) The CEQA Increment represents proposed Project impact minus CEQA Baseline impact. The NEPA Increment represents proposed Project impact minus NEPA baseline impact.

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

(4) For the acute hazard index, two possible maximum 1-hour scenarios were modeled: (1) one ship hoteling and one ship harbor transiting, turning, and docking; and (2) two ships hoteling. The scenario that yielded the highest result is reported for each impact type.

(5) Mitigation measures quantified in this HRA for the Mitigated Project include **AQ-6** through **AQ-12.** The HRA did not consider mitigated chronic non-cancer effects, as these unmitigated effects were less than significant.

**Table D3-9. Mitigated Project Source Contributions at the Maximum Residential and Occupational CEQA Cancer Increment Locations.**

| Emission Source | Maximum Residential Receptor Cancer Risk | Maximum Occupational Receptor Cancer Risk |
|---|---|---|
| Ships - Fairway Transit | 1.2% | 1.2% |
| Ships - Precautionary Area Transit | 0.7% | 0.7% |
| Ships - Harbor Travel | 2.8% | 2.2% |
| Ships – Hoteling | 19.7% | 10.9% |
| Tugboats - Harbor Travel & Turning and Docking | 1.3% | 0.8% |
| Terminal and rail yard Equipment | 8.0% | 4.1% |
| Trucks – On-Terminal | 1.6% | 0.8% |
| Trucks - Off-Terminal | 12.4% | 2.0% |
| Trains - ICTF | 1.0% | 0.6% |
| Trains - PHL | 16.7% | 7.9% |
| Trains - Haul from ICTF to Anaheim | 29.5% | 66.4% |
| Construction | 5.1% | 2.4% |

### 7.3 No Project (Alternative 1) Health Impacts

Under the No Project Alternative 1, the existing Berths 136-147 container terminal would continue to operate without any new development on the existing 176-acre facility. Container throughput and associated emission source activities in future years would increase from current levels, but at a slower rate then the proposed Project.

An analysis to evaluate public cancer risks generated by No Project operational emissions of TACs was performed by the same methods used for the proposed Project cancer analysis. Figure D3-3 shows the locations of No Project emission sources simulated in the ISCST3 modeling analyses (this simulation also applies to the CEQA baseline scenario). Non-cancer effects from No Project TACs were estimated by multiplying the results of the proposed Project non-cancer analysis with the ratio of No Project to proposed Project operational emissions that would occur within the Berths 136-147 terminal and in direct proximity to the facility during year 2010. Emission sources considered in this comparison include (1) OGV and tug harbor transit within 1 mile of Berths 136-147, (2) OGV hoteling, (3) terminal and rail yard equipment, (4) trains and truck within 1 mile of the terminal, and (5) locomotives within the Pier A railyard. This approach produced adequate results, as the operational locations and activities of most emission sources are similar for both the proposed Project and Project Alternative scenarios.

Table D3-10 presents a summary of the maximum health impacts that would occur for each receptor type due to the operation of the No Project Alternative. These data show that the maximum CEQA increment for residential cancer risk predicted for the unmitigated No Project Alternative is 107 in a million ($107 \times 10^{-6}$), which exceeds the significance criterion of 10 in a million. The location of this impact is near the intersection of C Street and Mar Vista Avenue in Wilmington. The maximum cancer risk increments at an occupational, sensitive, and recreational receptor also would exceed the 10 in a million significance criterion. The maximum cancer risk increment at a student receptor would be less than significant. The maximum CEQA increments for non-cancer effects would not exceed the significance criterion of 1.0 at any receptor type. Therefore, operational activities from the No Project Alternative would produce significant cancer risks under CEQA.

Figures D3-18 and D3-19 show the distribution of predicted residential cancer risks for the (1) No Project and (2) No Project CEQA increment (unmitigated Alternative 1 minus CEQA Baseline).

## 7.4 Proposed Project without the 10-Acre Fill (Alternative 2) Health Impacts

Alternative 2 would produce operational emissions that are (1) equal those estimated for the proposed Project in years 2007 and 2015 and (2) greater by less than two percent than the proposed Project in years 2010 and 2038. In other words, emissions and ambient impacts produced from Alternative 2 are essentially equal to those estimated for the proposed Project. Therefore, the description of health impacts from the unmitigated and mitigated Project in sections 7.1 and 7.2 also would also describe potential health impacts associated with Alternative 2.

## 7.5 Reduced Wharf (Alternative 3) Health Impacts

An analysis to evaluate public cancer risks generated by Alternative 3 operational emissions of TACs was performed by the same methods used for the proposed Project cancer analysis. Non-cancer effects from Alternative 3 TACs were estimated by multiplying the results of the proposed Project non-cancer analysis with the ratio of Alternative 3 to proposed Project operational emissions that would occur within the Berths 136-147 terminal and in direct proximity to the facility during year 2010.

Table D3-11 presents a summary of the maximum health impacts that would occur for each receptor type due to the operation of Alternative 3. These data show that the maximum CEQA increment for residential cancer risk is predicted to be 122 in a million. This risk value exceeds the significance criterion of 10 in a million. The maximum cancer risk increments at occupational, sensitive, and recreational receptors also would exceed the 10 in a million significance criterion. The maximum cancer risk increment at a student receptor would be less than significant. The maximum CEQA increment for chronic and acute non-cancer effects to all receptor types would remain below the significance criterion of 1.0.

The maximum NEPA increment for residential cancer risk predicted for the unmitigated Alternative 3 is 197 in a million, which exceeds the significance criterion of 10 in a million. The maximum cancer risk increments at occupational, sensitive, and recreational receptors also would exceed the 10 in a million significance criterion. The maximum cancer risk increment at a student receptor would be less than significant. The maximum NEPA increment for chronic and acute non-cancer effects to all receptor types would remain below the significance criterion of 1.0.

**Table D3-10. Maximum Health Impacts due to the No Project Alternative without Mitigation.**

| *Health Impact* | *Receptor Type* | MAXIMUM PREDICTED IMPACT[1] | | | | | | *Significance Threshold3* |
|---|---|---|---|---|---|---|---|---|
| | | *No Project* | *CEQA Baseline* | *CEQA Increment*[2] | | | | |
| Cancer Risk | Residential | $224 \times 10^{-6}$ | $117 \times 10^{-6}$ | $\mathbf{107 \times 10^{-6}}$ | | | | 10 × 10-6 |
| | Occupational | $97 \times 10^{-6}$ | $48 \times 10^{-6}$ | $\mathbf{49 \times 10^{-6}}$ | | | | |
| | Sensitive | $134 \times 10^{-6}$ | $70 \times 10^{-6}$ | $\mathbf{64 \times 10^{-6}}$ | | | | |
| | Student | $2.8 \times 10^{-6}$ | $1.5 \times 10^{-6}$ | $1.3 \times 10^{-6}$ | | | | |
| | Recreational | $103\times 10^{-6}$ | $55. \times 10^{-6}$ | $\mathbf{48 \times 10^{-6}}$ | | | | |
| Chronic Hazard Index | Residential | | | 0.07 | | | | 1.0 |
| | Occupational | | | 0.13 | | | | |
| | Sensitive | | | 0.08 | | | | |
| | Student | | | 0.04 | | | | |
| | Recreational | | | 0.19 | | | | |
| Acute Hazard Index[4] | Residential | | | 0.37 | | | | 1.0 |
| | Occupational | | | 0.54 | | | | |
| | Sensitive | | | 0.31 | | | | |
| | Student | | | 0.26 | | | | |
| | Recreational | | | 0.45 | | | | |

*Notes:* (1) Data represent project scenario impacts that contribute to maximum CEQA incremental impacts.

(2) The CEQA Increment represents No Project impact minus CEQA Baseline impact. However, non-cancer increments were estimated by factoring proposed Project incremental results with the ratio of No Project/proposed Project emissions.

(3) Exceedances of the significance criteria are in bold. The significance thresholds only apply to the CEQA increments.

(4) For the acute hazard index, two possible maximum 1-hour scenarios were modeled: (1) one ship hoteling and one ship harbor transiting, turning, and docking; and (2) two ships hoteling. The scenario that yielded the highest result is reported for each impact type.

No federal action would occur for the No Project Alternative; thus, no impacts to Health Impacts would result under NEPA.

**Table D3-11. Maximum Health Impacts due to Alternative 3 Without Mitigation**

| *Health Impact* | *Receptor Type* | MAXIMUM PREDICTED IMPACT[1] | | | | | | *Significance Threshold*[3] |
|---|---|---|---|---|---|---|---|---|
| | | *Alternative 3* | *CEQA Baseline* | *CEQA Increment*[2] | *Alternative 3* | *NEPA Baseline* | *NEPA Increment*[2] | |
| Cancer Risk | Residential | $239 \times 10^{-6}$ | $117 \times 10^{-6}$ | **$122 \times 10^{-6}$** | $239 \times 10^{-6}$ | $43 \times 10^{-6}$ | **$197 \times 10^{-6}$** | $10 \times 10^{-6}$ |
| | Occupational | $114 \times 10^{-6}$ | $48 \times 10^{-6}$ | **$67 \times 10^{-6}$** | $114 \times 10^{-6}$ | $16 \times 10^{-6}$ | **$99 \times 10^{-6}$** | |
| | Sensitive | $155 \times 10^{-6}$ | $70 \times 10^{-6}$ | **$85 \times 10^{-6}$** | $155 \times 10^{-6}$ | $30 \times 10^{-6}$ | **$125 \times 10^{-6}$** | |
| | Student | $3.3 \times 10^{-6}$ | $1.5 \times 10^{-6}$ | $1.8 \times 10^{-6}$ | $3.3 \times 10^{-6}$ | $0.6 \times 10^{-6}$ | $2.6 \times 10^{-6}$ | |
| | Recreational | $97 \times 10^{-6}$ | $49 \times 10^{-6}$ | **$49 \times 10^{-6}$** | $102 \times 10^{-6}$ | $20 \times 10^{-6}$ | **$82 \times 10^{-6}$** | |
| Chronic Hazard Index | Residential | | | 0.11 | | | 0.24 | 1.0 |
| | Occupational | | | 0.19 | | | 0.35 | |
| | Sensitive | | | 0.11 | | | 0.15 | |
| | Student | | | 0.07 | | | 0.13 | |
| | Recreational | | | 0.25 | | | 0.35 | |
| Acute Hazard Index[4] | Residential | | | 0.61 | | | **1.25** | 1.0 |
| | Occupational | | | 0.82 | | | **1.53** | |
| | Sensitive | | | 0.54 | | | **1.15** | |
| | Student | | | 0.45 | | | 0.95 | |
| | Recreational | | | 0.77 | | | **1.61** | |

*Notes:*

(1) Data represent project scenario impacts that contribute to maximum CEQA/NEPA incremental impacts.

(2) The CEQA Increment represents Alternative 3 impact minus CEQA Baseline impact. The NEPA Increment represents Alternative 3 impact minus NEPA baseline impact. However, non-cancer increments estimated by factoring proposed Project incremental results with the ratio of Alternative 3/proposed Project emissions.

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

(4) For the acute hazard index, two possible maximum 1-hour scenarios were modeled: (1) one ship hoteling and one ship harbor transiting, turning, and docking; and (2) two ships hoteling. The scenario that yielded the highest result is reported for each impact type.

Figures D3-20 through D3-22 show the distribution of predicted residential cancer risks for (1) unmitigated Alternative 3, (2) unmitigated CEQA increment (unmitigated Alternative 3 minus CEQA Baseline), and (3) unmitigated NEPA increment (unmitigated Alternative 3 minus NEPA Baseline).

Consistent with the approach taken to mitigate health impacts from the proposed Project, the mitigated HRA considered the ability of **Mitigation Measures AQ-6** through **AQ-12** to reduce emissions of TACs from Alternative 3. Table D3-12 summarizes the maximum health impacts predicted to occur at each receptor type due to the operation of Alternative 3 with mitigation. An analysis was not performed for mitigated chronic non-cancer effects, due to the minimal unmitigated values of the Alternative increments. Implementation of **Mitigation Measures AQ-**

**6** through **AQ-12** would reduce predicted cancer and non-cancer public health impacts from Alternative 3 to less than significant levels under CEQA and NEPA.

**Table D3-12. Maximum Health Impacts due to Alternative 3 after Mitigation.**

| *Health Impact* | *Receptor Type* | MAXIMUM PREDICTED IMPACT[1] | | | | | | *Significance Threshold*[3] |
|---|---|---|---|---|---|---|---|---|
| | | *Alternative 3* | *CEQA Baseline* | *CEQA Increment*[2] | *Alternative 3* | *NEPA Baseline* | *NEPA Increment*[2] | |
| Cancer Risk | Residential | $13.9 \times 10^{-6}$ | $13.6 \times 10^{-6}$ | $0.4 \times 10^{-6}$ | $51.9 \times 10^{-6}$ | $42.7 \times 10^{-6}$ | $9.2 \times 10^{-6}$ | $10 \times 10^{-6}$ |
| | Occupational | $2.8 \times 10^{-6}$ | $1.6 \times 10^{-6}$ | $1.6 \times 10^{-6}$ | $20.7 \times 10^{-6}$ | $15.7 \times 10^{-6}$ | $5.0 \times 10^{-6}$ | |
| | Sensitive | $2.9 \times 10^{-6}$ | $5.7 \times 10^{-6}$ | $-2.8\times 10^{-6}$ | $30.2 \times 10^{-6}$ | $24.5 \times 10^{-6}$ | $5.7 \times 10^{-6}$ | |
| | Student | $0.1 \times 10^{-6}$ | $0.1 \times 10^{-6}$ | $0.0 \times 10^{-6}$ | $0.6 \times 10^{-6}$ | $0..5 \times 10^{-6}$ | $0.1 \times 10^{-6}$ | |
| | Recreational | $12.4\times 10^{-6}$ | $16.7 \times 10^{-6}$ | $4.3 \times 10^{-6}$ | $23.4 \times 10^{-6}$ | $19.8 \times 10^{-6}$ | $3.6 \times 10^{-6}$ | |
| Acute Hazard Index[4] | Residential | | | -0.12 | | | | 1.0 |
| | Occupational | | | -0.12 | | | | |
| | Sensitive | | | -0.08 | | | | |
| | Student | | | -0.13 | | | | |
| | Recreational | | | -0.45 | | | | |

*Notes:*

(1) Data represent project scenario impacts that contribute to maximum CEQA/NEPA incremental impacts.

(2) The CEQA Increment represents Alternative 3 impact minus CEQA Baseline impact. The NEPA Increment represents Alternative 3 impact minus NEPA baseline impact. However, non-cancer increments estimated by factoring proposed Project incremental results with the ratio of Alternative 3/proposed Project emissions.

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

(4) For the acute hazard index, two possible maximum 1-hour scenarios were modeled: (1) one ship hoteling and one ship harbor transiting, turning, and docking; and (2) two ships hoteling. The scenario that yielded the highest result is reported for each impact type.

An analysis was not performed for chronic effects, due to the minimal unmitigated values of the Alternative increments

Figures D3-23 through D3-25 show the geographic distribution of predicted residential cancer risks within the modeling domain for the (1) mitigated Alternative 3, (2) CEQA increment (mitigated Alternative 3 minus CEQA baseline), and (3) NEPA increment (mitigated Alternative 3 minus NEPA baseline).

## 7.6 Omni Terminal (Alternative 4) Health Impacts

An analysis to evaluate public cancer risks generated by Alternative 4 operational emissions of TACs was performed by the same methods used for the proposed Project cancer analysis. Non-cancer effects from Alternative 4 TACs were estimated by multiplying the results of the proposed Project non-cancer analysis with the ratio of Alternative 4 to proposed Project operational emissions that would occur within the Berths 136-147 terminal and in direct proximity to the facility during year 2010.

Table D3-13 presents a summary of the maximum health impacts that would occur for each receptor type due to the operation of Alternative 4. These data show that the maximum cancer and non-cancer CEQA increments due to Alternative 4 would be less than zero and remain below all significance criteria. This is the case, as the Alternative would produce few emissions compared to the CEQA Baseline.

Figures D3-26 and D3-27 show the distribution of predicted residential cancer risks for (1) unmitigated Alternative 4 and (2) unmitigated CEQA increment (unmitigated Alternative 4 minus CEQA Baseline).

**Table D3-13. Maximum Health Impacts due to Alternative 4 Without Mitigation**

| *Health Impact* | *Receptor Type* | MAXIMUM PREDICTED IMPACT[1] | | | | | | *Significance Threshold*[3] |
|---|---|---|---|---|---|---|---|---|
| | | *Alternative 3* | *CEQA Baseline* | *CEQA Increment*[2] | | | | |
| Cancer Risk | Residential | $3.2 \times 10^{-6}$ | $4.5 \times 10^{-6}$ | $-1.3 \times 10^{-6}$ | | | | $10 \times 10^{-6}$ |
| | Occupational | $0.5 \times 10^{-6}$ | $0.7 \times 10^{-6}$ | $-0.21 \times 10^{-6}$ | | | | |
| | Sensitive | $4.0 \times 10^{-6}$ | $5.7 \times 10^{-6}$ | $-1.6 \times 10^{-6}$ | | | | |
| | Student | $0.1 \times 10^{-6}$ | $0.1 \times 10^{-6}$ | $0.0 \times 10^{-6}$ | | | | |
| | Recreational | $9.4 \times 10^{-6}$ | $12.2 \times 10^{-6}$ | $-2.8 \times 10^{-6}$ | | | | |
| Chronic Hazard Index | Residential | | | -0.16 | | | | 1.0 |
| | Occupational | | | -0.29 | | | | |
| | Sensitive | | | -0.10 | | | | |
| | Student | | | -0.10 | | | | |
| | Recreational | | | -0.20 | | | | |
| Acute Hazard Index[4] | Residential | | | -1.33 | | | | 1.0 |
| | Occupational | | | -1.35 | | | | |
| | Sensitive | | | -1.27 | | | | |
| | Student | | | -1.04 | | | | |
| | Recreational | | | -1.74 | | | | |

*Notes:*

(1) Data represent project scenario impacts that contribute to maximum CEQA incremental impacts.

(2) The CEQA Increment represents Alternative 4 impact minus CEQA Baseline impact. However, non-cancer increments estimated by factoring proposed Project incremental results with the ratio of Alternative 4/proposed Project emissions.

(3) Exceedances of the significance criteria are in bold. The significance thresholds only apply to the CEQA increments.

(4) For the acute hazard index, two possible maximum 1-hour scenarios were modeled: (1) one ship hoteling and one ship harbor transiting, turning, and docking; and (2) two ships hoteling. The scenario that yielded the highest result is reported for each impact type.

No federal action would occur for the No Project Alternative; thus, no impacts to Health Impacts would result under NEPA.

## 7.7 Landside Terminal Improvements (Alternative 5) Health Impacts

An analysis to evaluate public cancer risks generated by Alternative 5 operational emissions of TACs was performed by the same methods used for the proposed Project cancer analysis. Non-cancer effects from Alternative 5 TACs were estimated by multiplying the results of the proposed Project non-cancer analysis with the ratio of Alternative 5 to proposed Project operational emissions that would occur within the Berths 136-147 terminal and in direct proximity to the facility during year 2010.

Table D3-14 presents a summary of the maximum health impacts that would occur for each receptor type due to the operation of Alternative 5. These data show that the maximum cancer and non-cancer CEQA increments due to Alternative 5 would remain below all significance criteria.

Figures D3-28 through D3-29 in Appendix D3 show the distribution of predicted residential cancer risks for (1) Alternative 5 and (2) CEQA increment (Alternative 5 minus CEQA Baseline).

**Table D3-14. Maximum Health Impacts due to Alternative 5 Without Mitigation**

| *Health Impact* | *Receptor Type* | MAXIMUM PREDICTED IMPACT[1] | | | | | | *Significance Threshold*[3] |
|---|---|---|---|---|---|---|---|---|
| | | *Alternative 5* | *CEQA Baseline* | *CEQA Increment*[2] | | | | |
| Cancer Risk | Residential | $8.5 \times 10^{-6}$ | $9.8 \times 10^{-6}$ | $-1.4 \times 10^{-6}$ | | | | $10 \times 10^{-6}$ |
| | Occupational | $2.8 \times 10^{-6}$ | $1.6 \times 10^{-6}$ | $1.2 \times 10^{-6}$ | | | | |
| | Sensitive | $4.1 \times 10^{-6}$ | $7.3 \times 10^{-6}$ | $-3.2 \times 10^{-6}$ | | | | |
| | Student | $0.1 \times 10^{-6}$ | $0.2 \times 10^{-6}$ | $-0.1 \times 10^{-6}$ | | | | |
| | Recreational | $6.8 \times 10^{-6}$ | $12.2 \times 10^{-6}$ | $-5.4 \times 10^{-6}$ | | | | |
| Chronic Hazard Index | Residential | | | -0.08 | | | | 1.0 |
| | Occupational | | | 0.14 | | | | |
| | Sensitive | | | -0.04 | | | | |
| | Student | | | -0.05 | | | | |
| | Recreational | | | -0.06 | | | | |
| Acute Hazard Index[4] | Residential | | | -0.74 | | | | 1.0 |
| | Occupational | | | -0.69 | | | | |
| | Sensitive | | | -0.72 | | | | |
| | Student | | | -0.59 | | | | |
| | Recreational | | | -0.97 | | | | |

*Notes:*

(1) Data represent project scenario impacts that contribute to maximum CEQA/NEPA incremental impacts.

(2) The CEQA Increment represents Alternative 5 impact minus CEQA Baseline impact. The NEPA Increment represents Alternative 5 impact minus NEPA baseline impact. However, non-cancer increments estimated by factoring proposed Project incremental results with the ratio of Alternative 5/proposed Project emissions.

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

(4) For the acute hazard index, two possible maximum 1-hour scenarios were modeled: (1) one ship hoteling and one ship harbor transiting, turning, and docking; and (2) two ships hoteling. The scenario that yielded the highest result is reported for each impact type.

No federal action would occur for the No Project Alternative; thus, no impacts to Health Impacts would result under NEPA.

## 8.0 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 and how different pollutants may 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 generally are very conservative so they provide a margin of safety to protect human health. For example, regarding exposure durations for cancer risks, essentially no one resides in one location 24 hours a day, 350 days a year, and 70 years. Additionally, there is no one standard way 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 result in different results.

OEHHA provided the following discussion of risk assessment uncertainties (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.*

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# Figures

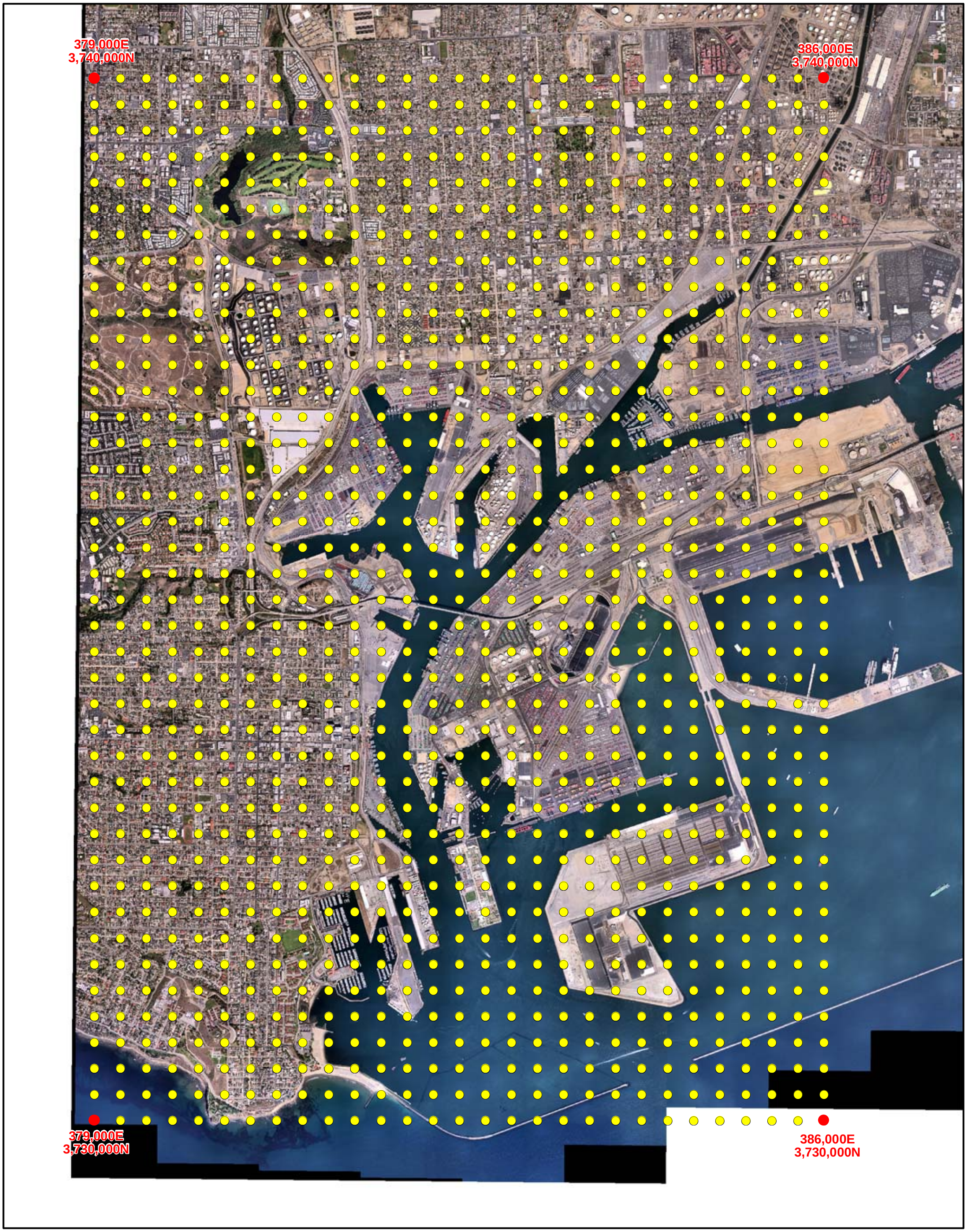



**Figure D3-1. Receptor Field Used in the Berths 136-147 Terminal Project Dispersion Modeling Analyses**

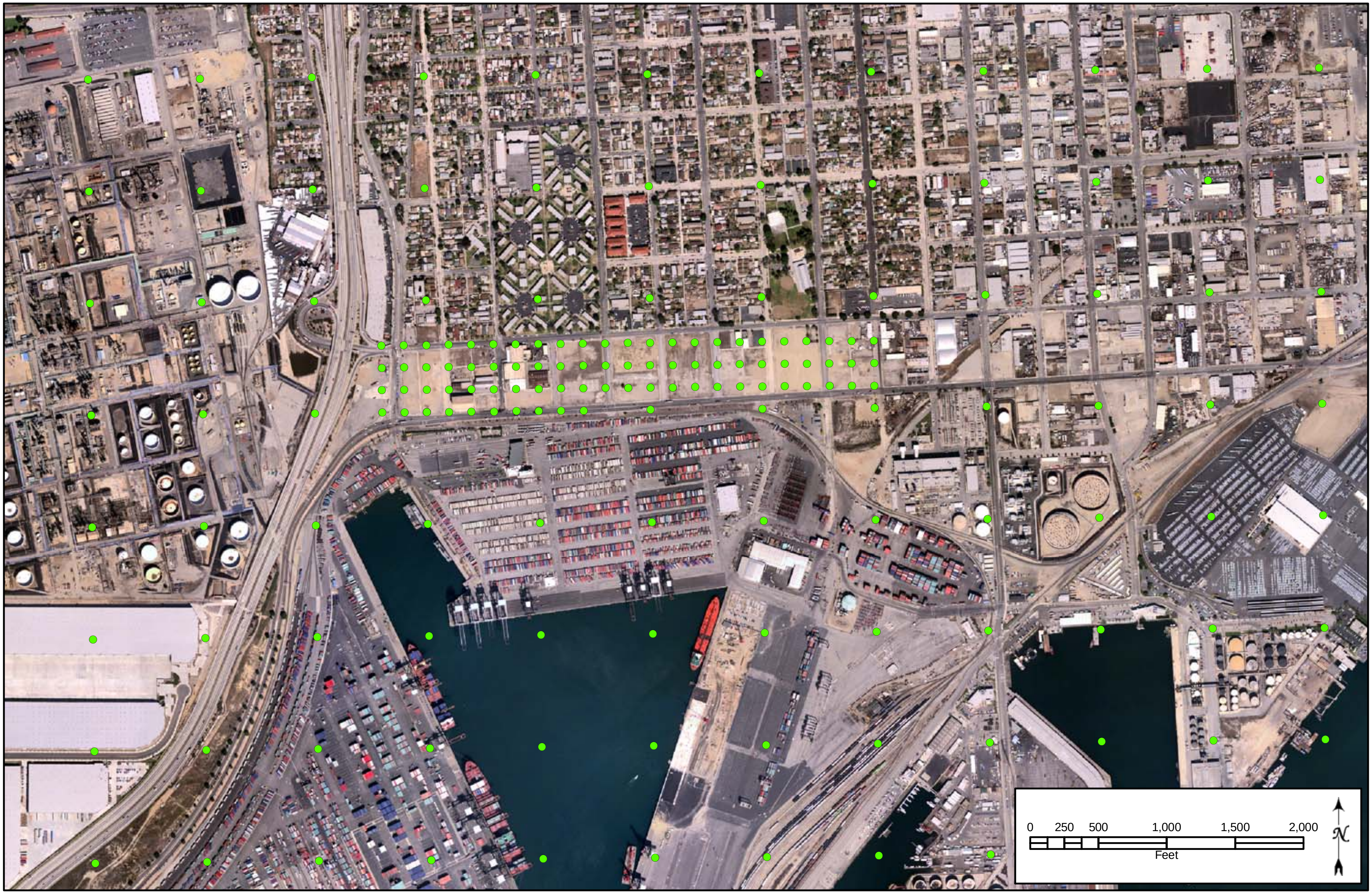
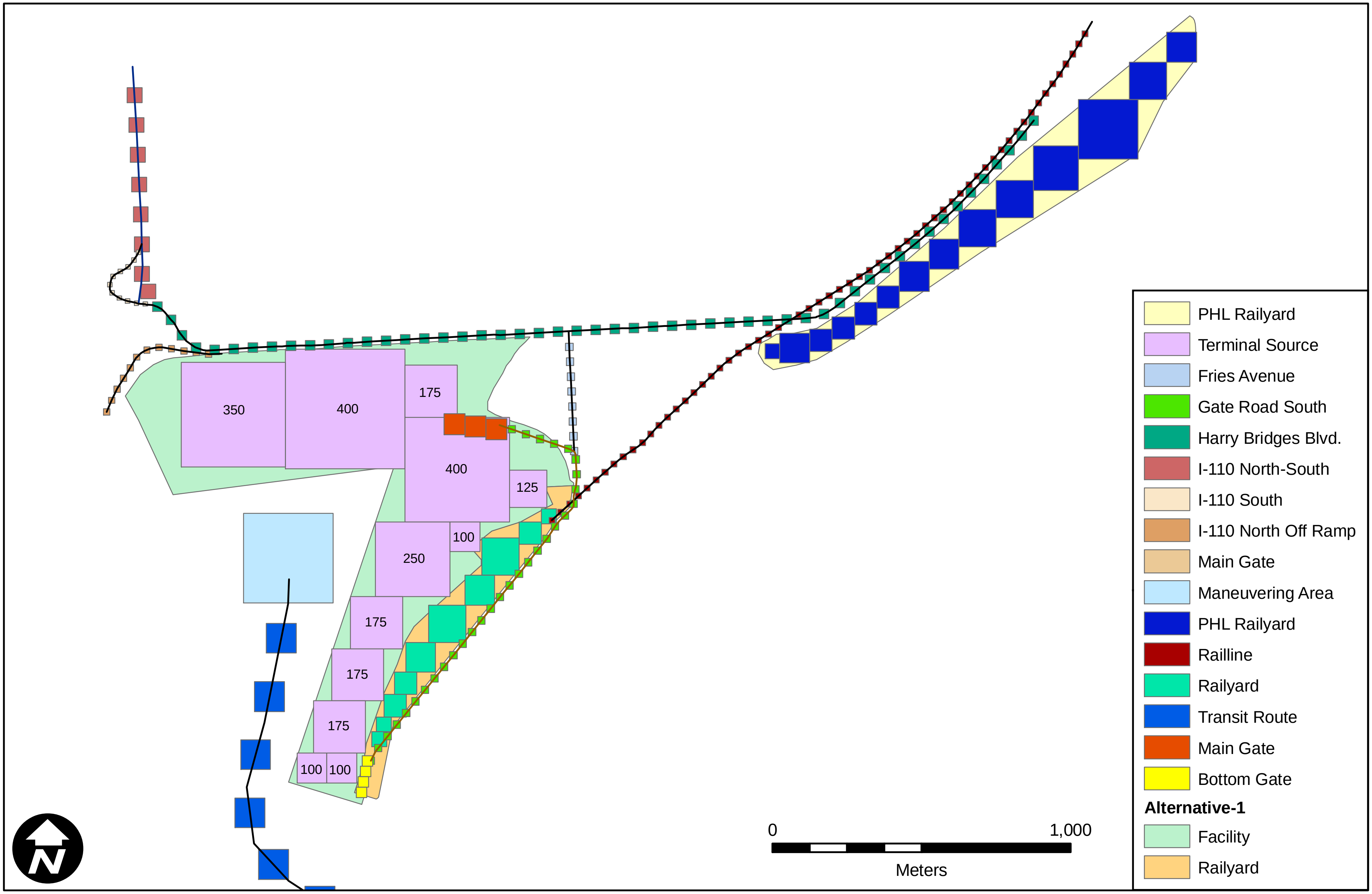
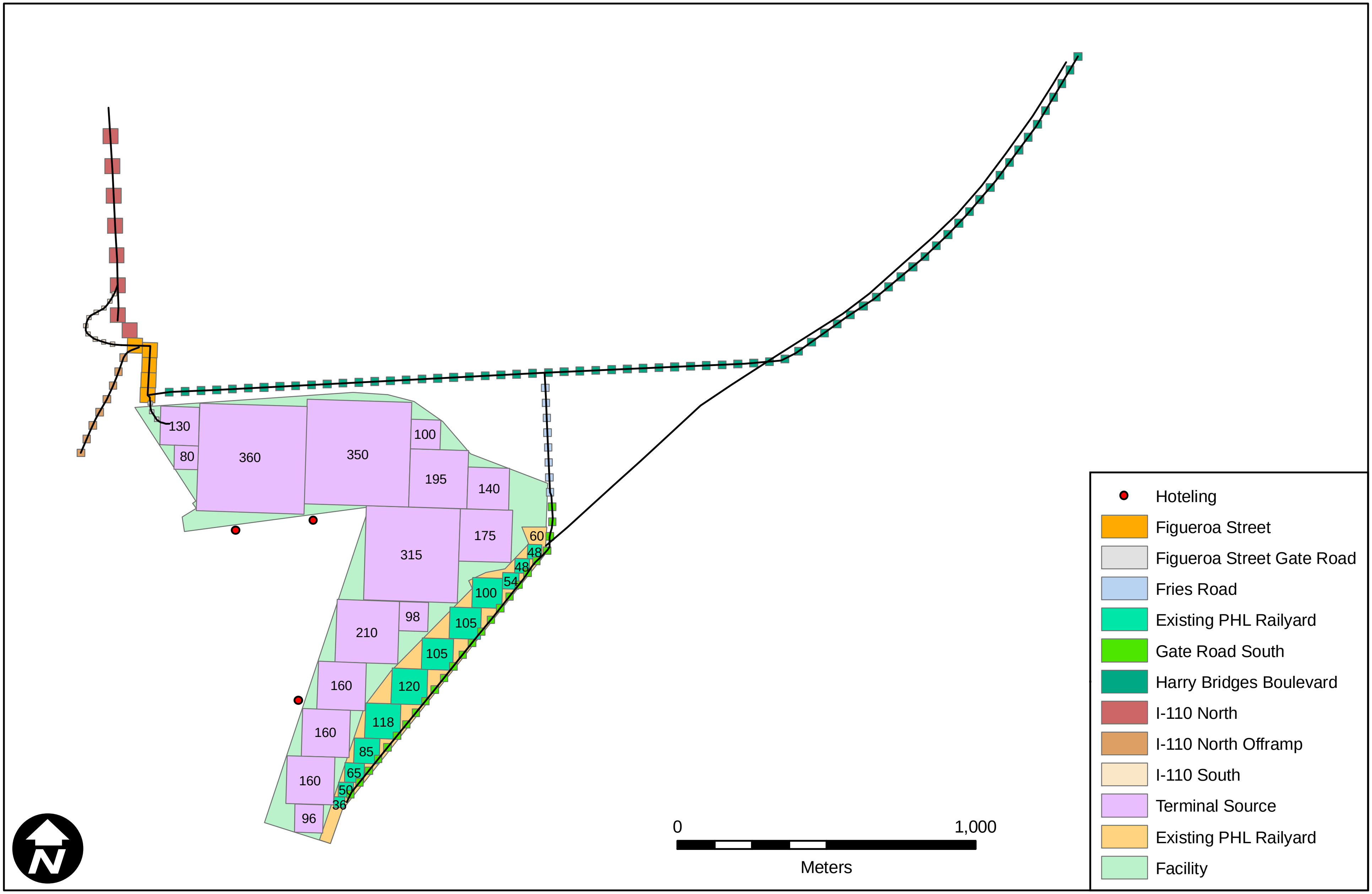



**Figure D3-1A. Fine Receptor Grid Points for the Harry Bridges Boulevard Buffer.**




**D3-2. Locations of Emission Sources Simulated in the Dispersion Modeling Analyses - Berths 136-147 Terminal Project - Proposed Project**




**D3-3. Locations of Emission Sources Simulated in the Dispersion Modeling Analyses - Berths 136-147 Terminal Project - CEQA Baseline**

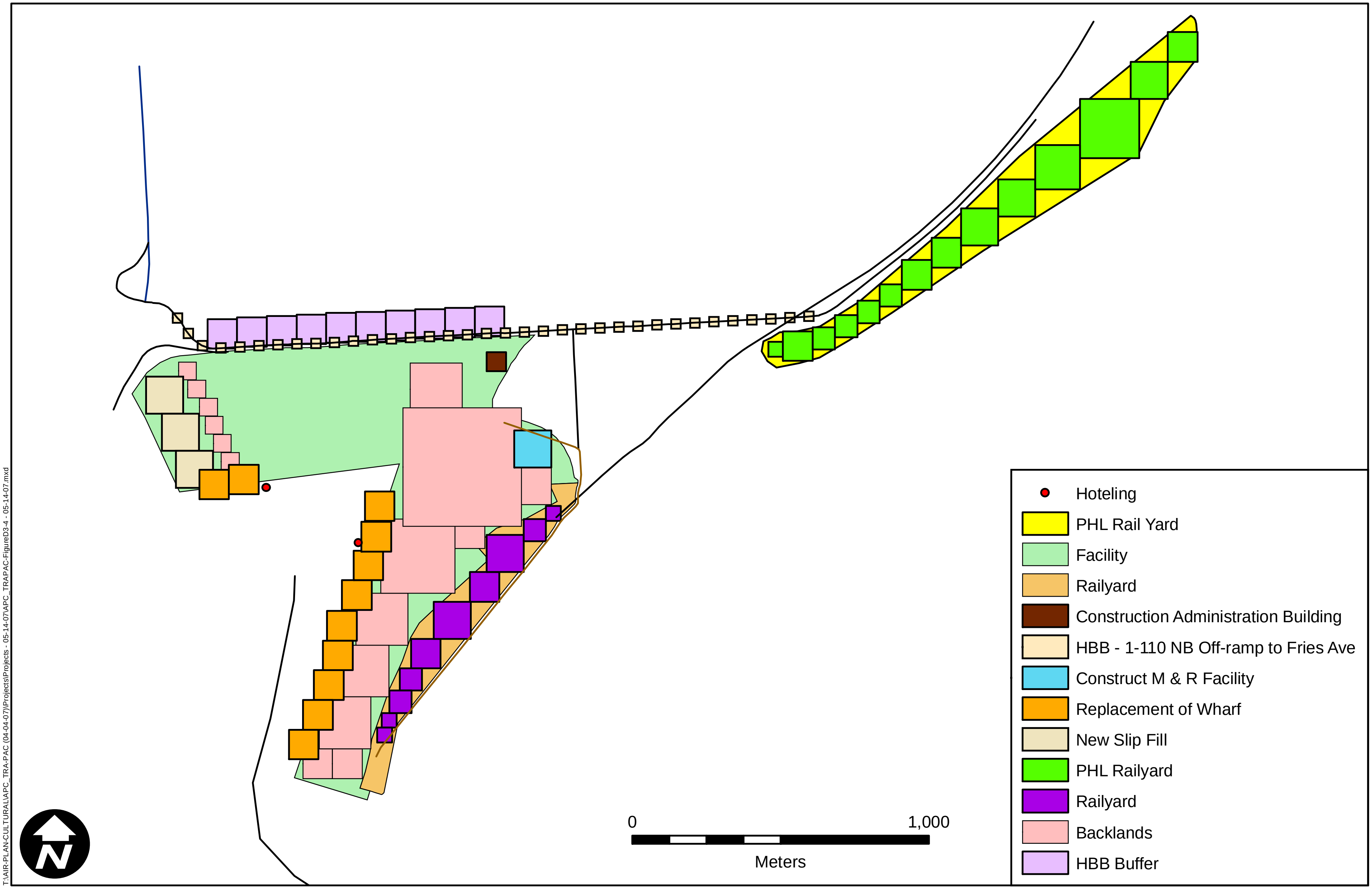



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**Figure D3-4. Construction Sources of DMP included in the Berths 136-147 Terminal Project HRA.**

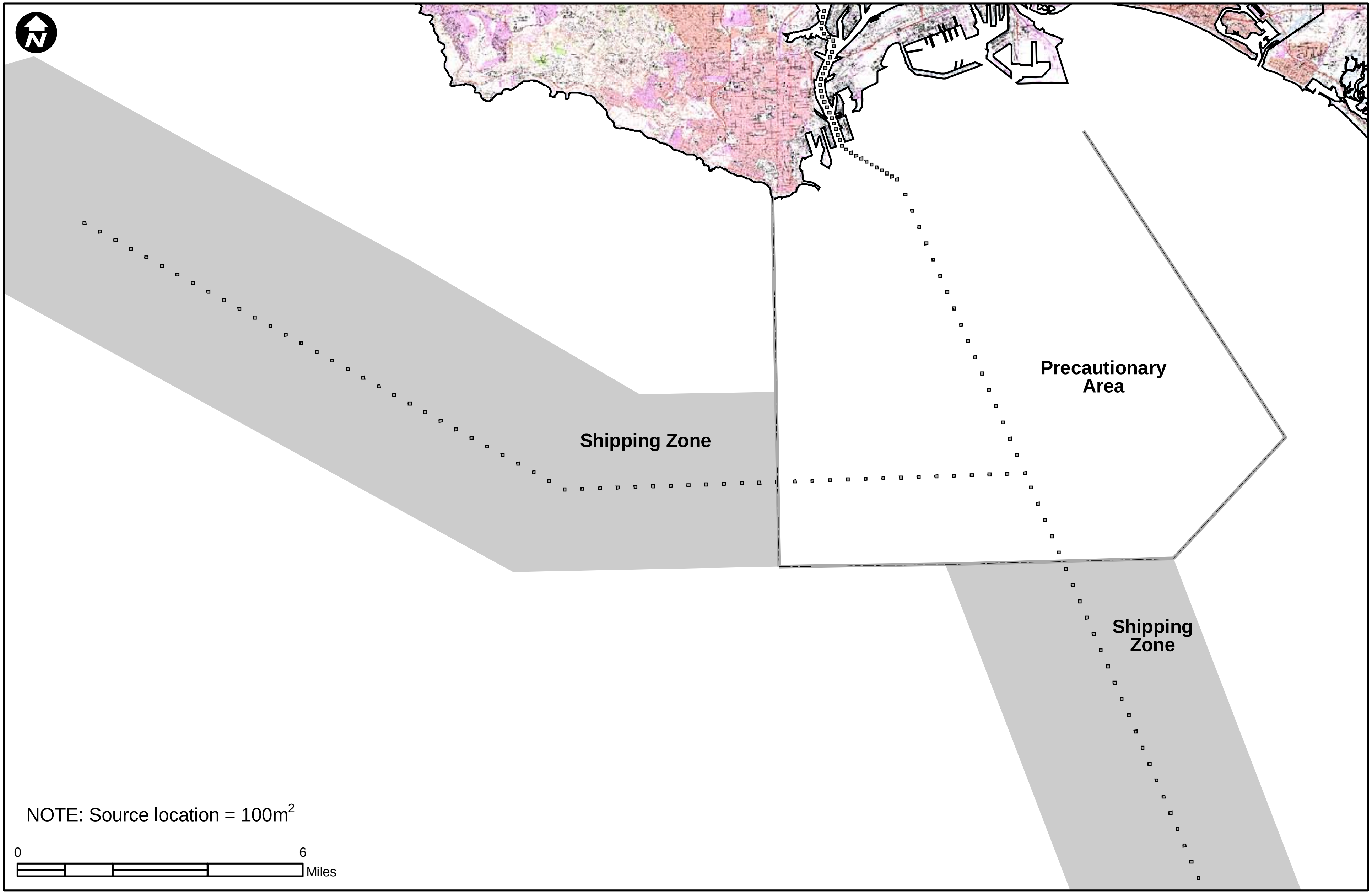


**Figure D3-5. Vessel Transit Volume Source Locations Simulated in the Dispersion Modeling Analyses - Berths 136-147 Terminal Project**

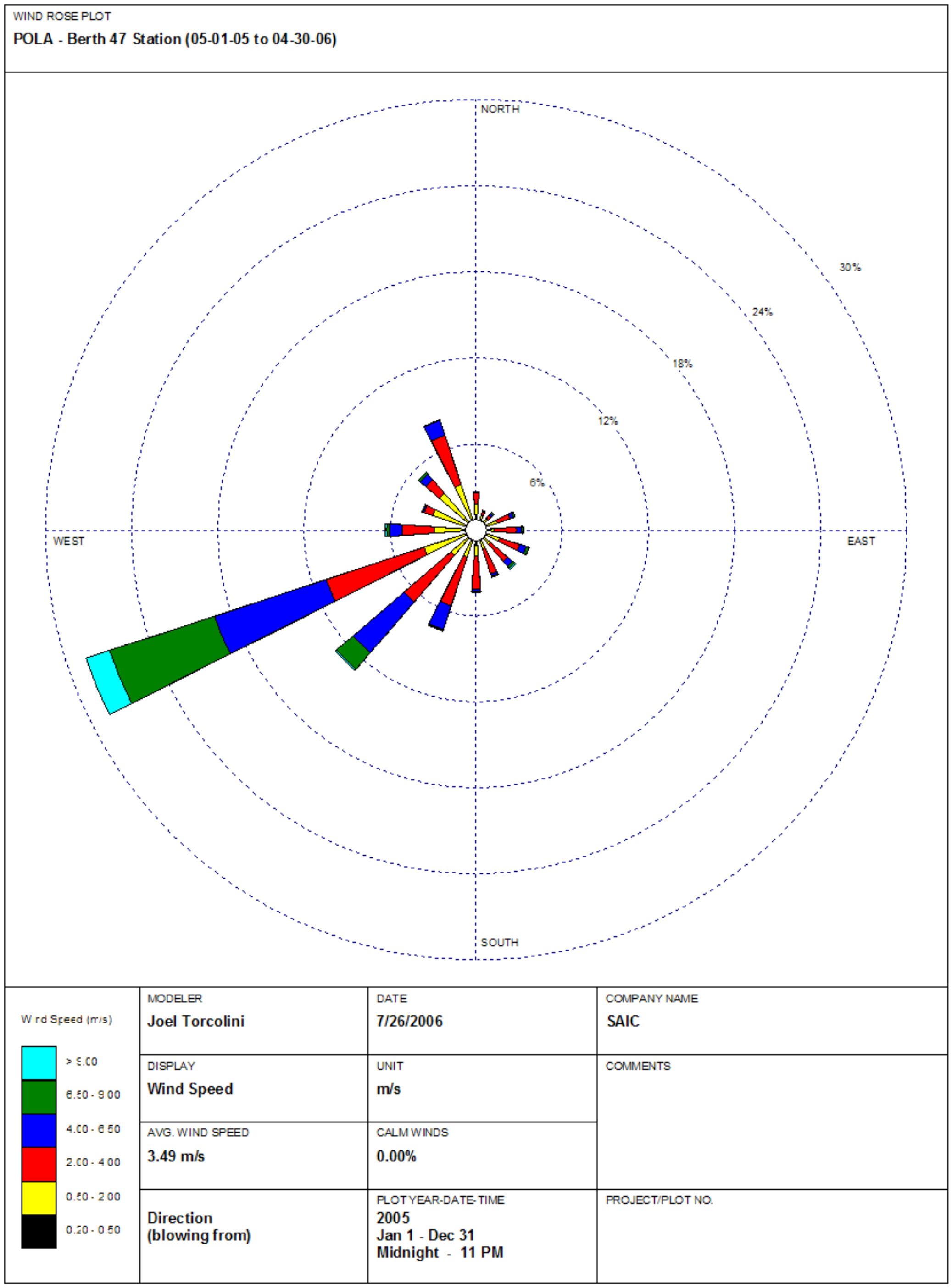


**Figure D3-6. POLA Berth 47 Monitoring Station Wind Rose – May 1, 2005 through April 30, 2006**

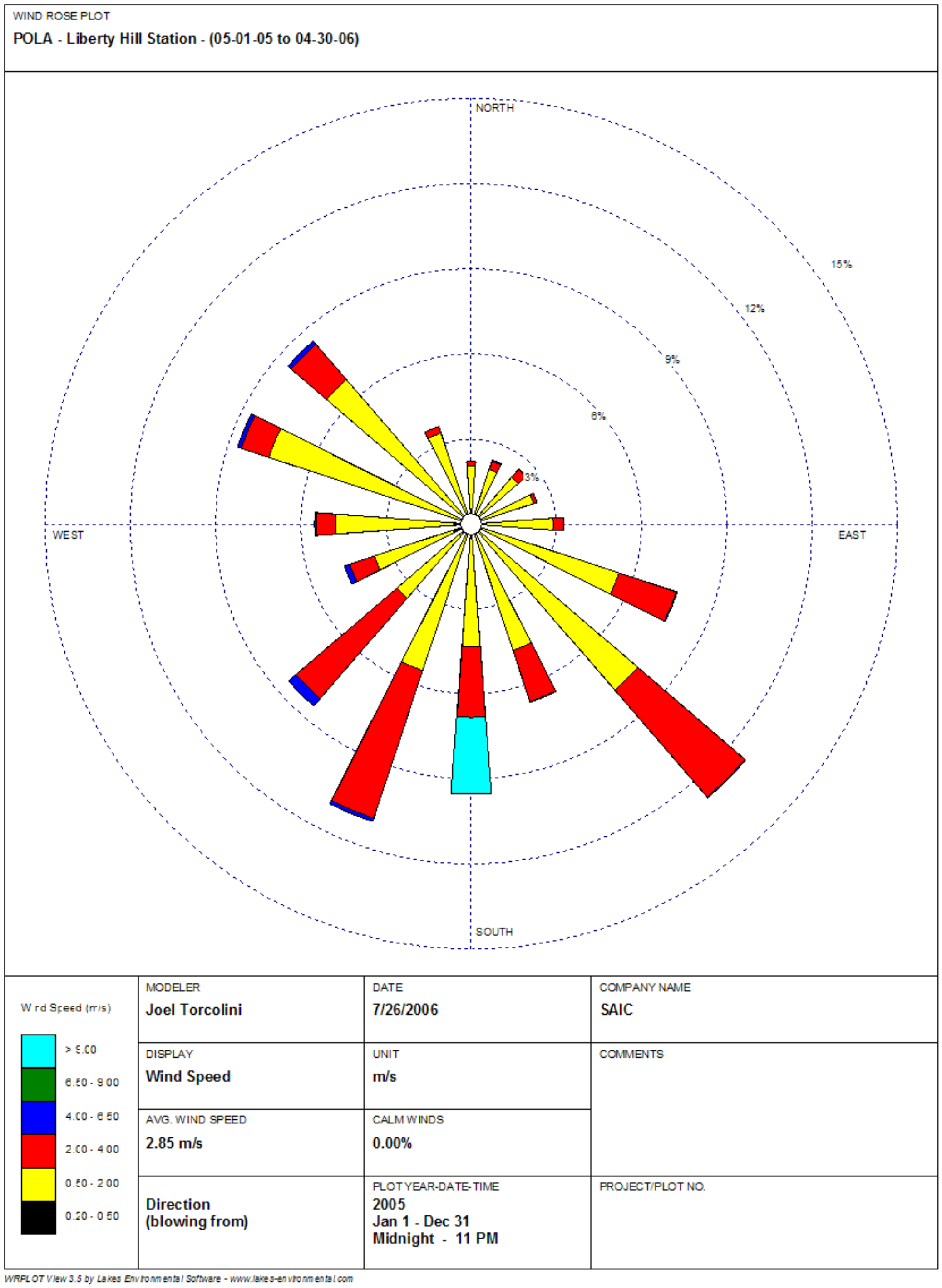


**Figure D3-7. POLA Liberty Hill Plaza Monitoring Station Wind Rose – May 1, 2005 through April 30, 2006**

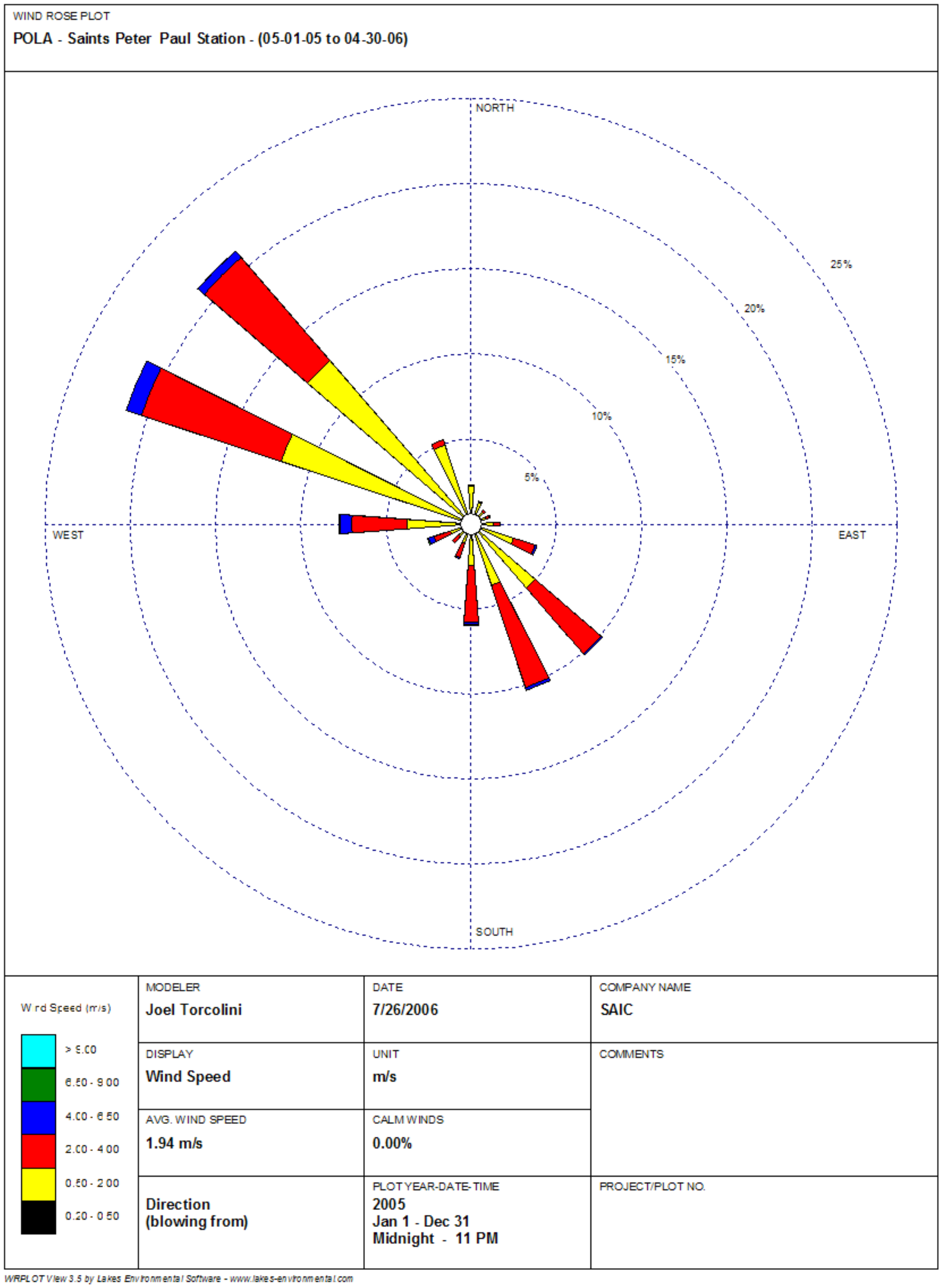


**Figure D3-8. POLA Saints Peter & Paul School Monitoring Station Wind Rose – May 1, 2005 through April 30, 2006**

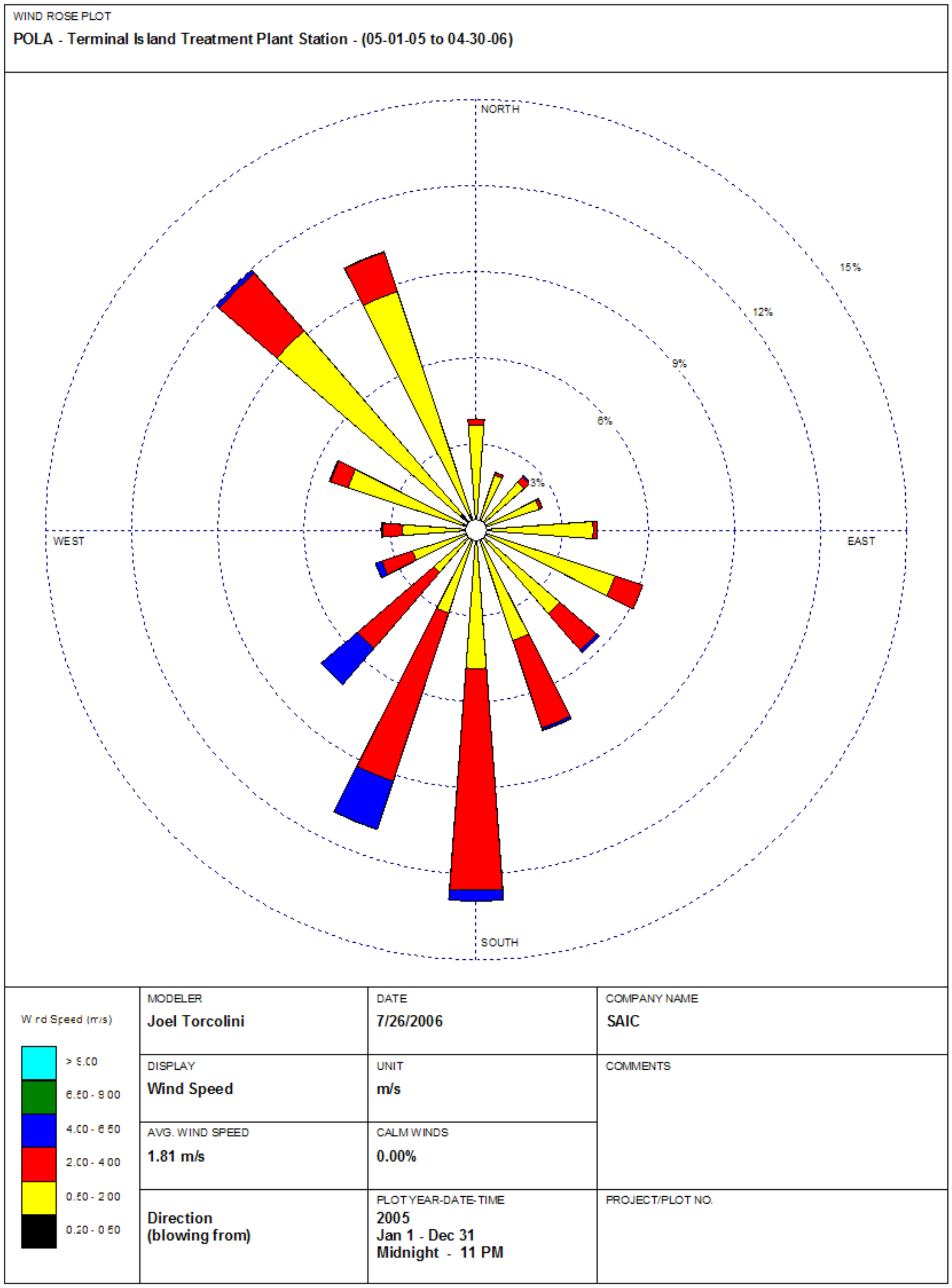


**Figure D3-9. POLA Terminal Island Treatment Plant Monitoring Station Wind Rose – May 1, 2005 through April 30, 2006**

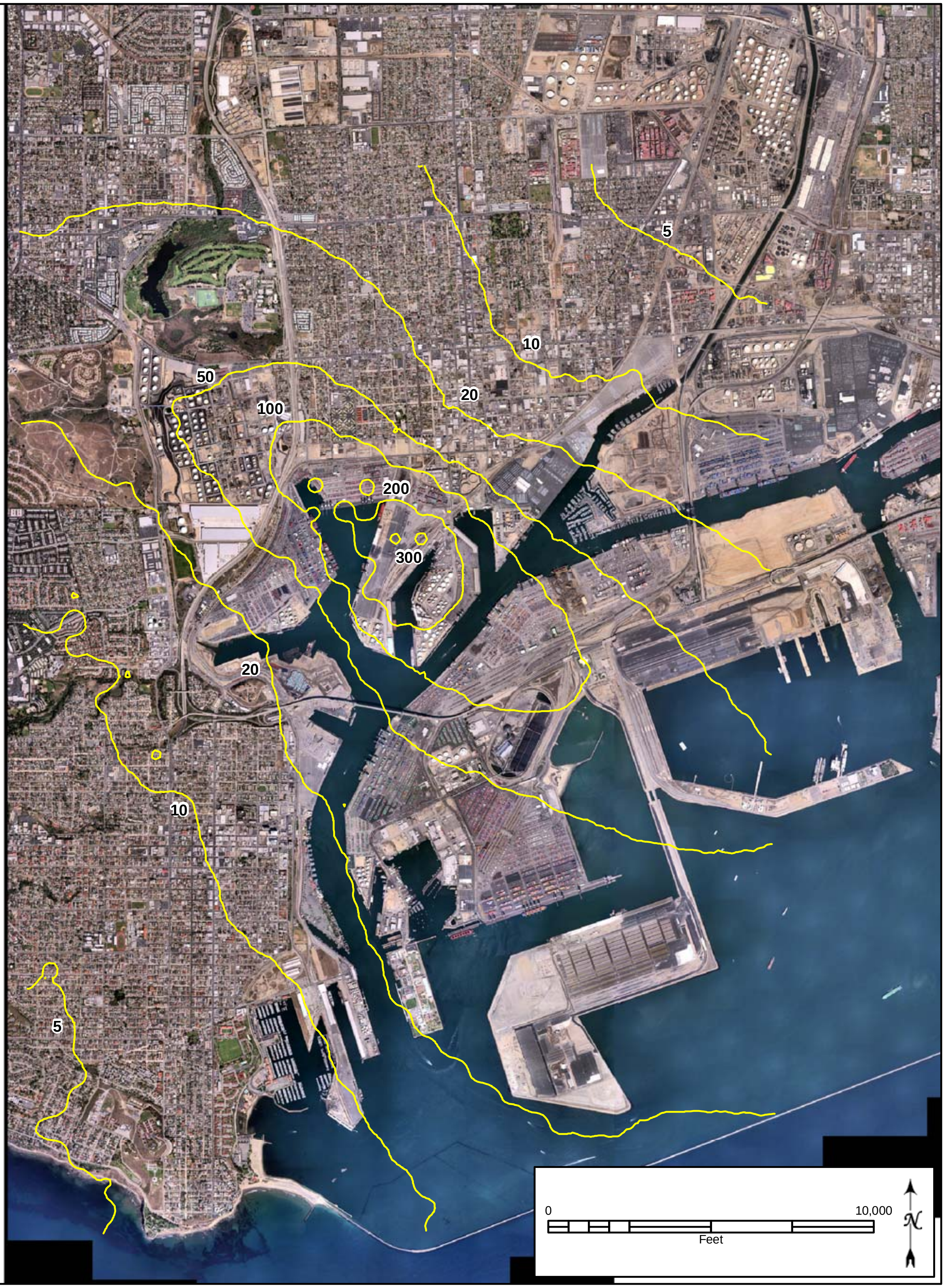


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**Figure D3-10. CEQA Baseline Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**

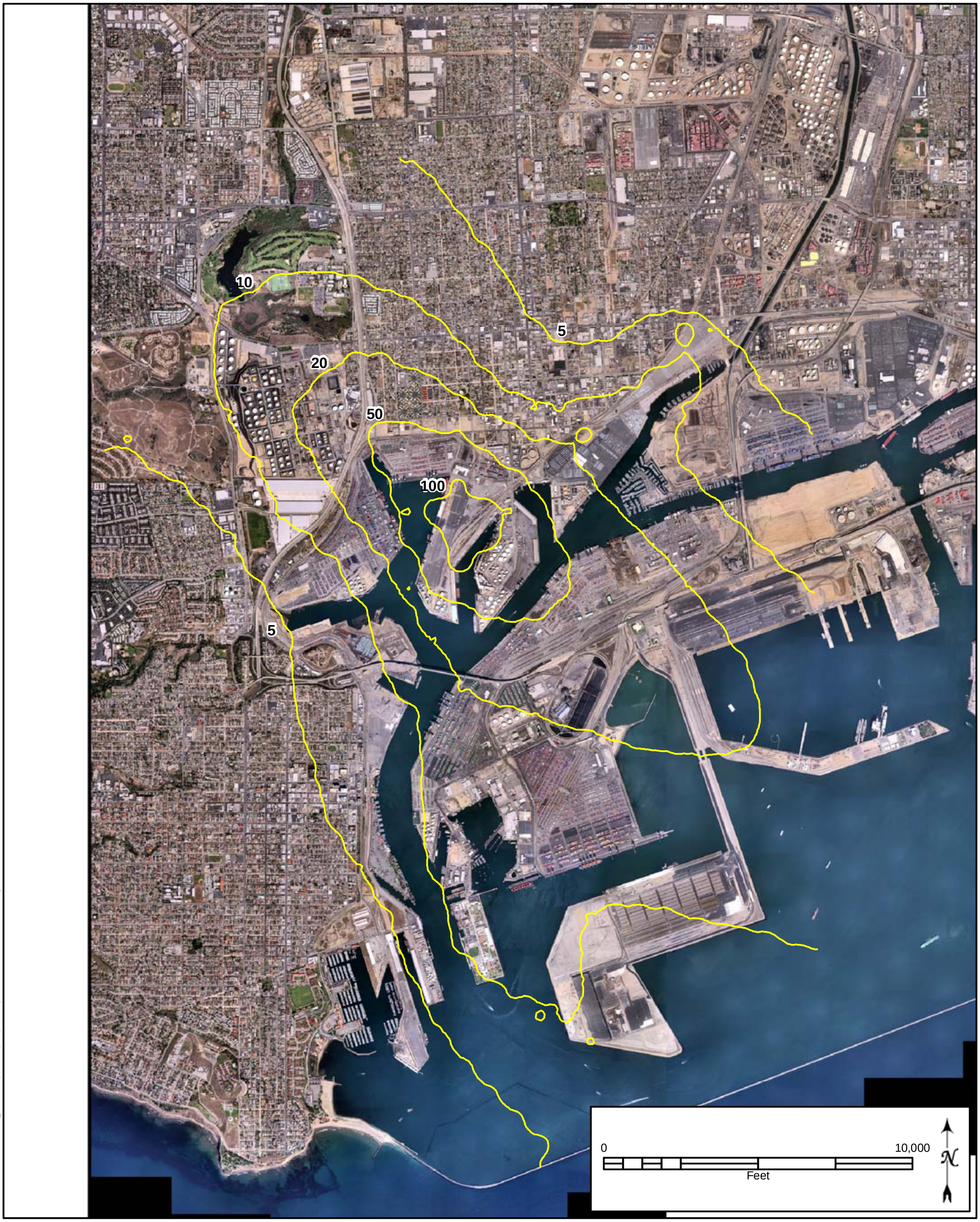


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**Figure D3-11. NEPA Baseline Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**

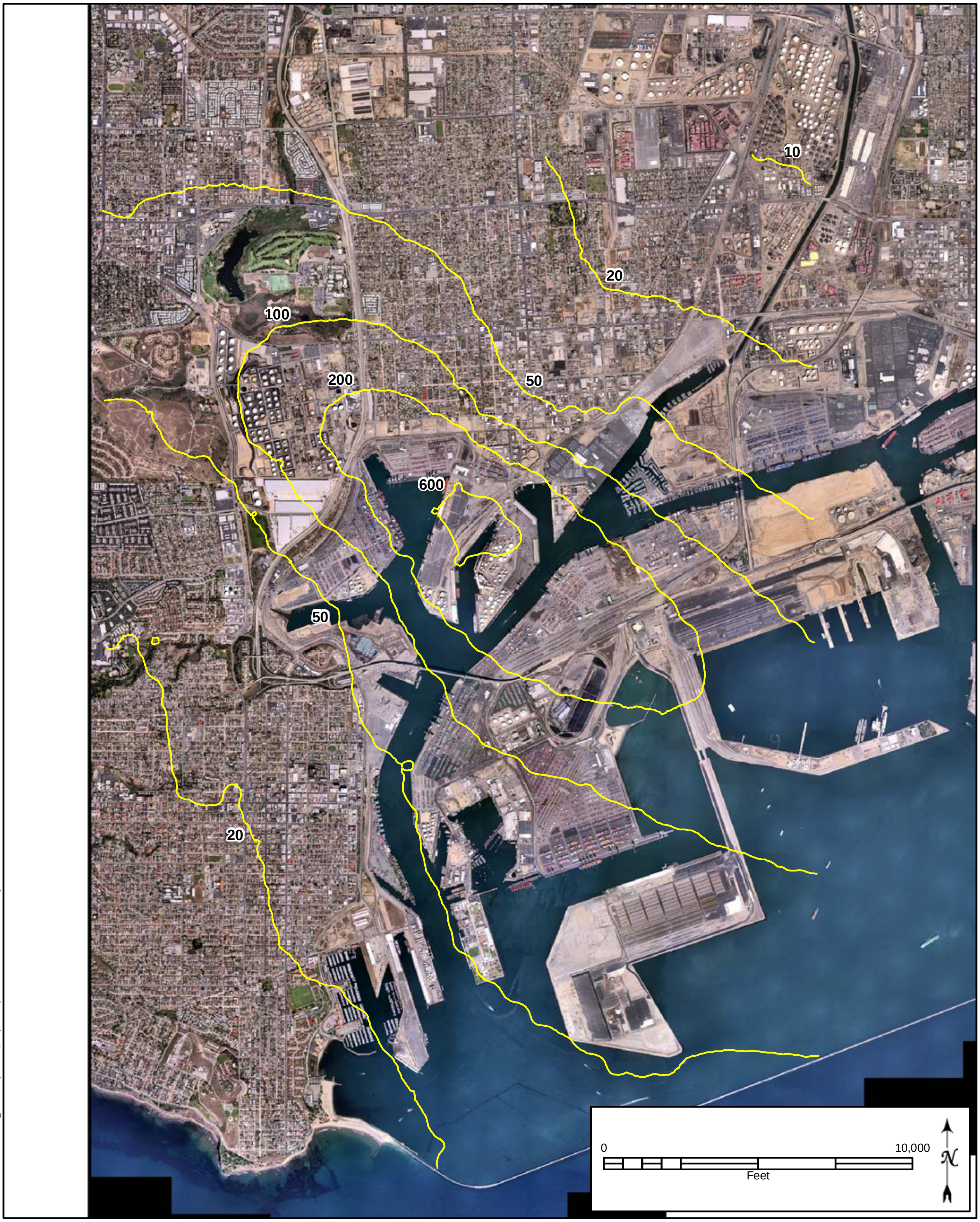


Figure D3-12. Proposed Project Unmitigated Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.

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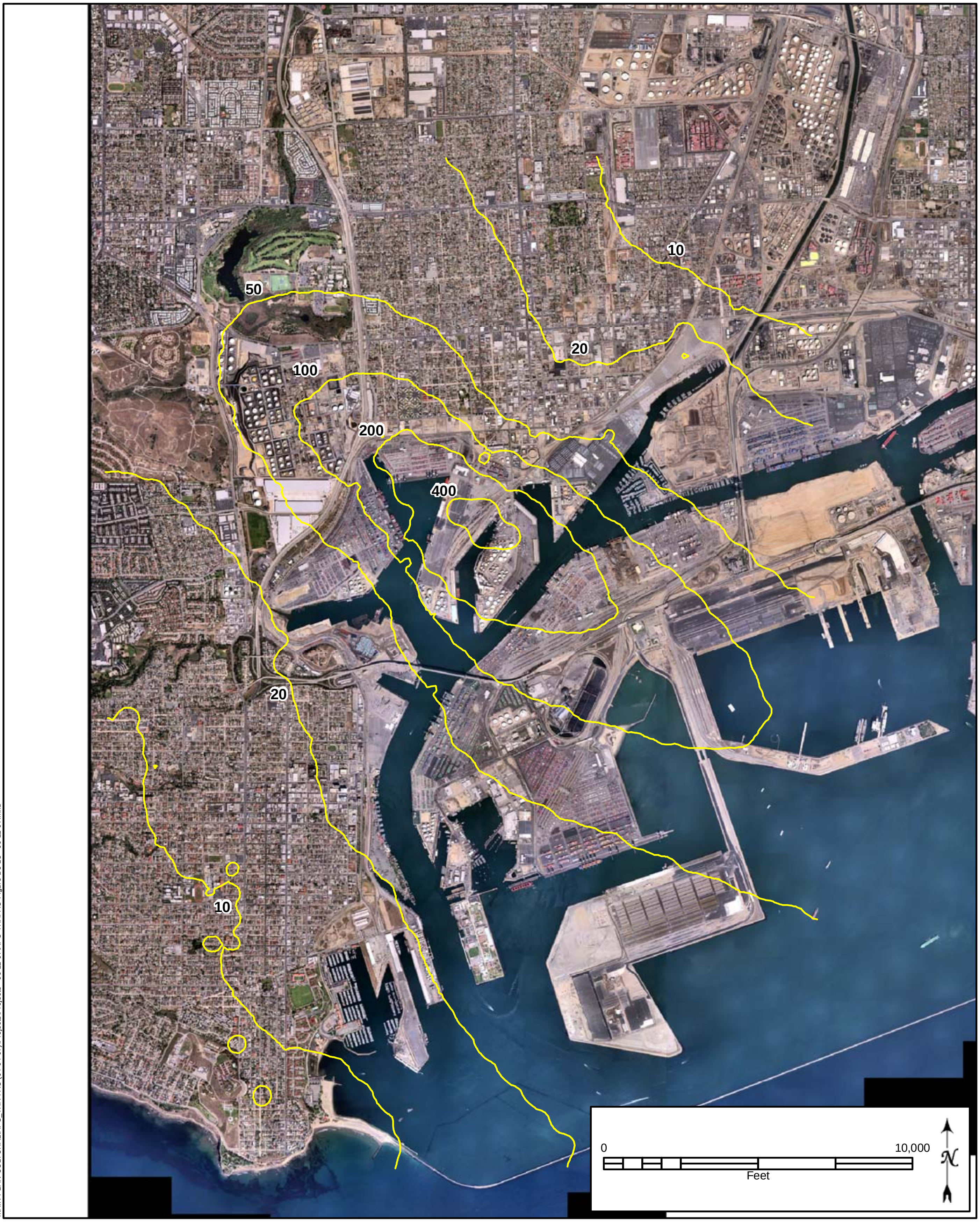


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**Figure D3-13. Proposed Project Unmitigated minus CEQA Baseline Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**


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**Figure D3-14. Proposed Project Unmitigated minus NEPA Baseline Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**


**Figure D3-15. Proposed Project Mitigated Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**

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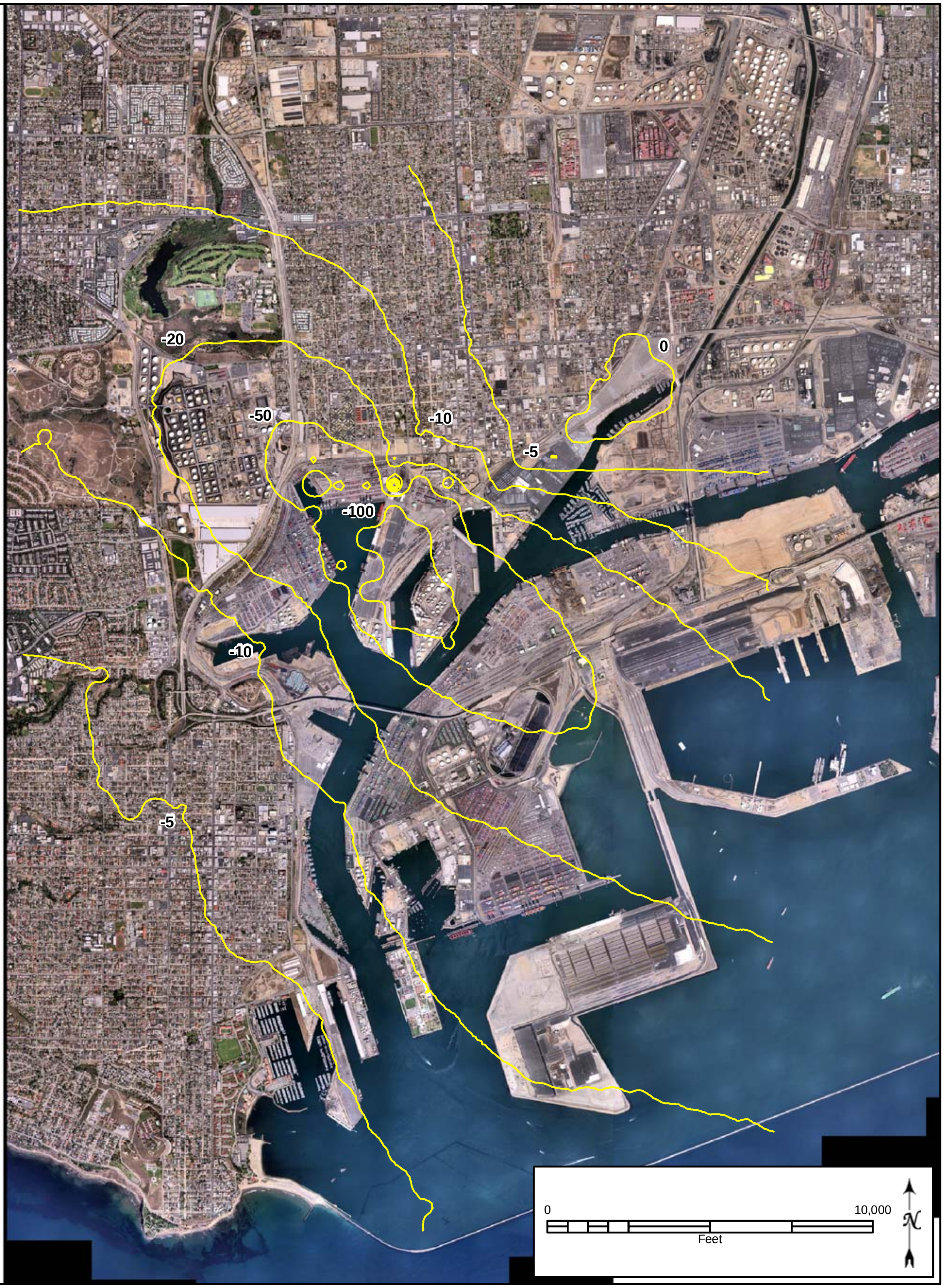


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**Figure D3-16. Proposed Project Mitigated minus CEQA Baseline Residential Cancer Risk Estimate  Berth5s 136-147 Terminal Project EIS/EIR.**


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**Figure D3-17. Proposed Project Mitigated minus NEPA Baseline Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**


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**Figure D3-18. Alternative 1 (No Project) Unmitigated Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**

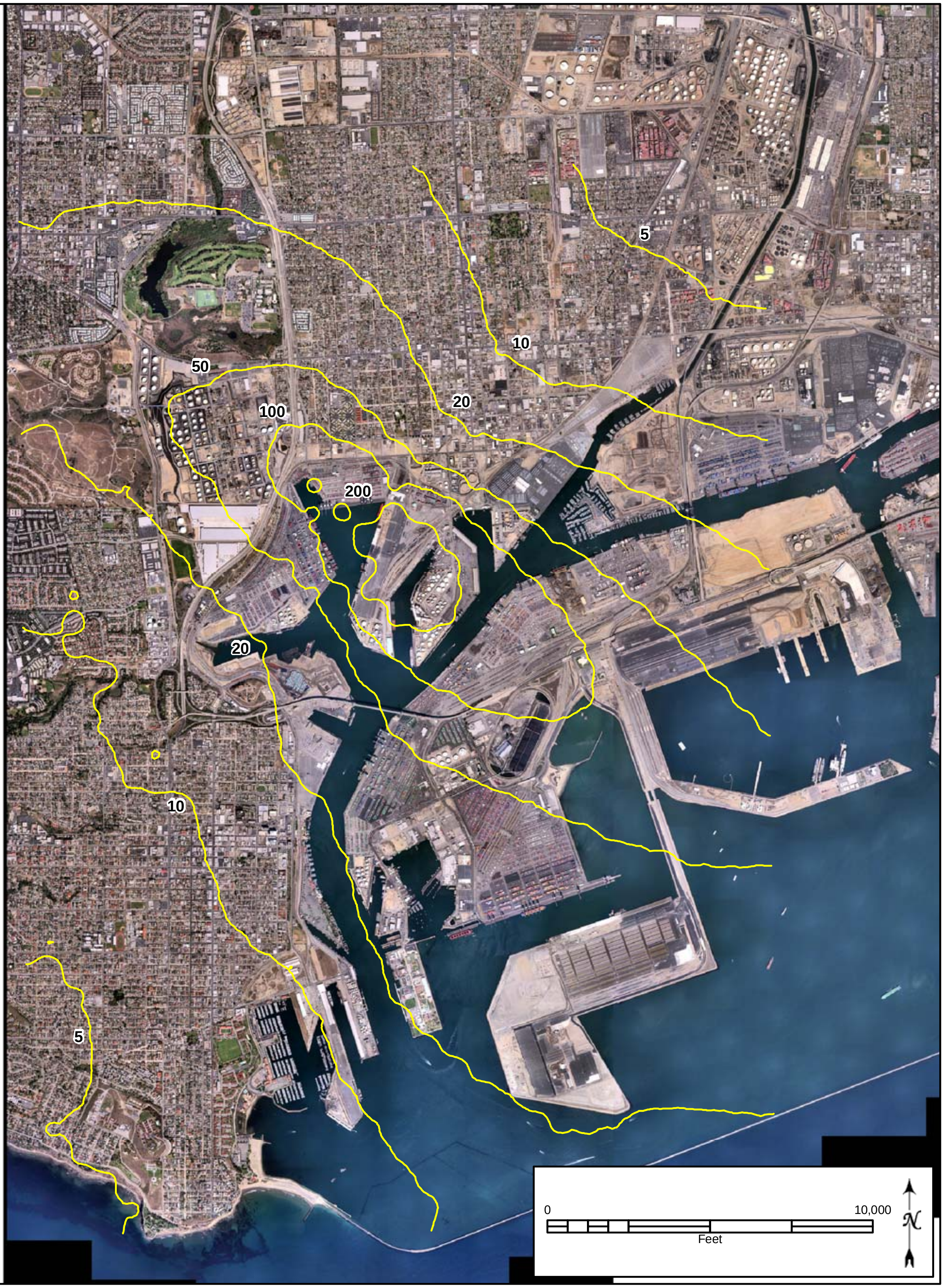


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**Figure D3-19. Alternative 1 (No Project) Unmitigated minus CEQA Baseline Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**


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**Figure D3-20. Alternative 3 (Reduced Wharf) Unmitigated Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**

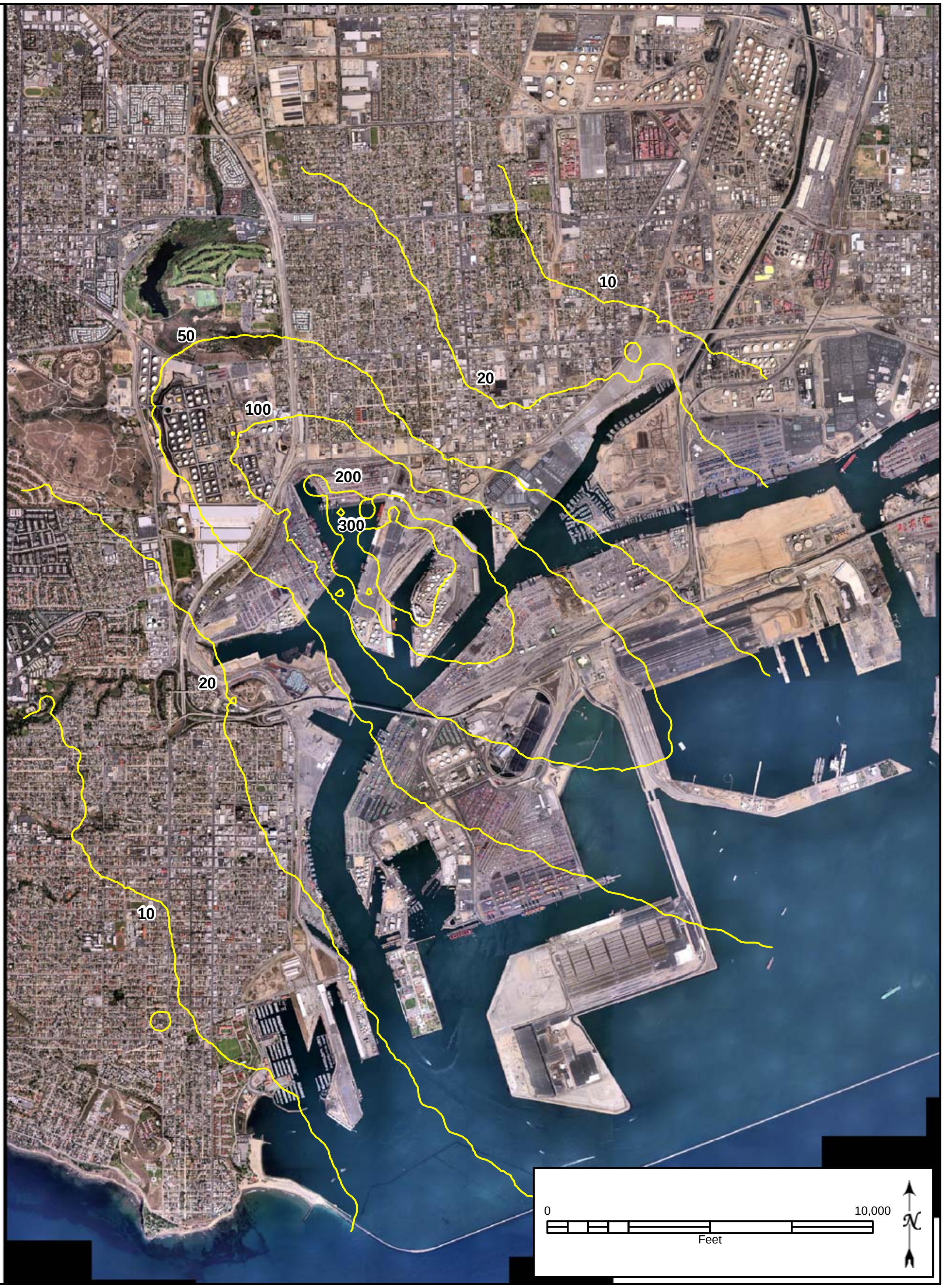


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**Figure D3-21. Alternative 3 (Reduced Wharf) Unmitigated minus CEQA Baseline Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**


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**Figure D3-22. Alternative 3 (Reduced Wharf) Unmitigated minus NEPA Baseline Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**


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**Figure D3-23. Alternative 3 (Reduced Wharf) Mitigated Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**

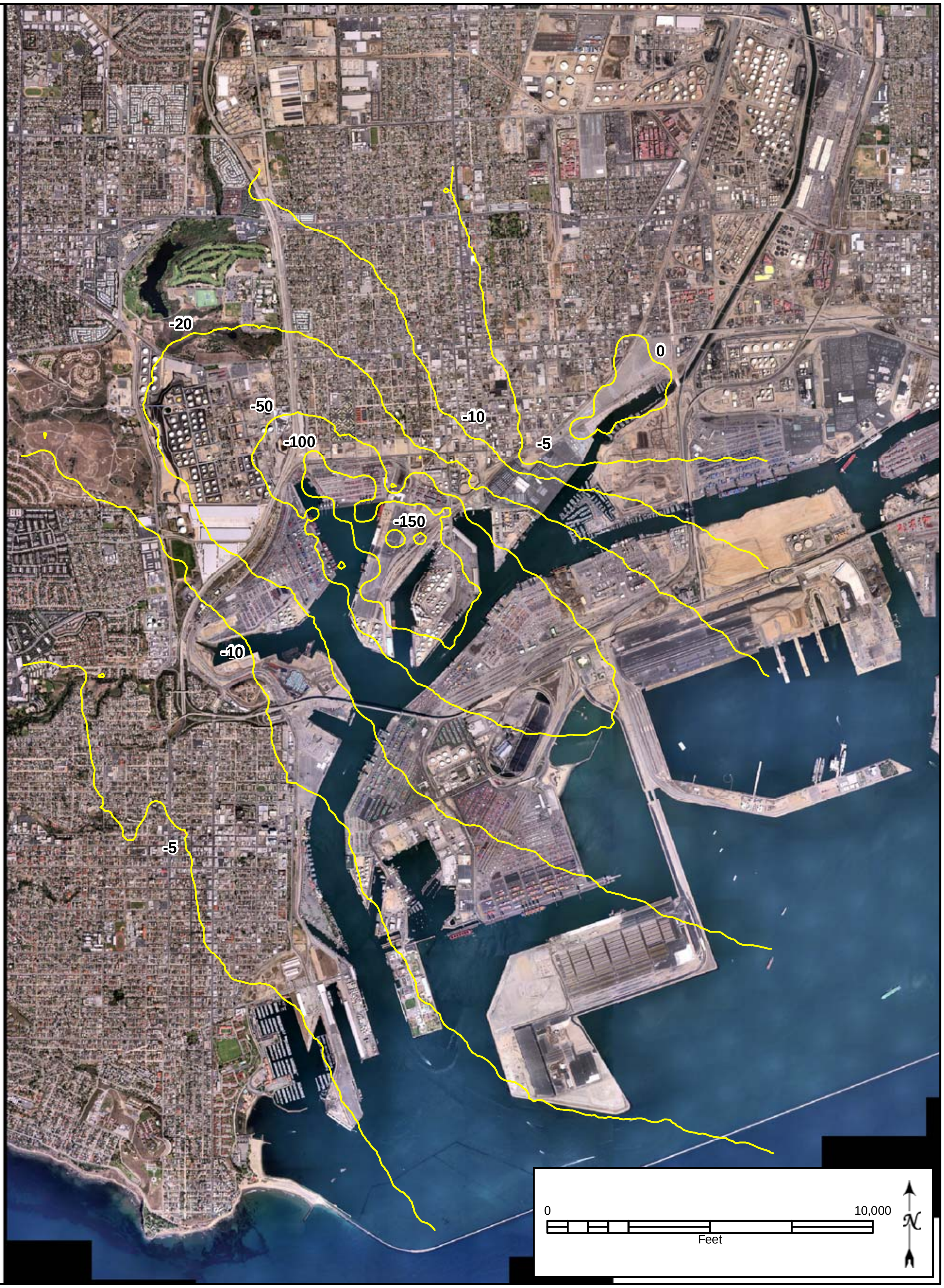

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**Figure D3-24. Alternative 3 (Reduced Wharf) Mitigated minus CEQA Baseline Residential Cancer Risk Estimate Berth5s 136-147 Terminal Project EIS/EIR.**


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**Figure D3-25. Alternative 3 (Reduced Wharf) Mitigated minus NEPA Baseline Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**


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**Figure D3-26. Alternative 4 (Omni Terminal) Unmitigated Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**

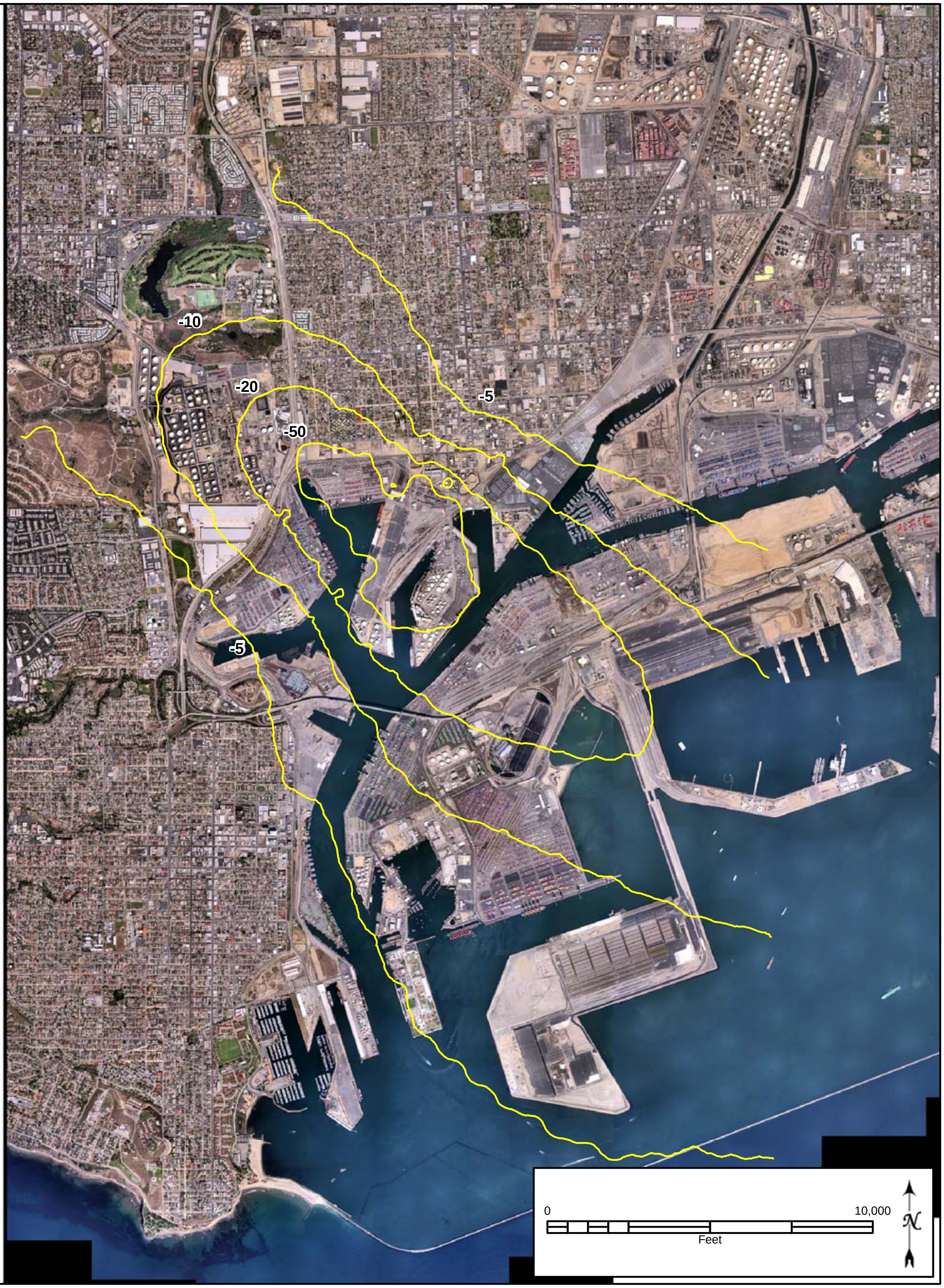


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**Figure D3-27. Alternative 4 (Omni Terminal) Unmitigated minus CEQA Baseline Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**

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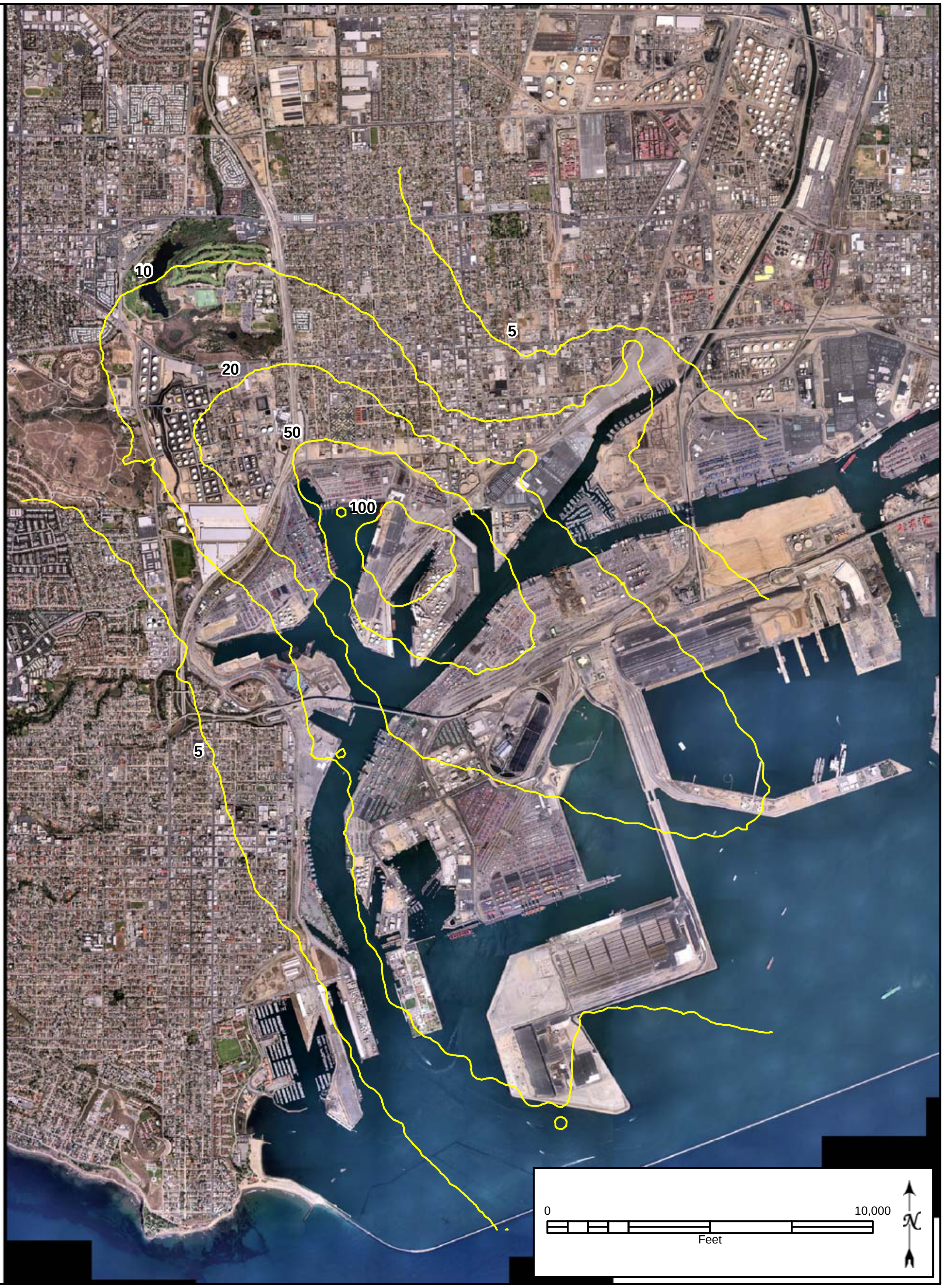


**Figure D3-28. Alternative 5 (Landside Terminal Improvements) Unmitigated Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**


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**Figure D3-29. Alternative 5 (Landside Terminal Improvements) Unmitigated minus CEQA Baseline Residential Cancer Risk Estimate - Berths 136-147 Terminal Project EIS/EIR.**