# APPENDIX H4

## Health Risk Assessment Documentation

# H4

# HEALTH RISK ASSESSMENT DOCUMENTATION

## 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 that would be generated by the operation of the Pacific L.A. Marine Terminal (PLAMT) Crude Oil Terminal project (the proposed Project). The methods and assumptions described also apply to the HRA for the Reduced Project and the No Federal Action/No Project Alternatives unless noted otherwise.

TACs are compounds that are known or suspected to cause adverse health effects after short-term (acute) and/or long-term (chronic) exposure. The California Air Resources Board (CARB) designates the following pollutants from the proposed Project as TACs:

- Diesel particulate matter (DPM) and other TACs from the internal combustion of fuel oils (e.g., heavy fuel oil or distillate fuels such as diesel) for propulsion and auxiliary power of ocean going vessels (OGV) and harbor craft (e.g., tugs, barges);

- Various TACs from the external combustion of fuel oils (e.g., heavy fuel oil or distillate fuels such as diesel) in boilers for the production of steam onboard OGVs;

- Various TACs in fugitive crude oil emissions released from crude oil storage tanks;

- Various TACs from the combustion of natural gas and crude oil vapors in vapor destruction units (VDUs); and

- DPM and various TACs from the internal combustion of diesel fuel in various on-road and off-road vehicles.

Most of the particulate matter emissions associated with operation of the proposed Project emission sources would result from the combustion of fuel oils. For this analysis, all particulate matter emissions from internal combustion engines were conservatively considered to be DPM. The CARB designates DPM as a TAC and considers DPM as the surrogate for the total chronic non-carcinogenic and carcinogenic health effects from the combustion of diesel fuel. An analysis performed by the South Coast Air Quality Management District (SCAQMD) determined that DPM causes the majority of the cancer risk from the inhalation of air contaminants in the Port of

Los Angeles (the Port or Los Angeles Harbor Department [LAHD]) region (SCAQMD 2000). Another recent study released by CARB indicates that, together, the San Pedro Bay Ports are one of the major contributors to the release of DPM emissions and a primary cause of elevated cancer risks in a large area of the South Coast Air Basin (CARB 2006).

This HRA was prepared in accordance with the *Health Risk Assessment Protocol for Port of Los Angeles Terminal Improvement Projects* (Protocol) (LAHD 2006) (see Appendix E.1 of the Protocol). The Protocol is a living document, developed by the LAHD in consultation with the SCAQMD and CARB. In general, the Protocol follows the methodology for preparing Tier 1 risk assessments described in the document prepared by the Office of Environmental Health Hazard Assessment (OEHHA), i.e., *The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* (OEHHA 2003), as well as guidance contained in *Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics "Hot Spots" Information and Assessment Act (AB2588)* (SCAQMD 2005a), *Health Risk Assessment Guidance for Analyzing Cancer Risks from Mobile Source Diesel Emissions* (SCAQMD 2002), and *Risk Assessment Procedures for Rules 1401, 1402, and 212* (SCAQMD 2003). The methods in these guidance documents are incorporated into the *Hot Spots Analysis and Reporting Program* (HARP) model released by the CARB in December 2003 (CARB 2003a). While the HARP model incorporates use of the U.S. Environmental Protection Agency's (USEPA) Industrial Source Complex Short-Term model (ISCST3) for dispersion modeling (USEPA 2006a), that model was not used. Rather, the newer USEPA AERMOD model was used for dispersion modeling in conjunction with the HARP AERMOD on-ramp application.

The HRA process requires four general steps to estimate health impact results: (1) quantify proposed Project 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 analysis to estimate ambient TAC concentrations at each receptor location; and (4) use a risk 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 HRA.

# 2.0 DEVELOPMENT OF EMISSION SCENARIOS USED IN THE HRA

## 2.1 Emission Sources

To estimate health impacts, emission scenarios were developed for the various Project-related sources of TACs as described below.

1. **Diesel-Powered Sources**. Diesel-powered sources associated with the Project included the following:

    - Tankers traveling to and from the port in the area from the Fairway into the Precautionary Area. Each trip includes approximately 20 miles of transit in the Fairway and the Precautionary Area. Emission sources during this transit include the main propulsion engine, auxiliary engines, and boilers.

    - Tankers traveling in the area from the pilot pick-up/drop-off point (about 3 miles beyond the Port breakwater) to and from the berth. Each trip includes approximately 3 miles of transit in the Precautionary Area located outside the breakwater, transit within the harbor from the breakwater entrance gate to/from the berth, and maneuvering in/out at the near-berth area. Emission sources during this transit include the main propulsion engine, auxiliary engines, and boilers.

- Tanker hoteling while at berth. Emission sources while the vessel is at berth include the ship boilers and auxiliary generators. The main propulsion engine is turned off during hoteling.

- Tugboats used to assist the tankers between the pilot pick-up/drop-off point and the berth (an average of two tugboats per ship assist). Tugboat emission sources include the tugs' main propulsion engines and auxiliary generators.

One additional diesel-powered emission source category – marine vessels transiting the shipping lane Fairway/Precautionary Area beyond the 3-mile pilot pick-up/drop-off point – was considered but omitted from the risk assessment because sensitivity runs indicated that the relative risk contribution from these distant sources at the points of maximum impact is small compared to the risk from the sources in and near the harbor area.

- Barge emissions used to deliver OGV fuel to Berth 408. This fuel would be stored at the terminal in a 15,000 gallon tank for use in fueling the OGVs calling at the terminal.

- Construction-related emission sources, including work tugs, OGVs delivering construction materials, on-road and off-road heavy duty diesel trucks, and off-road construction equipment necessary to construct the terminal, tankage, and pipelines.

2. **Tank Farm Tank Sources (working and breathing losses).** The proposed Project would include two tank farms with a total capacity of 4.0 million barrels (bbl) of storage. Table 1 contains a breakdown of the tank farms by location and the anticipated number of turnovers at each site per month. The characteristics of the crude oil in the tanks used for modeling of emissions are: total vapor pressure (TVP) of 10 pounds per square inch absolute (psia), liquid molecular weight of 207, vapor molecular weight of 50, and liquid density of 7.1 lb/gal (USEPA TANKS 4.09d model and Pacific LA Marine Terminal, Inc. [PLAMT]).

   There would also be a 15,000 bbl fueling tank at Berth 408 that would have the same characteristics as above except it would store diesel fuel with 0.008 TVP, liquid molecular weight of 188, and vapor molecular weight of 130 (USEPA TANKS 4.09d model and PLAMT).

**Table 1. Tank Farm Parameters**

| *Tank Farm* | *No. of Tanks* | *Size of Tank (bbl)* | *Diameter (ft)* | *Height (ft)* | *Turnovers (turns/month)* |
|---|---|---|---|---|---|
| Site 1 | 2 | 250k short | 202 | 51.5 | 5 |
| | 1 | 50k surge | 90 | 51.5 | 10 |
| | 1 | 15k fueling | 52 | 46.5 | 5 |
| Site 2 | 14 | 250k tall | 185 | 65.5 | 2.5 |

*Source:* Design information from SPEC Services and PLAMT 2005.

3. **Tank Farm Vapor Destruction Unit Sources.** Tank Farm Sites 1 and 2 would have vapor destruction units (VDU) to burn any excess vapors when the tanks are being filled and when the tank roofs are resting on their legs.

SCAQMD Rule 463(d)(2) prohibits the roof of a floating roof tank from resting on the legs except when the tank is being emptied for clean up and repair. During normal operations (i.e., not cleaning or repairing tanks), crude oil storage tanks at the facility may have their roofs temporarily resting on the lower legs. To comply with Rule 463(d)(2), the tanks will be vented to the VDU while the tank roofs are resting on their legs.

The amount of crude vapor for each VDU was based on the available tank storage volume. Table 2a contains the amounts of crude vapor combustion expected per month for tank filling. The following vapor distribution was used: Tank Farm Site 1 VDU would process 12.5 percent of the total gases and Tank Farm Site 2 would process 87.5 percent. Table 2b contains the amounts of crude vapor combustion expected per year for maintenance operations. It is expected that each tank will land on its legs 6 times per year and the VDU will run for 48 hours until the headspace vapors is below 5000 parts per million (ppm).

**Table 2a. VDU Assumptions for Tank Filling**

| *Ship Type* | *Crude Vapors from Tanks (standard cubic feet [scf]/call)* |
|---|---|
| Aframax | 224,000 |
| Very Large Crude Carrier (VLCC) | 596,313 |
| Suezmax | 333,333 |
| Panamax | 116,667 |
| *Source:* SPEC Services 2005 | |

**Table 2b. VDU Assumptions for Tank Maintenance**

| *Site* | *No. of Tanks* | *Annual Crude Vapors from Tanks (million standard cubic square feet per year [mmscf/yr])* |
|---|---|---|
| Site 1 | 4 | 17.3 |
| Site 2 | 14 | 77.8 |
| **TOTAL** | **16** | **138.3** |
| *Source:* SPEC Services 2005 | | |

4. **Fugitive Emission Sources.** Fugitive crude oil vapor emissions from various piping, valves, connections, and other crude oil transfer system components at the berth and the tank farms. It was assumed that crude oil service is considered a light liquid petroleum service. The number of valves, pumps, compressors, fittings, etc. was estimated based on preliminary design since final designs have not yet been developed. Table 3 lists the fugitive emission sources associated with the berth and tank farms.

**Table 3. Fugitive Emission Parameters**

| New Source Unit with Best Available Control Technology (BACT) | Service | Number of Sources |
|---|---|---|
| Valves | Light Liquid | 1,125 |
| Pumps | Light Liquid | 40 |
| Fittings (Connectors and Flanges) | Light Liquid | 1,650 |
| Others (Compressors and others) | Light Liquid | 960 |
| *Source:* SPEC Services 2005. | | |

## 2.2 Emission Factor Trends

The following methods were used to develop the 70-year trends in annual emission factors for the diesel-powered emission sources evaluated in this HRA:

1. **Tankers.** Emission factors for main engines, auxiliary generators, and boilers on ocean-going marine tankers were held constant at existing levels for the entire 70-year period. This approach is consistent with the European study on vessel emissions (ENTEC 2002), as presently there are no future standards promulgated for this source category that would result in more restrictive emission factors, and fleet turnover rate is slow and uncertain. Emission factors were specified based on fuel type, and fuel type was specified based on applicable project design and/or mitigation measures.

2. **Assist Tugboats.** The emission factors for main and auxiliary generators on assist tugboats assume the use of the Port diesel fuel (average 1,900 ppm sulfur) before 2006, CARB diesel (maximum 500 ppm sulfur) in 2006, and ultra low sulfur diesel (15 ppm sulfur) after 2006. Use of lower sulfur diesel fuel results in slight reductions in DPM emissions. The fuel sulfur content requirements starting in 2006 are for California harbor craft in accordance with California Code of Regulations Title 13, Division 3, Chapter 5, Article 2, Section 2281, "Sulfur Content of Diesel Fuel".

3. **Construction Sources.** DPM Emissions from construction equipment and haul trucks, general cargo ship (for stone delivery) transit and hoteling, tugboat/barge activities associated with wharf construction, were calculated by the methods presented in section 3.2.4 of the Supplemental Environmental Impact Statement/Subsequent Environmental Impact Report (SEIS/SEIR).

## 2.3 Emission Estimates

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 calendar year 2010 through 2080.

Annualized emission rates for use in the HRA were estimated based on the emission factors and emission estimation methodology presented in detail in Appendix H1 and Appendix H2. Table 5 summarizes the annual unmitigated and mitigated DPM emissions expected from proposed Project sources. The mitigated emissions include incorporation of Mitigation Measures (MMs) AQ-1 through MM AQ-21, as described in Section 3.2.4 of the SEIS/SEIR.

Much of the proposed 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 pollutant OEHHA considers in the estimation of cancer (lifetime) and chronic (annual) non-cancer effects from these sources. To estimate acute health effects, 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). For external combustion sources such as OGV boilers, organic and particulate-based TAC emissions were quantified pursuant applicable CARB speciation profiles.

## 3.0 RECEPTOR LOCATIONS USED IN THE HRA

This HRA analyzes the health risks associated with TAC emissions from Project sources at a variety of locations (receptors) throughout the San Pedro Bay Ports area, including at the locations of exposure to residents, offsite workers, and sensitive members of the public. The analysis utilized a regular coarse grid of 948 receptor points spaced every 500 meters apart around the Project sites. The regular receptor grid extended 17 kilometers (km) east-west by 14 km north-south. In addition, another 203 discrete receptors were placed at sensitive receptor locations of special concern, such as schools, day care centers, convalescent homes, and hospitals in the surrounding area. Table 4 summarizes the locations of these sensitive receptors. The coordinate information and elevation of each receptor location was determined from United States Geological Survey (USGS) topographic data.

Subsequent to the initial modeling analysis and preliminary identification of maximum impact locations, the HRA was refined by modeling proposed Project emissions using new finer-spaced 1.0 km x 1.0 km receptor grids that surrounded the maximum impact locations with receptors spaced every 50 meters apart.

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

- The residential MEI was selected from all receptors in residential or zoned residential areas, including the public marinas (for possible live-aboards) located west of Pier 400 (in the West Channel/Watchorn Basin area) and north of the Project's Terminal Island tank farm sites (in the East Basin/Cerritos Channel area).

- The occupational MEI was selected from all non-residential receptors outside the Project property boundaries and not over open water. Receptors directly on the Project property boundaries were also considered valid for this selection (e.g., APM/Maersk Pier 400 terminal). This approach is conservative, particularly for long-term occupational exposures, because it is unlikely that an off-site worker would be located on or very near the Project property lines except on an intermittent basis.

- The sensitive MEI was selected from all identified schools, day care centers, convalescent homes, and hospitals in the surrounding area.

- The student MEI was selected from all identified schools in the surrounding area.

## Table 4. Sensitive Receptors Evaluated in the HRA

| *Location* | *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 | 920 W 36th St | 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 |
| Federation / Coastline Headstart | | | 380017 | 3740136 |
| Voa / Caesar Chavez Head Start | 1269 N. Avalon St. | Wilmington | 383089 | 3739394 |
| A Love 4 Learning Academy | 306 Elm Ave. | Long Beach | 390048 | 3737366 |
| Carousel Preschool | 366 Cherry Ave. | Long Beach | 391856 | 3737375 |
| YMCA GLB Fairfield 3rd St. Preschool | 607 E. 3rd St. | Long Beach | 390292 | 3737325 |
| Young Horizons Child Development Centers | 501 Atlantic Ave. | Long Beach | 390248 | 3737631 |
| Coronado Head Start Child Care Center | 1395 Coronado St. | Long Beach | 393181 | 3738829 |
| First Foursquare Church Preschool | 2416 E. 11th St. | Long Beach | 392312 | 3738428 |
| Huntington Academy – Preschool | 2935 E. Spaulding St. | Long Beach | 392832 | 3738974 |
| Simply Kare Child Development Center | 1406 Obispo Ave. | Long Beach | 393126 | 3738858 |
| 12th Street Head Start | 1212 Long Beach Blvd. | Long Beach | 389912 | 3738586 |
| Atlantic Head Start | 1862 Atlantic Ave. | Long Beach | 390314 | 3739617 |
| Comprehensive Child Development | 2565 Pacific Ave. | Long Beach | 389484 | 3741032 |
| Elm Street Head Start | 1425 & 1429 Elm Ave. | Long Beach | 389991 | 3738889 |

## Table 4. Sensitive Receptors Evaluated in the HRA (continued)

| Location | Street Address | City | E UTM | N UTM |
|---|---|---|---|---|
| Fords Family Day Care | 2726 San Francisco Ave. | Long Beach | 388588 | 3741372 |
| Kelly's Kids Daycare Center | 855 W. Willow St. | Long Beach | 388761 | 3741139 |
| Long Beach Blvd Head Start | 2236 Long Beach Blvd. | Long Beach | 389932 | 3740374 |
| Long Beach Center for Child Development | 622 E. Hill St. | Long Beach | 390330 | 3740309 |
| Long Beach Child Development Center | 2222 Olive Ave. | Long Beach | 390493 | 3740339 |
| College Child Development – PCC | 1305 E. Pacific Coast Hwy | Long Beach | 391235 | 3739503 |
| Long Beach Day Nursery | 2801 Atlantic Ave. | Long Beach | 390295 | 3741518 |
| Oakwood Children's Center | 2650 Pacific Ave. | Long Beach | 389536 | 3741216 |
| Old King Cole Day Care | 3300 Oregon Ave. | Long Beach | 388795 | 3742493 |
| P.A.L. Family Day Care | 1980 Daisy Ave. | Long Beach | 388999 | 3739857 |
| Pacific Head Start | 2179 Pacific Ave. | Long Beach | 389473 | 3740259 |
| Ruiz Family Daycare | 2670 Daisy Ave. | Long Beach | 388990 | 3741078 |
| Signal Hill Head Start | 2285 Walnut Ave. | Long Beach | 391535 | 3740444 |
| Smart & Manageable | 2054 Myrtle Ave. | Long Beach | 390588 | 3739997 |
| Tender Child Care | 211 E. 29th St. | Long Beach | 389844 | 3741688 |
| Young Horizons Child Development Centers | 1840 Pacific Ave. | Long Beach | 389515 | 3739582 |
| Young Horizons Child Development Centers | 2418 Pacific Ave. | Long Beach | 389526 | 3740732 |
| Cabrillo Child Development Center | 2205 San Gabriel Ave. | Long Beach | 386680 | 3739773 |
| Garfield Head Start | 2240 Baltic Ave. | Long Beach | 387670 | 3740408 |
| Job Corp Head Start | 1903 Santa Fe Ave. | Long Beach | 387501 | 3739748 |
| West Child Development Center | 2125 Santa Fe. Ave. | Long Beach | 387505 | 3740187 |
| Bundle of Joy Daycare 2 | 1330 E. 16th St. | Long Beach | 391218 | 3739157 |
| Child Care Center at St. Mary Medical Center | 930 Elm Ave. | Long Beach | 390021 | 3738204 |
| Childtime Learning Center | 1 World Trade Ctr #199 | Long Beach | 388899 | 3737062 |
| Gaviota Head Start | 1131 Gaviota St. | Long Beach | 391569 | 3738492 |
| Jenkins Day Care | 1720 Cerritos Ave. | Long Beach | 390961 | 3739326 |
| Kelly's Care | 943 N. Washington Pl | Long Beach | 390636 | 3738218 |
| Little Lighthouse Educational Childcare Center | 911 Pine Ave. | Long Beach | 389577 | 3738177 |
| Lucy's Baby Care | 940 Maine Ave. | Long Beach | 388828 | 3738211 |
| My Three Kids Tons of Fun Day Care | 1240 E. 17th St. | Long Beach | 391142 | 3739294 |
| N 2 Lil Folkz | 1624 Chestnut Ave. | Long Beach | 389217 | 3739222 |
| Ole King Cole Development Center | 1814 E. 7th St. | Long Beach | 391695 | 3737831 |
| Pine Head Start | 927 Pine Ave. | Long Beach | 389581 | 3738225 |
| Play House, The | 1301 W. 12th St. | Long Beach | 388060 | 3738639 |
| Progressive Steps Children Center | 911 Pine Ave. | Long Beach | 389621 | 3738176 |
| Vincent Family Child Care | 925 Walnut Ave. | Long Beach | 391463 | 3738185 |
| West Anaheim Child Care Center | 440 W. Anaheim St. | Long Beach | 389183 | 3738668 |
| Young Horizons / El Jardin De La Felicidad | 507 Pacific Ave. | Long Beach | 389513 | 3738709 |
| Bethany Preschool | 2217 E. 6th St. | Long Beach | 392106 | 3737683 |
| Great Beginnings | 3027 E. 4th St. | Long Beach | 392907 | 3737426 |
| Our Saviour's Lutheran Preschool | 370 Junipero Ave. | Long Beach | 392172 | 3737336 |
| Phases – An Early Learning Comp. | 404 Newport Ave. | Long Beach | 393376 | 3737451 |
| Ruiz Family Daycare | 2670 Daisy Ave. | Long Beach | 388979 | 3741256 |
| **SCHOOLS** | | | | |
| Harbor City Christian School | | Harbor City | 380655 | 3739865 |
| 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 |

## Table 4. Sensitive Receptors Evaluated in the HRA (continued)

| *Location* | *Street Address* | *City* | *E UTM* | *N UTM* |
|---|---|---|---|---|
| Normont Elementary School | 1001 253rd St | Harbor City | 380360 | 3740007 |
| 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 |
| 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 |
| Banning New Elementary School #1 | 500 N. Island Ave. | Wilmington | 382098 | 3737638 |
| Holy Family Preschool and Elementary School | 1122 E. Robidoux St. | Wilmington | 384268 | 3739363 |
| Phineas Banning Senior High School | 1527 Lakme Ave. | Wilmington | 383235 | 3740075 |
| Saints Peter & Paul School | 706 Bay View Ave. | Wilmington | 382435 | 3738305 |
| Caesar Chavez Elementary | 730 W. 3rd St. | Long Beach | 388744 | 3737296 |
| Constellation Community Charter Middle | 620 Olive Ave. | Long Beach | 390505 | 3737788 |
| Edison Elementary | 625 Maine Ave. | Long Beach | 388805 | 3737814 |
| Franklin Classical Middle | 540 Cerritos Ave. | Long Beach | 390944 | 3737669 |
| Saint Anthony High School | 620 Olive Ave. | Long Beach | 390534 | 3737795 |
| Saint Anthony Preschool / Elementary | 855 E. 5th St. | Long Beach | 390580 | 3737582 |
| Select Community Day (Secondary) | 5869 Atlantic Ave. | Long Beach | 390248 | 3737371 |
| Stevenson Elementary | 515 Lime Ave. | Long Beach | 390365 | 3737647 |
| City Christian School | 2209 E. 6th St. | Long Beach | 392087 | 3737681 |
| Birney Elementary | 710 W. Spring St. | Long Beach | 388875 | 3741876 |
| Burnett Elementary | 565 E. Hill St. | Long Beach | 390228 | 3740326 |
| Cambodian Christian | 2474 Pacific Ave. | Long Beach | 389562 | 3740833 |
| Holy Innocents Elementary School | 2500 Pacific Ave. | Long Beach | 389544 | 3740927 |

## Table 4. Sensitive Receptors Evaluated in the HRA (continued)

| *Location* | *Street Address* | *City* | *E UTM* | *N UTM* |
|---|---|---|---|---|
| Jackie Robinson Academy | 2750 Pine Ave. | Long Beach | 389600 | 3741418 |
| Lafayette Elementary School | 2445 Chestnut Ave. | Long Beach | 389278 | 3740828 |
| Mary Butler Elementary | 1400 E. 20th St. | Long Beach | 391299 | 3739855 |
| Oakwood Academy | 2951 Long Beach Blvd. | Long Beach | 389888 | 3741829 |
| Signal Hill Elementary School | 2285 Walnut Ave. | Long Beach | 391480 | 3740435 |
| Cabrillo (Juan Rodriguez) High School | 2001 Santa Fe Ave. | Long Beach | 387439 | 3739936 |
| Hudson Development Center Daycare and Elementary School | 2335 Webster Ave. | Long Beach | 387067 | 3740604 |
| James A Garfield Elementary | 2240 Baltic Ave. | Long Beach | 387710 | 3740410 |
| Muir Elementary | 3038 Delta Ave. | Long Beach | 387933 | 3742038 |
| Saint Lucy School | 2320 Cota Ave. | Long Beach | 387406 | 3740569 |
| Stephens Middle | 1830 W. Columbia St. | Long Beach | 387350 | 3741632 |
| Abraham Lincoln Elementary School | 1175 E. 11th St. | Long Beach | 390987 | 3738499 |
| Artesia Well Preparatory Academy | 1235 Pacific Ave. | Long Beach | 389454 | 3738592 |
| Creative Arts Daycare and Elementary School | 1423 Walnut Ave. | Long Beach | 391473 | 3738915 |
| First Baptist Church School | 1000 Pine Ave. | Long Beach | 389638 | 3738317 |
| First Lutheran Day Care, Preschool and Elementary School | 946 Linden Ave. | Long Beach | 390184 | 3738233 |
| George Washington Middle School | 1450 Cedar Ave. | Long Beach | 389390 | 3738917 |
| Long Beach Montessori School | 525 E. 7th St. | Long Beach | 390202 | 3737906 |
| Polytechnic High School | 1600 Atlantic Ave. | Long Beach | 390337 | 3739143 |
| Regency High School | 490 W. 14th St. | Long Beach | 389126 | 3738772 |
| Renaissance High School for the Arts | 235 E. 8th St. | Long Beach | 389785 | 3738088 |
| Roosevelt Elementary | 1574 Linden Ave. | Long Beach | 390166 | 3739112 |
| The New City School | 1230 Pine Ave. | Long Beach | 389586 | 3738611 |
| John G Whittier Elementary School | 1761 Walnut Ave. | Long Beach | 391468 | 3739354 |
| Burbank Elementary | 501 Junipero Ave. | Long Beach | 392178 | 3737551 |
| **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 |
| Earl & Lorraine Miller Children's Hospital / Long Beach Memorial Medical Center and Hospital | 2801 Atlantic Ave. | Long Beach | 390174 | 3741498 |
| Pacific Hospital of Long Beach | 2776 Pacific Ave | Long Beach | 389484 | 3741460 |
| Long Beach Doctors Hospital | 1725 Pacific Ave | Long Beach | 389456 | 3739345 |
| St. Mary Medical Center | 1050 Linden Ave | Long Beach | 390100 | 3738380 |
| Tom Redgate Memorial Hospital | 1775 Chestnut Ave | Long Beach | 389227 | 3739447 |
| **NRS** | | | | |
| Bellagio Manor | 1046 East 4th St. | Long Beach | 390833 | 3737451 |
| Breakers of Long Beach, The | 210 East Ocean Blvd. | Long Beach | 389739 | 3736892 |
| Colonial Care Center | 1913 East 5th St. | Long Beach | 391786 | 3737576 |
| Crofton Manor Inn | 1950 East 5th St. | Long Beach | 391833 | 3737571 |
| Wells House | 245 Cherry Ave. | Long Beach | 391841 | 3737014 |
| Broadway By The Sea | 2725 East Broadway | Long Beach | 392578 | 3736808 |
| Villa Redondo Care Home | 237 Redondo Ave. | Long Beach | 393262 | 3736714 |
| Akin's Post Acute Rehab Hospital / Atlantic Memorial Healthcare Center | 2750 Atlantic Ave | Long Beach | 390343 | 3741381 |
| Caruthers Royale Care | 2204 Lime Ave. | Long Beach | 390386 | 3740307 |
| Courtyard Care Center | 1880 Dawson Ave. | Long Beach | 392087 | 3739639 |

**Table 4. Sensitive Receptors Evaluated in the HRA (continued)**

| *Location* | *Street Address* | *City* | *E UTM* | *N UTM* |
|---|---|---|---|---|
| Deluxe Guest Home | 3260 Pine Ave. | Long Beach | 389587 | 3740686 |
| Deluxe Guest Home II | 3266 Pine Ave. | Long Beach | 389586 | 3740722 |
| RMR Residential Care Facility, LLC | 2900 De Forest Ave. | Long Beach | 388554 | 3741647 |
| Royal Care Skilled Nursing Center | 2725 Pacific Ave. | Long Beach | 389543 | 3741355 |
| Burnett Home Care | 1740 West Burnett St. | Long Beach | 387440 | 3740697 |
| Loram Manor | 1925 Gemini St. | Long Beach | 387269 | 3740453 |
| Harbor View Rehabilitation Center | 490 West 14th St. | Long Beach | 389116 | 3738782 |
| Healthview – Pine Villa Assisted Living | 117 East 8th St. | Long Beach | 389645 | 3737994 |
| Olive Tree Home | 1035 Olive St. | Long Beach | 390455 | 3738345 |
| Skylight Convalescent Hospital | 1201 Walnut Ave. | Long Beach | 391465 | 3738580 |
| Villa Maria Care Center | 723 East 9th St. | Long Beach | 390433 | 3738121 |
| Edgewater Convalescent Hospital | 2625 East 4th St. | Long Beach | 392530 | 3737465 |
| Ruby's Guest Home | 2125 East 4th St. | Long Beach | 391994 | 3737434 |
| **OTHER** | | | | |
| Federal Prison | Reservation Point | | 382555 | 3732537 |
| Cabrillo Marina – Liveaboard Housing | | | 381489 | 3731926 |

**Table 5. Proposed Project DPM Emissions from Vessels**

| *Emission Source* | *Unmitigated DPM Emissions (pounds per year [lb/yr])* | *Mitigated DPM Emissions (pounds per year [lb/yr])* |
|---|---|---|
| Tanker Transit [1] | 79,692 | 67,849 |
| Tanker Maneuvering [2] | 19,081 | 9,332 |
| Tanker Hoteling [3] | 26,511 | 639 |
| Offloading Emissions [4] | 26,004 | 17,832 |
| Boiler Warm-up [5] | 7,387 | 1,294 |
| Tugboats | 11,002 | 11,002 |

*Notes:*
(1) These tanker main engine and auxiliary generator emissions occur in the area from Pilot pick-up to Berth 408 and back to Pilot drop-off. Per LAHD guidance, Pilot pick-up/drop-off is assumed to occur approximately 3 miles outside the breakwater.
(2) These tanker main engine and auxiliary generator emissions occur in an area approximately 250 m x 250 m in size adjacent to Berth 408.
(3) Includes emissions from 2 tanker auxiliary generators.
(4) Includes emissions from 2 tanker boilers.
(5) Includes boiler warm-up emissions while in South Coast Waters.

# 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. While HARP incorporates the Industrial Source Complex Short-Term model, Version 3 (ISCST3) for dispersion modeling, this analysis utilized the newer USEPA AERMOD dispersion model. The selection of the AERMOD model was appropriate 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) the availability of annual sets of hourly meteorological data for use by AERMOD, and (3) the model's ability to handle the various physical characteristics of project emission sources, including, "point," "area," and "volume" source types. AERMOD is an USEPA-approved Gaussian-plume dispersion model that was designated as a guideline model in December 2006 and the SCAQMD approves of its use for mobile source analyses.

## 4.1 Model Options

The AERMOD modeling analyses used the USEPA regulatory AERMOD default options for all modeling runs. However, as recommended by the SCAQMD, the analyses used urban dispersion parameters. All sources were modeled with emissions occurring 24 hours per day.

The AERMOD model incorporated the following general options and assumptions:

- Regulatory default option.
- Single urban area was set with an area population of 535,000 and a roughness length equal to 1.0.
- All sources were defined as “urban” sources.
- No downwash effects were included.
- Meteorological data from the LAHD Berth 47, Terminal Island Treatment Plant (TITP) and St. Peter & Paul School (SPPS) monitoring stations were used for modeling. These meteorological data sets were for the September 1, 2006 through August 31, 2007 period of record and were processed using the AERMET processor in accordance with the latest applicable USEPA guidance.

## 4.2 Emission Source Representation

The AERMOD modeling analysis evaluated Project-related operational TAC emission sources, including ocean-going vessels (tankers) and assist tugboats; tanks; VDUs; and fugitive sources. The HRA simulated project-related emission sources as realistically as possible, taking into consideration the physical characteristics and operational location of each source. Emissions from the movement of vessels and tugboats during transit are line source emissions that were simulated and modeled as a series of separated volume sources (Figure H4-1 shows the location of vessel sources modeled). Volume source emissions are simulated by AERMOD as being released and mixed vertically and horizontally within a volume of air prior to being dispersed down wind. The actual operational characteristics of each source type in terms of area of operation and vertical stack height or source height determined the dimensions of the volume source used in the model. Stationary emissions from vessel hoteling and offloading were modeled as point (stack) sources with upward plume velocity and buoyancy. Tank emissions were modeled as an area source for each tank farm site (TFS). VDU emissions are routed to exhaust stacks and were therefore modeled as point sources. Fugitive emissions from tank farm operations were modeled as occurring from area sources associated with each tank farm site. A total of 273 emission sources were simulated in AERMOD. The specific methodology for defining the various sources is discussed below.

1. **Vessel Cruising (Precautionary Area and beyond)**. Emissions from ocean going vessels were considered from the fairway into the Precautionary Area. Emissions for this leg were simulated as a series of separated volume sources between approximately 20 miles from Pt. Fermin and the pilot pick-up/drop-off point. Total transit emissions

for these legs were calculated and divided equally among the number of transit volume sources representing each segment.

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 1995a). 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:

a. Fairway/Precautionary Area – Center of volume source equal to 50 percent above stack height (36 m), or 54 m, and a volume source depth of 25 percent of stack height, or 9 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 Berth 408.

2. **Vessel Transit (Precautionary Area and In-Harbor Transit).** Emissions from marine vessels that transit between the pilot pick-up/drop-off point and the Project's marine terminal at Berth 408 were simulated as a series of separated volume sources beginning approximately 3 miles beyond the Port breakwater and extending to the Berth 408 wharf. Total transit emissions were calculated and divided equally among the number of transit volume sources representing each of the Precautionary Area and In-Harbor transit segments. Tug assist emissions were also calculated and represented as a series of volume sources collocated with the OGV volume sources (2 tugs per assist for an Aframax and Panamax Vessel, 3 tugs per assist for a Suezmax Vessel, and 4 tugs per assist for a VLCC).

The HRA used the following vertical dimensions for these vessel transit volume sources:

a. Harbor Transit – Center of volume source equal to 100 percent above stack height, or 72 m, and a volume source depth of 50 percent of stack height, or 18 m.

The transit volume sources were positioned approximately every 200 m along the centerline of the vessel inbound/outbound traffic lanes through the area from the pilot pick-up/drop-off point to Angels Gate, and then on to Berth 408.

3. **Vessel Near-Berth Maneuvering Area (Turning and Docking at Berth).** Approximately 20 percent of the total transit emissions from pilot pick-up/drop-off to berth would occur during vessel turning and docking activities near the berth. As a result, a dedicated near-berth volume source was created to simulate emissions from

these activities. Turning in the vicinity of Berth 408 is only required when leaving the berth to exit the harbor. Vessels docking at berth are positioned head-in, with the starboard side against the breasting dolphins. The turning/docking volume source was located in the area immediately west of Berth 408. The volume source width was set to 335 m, which is the approximate length of a typical VLCC tanker vessel. The release height and initial vertical thickness of the turning/docking volume source were as follows:

a. Near-Berth Maneuvering – Center of volume source equal to 200 percent above stack height, or 108 m, and a volume source depth of 100 percent of stack height, or 36 m.

4. **Vessel Tying up.** It takes approximately one-hour to tie the vessel to the dock and make it secure. Since the vessels are relatively stationary while this is occurring, the emissions occurring during this period were modeled as stack-type point sources. The vessel's main engine is shut off while at berth and only the boiler warm-up and auxiliary engines are working.

5. **Vessel hoteling/offloading.** Because vessels are stationary while hoteling and offloading, vessel hoteling/offloading emissions were modeled as stack-type point sources located adjacent to Berth 408. Auxiliary generator and boiler sources were modeled with separate release parameters. The release parameters (stack height, stack diameter, exhaust gas temperature, and exit velocity) for tanker hoteling/offloading emissions were obtained from Herbert Engineering Corporation (email, January 2005), and are shown in Table 6. The vessel's main engine is shut off while at berth.

**Table 6. Auxiliary Generator and Boiler Stack Parameters**

| *Source Description* | *Stack Height (ft)* | *Exhaust Temp (deg F)* | *Stack Exit Velocity (ft/sec)* | *Stack Diameter (ft)* |
|---|---|---|---|---|
| Auxiliary Generator 1 | 118 | 800 | 98.4 | 1.53 |
| Auxiliary Generator 2 | 118 | 800 | 98.4 | 1.53 |
| Boiler 1 | 121 | 800 | 80.5 | 4.24 |
| Boiler 2 | 121 | 800 | 80.5 | 4.24 |
| *Source:* Herbert Engineering Corporation 2005. | | | | |

6. **Tank Farm Tanks.** Fugitive emissions from crude oil tanks were modeled with the AERMOD as area sources. The emissions from each tank were first estimated by the USEPA's TANKS 4.09b model (see Appendix H.2, Attachment 8). Inputs to the model included: (1) specification of internal floating roofs for all tanks; (2) use of default values for roof fitting, tank condition, and paint; (3) assumption of crude oil with a TVP of 10 psia for all tanks; (4) assumption that crude oil vapor contains 0.38 percent by volume of benzene and 9.9 percent by volume of hexane; and (5) a maximum crude oil flow rate of 75,000 bbl/hour. Table 7 summarizes physical dimensions of the tanks.

### Table 7. Crude Oil Tanks - Modeling Inputs

| *Tank Location* | *No. of Tanks* | *Tank Size* | *Tank Diameter (ft)* | *Tank Height (ft)* | *Lateral Dimension* [1] *(ft)* | *Vertical Dimension* [2] *(ft)* |
|---|---|---|---|---|---|---|
| Site 1 | 2 | 250k short | 202 | 51.5 | 47 | 24.0 |
| | 1 | 50k surge | 90 | 51.5 | 20.9 | 24.0 |
| | 1 | 15k fueling | 52 | 46.5 | 12.1 | 21.6 |
| Site 2 | 14 | 250k tall | 185 | 65.5 | 40.7 | 30.5 |

*Notes:*
(1) Lateral dimension (sigma-y) for a single volume source is equal to the diameter divided by 4.3.
(2) Vertical dimension (sigma-z) for a single volume source is equal to the height divided by 2.15.
*Source:* SPEC Services 2005.

7. **Vapor Destruction Units.** VDUs would be located at Tank Farm Sites 1 and 2. All VDUs were modeled as stack-type point sources with parameters as follows: stack height = 50 ft, stack exhaust temperature = 1,400 deg. F, stack exit velocity = 587 ft/min, and stack diameter = 8 ft. The amount of crude vapor that would be incinerated for each VDU was based on the available tank volume. The following distribution was used: Site 1 VDU would process 12.5 percent of the total gases, and Site 2 would process 87.5 percent. Details of the VDU emission calculations are provided in Appendix H.2.

8. **Fugitive Components.** The number and type of fugitive emission components in the current design of the tank farms was provided by SPEC Services (see Appendix H.2). The emissions from the fugitive component sources at a given tank farm site were combined and modeled as occurring from an area source. Characteristics of the area sources are shown in Table 8. Emissions were estimated based on emission factors obtained from Table IV-2b (Method 3) of Guidelines for Fugitive Emission Calculations (see Appendix H.2, Attachment 11). The emissions were estimated using the assumptions that: (1) all of the fugitive components are categorized as "light liquid service"; (2) the typical crude oil that would be transported by the Project would contain 0.38 by volume benzene and 9.9 percent by volume hexane; and (3) the maximum hourly emissions would be equal to the annual average hourly emissions.

All emission sources in the HRA were positioned by using the Universal Transverse Mercator (UTM) coordinate system (NAD-27) referenced to topographic data obtained from the USGS.

### Table 8. Fugitive Components – Area Source Modeling Inputs

| *Tank Farm Site* | *Vertical Thickness (ft)* | *Lateral x-direction (ft)* | *Lateral y-direction (ft)* |
|---|---|---|---|
| Site 1 | 3.7 | 250 | 450 |
| Site 2 | 2.8 | 800 | 800 |

### 4.3 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 prevailing southwest sea breeze conditions, this geographic feature can create a relatively light wind zone in the Inner Harbor while the Outer Harbor experiences strong winds. The monthly and hourly streamlines developed for the SCAB in California South Coast Air Basin Hourly Wind Flow Patterns show that this is the case (SCAQMD 1977). Therefore, use of meteorological data collected from locations within the Port area would provide for the most accurate modeling results.

The LAHD has operated an air quality monitoring program at 4 locations within the Port area since February 2005 that includes the collection of meteorological data (LAHD 2004). This effort provided annual meteorological data sets that have been developed for purposes of dispersion modeling analyses. These data sets include hourly meteorological data (365 days × 24 hours/day = 8,760 hours) of wind speed, wind direction, temperature, stability, and mixing height.

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 meteorological areas. For this analysis, meteorological data from the LAHD Berth 47, Terminal Island Treatment Plant (SPPS) and St. Peter & Paul School (SPPS) monitoring stations was used. These data sets were used to represent meteorological conditions in the outer, middle, and inner harbor, respectively. All data sets were for the September 1, 2006 through August 31, 2007 period of record and were processed using the AERMET processor in accordance with the latest applicable USEPA guidance.

## 5.0 CALCULATION OF HEALTH RISKS

The results of the AERMOD dispersion modeling analysis represent an intermediate product in the HRA process. The HARP model was subsequently used to determine cancer risk and acute and chronic health effects 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 2005). Table 9 identifies the health risk areas of concern for each of the TACs that would be emitted by the Project.

### 5.1 Toxicity Factors

The inhalation unit risk factor is the pollutant-specific probability that a person will develop cancer from the continuous exposure to a concentration of 1 µg/m3 of that pollutant in the air over a period of 70 years. The unit risk factor for DPM is 300 in one million.

Long-term (chronic) exposure to low levels of DPM has also been shown to pose a hazard for chronic inflammation in the human lung. The USEPA has developed an inhalation reference concentration (RfC) of 5 µg/m3 for diesel exhaust, based on long-term data from human and animal studies. OEHHA has likewise developed a chronic REL of 5 µg/m3 for DPM. The chronic REL is an estimate of the continuous inhalation concentration to which the human population (including sensitive subgroups) can be exposed for a long period of time (generally 24 hours or greater) without appreciable risk of experiencing deleterious non-cancer effects.

In regard to short-term (acute) non-cancer effects, available health effects data show that at relatively high acute exposures, DPM can cause irritation to the eyes and upper respiratory system. However, neither the USEPA nor OEHHA has developed quantitative DPM dose-response estimates for acute non-cancer health effects (i.e., for exposures periods less than 24 hours) due to a lack of exposure-response information. Table 10 presents the cancer, chronic non-cancer, and acute non-cancer toxicity factors used to assess health risks for all TACs in this study.

### Table 9. Risk Assessment Concerns for Project TAC Emissions

| *TAC* | *Cancer Risk* | *Non-Cancer Risk (Chronic)* | *Non-Cancer Risk (Acute)* |
|---|---|---|---|
| 1,3-Butadiene [1] | X | X | |
| Acetaldehyde [1,3] | X | X | |
| Acrolein [3] | X | X | X |
| Benzene [1,2] | X | X | X |
| Chlorobenzene [1] | | X | |
| Ethylbenzene [1,3] | | X | |
| Formaldehyde [1,3] | X | X | X |
| Hexane [1,2] | | X | |
| Methyl Alcohol [1] | | X | X |
| MEK [1] | | X | X |
| Naphthalene [1,3] | X | X | |
| PAH [3] | X | | |
| Propylene [1,3] | | X | |
| Styrene [1] | | X | X |
| Toluene [1,3] | | X | X |
| Xylene [1,3] | | X | X |
| DPM [1] | X | X | |
| Ammonia [1] | | X | X |
| Antimony [1] | | X | |
| Arsenic [1] | X | X | X |
| Bromine [1] | | X | |
| Cadmium [1] | X | X | |
| Chromium [1] | X | X | |
| Copper [1] | | X | X |
| Lead [1] | X | | |
| Manganese [1] | | X | |
| Mercury [1] | | X | X |
| Nickel [1] | X | X | X |
| Phosphorous [1] | | X | |
| Selenium [1] | | X | |
| Sulfates [1] | | X | X |
| Vanadium [1] | | | X |
| Zinc [1] | | X | |

*Notes:*

(1) Sources are diesel combustion in tanker vessel main engines, tugboat main engines, boilers, and auxiliary generators.
(2) Sources are crude oil tank vapors, crude oil fugitive components, thermal destruction of crude oil vapors in VDUs, and natural gas combustion in VDUs.
(3) Source is from natural gas combustion in VDUs.

## Table 10. Toxicity Factors used in the HRA

| *Pollutant* | *CAS Number* | *Inhalation Cancer Unit Risk Factor ($\mu g/m^3$)$^{-1}$* | *Chronic Inhalation REL ($\mu g/m^3$)* | *Target Organ for Chronic Exposure* | *Acute Inhalation REL[1] ($\mu g/m^3$)* | *Target Organ for Acute Exposure* |
|---|---|---|---|---|---|---|
| 1,3-Butadiene | 106-99-0 | $1.7 \times 10^{-4}$ | 20.0 | Repr | n/a | n/a |
| Acetaldehyde | 75-07-0 | $2.7 \times 10^{-6}$ | 9.0 | Resp | n/a | n/a |
| Acrolein | 107-02-8 | n/a | 0.06 | Resp; Eyes | 0.19 | Eyes |
| Benzene | 71-43-2 | $2.9 \times 10^{-5}$ | 60 | Dev; CNS | 1,300 | Dev; Repr |
| Chlorobenzene | 108-90-7 | n/a | 1,000 | Al; Kid; Repr | n/a | n/a |
| Ethylbenzene | 100-41-4 | n/a | 2,000 | Al; Dev; Kidney; Endo | n/a | n/a |
| Formaldehyde | 50-00-0 | $6.0 \times 10^{-6}$ | 3.0 | Resp; Eyes | 94 | Eyes |
| Isomers of Xylene | 1330-20-7 | n/a | 700 | CNS; Resp | 22,000 | Eyes; Resp |
| Methyl Alcohol | 67-56-1 | n/a | 4,000 | Dev | 28,000 | CNS |
| MEK | 78-93-3 | n/a | 1,000 | Repr | 13,000 | Eyes; Resp |
| Naphthalene | 91-20-3 | $3.4 \times 10^{-5}$ | 9.0 | Resp | n/a | n/a |
| N-Hexane | 110-54-3 | n/a | 7,000 | CNS | n/a | n/a |
| Propylene | 115-07-1 | n/a | 3,000 | Resp | n/a | n/a |
| PAH | 50-32-8 | $1.1 \times 10^{-3}$ | n/a | n/a | n/a | n/a |
| Styrene | 100-42-5 | n/a | 900 | CNS | 21,000 | Eyes; Resp |
| Toluene | 108-88-3 | n/a | 300 | CNS; Dev; Resp | 37,000 | CNS; Eyes; Resp |
| DPM | 9901 | $3.0 \times 10^{-4}$ | 5.0 | Resp | n/a | n/a |
| Ammonia | 7664-41-7 | n/a | 200 | Resp | 3,200 | Eyes; Resp |
| Antimony | 7440-36-0 | n/a | 0.2 | Resp | n/a | n/a |
| Arsenic | 7440-38-2 | $3.3 \times 10^{-3}$ | 0.03 | Dev; CV; CNS | 0.19 | Dev; Repr |
| Bromine | 7726-95-6 | n/a | 1.7 | Resp | n/a | n/a |
| Cadmium | 7740-43-9 | $4.2 \times 10^{-3}$ | 0.02 | Kid; Resp | n/a | n/a |
| Chromium | 18540-29-9 | $1.5 \times 10^{-1}$ | 0.2 | Resp | n/a | n/a |
| Copper | 7440-50-8 | n/a | 2.4 | Resp | 100 | Resp |
| Lead | 7439-92-1 | $1.2 \times 10^{-5}$ | n/a | n/a | n/a | n/a |
| Manganese | 7439-96-5 | n/a | 0.2 | CNS | n/a | n/a |
| Mercury | 7439-97-6 | n/a | 0.09 | CNS | 1.8 | Dev; Repr |
| Nickel | 7440-02-0 | $2.6 \times 10^{-4}$ | 0.05 | Resp; Hem | 6.0 | Resp; Imm |
| Phosphorous | 7723-14-0 | n/a | 0.07 | Dev; Repr | n/a | n/a |
| Selenium | 7782-49-2 | n/a | 20.0 | Al; CV; CNS | n/a | n/a |
| Sulfates | 9960 | n/a | 25.0 | Resp | 120 | Resp |
| Vanadium | 7440-62-2 | n/a | n/a | n/a | 30 | Resp |
| Zinc | 7440-66-6 | n/a | 35.0 | CV; Hem; Resp | n/a | n/a |

*Notes:*

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

Key:

| | | | |
|---|---|---|---|
| n/a | = not applicable | Hem | = Hematopoietic System |
| AL | = Alimentary System | Imm | = Immune System |
| CNS | = Central Nervous System | Kid | = Kidney |
| CV | = Cardiovascular System | NS | = Nervous System |
| Dev | = Developmental System | Repr | = Reproductive System |
| Endo | = Endocrine System | Resp | = Respiratory System |

Source: CARB 2005.

## 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 2004). 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 CARB policy recommends that the potential cancer risk be based on the breathing rate representing the 80th percentile for a 70-year exposure period. The 80th percentile lifetime breathing rate is equal to 302 liters per kilogram of body weight per day (L/kg BW-day) (CARB 2004). Therefore, the HRA determined maximum residential and sensitive receptor cancer risk impacts by using HARP's built-in 80th 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 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.

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 $(8 \times 245.7 \times 40)/(24 \times 350 \times 70) = 0.134$. This factor is further modified to account for differences in the breathing rate of workers compared to the 80th 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 $(0.134 \times 447 / 302) = 0.20$ to produce the maximum occupational impacts actually expected from the project.

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 $(6 \times 180 \times 6)/(24 \times 350 \times 70) = 0.011$. 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 $(0.011 \times 581 / 302) = 0.021$ 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 US EPA Exposure Factors Handbook (USEPA, 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 11 summarizes the primary exposure assumptions used to calculate individual lifetime cancer risks by receptor type.

**Table 11. Exposure Assumptions for Individual Lifetime Cancer Risk**

| *Receptor Type* | *Exposure Frequency* | | *Exposure Duration (Years)* | *Breathing Rate (L/kg BW-day)* |
|---|---|---|---|---|
| | *Hours/Day* | *Days/Year* | | |
| Residential [1] | 24 | 350 | 70 | 302 |
| Sensitive [1] | 24 | 350 | 70 | 302 |
| Occupational [2] | 8 | 245.7 | 40 | 447 |
| Student [3] | 6 | 180 | 6 | 581 |

*Notes:*

(1) The residential/sensitive receptor 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 245.7 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).

The HARP model printouts for this HRA are too voluminous to include in an attachment; they are available in electronic format upon request.

# 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 × 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.

# 7.0 PREDICTED HEALTH IMPACTS

## 7.1 Unmitigated Project Health Impacts

Table 12 presents a summary of the maximum health impacts that would occur for each receptor type due to the operation of the Project. Because these results represent the maximum impacts predicted for each receptor type, all other impacts for similar receptor types would be less than these values.

The data in Table 12 show that the maximum Project residential cancer risk would be 12 in a million, which would occur in the Reservation Point correctional facility, which has housing. This number is greater than the 10 in a million threshold. The maximum chronic and acute hazard indices would be below the SCAQMD hazard index threshold value of 1.0 for all residential.

The maximum Project occupational cancer risk of 9.7 in a million would occur at the Maersk Inspection Building, in the APM/Maersk Pier 400 terminal. The maximum Project cancer risk for a sensitive receptor (the Federal Correctional Institution medical facilities on Terminal Island at Reservation Point) would be 12 in a million.

Figure H4-2 presents the distributions of residential and occupational cancer risks estimated for the proposed Project without mitigation. It should be noted that residential and occupational impact points are not necessarily located directly on existing homes or workplaces; rather, they are located in areas that contain these land use types.

**Table 12. Maximum Health Impacts Produced by the Proposed Project without Mitigation**

| *Health Impact* | *Receptor Type* | *Maximum Impact* [1, 2] | *Significance Thresholds* | *Significant Impact* |
|---|---|---|---|---|
| Cancer Risk | Residential | $12 \times 10^{-6}$ (12 in a million) | $10.0 \times 10^{-6}$ (10 in a million) | Yes |
| | Occupational Area | $9.7 \times 10^{-6}$ (9.7 in a million) | | No |
| | Sensitive Receptor | $12 \times 10^{-6}$ (12 in a million) | | Yes |
| | Student | $6.9 \times 10^{-6}$ (6.9 in a million) | | No |
| Non-Cancer Chronic Hazard Index | Residential | 0.017 | 1.0 | No |
| | Occupational Area | 0.073 | | No |
| | Sensitive Receptor | 0.017 | | No |
| | Student | 0.012 | | No |
| Non-Cancer Acute Hazard Index | Residential | 0.040 | 1.0 | No |
| | Occupational Area | 0.043 | | No |
| | Sensitive Receptor | 0.040 | | No |
| | Student | 0.028 | | No |

*Notes:*

1. Maximum impacts for cancer risk values are presented in terms of a probability of contracting cancer. For example a cancer risk of $10.0 \times 10^{-6}$ would equate to 10 chances in a million of contracting cancer. Maximum impacts for acute or chronic health risk are presented as a Hazard Index that is calculated as the maximum Project exposure concentration divided by the acceptable concentration.
2. Location of the maximum cancer impacts were predicted as follows: residential receptor, Reservation Point; occupational receptor, Pier 400 container terminal (APM/Maersk); sensitive receptor, Reservation Point; student receptor, Point Fermin Elementary School.

## 7.2 Mitigated Project Health Impacts

The HRA evaluated the reduction of public health impacts that would occur with the implementation of feasible mitigation measures. Based upon technological feasibility, consideration of future schedules for implementation of emissions and fuel standards, and costs, the following measures were analyzed as the most feasible for adoption: (1) mandatory speed reduction for vessels within California Coastal Waters, (2) use of low-sulfur fuel in vessel auxiliary generators and boilers while at berth, and (3) use of cleaner, lower-sulfur fuel in vessel auxiliary generators and boilers while cruising and maneuvering in coastal waters. (Refer to the discussion of impact AQ-3 in Section 3.2.4.5.1 of the SEIS/SEIR for a discussion of these adopted mitigation measures and other measures that were investigated but found to be infeasible.)

Table 13 presents a summary of the maximum mitigated health impacts that would occur for each receptor type due to the operation of the Project. These data show that the Project maximum mitigated residential cancer risk would be 5.3 in a million, which would occur at Reservation Point. Therefore, operation of the mitigated Project would produce less then significant cancer risks residential receptors. The Project maximum mitigated chronic and acute hazard indices would be below the SCAQMD hazard index threshold value of 1.0 for all residential receptors.

**Table 13. Maximum Health Impacts Produced by the Proposed Project with Mitigation**

| *Health Impact* | *Receptor Type* | *Maximum Impact* [1,2] | *Significance Thresholds* | *Significant Impact* |
|---|---|---|---|---|
| Cancer Risk | Residential | $5.3 \times 10^{-6}$ (5.3 in a million) | $10.0 \times 10^{-6}$ (10 in a million) | No |
| | Occupational Area | $4.8 \times 10^{-6}$ (4.8 in a million) | | No |
| | Sensitive Receptor | $5.3 \times 10^{-6}$ (5.3 in a million) | | No |
| | Student | $2.4 \times 10^{-6}$ (2.4 in a million) | | No |
| Non-Cancer Chronic Hazard Index | Residential | 0.0095 | 1.0 | No |
| | Occupational Area | 0.044 | | No |
| | Sensitive Receptor | 0.0095 | | No |
| | Student | 0.0064 | | No |
| Non-Cancer Acute Hazard Index | Residential | 0.019 | 1.0 | No |
| | Occupational Area | 0.026 | | No |
| | Sensitive Receptor | 0.019 | | No |
| | Student | 0.013 | | No |

*Notes:*

1. Maximum impacts for cancer risk values are presented in terms of a probability of contracting cancer. For example a cancer risk of $10.0 \times 10^{-6}$ would equate to 10 chances in a million of contracting cancer. Maximum impacts for acute or chronic health risk are presented as a Hazard Index that is calculated as the maximum Project exposure concentration divided by the acceptable concentration.
2. Location of the maximum cancer impacts were predicted as follows: residential receptor, Reservation Point; occupational receptor, Pier 400 container terminal (APM/Maersk); sensitive receptor, Reservation Point; student receptor, Point Fermin Elementary School.

Figure H4-3 presents the distributions of residential and occupational cancer risks estimated for the proposed Project with mitigation.

## 7.3 Unmitigated Reduced Project Health Impacts

Table 14 presents a summary of the maximum health impacts that would occur for each receptor type due to the operation of the Reduced Project Alternative. Because these results represent the maximum impacts predicted for each receptor type, all other impacts for similar receptor types would be less than these values.

The data in Table 14 show that the maximum Reduced Project residential cancer risk would be 25 in a million, which would occur in the Reservation Point correctional facility, which has housing. This number is greater than the 10 in a million threshold. The maximum chronic and acute hazard indices would be below the SCAQMD hazard index threshold value of 1.0 for all residential.

The maximum Reduced Project occupational cancer risk of 9.6 in a million would occur at the Maersk Inspection Building, in the APM/Maersk Pier 400 terminal. The maximum Reduced Project cancer risk for a sensitive receptor (the Federal Correctional Institution medical facilities on Terminal Island at Reservation Point) would be 25 in a million.

**Table 14. Maximum Health Impacts Produced by the Reduced Project Alternative without Mitigation**

| *Health Impact* | *Receptor Type* | *Maximum Impact* [1, 2] | *Significance Thresholds* | *Significant Impact* |
|---|---|---|---|---|
| Cancer Risk | Residential | $25 \times 10^{-6}$ (25 in a million) | $10.0 \times 10^{-6}$ (10 in a million) | Yes |
| | Occupational Area | $9.6 \times 10^{-6}$ (9.6 in a million) | | No |
| | Sensitive Receptor | $25 \times 10^{-6}$ (25 in a million) | | Yes |
| | Student | $11 \times 10^{-6}$ (11 in a million) | | Yes |
| Non-Cancer Chronic Hazard Index | Residential | 0.093 | 1.0 | No |
| | Occupational Area | 0.059 | | No |
| | Sensitive Receptor | 0.098 | | No |
| | Student | 0.098 | | No |
| Non-Cancer Acute Hazard Index | Residential | 0.074 | 1.0 | No |
| | Occupational Area | 0.042 | | No |
| | Sensitive Receptor | 0.083 | | No |
| | Student | 0.083 | | No |

*Notes:*

1. Maximum impacts for cancer risk values are presented in terms of a probability of contracting cancer. For example a cancer risk of 10.0 x 10-6 would equate to 10 chances in a million of contracting cancer. Maximum impacts for acute or chronic health risk are presented as a Hazard Index that is calculated as the maximum Project exposure concentration divided by the acceptable concentration.
2. Location of the maximum cancer impacts were predicted as follows: residential receptor, Reservation Point; occupational receptor, Pier 400 container terminal (APM/Maersk); sensitive receptor, Reservation Point; student receptor, Point Fermin Elementary School.

Figure H4-4 presents the distributions of residential and occupational cancer risks estimated for the Reduced Project without mitigation. It should be noted that residential and occupational impact points are not necessarily located directly on existing homes or workplaces; rather, they are located in areas that contain these land use types.

## 7.4 Mitigated Reduced Project Health Impacts

The HRA evaluated the reduction of public health impacts that would occur with the implementation of feasible mitigation measures under the Reduced Project Alternative. For the Berth 408 and associated PLAMT operations, the Reduced Project analysis assumed that the mitigation measures discussed under the proposed Project would be applied. Under the Reduced Project Alternative, it is assumed that several existing crude oil terminals within the San Pedro Bay Ports (SPBP) complex would receive additional crude oil due to market demand. For these terminals, it was assumed to certain measures of the SPBP Clean Air Action Plan (CAAP) would eventually be applied to those terminals under lease renewal schedules (see SEIS/SEIR Section 3.2 for a discussion of these applied measures.)

Table 15 presents a summary of the maximum mitigated health impacts that would occur for each receptor type due to the operation of the Reduced Project. These data show that the Reduced Project maximum mitigated residential cancer risk would be 18 in a million, which would occur at Reservation Point. Therefore, operation of the mitigated Project would produce significant cancer risks residential receptors. The Project maximum mitigated chronic and acute hazard indices would be below the SCAQMD hazard index threshold value of 1.0 for all residential receptors.

Figure H4-5 presents the distributions of residential and occupational cancer risks estimated for the Reduced Project with mitigation.

**Table 15. Maximum Health Impacts Produced by the Reduced Project Alternative with Mitigation**

| *Health Impact* | *Receptor Type* | *Maximum Impact* [1,2] | *Significance Thresholds* | *Significant Impact* |
|---|---|---|---|---|
| Cancer Risk | Residential | $18 \times 10^{-6}$ (18 in a million) | $10.0 \times 10^{-6}$ (10 in a million) | Yes |
| | Occupational Area | $5.8 \times 10^{-6}$ (5.8 in a million) | | No |
| | Sensitive Receptor | $18 \times 10^{-6}$ (18 in a million) | | Yes |
| | Student | $5.7 \times 10^{-6}$ (5.7 in a million) | | No |
| Non-Cancer Chronic Hazard Index | Residential | 0.077 | 1.0 | No |
| | Occupational Area | 0.025 | | No |
| | Sensitive Receptor | 0.087 | | No |
| | Student | 0.087 | | No |
| Non-Cancer Acute Hazard Index | Residential | 0.050 | 1.0 | No |
| | Occupational Area | 0.019 | | No |
| | Sensitive Receptor | 0.066 | | No |
| | Student | 0.066 | | No |

*Notes:*

1. Maximum impacts for cancer risk values are presented in terms of a probability of contracting cancer. For example a cancer risk of $10.0 \times 10^{-6}$ would equate to 10 chances in a million of contracting cancer. Maximum impacts for acute or chronic health risk are presented as a Hazard Index that is calculated as the maximum Project exposure concentration divided by the acceptable concentration.
2. Location of the maximum cancer impacts were predicted as follows: residential receptor, Reservation Point; occupational receptor, Pier 400 container terminal (APM/Maersk); sensitive receptor, Reservation Point; student receptor, Fifteenth Street Elementary School.

## 7.5 No Federal Action/No Project Alternative Health Impacts

The HRA evaluated the reduction of public health impacts that would occur with the implementation of feasible mitigation measures under the No Federal Action/No Project Alternative. As with the Reduced Project Alternative, the No Federal Action/No Project Alternative assumed that several existing crude oil terminals within the SPBP complex would receive additional crude oil due to market demand. For these terminals, it was assumed to certain measures of the SPBP CAAP would eventually be applied to those terminals under lease renewal schedules (see SEIS/SEIR Section 3.2 for a discussion of these applied measures).

Table 16 presents a summary of the maximum health impacts that would occur for each receptor type due to the operation of the No Federal Action/No Project Alternative. These data show that the No Project maximum residential cancer risk would be 26 in a million, which would occur at Reservation Point. Therefore, operation of the mitigated Project would produce significant cancer risks for residential receptors. The maximum occupational impact would be 23 in a million, which is above the significant threshold. Additionally, the maximum sensitive receptor impact would be above the significance threshold. The Project maximum mitigated chronic and acute hazard indices would be below the SCAQMD hazard index threshold value of 1.0 for all residential receptors.

**Table 16. Maximum Health Impacts Produced by the No Federal Action/No Project Alternative**

| *Health Impact* | *Receptor Type* | *Maximum Impact* [1,2] | *Significance Thresholds* | *Significant Impact* |
|---|---|---|---|---|
| Cancer Risk | Residential | $26 \times 10^{-6}$ (26 in a million) | $10.0 \times 10^{-6}$ (10 in a million) | Yes |
| | Occupational Area | $23 \times 10^{-6}$ (23 in a million) | | Yes |
| | Sensitive Receptor | $26 \times 10^{-6}$ (26 in a million) | | Yes |
| | Student | $17 \times 10^{-6}$ (17 in a million) | | Yes |
| Non-Cancer Chronic Hazard Index | Residential | 0.061 | 1.0 | No |
| | Occupational Area | 0.078 | | No |
| | Sensitive Receptor | 0.073 | | No |
| | Student | 0.073 | | No |
| Non-Cancer Acute Hazard Index | Residential | 0.19 | 1.0 | No |
| | Occupational Area | 0.29 | | No |
| | Sensitive Receptor | 0.23 | | No |
| | Student | 0.23 | | No |

*Notes:*

1. Maximum impacts for cancer risk values are presented in terms of a probability of contracting cancer. For example a cancer risk of $10.0 \times 10^{-6}$ would equate to 10 chances in a million of contracting cancer. Maximum impacts for acute or chronic health risk are presented as a Hazard Index that is calculated as the maximum Project exposure concentration divided by the acceptable concentration.
2. Location of the maximum cancer impacts were predicted as follows: residential receptor, Reservation Point; occupational receptor, Pier 400 container terminal (south fenceline of Tank Farm Site 2); sensitive receptor, Reservation Point; student receptor, Childtime Learning Center.

Figure H4-6 presents the distributions of residential and occupational cancer risks estimated for the No Federal Action/No Project Alternative.

# 8.0 RISK UNCERTAINTY

OEHHA (2003) provides a discussion of risk uncertainty, which is presented here:

*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 non-cancer 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.*

Additionally, please see Appendix H.3 for a brief primer on HRAs at the Port of Los Angeles.

# 9.0 REFERENCES

California Air Resources Board (CARB). 2002a. EMFAC *2002 On-road Mobile Source Emissions Estimation Model*. Web site: http://www.arb.ca.gov/msei/msei.htm.

____. 2002b. California Emission Inventory Development and Reporting System (CEIDARS). Particulate Matter (PM) Speciation Profiles. September 27.

____. 2003a. Hotspots Analysis Reporting Program (HARP) website: http://www.arb.ca.gov/toxics/harp/downloads.htm.

____. 2003b. Draft California Emission Inventory Development and Reporting System (CEIDARS). ARB Organic Gas Speciation Profiles. March 19.

____. 2004. *Recommended Interim Risk Management Policy*. Web site: http://www.arb.ca.gov/toxics/harp/rmpolicyfaq.htm.

____. 2005. *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values*. Web site: http://www.arb.ca.gov/toxics/healthval/contable.pdf. April 25.

____. 2006. *Diesel Particulate Matter Exposure Assessment Study for the Ports of Los Angeles and Long Beach – Final Report*.

California Office of Environmental Health Hazard Assessment (OEHHA). 2003. *Air Toxics Hot Spots Program Risk Assessment Guidelines. The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments.* August.

Dillingham Software Engineering. 2004. *HARP Express – User Manuel*. Version 2.07, September 20, 2004.

Hebert Engineering Corp. 2005. *Tanker Information – Proposed Pier 400 Terminal – Draft*.

Entec UK Limited. 2002. *Quantification of Emissions from Ships Associated with Ship Movements between Ports in the European Community*. Final Report to the European Commission. July.

Los Angeles Harbor Department (LAHD). 2004. *Final Air Quality Monitoring Work Plan for the Port of Los Angeles*.

Los Angeles Harbor Department (LAHD). 2006. *Health Risk Assessment Protocol for Port of Los Angeles Terminal Improvement Projects*. June 27.

South Coast Air Quality Management District (SCAQMD). 1977. *California South Coast Air Basin Hourly Wind Flow Patterns*. Air Programs Division.

____. 2000. *The Multiple Air Toxics Exposure Study (MATES-II) for the South Coast Air Basin*. Planning Division.

____. 2002. *Health Risk Assessment Guidance for Analyzing Cancer Risks from Mobile Source Diesel Emissions*.

____. 2003. *Risk Assessment Procedures for Rules 1401, 1402, and 212*.

____. 2005a. *Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics "Hot Spots" Information and Assessment Act (AB2588)*.

____. 2005b. SCAQMD Air Quality Significance Thresholds. Web site: http://www.aqmd.gov/ceqa/handbook/signthres.doc. September 2.

Starcrest Consulting Group, LLC. 2005. *Port of Los Angeles Baseline Air Emissions Inventory - 2001*.

——. 2007. *The Port of Los Angeles Inventory of Air Emissions for Calendar Year 2005*.

SPEC Services. 2005. Pacific Pier 400 Project – Marine Terminal Ship Hydraulics.

U.S. Environmental Protection Agency (USEPA). 1995a. *User's Guide for the Industrial Source Complex Dispersion Models*. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. EPA-454/B-95-003a.

____. 1995b. *SCREEN3 Model User's Guide*. Office of Air Quality Planning and Standards. EPA-454/B-95-004. September.

——. 1997. *Exposure Factors Handbook*. August.

——. 1999. *Control of Emissions of Air Pollution from New Marine Compression-Ignition Engines at or Above 37 kW; Final Rule*. 40 CFR Part 89 et al. December 29.

____. 2004. *User's Guide for the AMS/EPA Regulatory Model – AERMOD*. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. EPA-454/B-03-001. September.

____. 2004b. *User's Guide for the AERMOD Meteorological Preprocessor (AERMET)*. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. EPA-454/B-03-002. November.

____. 2006a. *Addendum - User's Guide for the AMS/EPA Regulatory Model – AERMOD*. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. EPA-454/B-03-001. December.

____. 2006b. *Addendum - User's Guide for the AERMOD Meteorological Preprocessor (AERMET)*. Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. EPA-454/B-03-002. December.

**This page intentionally left blank.**

T:\AIR-PLAN-CULTURAL\APC_Plains\Projects\Projects 04-15-08\APC-Plains-Figure H.4-1.mxd

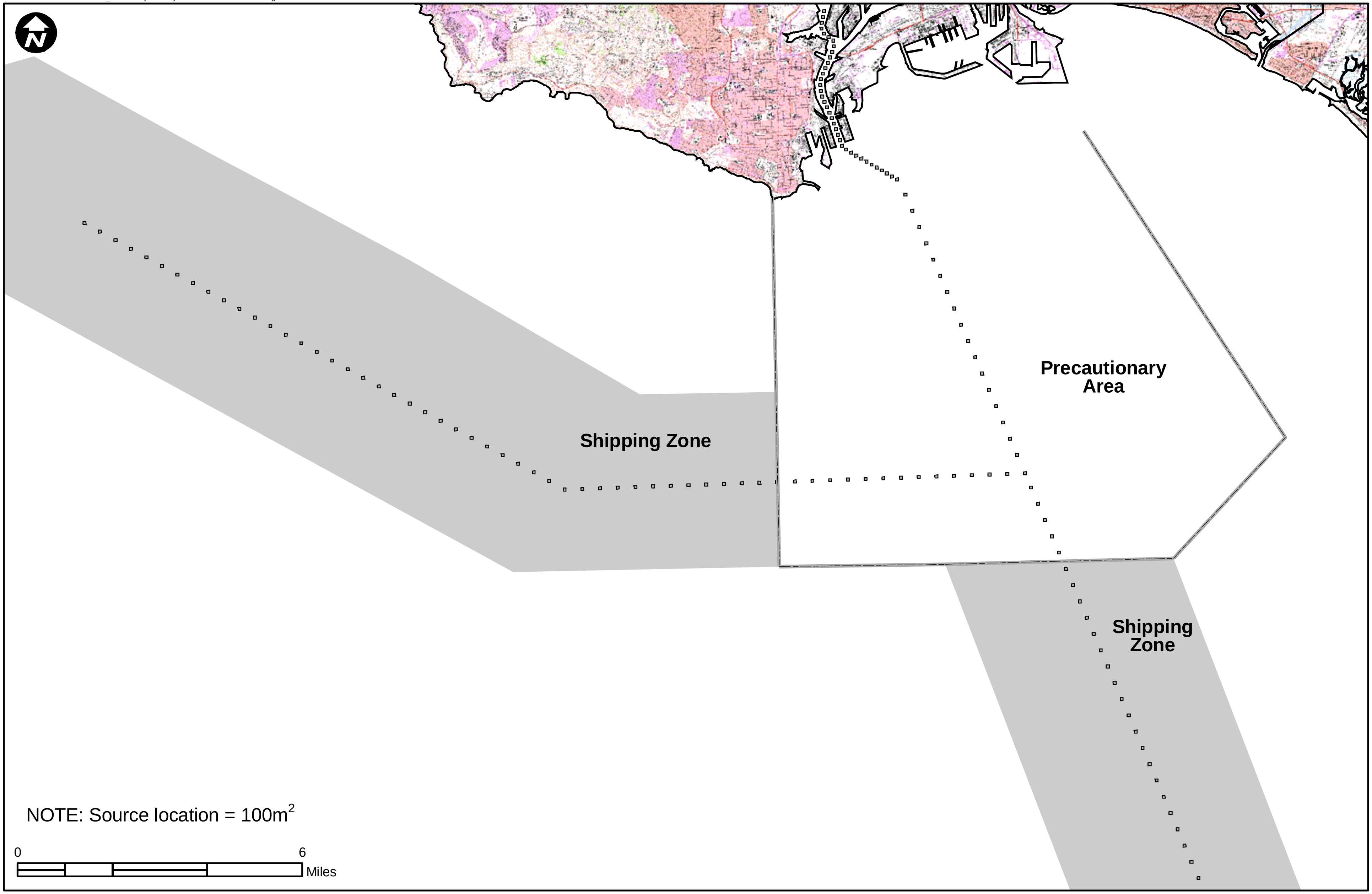



**Figure H.4-1. Vessel Transit Volume Source Locations Simulated in the Dispersion Modeling Analyses**

**This page intentionally left blank.**

T:\AIR-PLAN-CULTURAL\APC_Plains\Projects\Projects 04-15-08\APC_Plains-Figure H.4-2.mxd

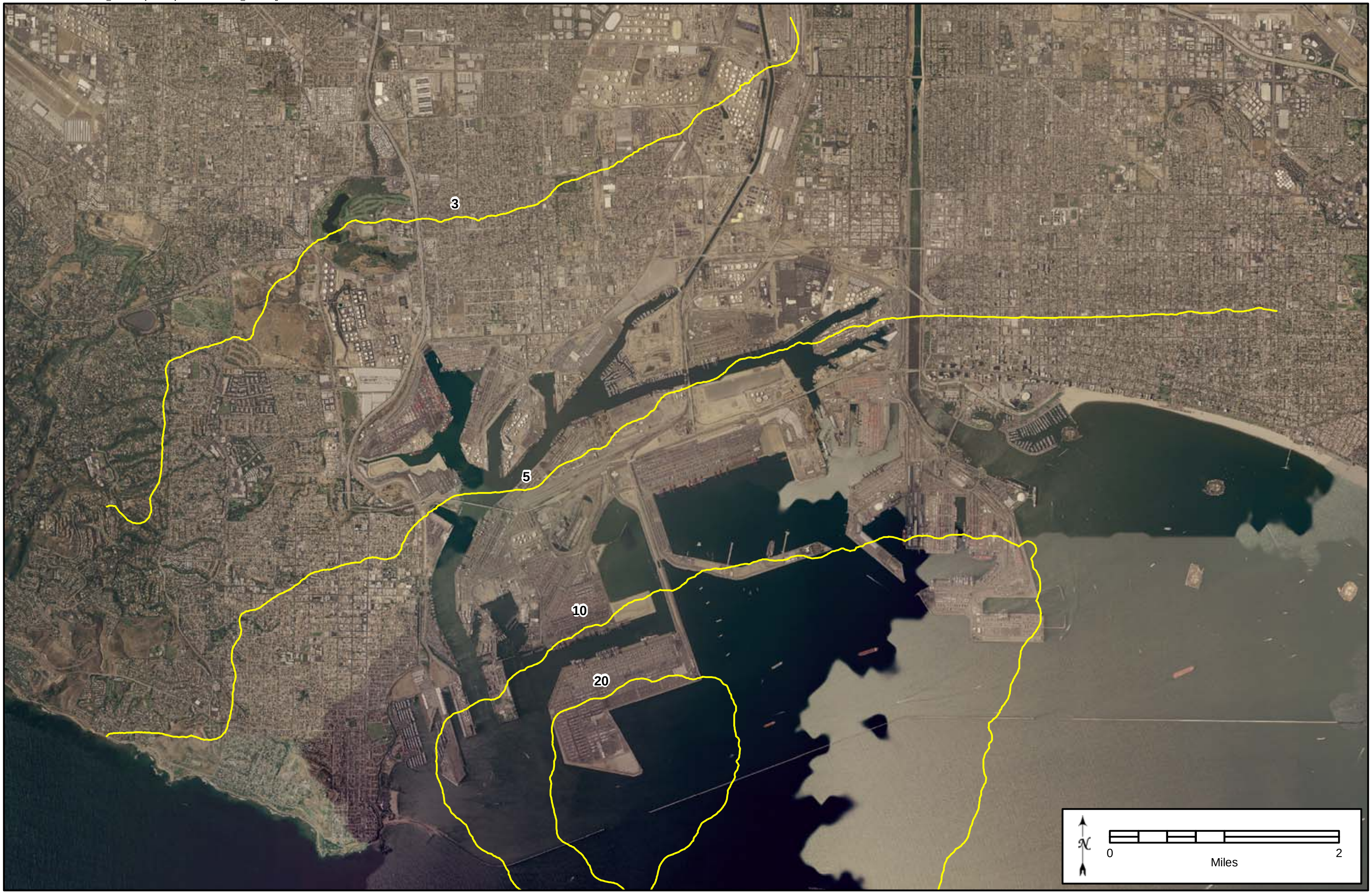



**Figure H.4-2. Proposed Project without Mitigation: Residential Cancer Risk under CEQA**

This page intentionally left blank.

T:\AIR-PLAN-CULTURAL\APC_Plains\Projects\Projects 04-15-08\APC_Plains-Figure H.4-3.mxd


**Figure H.4-3. Proposed Project with Mitigation: Residential Cancer Risk under CEQA**

T:\AIR-PLAN-CULTURAL\APC_Plains\Projects\Projects 04-15-08\APC_Plains-Figure H.4-4.mxd

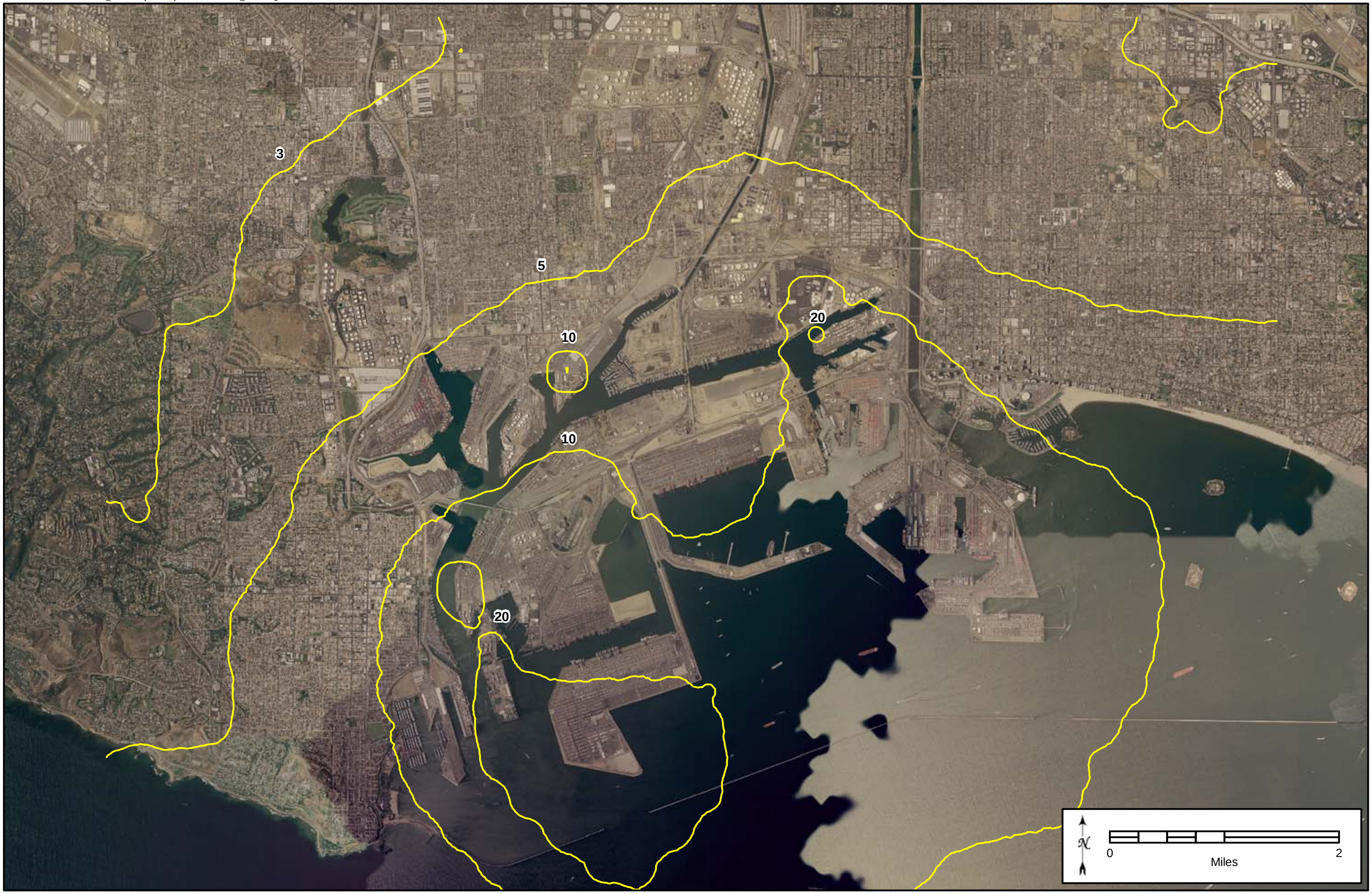



**Figure H.4-4. Reduced Project Alternative without Mitigation: Residential Cancer Risk under CEQA**

**This page intentionally left blank.**

T:\AIR-PLAN-CULTURAL\APC_Plains\Projects\Projects 04-15-08\APC_Plains-Figure H.4-5.mxd


**Figure H.4-5. Reduced Project Alternative with Mitigation: Residential Cancer Risk under CEQA**

**This page intentionally left blank.**

T:\AIR-PLAN-CULTURAL\APC_Plains\Projects\Projects 04-15-08\APC_Plains-Figure H.4-6.mxd


**Figure H.4-6. No Project Alternative: Residential Cancer Risk under CEQA**

**This page intentionally left blank.**

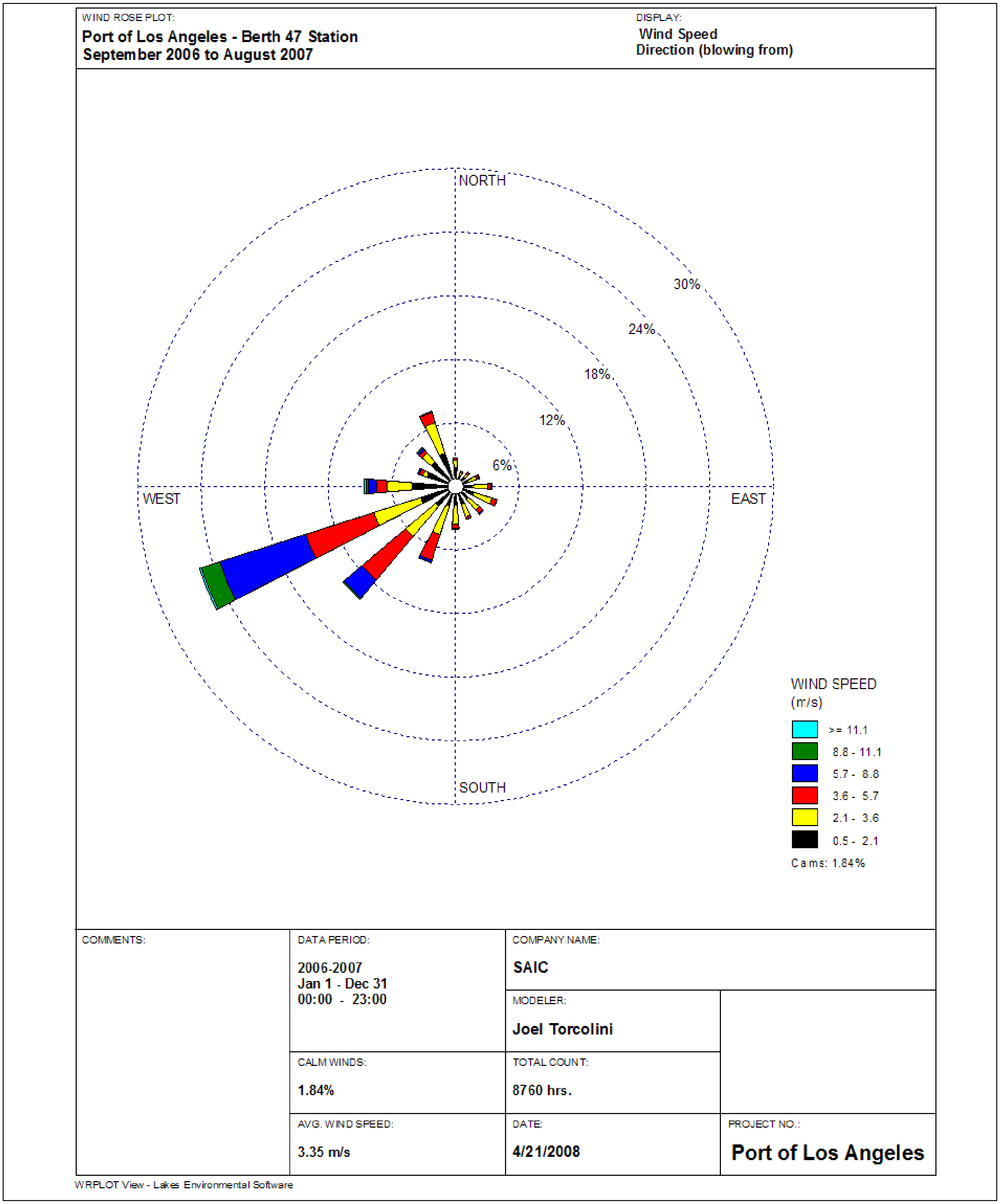



**Figure H4-7. Wind Rose for Port of Los Angeles Berth 47 Monitoring Station**

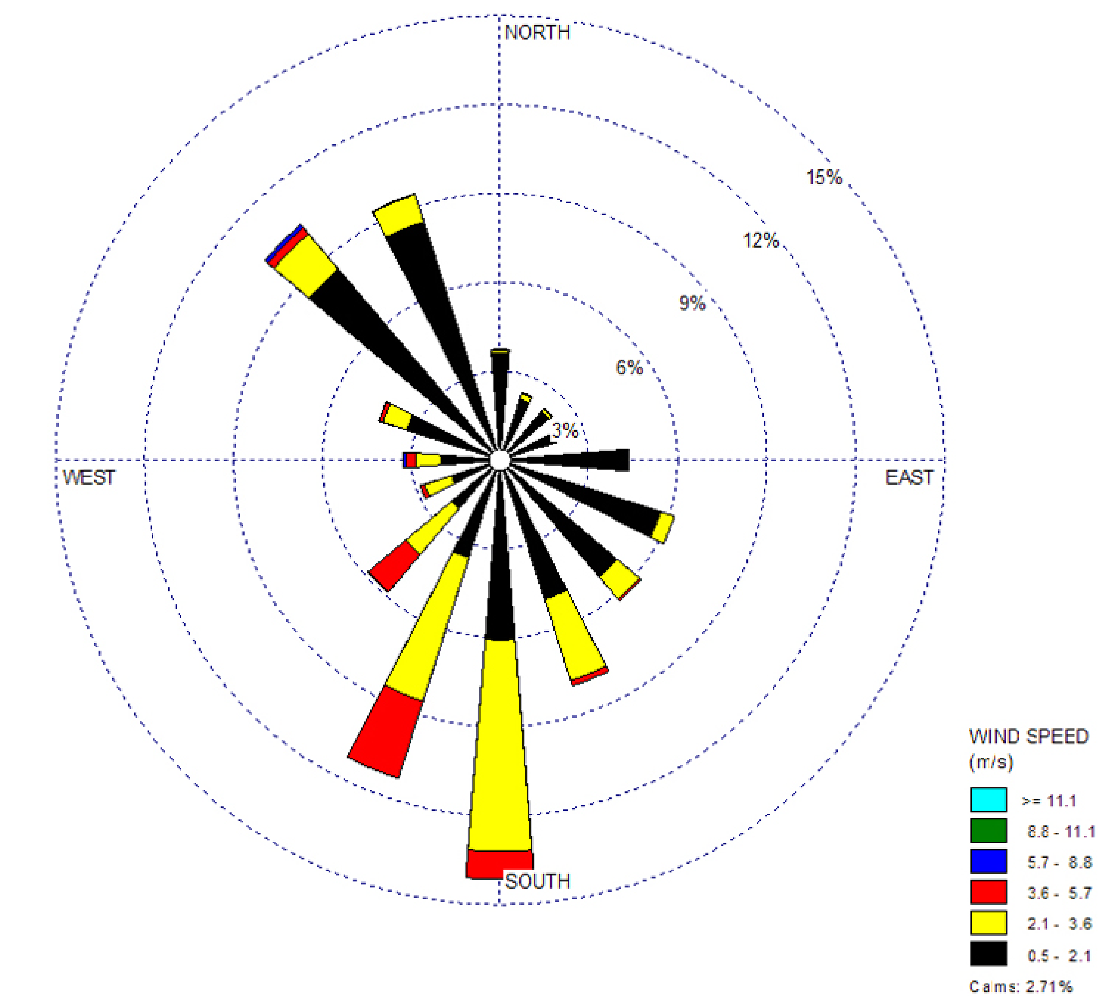
**This page intentionally left blank.**

WIND ROSE PLOT:

**Port of Los Angeles - Terminal Island Treatment Plant**
**September 2006 to August 2007**

DISPLAY:

**Wind Speed**
**Direction (blowing from)**




| COMMENTS: | DATA PERIOD: | COMPANY NAME: | |
|---|---|---|---|
| | **2006-2007**<br>**Jan 1 - Dec 31**<br>**00:00 - 23:00** | **SAIC** | |
| | | MODELER:<br>**Joel Torcolini** | |
| | CALM WINDS:<br>**2.71%** | TOTAL COUNT:<br>**8760 hrs.** | |
| | AVG. WIND SPEED:<br>**1.79 m/s** | DATE:<br>**4/21/2008** | PROJECT NO.:<br>**Port of Los Angeles** |

WRPLOT View - Lakes Environmental Software

**Figure H4-8. Wind Rose for Port of Los Angeles Terminal Island Treatment Plant (TITP) Monitoring Station**

**This page intentionally left blank.**

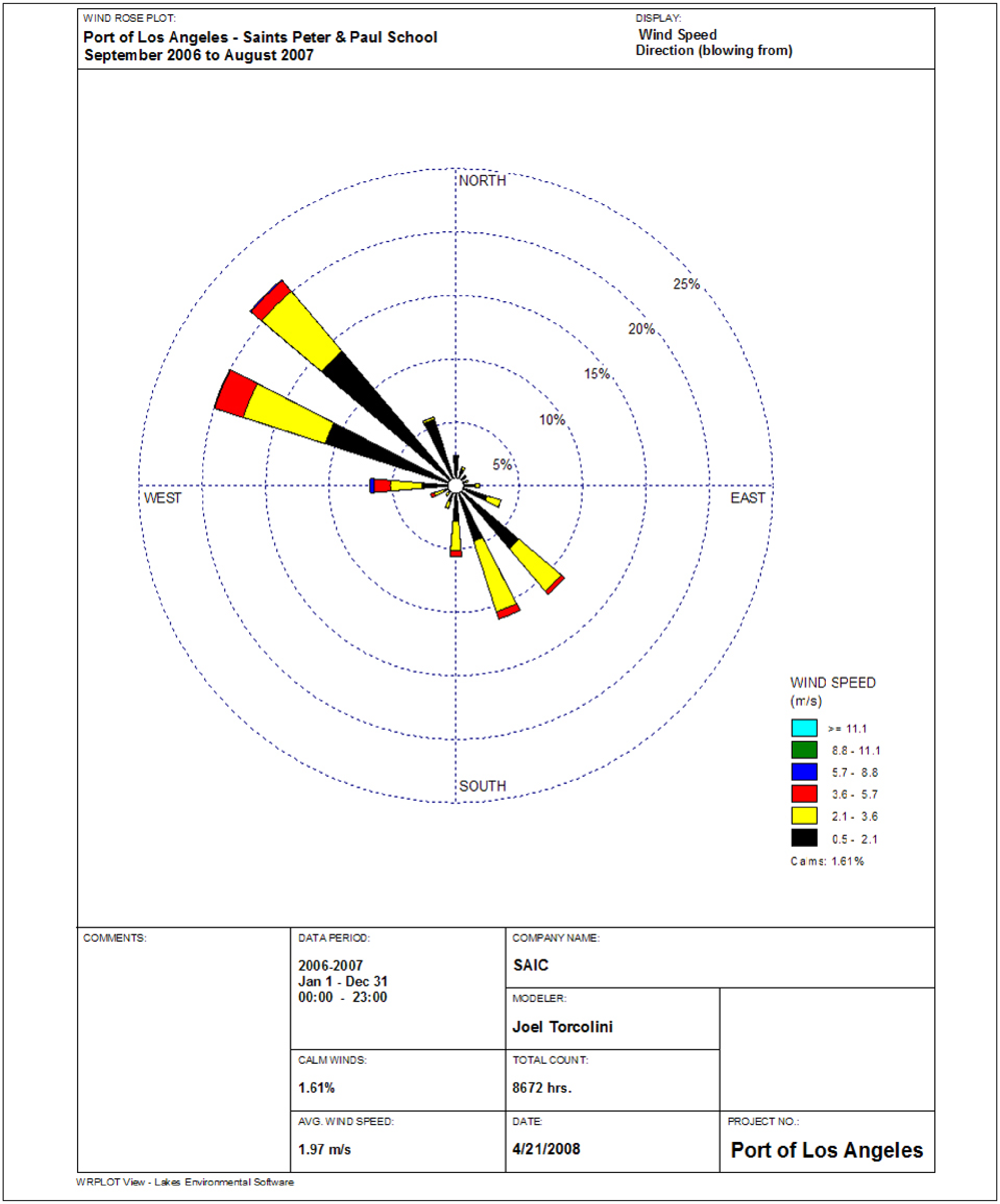



**Figure H4-9. Wind Rose for Port of Los Angeles Saints Peter and Paul School (SPPS) Monitoring Station**

**This page intentionally left blank.**