Port of
LONG BEACH
The Green Port

THE PORT
OF LOS ANGELES

San Pedro Bay Ports Clean Air Action Plan
2010 Update

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San Pedro Bay Ports Clean Air Action Plan

Prepared by:

The Port of Los Angeles

Port of Long Beach
The Green Port

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FOREWORD

To effectively integrate common goals for air quality in the South Coast Air Basin, the Port of Los Angeles (POLA) and the Port of Long Beach (POLB) worked together in close coordination with the staff of the United States Environmental Protection Agency Region 9 (USEPA Region 9), the California Air Resources Board (CARB), and the South Coast Air Quality Management District (SCAQMD) to develop the 2006 San Pedro Bay Ports Clean Air Action Plan (CAAP). This plan was the first of its kind in the country, linking the emission reduction efforts and visions of the two largest ports in the United States with similar efforts and goals of the regulatory agencies responsible for ensuring compliance with air quality standards. The collaborative effort continues with this update of the CAAP.

The air agencies have extensively reviewed and commented on this 2010 CAAP Update and continue to support the collaborative process that has been established. By participating in the development and update of this CAAP, these regulatory agencies do not waive or forfeit their rights or obligations to continue to regulate emissions sources under their control. Participation in this process is voluntary by all parties and does not in any way inhibit or preclude the agencies from any legal authorities and responsibilities to meet federal, state, and local air quality standards. Participation does not mean that the agencies necessarily endorse each of the measures and concepts proposed in the CAAP Update.

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EXECUTIVE SUMMARY

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Since the release and implementation of the CAAP, the concepts presented in the plan and the actions taken by the ports have had a profound effect on the dialogue regarding a port's role in addressing port-related air quality issues on the local, national, and international levels. The CAAP has significantly redefined what port authorities can do to ensure that surrounding communities are not adversely impacted by port-related operations. Since its release, there are now published air quality plans in the Pacific Northwest, there are plans being developed in the Northeast and Gulf coasts of North America, and plans being discussed and prepared in Asia and Europe. Inquires about the CAAP have come from ports around the world. In recognition of the groundbreaking work and commitment by both ports, several awards and recognitions have been received, including in 2007, the ports received the 8th Annual National USEPA Clean Air Excellence Award for the CAAP.

Port's Commitment to CAAP

The ports recognize that their ability to accommodate the projected growth in trade will depend upon their ability to address adverse environmental impacts (and, in particular, air quality impacts) that result from such trade. The CAAP was designed to develop and implement strategies and programs necessary to reduce air emissions and d health risks while allowing port development to continue. This remains the primary goal of the CAAP Update.

At this time, the ports have two planned terminal redevelopment projects underway, in addition to a number of infrastructure improvement projects that could be approved and implemented in the next five years. As with the terminal redevelopment projects that have already been approved since the CAAP was adopted, these upcoming projects present significant opportunities to implement the measures defined by the CAAP and satisfy the ports' twin goals of clean air and economic growth. The ports also anticipate lease amendments in the next five years, and through these opportunities, the ports will continue to implement the strategies defined in the CAAP. In short, the ports have already started to serve as a catalyst for rapid change towards reducing air pollution, proactively addressing the impacts to communities affected by port operations.

The CAAP is the ports' long-term commitment to reduce emissions associated with port activities. In November 2006, the first version of the CAAP was adopted at a historic joint meeting of each port's Board of Harbor Commissioners. The 2006 CAAP was a five-year action plan that highlighted the near-term goals, emissions reductions, and budgetary needs for fiscal years 2006 through 2011. Consistent with each port's air quality program goals, the 2006 CAAP focused primarily on reducing health risks to the local communities and reducing emissions of DPM, NOx and SOx.

As stated when the original CAAP was developed, the ports believe it is important to continuously update and improve upon the CAAP, where necessary, in order to monitor progress, plan for the future, and maximize success. Staffs from both ports meet regularly to evaluate progress towards meeting the CAAP goals, review status of existing control measures, evaluate new measures, and jointly develop updates to the CAAP as needed.

It should be emphasized that the air quality regulatory agencies, USEPA, CARB and SCAQMD, continue to fulfill their commitment to work with the staff of the two ports on their efforts associated with the implementation of the CAAP.

Enhancements to the CAAP

There are three categories of major enhancements in the updated version of the CAAP: Measure Changes, San Pedro Bay Standards, and CAAP Progress Tracking. Highlights of these enhancements are as follows:

- **Measure Changes** – Several of the measures have been updated to include information on the implementation details and measureable results for programs that have been developed or improved since the original CAAP was adopted. Further, some measures have been updated to reflect regulatory changes that have occurred over the past several years. The most significant changes to the measures are associated with ocean-going vessel (OGV) main engines and line haul rail locomotives.

    - A new measure has been introduced as OGV5 which seeks to maximize the early introduction and preferential deployment of vessels to the San Pedro Bay ports with cleaner/newer engines meeting the new International Maritime Organization (IMO) oxides of nitrogen (NOx) standard for Emission Control Areas. The previous OGV5, Main & Auxiliary Engine Emissions Improvements, has been re-classified as OGV6, with the focus of reducing diesel particulate matter (DPM) and NOx emissions from the existing fleet of vessels through the identification of new effective technologies. Numerous emission reduction technologies are being evaluated for integration into vessel new builds and use of these technologies as a retrofit for existing vessels will be explored. The ports intend to work cooperatively with vessel owners and engine and technology manufacturers to advance these efforts. This strategy will be coupled with the Technology Advancement Program and will include a systematic outreach, evaluation and demonstration effort.

- Measure RL3, New and Redeveloped Near-Dock Rail Yards, has been revised to reflect the new locomotive engine standards promulgated by USEPA and supports achievement of CARB's stated goal of a state-wide fleet of 95% Tier 4 locomotive engines by 2020, contained in CARB's "Staff Recommendations to Provide Further Locomotive and Railyard Emission Reductions" adopted in September 2009. In addition, the measure also identifies the voluntary commitments proposed by the Class 1 rail companies and CARB in June 2010, which focuses on emissions reductions at four selected railyards in Southern California.

- **San Pedro Bay Standards** – The San Pedro Bay Standards are perhaps the most significant addition to the CAAP and are a statement of the ports' commitments to significantly reduce the air quality impacts from port operations. Achievement of the Standards listed below will require diligent implementation of all of the known CAAP measures and aggressive action to seek out further emissions and health risk reductions from port-related sources from strategies that will emerge over time.

Health Risk Reduction Standard. To complement the CARB's Emission Reduction Plan, the ports of Long Beach and Los Angeles have developed the following standard for reducing overall port-related health risk impacts, relative to 2005 conditions:

- By 2020, reduce the population-weighted cancer risk of ports-related DPM emissions by 85%, in highly-impacted communities located proximate to port sources and throughout the residential areas in the port region.

Emissions Reduction Standard. Consistent with the ports' commitment to meet their fair-share of mass emission reductions of air pollutants, the ports of Long Beach and Los Angeles have developed the following standards for reducing air pollutant emissions of ports-related activities, relative to 2005 levels:

- By 2014, reduce emissions by 22% for NOx, 93% for sulfur oxides (SOx), and 72% for DPM to support attainment of the federal fine particulate matter (PM2.5) standards.
- By 2023, reduce emissions by 59% for NOx to support attainment of the federal 8-hour ozone standard. The corresponding SOx and DPM reductions in 2023 are 93% and 77%, respectively.

The ports will strive to exceed the 2014 NOx standard of 22% reduction, potentially exceeding 40% reduction, given the forecasted cargo volumes and efforts to implement new technologies.

- **CAAP Progress Tracking** - The original CAAP was published in November of 2006, prior to the establishment of the San Pedro Bay Standards. In the absence of San Pedro Bay Standards, the progress and effectiveness of the plan were forecasted through 2011 by estimating the growth in emissions due to anticipated cargo activity increases and then applying the effectiveness of the various control measures. The resulting controlled emission forecasts were compared with the same year's uncontrolled forecasted emissions grown from the CAAP 2005 emission estimates. Now that the San Pedro Bay Standards have been established, on-going CAAP progress and effectiveness will be measured against the Standards which consist of reductions as compared to 2005 published emissions inventories.

Measures & Strategies Recap

Since the original CAAP was adopted in late-2006, staff of both ports have been diligently working together to develop, implement and operate the various ground breaking measures and initiatives of the CAAP. The initiatives that the ports of Long Beach and Los Angeles have been working on together since the adoption of the 2006 CAAP and will continue to implement over the next five years include:

- **Heavy-Duty Vehicle Control Measures** – The Clean Trucks Program (CTP) will produce 80% emission reductions by 2012 from all port trucks serving both ports. This will be accomplished through a port tariff that will gradually limit access to all but the cleanest on-road trucks meeting the USEPA's 2007+ on-road truck emissions standards. Older trucks will be banned according to the following schedule:

    - Phase 1: By October 1, 2008, all pre-1989 MY engines are banned from operation in the ports.
    - Phase 2: By January 1, 2010, all 1989 to 1993 MY engines are banned from operation in the ports. Further, all 1994-2003 MY engines will be required to achieve an 85 percent DPM reduction and a 25 percent NOx reduction through the use of a CARB approved level 3 plus NOx VDECS.
    - Phase 3: By January 1, 2012, all drayage truck engines that do not meet 2007 federal on-road standards will be banned from the ports.

  Milestones reached in the CTP include:

    - In 2007, both ports worked together to develop the Clean Trucks Program. Each port's Board of Harbor Commissioners approved the Clean Trucks Program Tariff in November 2007.
    - In October 2008, the first ban date for the oldest trucks (pre-1989) was successfully implemented.
    - In February 2009, the Truck Environmental Fee was initiated for all non-exempt trucks and all trucks operating in the ports were required to be registered in the Drayage Truck Registry.
    - In 2009, 42% of all truck trips were made by clean trucks which meet the 2007 USEPA on-road standards.

  - Participation rates for the Clean Tucks Program have exceeded the goals set forth in the original plan. Since mid-June 2010, an average of 90% of container cargo moves to terminals at both ports were made by clean trucks

- **Ocean-Going Vessels Control Measures** – These measures include: vessel speed reduction; shore-power/alternative maritime power; fuel improvements for main engines, auxiliary engines, and auxiliary boilers; cleaner OGV engines; and technology improvements for OGV engines.

  Milestones reached in the OGV measures include:

  - The POLB Green Flag Program has been in place since late 2005. POLA approved a Vessel Speed Reduction Incentive Program in June 2008. In 2009, the POLB Green Flag Program compliance rate to 20 nautical miles (nm) from the port was 95%; POLA's 2009 compliance to 20 nm was 90%. Starting in 2009, POLB expanded its Green Flag Program to 40 nm from the port, and throughout 2009, the compliance rate to 40 nm was up to 72% of all vessels, climbing to 74% by mid-June 2010. POLA expanded their incentive program to 40 nm starting late-September 2009; POLA's compliance rate to 40 nm for the second quarter of 2010 was 60%.
  - In March 2008, the ports approved the Vessel Main Engine Fuel Inventive Program to provide a monetary incentive for the use of low-sulfur marine fuel in vessel main engines, for the period from July 1, 2008 through June 30, 2009. During the program, approximately 15% of all calls at the two ports used low sulfur fuel in the main engines for arrivals and departures. The CARB vessel fuel regulation, requiring low sulfur fuel in main and auxiliary engines and boilers, went into effect on July 1, 2009, at which time the ports' fuel incentive program ended.
  - Both ports are continuing to move forward with design, construction and commissioning of shore power infrastructure at their container, cruise and one tanker terminals. As of 2nd Quarter 2010, Alternative Maritime Power (AMP) infrastructure is operational at two terminals in POLA with another two terminals anticipated to be active by 4th Quarter 2010. By 2nd Quarter 2010, shore power infrastructure was operational at three terminals in POLB and was in construction at a fourth terminal. Remaining port cruise and container terminals at both ports will be outfitted with shore power infrastructure by 2014.

- **Cargo Handling Equipment (CHE) Control Measures** - Performance standards for CHE which call for progressive replacement with equipment meeting cleaner engine standards as implemented through lease conditions, and port assistance for securing grant funding for equipment replacements, repowers and retrofits, in conjunction with CARB regulations, continue to be effective strategies for reducing emissions from this source category.

- **Harbor Craft (HC) Control Measures** - Performance standards for HC which establish goals for early replacement of harbor craft engines with engines meeting cleaner standards, and port assistance for securing grant funding for engine repowers, in conjunction with CARB regulations, continue to be effective strategies for reducing emissions from this source category.

- **Railroad Locomotive Control Measures** – Engine modernization for the rail switch operations in the port complex has been successfully completed, upgrading 16 locomotives to Tier 2 engine standards. Six additional gen-set locomotives that meet the more stringent Tier 3 standards have also been added to the ports' switching fleet. By 2010, all Class 1 locomotives operating in the ports will meet the emissions equivalent of Tier 2 standards in accordance with the CARB's South Coast Air Basin (SoCAB) MOU. Additional requirements will be implemented through any new or redeveloped railyard projects.

- **Construction Activity** – The ports have developed key Best Management Practices which are focused on reducing emissions associated with construction activities. Compliance with these practices is required in all project bid specifications.

- **Technology Advancement Program (TAP)** – The ports' Technology Advancement Program is focused on the development and implementation of near-term emission reduction technologies. The ports have funded over $5.4 million towards TAP related projects since 2007.

- **Emissions Inventory Improvements** - The annual emissions inventories are the ports' measurement tool for evaluating and reporting on progress toward meeting the San Pedro Bay Standards. The ports continue to identify opportunities to improve the accuracy of key monitoring and tracking elements used in development of the ports' emissions inventories. Several improvements have been made to the methods, data and understanding of the sources types since 2006 and the ports inventories are considered "state-of-art."

- **Zero Emission Container Movement** - Over the past several years, the ports have been evaluating various Zero Emission Container Movement Systems (ZECMS) for potential application at the ports. The short-term goal is to determine if ZECMS are feasible for the ports and if so, demonstrate innovative technologies that can be utilized for more efficient and greener movement of cargo. The ultimate goal is to handle the anticipated cargo throughput growth with pollution-free technologies and strategies.

- **Operational Efficiency Improvement Initiatives** - This initiative identifies projects at the San Pedro Bay ports that improve infrastructure and operational efficiencies, as well as have an air quality benefit. The types of projects that are included in this element of the CAAP are generally initiated primarily as transportation or operational improvements; however, an air quality benefit does result from completing these projects.

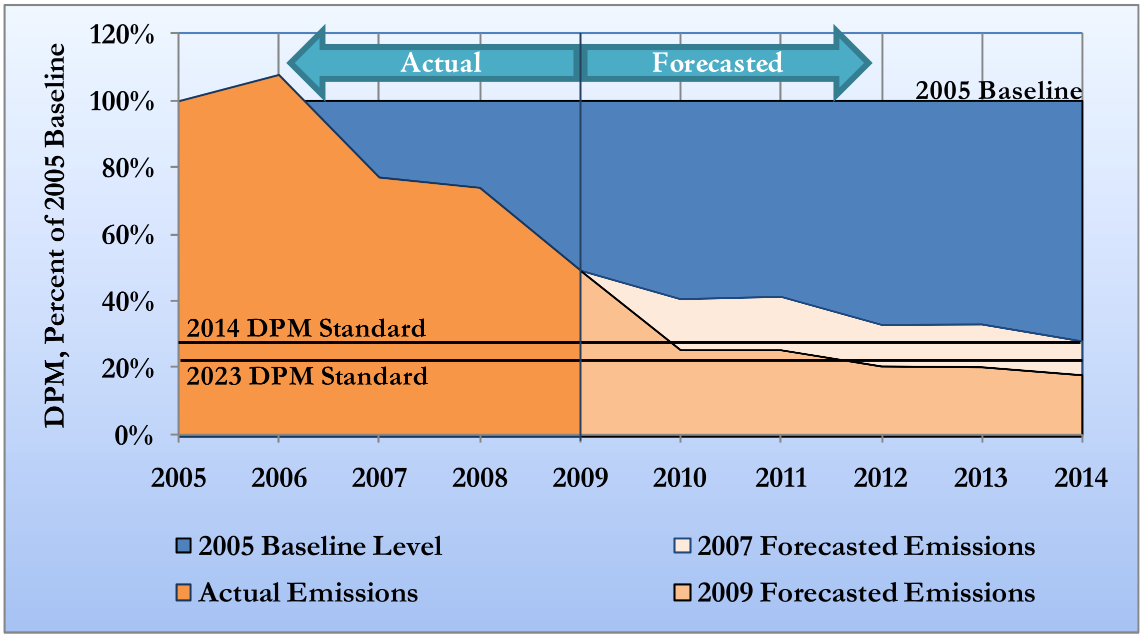
Progress to Date & Future Benefits

In order to determine the projected benefits from the CAAP and applicable regulations, emissions are forecasted through 2014 based on the 2005 emissions inventory assumptions and the 2007 San Pedro Bay cargo forecast, consistent with the forecasting that was used to establish the San Pedro Bay Standards. Comparing the forecasted out-years to the 2005 baseline provides the projected benefits from 2010 through 2014. Benefits for 2005 through 2009 are based on the actual annual activity and the 2005 inventory methodology.

For further information, the projected emissions using the lower growth 2009 cargo forecast have also been determined through 2014. It should be noted that cargo forecasts vary along with changes in the financial markets. The 2007 San Pedro Bay cargo forecast used to establish the San Pedro Bay Standards was developed and published before the market collapse and ensuing recession and was based on previous year's cargo throughput changes. However, the forecasted volumes for 2007 through 2009 have not been realized at the ports. In fact, all the ports on the U.S. west coast have experienced significant cargo reductions during those two years due to the massive reductions in international trade volumes. The 2007 cargo forecast utilized for development of the Standards projected that the ports would continue to experience steady growth and reach cargo capacity (over 42 million twenty-foot equivalents (TEUs)) by 2023. In actuality, the TEUs at the San Pedro Bay ports were flat in 2007 and declined in 2008 and 2009. In 2009, the ports developed a revised growth forecast which takes into account the down turn that started in 2008 and predicts significantly slower growth in the out years. While the more conservative 2007 growth forecast has been used for planning purposes, both the 2007 (considered a "high-growth" forecast) and 2009 (considered a "low-growth" forecast) are represented in the forecasting of future CAAP benefits. It is most likely that actual growth will be somewhere between these two forecasts.

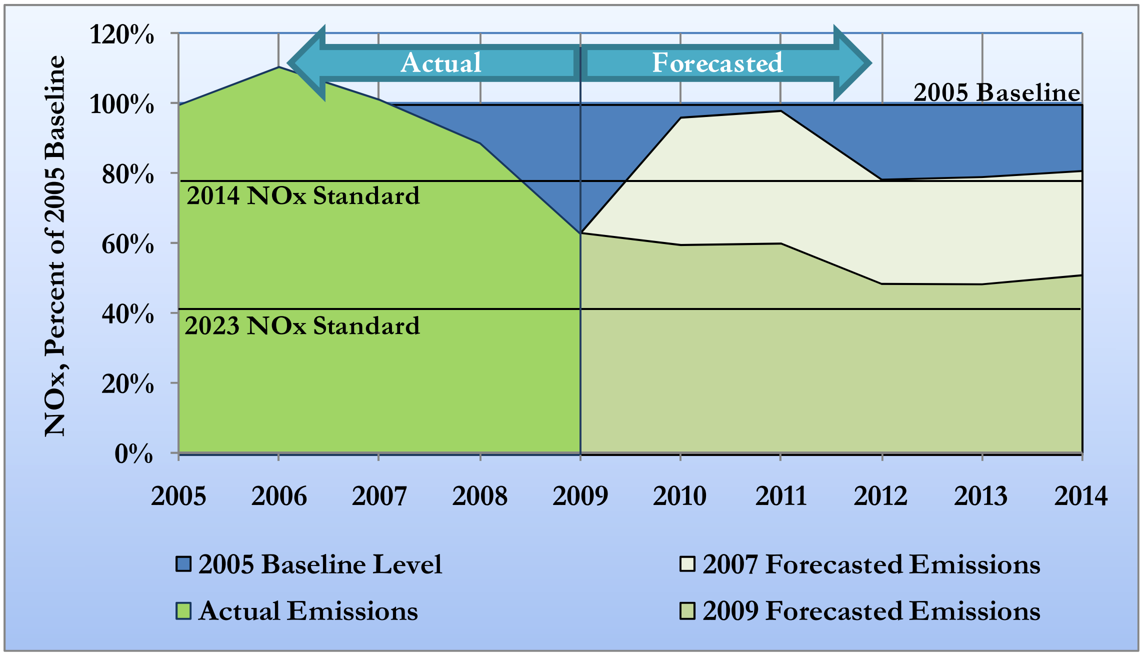
Figures ES.1 through ES.4 present the 2005 baseline and the year-to-year percent change in the magnitude of both ports' emissions, with respect to 2005 and the Emissions Reduction and Health Risk Standards.

Figure ES.1: DPM Progress To Date & Forecasted Benefits



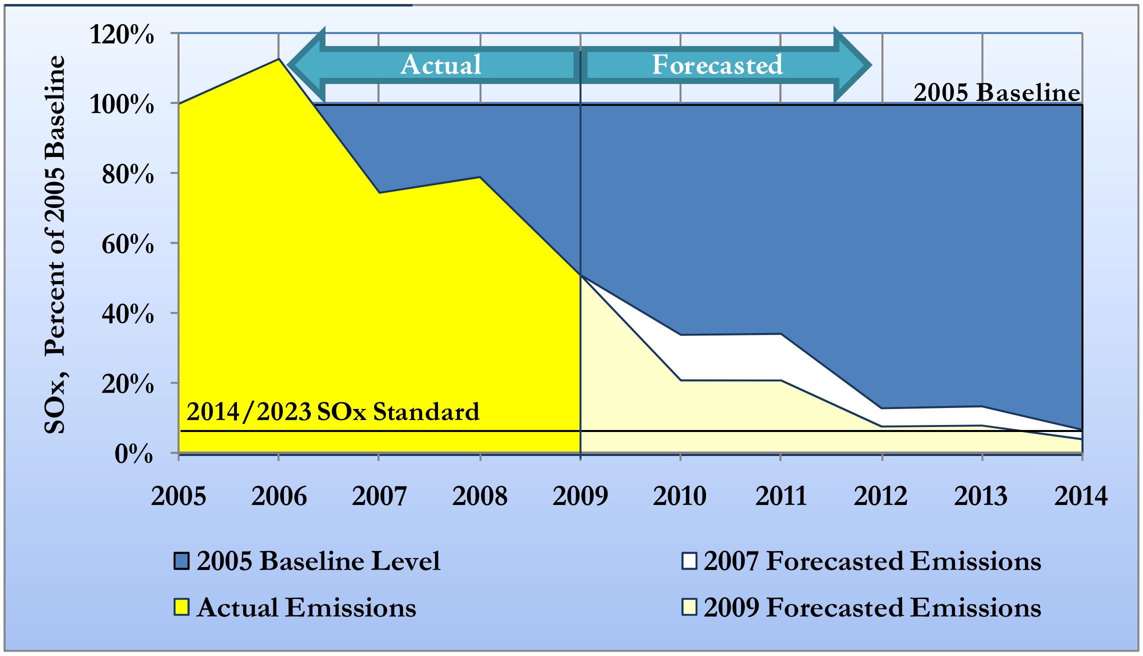
As presented above, with the implementation of additional CAAP measures coming on line, the ports' 2008/2009 OGV fuel switch incentive program, CARB's OGV fuel switch regulation implemented in mid-2009, and the Clean Truck Program, it is anticipated that the reduction trend observed through 2009 will continue through 2010. In 2014, the ports are anticipated to achieve their 2014 DPM Emissions Reduction Standard. Though significant progress has been made, significant challenges remain to achieve the 2023 goals.

Figure ES.2: NOx Progress To Date & Forecasted Benefits



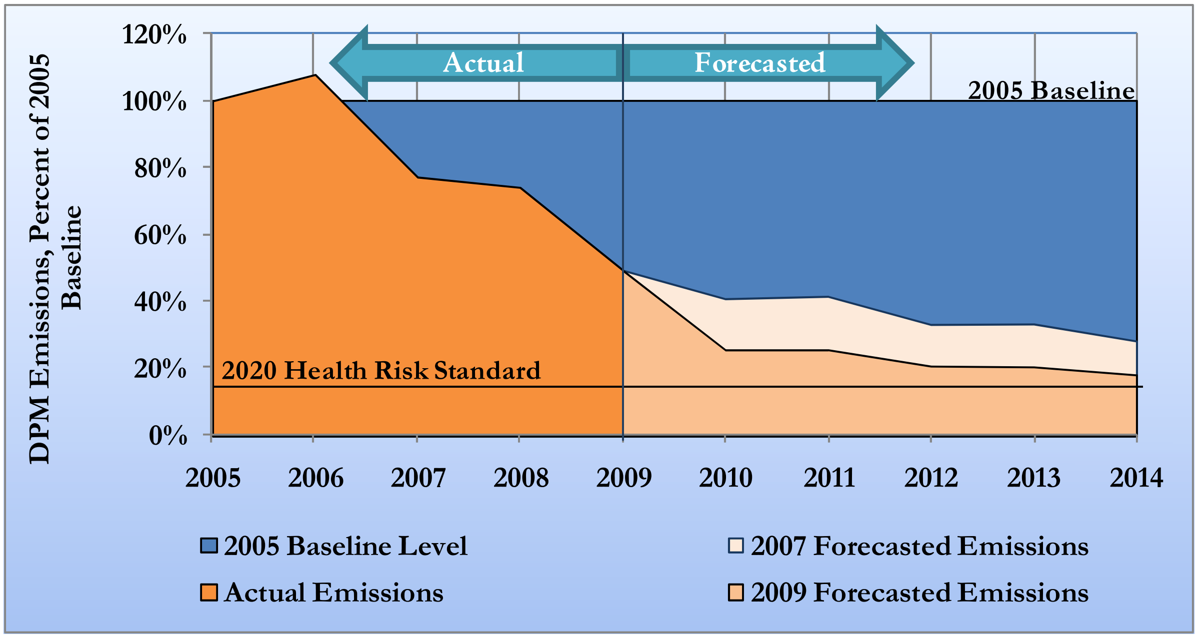
As presented above, with the implementation of the CAAP measures, including the vessel speed reduction (VSR) program, shore-power, the Clean Truck Program (CTP), and the other CAAP measures, the port's met the 2014 NOx Emission Reduction Standard in 2009. The increase in emission levels in 2010 is a manifestation of the cargo forecast compared to the actual cargo throughputs in the preceding years. The decrease in NOx emissions in 2010 is less than 2007 to 2009 because uncontrolled emissions for that year are based on the higher estimated growth from the 2007 cargo forecast, whereas controlled emissions in 2007 to 2009 reflect the actual decline in growth that occurred during those years. Increased participation in VSR out to 40 nm, increased use of shore power (or equivalent technologies) at berth, implementation of ECA in August of 2012, and introduction of new control technologies on existing and new build OGVs will significantly help in meeting the 2014 and 2023 NOx emissions reduction standard. One contributing factor to the lower NOx emissions between 2007 and 2009 has been reduced cargo volumes at both ports. If cargo volumes return to the levels projected in the 2007 cargo forecast, emissions may increase in the near-term. Therefore, diligent efforts to continue to reduce NOx emissions must be implemented to stay on track with achieving the NOx Standard in 2014 and beyond. Additionally, continued fleet turnover in other source categories will also contribute to NOx reductions. There will still continue to be significant challenges in meeting the 2023 NOx standard as the remaining emission reductions will need to come primarily from ships.

Figure ES.3: SOx Progress To Date & Forecasted Benefits



As presented above, with the implementation of additional CAAP measures, the ports' 2008/2009 OGV fuel switch incentive program, and CARB's OGV fuel regulation implemented in mid-2009, it is anticipated that the high rate of SOx reductions will continue in the coming years. The slight increase of SOx emissions from 2007 and 2008 was due to the injunction of the previous CARB OGV fuel rule in 2008. The ports are anticipated to achieve their 2014 and 2023 SOx Emissions Reduction Standards in 2014. Significant challenges however remain with closing the final gap and sustaining these reductions below the standards.

Figure ES.4: Health Risk Progress To Date and Forecasted Benefits



As presented above, with implementation of the CAAP and reduced cargo throughputs, in 2009 the ports have realized in 2009 reductions which are equivalent to over half of the 2020 Health Risk Standard. Additional DPM reducing measures like the CTP, VSR out to 40 nm, shore-power, and implementation of the ECA in August of 2012 are projected to continue and maintain the significant reductions to date. There are still significant challenges though in making the last incremental reductions to get to the 85% reduction standard and maintaining those levels.

Looking Ahead

The CAAP is a planning tool to assist the ports, the port operators, and the air quality regulatory agencies to move forward with strategies that will achieve the ports' commitment to reduce emissions associated with port activities. The CAAP was designed to provide direction for developing and implementing strategies and programs necessary to progressively achieve real and measurable air quality and public health improvements, while allowing port development to continue. This remains the primary goal of the CAAP Update and, as shown above, real and measurable benefits are being achieved and are forecasted. The most significant addition to the CAAP Update is the development of the San Pedro Bay Standards which establish long-term goals for emissions and health risk reductions for the overall two port complex. Achievement of the Standards will require diligent implementation of all of the known CAAP measures and aggressive action to seek out further emissions and health risk reductions from port-related sources from strategies that will emerge over time. In looking ahead over the next five years, the preeminent goal of the ports is to demonstrate progress in achievement of the Standards and to annually report performance and effectiveness in meeting this challenge with consistently improved, accurate and state-of-the-art emission inventories. An impressive array of enhanced measures is contained in the CAAP Update and the key areas of focus over next five years are highlighted below:

- Continue to implement the Clean Trucks Programs at each port, with full implementation of trucks meeting the 2007 USEPA on-road standard by January 2012
- Achieve 90% or greater VSR participation to 40nm
- Continue implementation of shore-power infrastructure to meet the ports' lease schedules and to support CARB's requirement of 50% compliant calls for regulated vessels by 2014
- Implement use of marine fuel for OGVs with reduced sulfur content of 0.1% in 2012 through CARB's regulation
- North America and Canada Emission Control Area
- Encourage demonstration and deployment of OGV control technologies for existing vessels calling at the San Pedro Bay ports
- Encourage vessels meeting the cleanest new engine standards to preferentially call at the ports of Long Beach and Los Angeles
- Continue aggressive implementation of the Technology Advancement Program to demonstrate, verify and commercialize new, cleaner engine technologies
- Evaluate progress toward achieving the San Pedro Bay Standards in 2012, and update as needed.

Lastly, in looking ahead, the ports will continue the collaborative and cooperative partnership with our agency partners and industry stakeholders to implement these strategies and to develop new technologies and control strategies to further accelerate progress toward meeting the ports' goals. Federal, state and local air quality agencies will play an essential role by identifying and pursuing future regulatory measures targeting specific source categories to further reduce emissions to order to achieve the San Pedro Bay Standards. As stated in CARB's 2006 Emission Reduction Plan for Ports and Goods Movement in California - "Successful implementation of the CARB emission reduction plan will depend upon actions at all levels of government and partnership with the private sector. No single entity can solve this problem in isolation."[1] This is also true for the CAAP.

[1] *Emission Reduction Plan for Ports and Goods Movement in California*, Executive Summary, ES-1, CARB, 2006

SECTION 1: INTRODUCTION

In March 2006, a groundbreaking meeting occurred at the highest level between the Port of Long Beach (POLB), Port of Los Angeles (POLA), and the South Coast Air Quality Management District (SCAQMD) where all parties expressed the need to work jointly toward sustainable solutions to improve air quality from port-related sources. Shortly thereafter, the ports also engaged the California Air Resources Board (CARB) and the United States Environmental Protection Agency (USEPA) Region 9 in the spirit of cooperation to help the ports develop the original 2006 San Pedro Bay Ports Clean Air Action Plan (CAAP).

The CAAP is the ports' long-term commitment to reduce emissions associated with port activities. In November 2006, the first version of the CAAP was adopted at an historic joint meeting of each port's Board of Harbor Commissioners. The 2006 CAAP was a five-year action plan that highlighted the near-term goals, emissions reductions, and budgetary needs for fiscal years (FY) 2006/2007 through 2010/2011. Consistent with each port's air quality program goals, the 2006 CAAP focused primarily on reducing health risks to the local communities and reducing emissions of diesel particulate matter (DPM), oxides of nitrogen (NOx) and oxides of sulfur (SOx).

As stated when the original CAAP was developed, the ports believe it is important to continuously update and improve upon the CAAP, where necessary, in order to monitor progress, plan for the future, and maximize success. Staff from both ports meet regularly to evaluate progress towards meeting the CAAP goals, review status of existing control measures, evaluate new measures, and jointly develop updates to the CAAP as needed.

This document is the first update to the 2006 CAAP. This joint update to the CAAP describes the measures that the ports of Los Angeles and Long Beach are implementing or will be implementing over the next five-year period to continue to reduce emissions related to port operations.

It should be emphasized that the air quality regulatory agencies, USEPA, CARB and SCAQMD, continue to fulfill their commitment to work with the staff of the two ports on their efforts associated with the implementation of the CAAP.

Throughout this document, this update to the CAAP will hereinafter be referred to as the CAAP Update.

1.1 The Ports' Mandate

In the early 1900s, the State conveyed the port tidelands to Los Angeles and Long Beach, as trustees for the people of the State of California, to accommodate and promote harbor commerce, navigation and fisheries. The ports are landlord ports; they build terminal facilities and lease them to shipping lines and stevedoring companies. The ports do not own or operate the terminals, ships, yard equipment, trucks or trains that move the cargo. However, the ports are determined to accelerate the efforts to reduce air pollution from "goods movement" activities using all the powers available to them.

The two ports comprise a huge regional and national economic engine. The Los Angeles Customs District accounts for approximately $300 billion in annual trade. More than 30% of all containerized trade in the nation flows through the two ports. Although recent economic conditions have caused a near-term reduction in imports and exports, the latest economic forecasts still indicate that the demand for containerized cargo moving through the San Pedro Bay region will increase significantly, and will more than double by the year 2025.

The economic benefits of the ports are felt throughout the nation; however, the environmental impacts of trade are more locally concentrated. In order to address these local impacts, both ports have adopted and are implementing a wide range of aggressive environmental initiatives. These efforts include better documentation of environmental impacts and more detailed evaluation and implementation of effective mitigation measures. The ports are cognizant of the view held by environmental groups, local residents, and regulatory agencies that not enough has been done to address port-related air quality issues. The ports are also aware of the views held by port users and operators that inconsistent or conflicting environmental measures could have unintended and even counterproductive effects.

The ports recognize that their ability to accommodate the projected growth in trade will depend upon their ability to address adverse environmental impacts (and, in particular, air quality impacts) that result from such trade. The CAAP was designed to develop and implement strategies and programs necessary to reduce air emissions and health risks while allowing port development to continue. This remains the primary goal of the CAAP Update.

At this time, the ports have two planned terminal redevelopment projects, in addition to a number of infrastructure improvement projects that could be approved and implemented in the next five years. As with the terminal redevelopment projects that have been approved since the CAAP was adopted, these projects present significant opportunities to implement the measures defined by the CAAP and satisfy the ports' twin goals of clean air and economic growth. The ports also anticipate lease amendments in the next five years, and through these opportunities, the ports will continue to implement the strategies defined in the CAAP. In short, the ports have already started to serve as a catalyst for rapid change, recognizing the rights of all involved in, and affected by, port operations.

1.2 San Pedro Bay Ports Clean Air Action Plan Achievements To Date

It is important to recognize that while there is still much effort needed for the ports to achieve their clean air goals, significant progress has already been made to reduce the air quality impacts of port operations. The following major CAAP milestones have been achieved:

Clean Air Action Plan (CAAP)

- Jointly adopted by the Boards of Harbor Commissioners from the ports of Long Beach and Los Angeles in November 2006. The CAAP includes control measures to reduce air emissions by 45% or more within five years.

- The CAAP website (www.cleanairactionplan.org) was developed to provide the public the status of implementation progress, port emissions and reductions, and updates in the Technology Advancement Program.

- An annual program, the CAAP Air Quality Awards, was developed to recognize industry efforts to reduce port-related air pollution consistent with the CAAP goals. Since development, three awards ceremonies have been held, in 2008, 2009 and 2010, and a total of 18 awards have been distributed.

CAAP Implementation Stakeholder Task Force

- The CAAP Implementation Stakeholder Task Force was formed in 2007 by each City's Mayor's office, and consists of representatives from federal, state as well as local air quality agencies, industry, environmental organizations, labor groups and academia to provide input for CAAP implementation plans. The Task Force meets on an as needed basis, typically a few times per year.

Air Emissions Inventory

- The ports committed to updating their air emissions inventories annually to track progress for reducing air emissions from port operations. POLB and POLA each released their respective 2005 Air Emissions Inventories in September 2007; 2006 air emissions inventories in the summer of 2008; 2007 air emissions inventories in January 2009; 2008 air emissions inventories in December 2009; and the 2009 air emissions inventories were published in June of 2010. Complete emissions inventory reports can be found at:
  POLB - *http://www.polb.com/environment/air/emissions.asp*
  POLA - *http://www.portoflosangeles.org/environment/studies_reports.asp*

Air Monitoring Network

- The Port of Long Beach's real-time air monitoring data website was launched in October 2006. The website was expanded in February 11, 2008 to provide real-time monitoring of actual air pollution concentrations in and around the San Pedro Bay from all six POLB and POLA air monitoring stations (*http://caap.airsis.com/*). The Port of Los Angeles initiated filter-based air monitoring for particulates and elemental carbon at four stations starting in 2005 and that program continues today. This data is accessible at: *http://www.portoflosangeles.org/environment/air_quality.asp*.

Clean Truck Program

- In 2007, both ports worked together to develop the Clean Truck Program. Each port's Board of Harbor Commissioners approved the Clean Truck Program Tariff in November 2007 and the Truck Environmental Fee in December 2007. In March 2008, each port adopted their concession program requirements.

- In October 2008, the first ban date for the oldest trucks (pre-1989 model year) was successfully implemented.

- In February 2009, the Truck Environmental Fee was initiated for all non-exempt trucks and all trucks operating in the ports were required to be registered in the Drayage Truck Registry (DTR).

- As of September 2009, the first anniversary of the Clean Truck Program, over half of all truck trips were made by clean trucks which meet the 2007 USEPA on-road standards.

- Participation rates for the Clean Tucks Program have exceeded the goals set forth in the original plan. Since mid-June 2010, an average of 90% of container cargo moves to terminals at both ports were made by clean trucks.

- Clean Energy Fuels Corp. constructed a liquefied natural gas (LNG) fueling facility in the port area for on-road trucks. Fueling operations began during the second quarter of 2009. By mid-2010, a little over nine percent of the truck fleet was powered by natural gas.

- In 2008, POLA completed a successful prototype test of a zero-emission Class 8 all-electric truck. Through 2009 to 2010, POLA will receive delivery of 25 electric trucks operating with advanced lithium-ion battery systems for use between marine terminals and near-dock rail facilities and within terminals.

- The Clean Truck Program website can be accessed at:
  POLB - *http://www.polb.com/cleantrucks*
  POLA - *http://www.portoflosangeles.org/ctp/idx_ctp.asp*

Technology Advancement Program

- The Technology Advancement Program (TAP) was established in first quarter 2007, and program guidelines were published and are available on the TAP page on the CAAP website. The mission of the TAP is to accelerate the verification and commercial availability of new, clean technologies, through evaluation and demonstration.

- The TAP Advisory Committee was formed consisting of agency partners from the POLB, POLA, USEPA Region 9, CARB and SCAQMD. The Advisory Committee provides input on the proposal and technologies submitted to the TAP for consideration.

- From 2007 to mid-2010, POLB and POLA have funded $5.4 million towards TAP related projects, targeting cargo handling equipment, vessels, harbor craft and on-road trucks.

  The TAP page on the CAAP website can be accessed at:
  http://www.cleanairactionplan.org/programs/tap/default.asp

Ocean-Going Vessels

- The Port of Long Beach Green Flag Program has been in place since late 2005. POLA approved a Vessel Speed Reduction Incentive Program in June 2008. In 2009, the Port of Long Beach Green Flag Program compliance rate to 20 nautical miles (nm) from the port was 95%; POLA's compliance to 20 nm was 90%. Starting in 2009, POLB expanded its Green Flag Program to 40 nm from the port, and throughout 2009, the compliance rate to 40 nm was up to 72% of all vessels, climbing to 74% by mid-June 2010. POLA expanded their incentive program to 40 nm starting late-September 2009; POLA's 2010 compliance rate to 40 nm through the second quarter was 61%.

- In March 2008, the ports approved the Vessel Main Engine Fuel Incentive Program to provide monetary incentives for the use of low-sulfur marine gas oil (MGO) in vessel main engines, for the period from July 1, 2008 through June 30, 2009. During the program, approximately 15% of all calls at the two ports used low sulfur fuel in the main engines for arrivals and departures. The CARB vessel fuel regulation, requiring low sulfur fuel in main and auxiliary engines and boilers, went into effect on July 1, 2009 when the ports' fuel incentive portion of the program ended.

- Both ports are continuing to move forward with design, construction, and commissioning of shore power infrastructure at their container and cruise terminals and one tanker terminal. As of 4th Quarter 2009, Alternative Maritime Power (AMP) infrastructure is operational at two terminals in POLA with another two terminals anticipated to be active by 4th Quarter 2010. By 2nd Quarter 2010, shore power infrastructure was operational at three terminals in POLB and was in construction at a fourth terminal. Remaining port cruise and container terminals at both ports will be outfitted with shore power infrastructure by 2014.

Railroad Locomotives

- The majority of diesel-powered Class 1 switcher and helper locomotives entering port facilities began using ultra-low sulfur diesel fuels after January 1, 2007.

- Pacific Harbor Line (PHL) has replaced their entire fleet with sixteen USEPA Tier 2 locomotives. PHL has also begun operating six Tier 3-equivalent non-road engine-equipped "genset" locomotives. In addition, a one-year demonstration of a LNG locomotive was conducted from early-2008 through early-2009.

- In 2010, PHL and the ports entered into third amendment to their operating agreements which, if PHL is successful in receiving grant funding, will result in an additional upgrade of the Tier 2 switcher locomotive fleet to meet "Tier 3-plus" standards by the end of 2011.

Harbor Craft

- The Foss Maritime Green Assist™ Hybrid Tug completed its first year of operation in the San Pedro Bay ports. Emission testing is underway; a 44% reduction in emissions and fuel consumption is anticipated.

- POLA's Air Quality Mitigation Incentive Program approved over $10.9 million in grant funding to repower 53 main and auxiliary marine engines, resulting in over 13.5 and 428 tons per year of DPM and NOx, respectively.

- SCAQMD's Carl Moyer Program provided over $14.6 million in grant funding to repower 92 main and auxiliary engines, resulting in approximately 8 and 228 tons per year of DPM and NOx, respectively.

- POLB received more than $1.9 million in USEPA Diesel Emission Reduction Act (DERA) grant funding to repower 14 engines onboard two crew boats, two tug boats, and two pilot boats.

Cargo Handling Equipment (CHE)

- In 2008, 30% of all CHE at the ports of Long Beach and Los Angeles were equipped with on-road engines which emit significantly less pollution compared to similar off-road engines. In addition, two of the cranes at the port of Long Beach and three cranes at the port of Los Angeles are equipped with Vycon REGEN Flywheel System which is one of the few emissions control technologies available for crane operations to reduce NOx and DPM emissions.

- POLB received over $3.7 million and POLA received over $1.6 million in USEPA DERA grant funding to be used for a combined total of 63 retrofits, 21 engine repowers and 63 equipment replacements for cargo handling equipment at port terminals.

- POLA's Air Quality Mitigation Incentive Program approved approximately $3.5 million in grant funding to replace, repower or retrofit 327 vehicles or engines, resulting in a reduction of 4.6 and 110 tons per year of DPM and NOx, respectively.

- In 2009, POLA provided $1.2 million in funding and assisted in the implementation of an electric rubber-tired gantry crane demonstration project at its China Shipping terminal. This represents another promising retrofit technology for crane operations.

1.3 South Coast Air Basin

The two ports are located in the South Coast Air Basin (SoCAB). The SoCAB includes all or part of four counties in southern California (Los Angeles, Orange, San Bernardino and Riverside) covering an area of 6,745 square miles with a population of over 16.5 million people. The SoCAB has some of the worst air quality in the nation, which represents a major health concern for its residents. Much of this air quality problem is attributable to the fact that the SoCAB is the second largest urban area in the nation (with all its associated emissions sources) and to the existence of topographical and meteorological conditions that enhance the formation of air pollution. Currently, the SoCAB is designated by the USEPA as being in nonattainment of the National Ambient Air Quality Standards (NAAQS) for ozone and for particulate matter less than 2.5 microns ($PM_{2.5}$). Ozone is formed when sunlight reacts with available oxides of nitrogen (NOx) and volatile organic compounds (VOCs) in the atmosphere, making NOx a primary pollutant of concern in the SoCAB, particularly from mobile sources of emissions. Similarly, oxides of sulfur (SOx) are precursors to secondary $PM_{2.5}$ formation in the atmosphere, making SOx a critical pollutant to control in light of the large contribution of SOx in the SoCAB from maritime sources. In addition, NOx and directly-emitted $PM_{2.5}$ also contribute to the $PM_{2.5}$ air quality. The federal 8-hour ozone attainment deadline for the SoCAB is 2023. The federal annual $PM_{2.5}$ attainment deadline is 2014.

In addition, CARB designated the exhaust from diesel-fueled engines as a toxic air contaminant, with diesel particulate matter (DPM) as a surrogate for total emissions. The USEPA also lists diesel exhaust as a mobile source air toxic. According to CARB, about 70% of the potential cancer risk from toxic air contaminants in California can be attributed to DPM. Therefore, the concentration of DPM in communities has become a major public health concern and the focus of CARB and SCAQMD regulations.

In 2000, the SCAQMD released results from its second Multiple Air Toxics Exposure Study (MATES II), which raised concerns about the impact of emissions from ships, trucks and trains in the vicinity of the ports and major transportation corridors. Since then, both ports have had terminal development plans challenged and delayed due to concerns about the adequacy of environmental mitigation. In 2008, the SCAQMD released their MATES III report[2], which continued to raise concerns over emissions from port operations. The MATES III modeling analysis showed the highest carcinogenic health risks from air toxics at areas surrounding the ports, ranging from 1,100 to 3,700 per million. In addition, compared to the MATES II period (i.e., 1998-1999), the areas near the ports (as well as inland areas in the eastern and northern portions of SCAQMD) also showed an increase in estimated air toxics risk primarily due to the additional cargo container throughputs that occurred between the MATES II and MATES III time periods.[3]

In order for the SoCAB to attain the NAAQS, and to protect public health, immediate action is necessary to significantly reduce emissions from all sectors, including "goods movement", which is why the ports have worked aggressively to implement the emission reduction programs outlined in the CAAP. In addition, CARB recently undertook several major actions targeted at reducing emissions from goods movement activities. These actions are described later in detail in Section 1.5. The implementation of the CAAP measures and CARB's regulations is expected to substantially reduce emissions and air toxics risks associated with port-related operations.

1.4 The Global Picture – Climate Change

Climate Change is a global concern. During the 20th century, global average temperatures increased about one degree centigrade. Over the next 100 years, temperatures are likely to increase another two to ten degrees centigrade.

Greenhouse gases (GHGs) are the gases present in the earth's atmosphere that reduce the loss of heat into space. GHGs primarily include water vapor, carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). GHGs affect climate as they concentrate in the Earth's atmosphere and trap heat by blocking some of the long-wave energy normally radiated back to space.

[2] *Multiple Air Toxics Exposure Study in the South Coast Air Basin, Final Report*, September 2008, South Coast Air Quality Management District. [MATES III]
[3] MATES III, Section 6.4, pg. 6-3, 2008

While some GHGs occur naturally, there is widespread agreement among climate scientists worldwide that human activity is increasing the GHGs in the Earth's atmosphere and accelerating global warming. Activities causing this warming include those that occur in and around a port setting, such as the burning of fossil fuels for industrial operations, transportation, heating, and electricity.

In addition to the focus on DPM, NOx, and SOx, both ports recognize that GHGs are also an important consideration when evaluating emissions from mobile sources, due to their potential global effect. It should be noted that the immediate purpose of this CAAP is to address emissions that affect public health risk on a local basis and prevent the attainment of health-based NAAQS. Both ports are addressing GHG emissions under separate programs, however, implementation of the some of the CAAP measures will result in GHG co-benefits, or reductions, which have been identified in this document. Further, state-wide GHG emission reductions are expected to be achieved through Assembly Bill (AB) 32, which was signed into law in September 2006. AB 32 requires CARB to develop regulations and market mechanisms to implement a cap on GHG emissions from mobile and stationary sources that will reduce California's GHG emissions to 1990 levels by 2020. To mitigate climate change in California, the Governor's Climate Action Team has proposed a series of early action measures relevant to port operations to be in place by 2010 or shortly thereafter. These state measures are in parallel with those presented in the CAAP. In December 2008, CARB adopted the Climate Change Scoping Plan to achieve the GHG reductions mandated by AB 32 including several measures targeting goods movement and ports.

In May 2007, Los Angeles Mayor Villaraigosa unveiled GREEN LA – An Action Plan to Lead the Nation in Fighting Global Warming, which set a goal to reduce the City of Los Angeles' GHGs by 35% below 1990 levels, by 2030. This plan included the POLA, which published its GREEN LA component, City of Los Angeles Harbor Department Climate Action Plan, in December 2007. This Action Plan focused on meeting the GREEN LA targets with the ports' own municipally-controlled operations and buildings. In September 2008, the POLB Board adopted a policy resolution, establishing a framework for reducing emissions of GHGs in a cooperative effort with the other departments of the City of Long Beach. In addition, both ports, through their respective cities, are members of the California Climate Action Registry. Both ports began annually reporting GHG emissions for their Harbor Department operations in 2007. Further, to gain a better understanding of the GHG impacts from port tenant operations, both ports also began reporting on GHG emissions in their annual air emissions inventories, starting with the 2006 Emissions Inventory. This will be standard practice for all future Emission Inventories. Finally, for each of the control measures in this CAAP Update, the impact on GHG emissions is quantified. Since both cities have different approaches and goals relating to GHGs, each port is developing a comprehensive GHG or Climate Action Plan outside of the CAAP to meet their respective Board of Harbor Commissioners' and City Administration GHG emission reduction goals. These GHG or Climate Action Plans will include strategies for all port operations, including tenant operations.

1.5 Regulatory Measures Addressing Port-Related Activities

Almost all of the emissions associated with port related activities are attributable to five diesel-fueled source categories. These source categories include ocean-going vessels (OGVs), On-Road Heavy-Duty Vehicles (HDVs), Cargo Handling Equipment (CHE), Harbor Craft (HC) and Railroad Locomotives (RL). The responsibility for the control of emissions from the majority of these sources falls under the jurisdiction of federal (USEPA) and state (CARB) air regulatory agencies. In addition to a summary of key regulations already affecting port operations, a list of the recently adopted and proposed regulatory measures that may impact the ports over the next five calendar years is presented below. When evaluating the future year benefits from the CAAP, the impacts of the adopted measures were estimated and considered in order to ensure the CAAP's consistency with and support of the regulations, as well as both the effectiveness and cost efficiency of the ports' proposed measures. Regulatory measures that have been announced in concept but for which no detailed information on approach has been released, have not been included in the following discussion. Once developed, these regulations will be included in future revisions to the CAAP.

1.5.1 On-Road Heavy-Duty Vehicles

Emission Standards for New 2007+ On-Road Heavy-Duty Vehicles

In 2001, CARB adopted USEPA's stringent emission standards for 2007+ On-Road Heavy-Duty Vehicles (HDV), which will ultimately result in a 90% reduction in NOx and particulate matter (PM) emissions. This regulation requires HDV engine manufacturers to meet a 0.01 g/bhp-hr PM standard starting in 2007, which is 90% lower than the 2004 PM standard of 0.1 g/bhp-hr. The regulation further requires a phase-in of a 0.2 g/bhp-hr NOx standard between 2007 and 2010. By 2010, all engines will be required to meet the 0.2 g/bhp-hr NOx standard, which represents a greater than 90% reduction compared to the 2004 NOx standard of 2.4 g/bhp-hr. Between 2007 and 2010, on average, manufacturers have produced HDV engines meeting a PM standard of 0.01 g/bhp-hr and a NOx standard of 1.2 g/bhp-hr. This latter was referred to as the 2007 interim standard.

Ultra-Low Sulfur Diesel (ULSD) Fuel Requirement

In 2003, CARB adopted a regulation requiring that diesel fuel produced or offered for sale in California for use in any on-road or non-road vehicular diesel engine (with the exception of locomotive and marine diesel engines) contain no more than 15 parts per million (ppm) of sulfur (S) by weight, beginning June of 2006. This ULSD fuel is needed in order for retrofit technologies, such as diesel particulate filters, to operate effectively.

Heavy-Duty Vehicle On-Board Diagnostics (OBD) Requirement

In 2005, CARB adopted a comprehensive HDV On-Board Diagnostics (OBD) regulation, which ensures that the increasingly stringent HDV emissions standards being phased in are maintained throughout the vehicle's useful life. The OBD regulation requires manufacturers to install a system in HDVs to monitor virtually every emissions-related component on the vehicle. The OBD regulation will be phased in beginning with the 2010 model years with full implementation required by 2016.

Requirements for In-Use On-Road Diesel-Fueled Heavy-Duty Drayage Trucks at Ports and Intermodal Rail Yard Facilities
As a part of CARB's emissions reduction plan for ports and goods movement in California, in December of 2007, CARB adopted a regulation designed to modernize the drayage truck fleet in use at California's ports. This objective is to be achieved in two phases:

1. By December 31, 2009, all pre-1994 model year (MY) engines are to be retired or replaced with 1994 and newer MY engines. Furthermore, all drayage trucks with 1994 to 2003 MY engines will be required to achieve an 85% PM emission reduction through the use of a CARB Level 3 verified diesel emission control strategy (VDECS).

2. By December 31, 2013, all trucks operating at California ports must comply with the 2007+ on-road heavy-duty truck engine standards.

Statewide Truck and Bus Regulation
In December 2008, CARB adopted its Truck and Bus Regulation, which places requirements on in-use HDVs operating throughout the state. The Truck and Bus Regulation is currently being implemented concurrently with CARB's Drayage Truck Regulation. However it is anticipated that in 2017, both rules will be consistent and the Drayage Truck Regulation which will be superseded by the Truck and Bus Regulation. Under the Truck and Bus Regulation, existing HDVs are required to be replaced with HDVs meeting the latest NOx and PM Best Available Control Technology (BACT). By January 1, 2021, all MY 2007 trucks are required to meet NOx and PM BACT (i.e., 2010+ USEPA Engine Standards). MY 2008 and MY 2009 must be replaced with 2010+ engines by January 1, 2022 and January 1, 2023, respectively

1.5.2 Ocean-Going Vessels
International Emission Standards for Marine Propulsion Engines
The International Maritime Organization (IMO) adopted limits for NOx in Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL) in 1997. These NOx limits apply to marine engines over 130 kilowatts (kW) installed on vessels built on or after 2000 and are summarized below. The required number of countries ratified Annex VI in May 2004 and it went into force for the ratifying countries in May of 2005. Engine manufacturers have been certifying engines to the Annex VI NOx limits since 2000 as the standards are retroactive in other countries, once Annex VI is ratified. In April 2008, the Marine Environment Protection Committee of the IMO approved a recommendation for new MARPOL Annex VI sulfur limits for fuel and further NOx limits for engines. In October 2008, the IMO adopted these amendments to the international requirements under MARPOL Annex VI, which place a global limit on marine fuel sulfur content of 3.5% by 2012, reduced from the current 4.5%, which will be further reduced to 0.5% sulfur by 2020, or 2025 at the latest, pending a technical review in 2018[4]. In Emissions Control Areas (ECAs),

[4] *http://www.epa.gov/otaq/regs/nonroad/marine/ci/mepc58-5noxsecretariat.pdf*

sulfur content will be limited to 1.0% in 2010, and further reduced to 0.1% sulfur in 2015 from the current 1.5% limit. In addition, new engine emission rate limits for NOx for marine diesel engines installed on newly built ships are based on rated engine speed (n) and the year the ship is built. The NOx standards are summarized as follows:

- NOx - Tier 1; For ships built between January 1, 2000 and December 31, 2010:
  - 17.0 g/kW-hr if n is less than 130 rpm
  - 45 * $n^{(-0.2)}$ g/kW-hr if n is equal to 130 rpm or less than 2000 rpm
  - 9.8 g/kW-hr if n is equal to or greater than 2000 rpm

- NOx - Tier 2; For ships built starting in January 1, 2011:
  - 14.4 g/kW-hr if n is less than 130 rpm
  - 44 * $n^{(-0.23)}$ g/kW-hr if n is equal to 130 rpm or less than 2000 rpm
  - 7.7 g/kW-hr if n is equal to or greater than 2000 rpm

- NOx - Tier 3; For ships built starting in January 1, 2016 and operate in ECA area:
  - 3.4 g/kW-hr if n is less than 130 rpm
  - 9 * $n^{(-0.2)}$ g/kW-hr if n is equal to 130 rpm or less than 2000 rpm
  - 2.0 g/kW-hr if n is equal to or greater than 2000 rpm
  - Tier 3 NOx standards are based on the use of advanced catalytic after-treatment systems.

The United States ratified Annex VI in October 2008, and the requirements became enforceable through the Act to Prevent Pollution from Ships (APPS) in January 2009. In March 2009, the United States and Canada submitted a proposal to the IMO for the designation of an ECA in which the stringent international emission controls described above would apply to ocean-going vessels in waters extending to 200 nm from the Pacific coast, Atlantic/Gulf coast, and the eight main Hawaiian Islands. On March 26, 2010, IMO approved the North American ECA, which will enter into force on August 1, 2011, and allow for 1.0% sulfur fuel limits to take effect on August 1, 2012.

USEPA's Emission Standards for Marine Diesel Engines Above 30 Liters per Cylinder (Category 3 Engines)

Under the Clean Air Act, on December 22, 2009, USEPA announced final emission standards for new marine diesel engines with per-cylinder displacement at or above 30 liters or Category 3 marine diesel engines installed on U.S.-flagged vessels. The final engine standards are equivalent to IMO's latest MARPOL standards as described above. The emission standards apply in two stages: near-term standards for newly-built engines will apply beginning in 2011, and long-term standards requiring an 80 percent reduction in NOx will begin in 2016. USEPA has also adopted MARPOL Annex VI standards for existing engines built between 1990 and 2000. The USEPA also applied to IMO to designate U.S. coasts as an Emissions Control Area (ECA), and forbid the production and sale of fuel with greater than 0.1% sulfur for use in waters within a U.S. ECA.

USEPA's Final Regulation for the Control of Air Pollution from Locomotive and Marine Compression Ignited Engines Less than 30 Liters Per Cylinder

On March 14, 2008[5], the USEPA finalized a program designed to dramatically reduce emissions from marine diesel engines below 30 liters per cylinder displacement. These include marine propulsion engines used on vessels and marine auxiliary engines. When fully implemented, this rule will cut PM emissions from these engines by as much as 90% and NOx emissions by as much as 80%.

The regulations introduce two tiers of standards – Tier 3 and Tier 4 – which apply to both new and remanufactured marine diesel engines, as follows:

- *Newly-built engines:* Tier 3 standards apply to engines used in commercial, recreational and auxiliary power applications (including those below 37 kW that were previously covered by non-road engine standards). The emissions standards for newly-built engines will phase in beginning in 2009. Tier 4 standards apply to engines above 600 kW on commercial vessels based on the application of high-efficiency catalytic after-treatment technology, phasing in beginning in 2014.

- *Remanufactured engines:* The standards apply to commercial marine diesel engines above 600 kW when these engines were remanufactured and will take effect as soon as certified systems are available, as early as 2008.

CARB's Regulation to Reduce Emissions from Diesel Auxiliary Engines on Ocean-Going Vessels While at Berth at a California Port[6]

On December 6, 2007, CARB adopted a regulation to reduce emissions from diesel auxiliary engines on ocean-going vessels (OGVs) while at berth for container, cruise and refrigerated cargo vessels. The regulation requires that auxiliary diesel engines on OGVs be shut down (i.e., use shore power) for specified percentages of the fleet's visits and that the fleet's at-berth auxiliary engine power generation be reduced by the same percentages. As an alternative, vessel operators may employ any combination of clean emissions control technologies to achieve equivalent reductions. Specifically, by 2014, vessel operators relying on shore power are required to shut down their auxiliary engines at-berth for 50% of the fleet's vessel visits and reduce their onboard auxiliary engine power generation by 50 percent. The specified percentages increase to 70% in 2017 and 80% in 2020. For vessel operators choosing the emission reduction equivalency alternative, the regulation requires a 10% reduction in OGV hotelling emissions starting in 2010, increasing in stringency to an 80% reduction by 2020.

[5] *http://wwww.epa.gov/otaq/regs/nonroad/420f08004.htm#wxhaust*

[6] *http://www.arb.ca.gov/regact/2007/shorepwr07/shorepwr07.htm*

CARB's Regulation for Low Sulfur Fuel for Marine Engines and Auxiliary Boilers
On July 24, 2008, CARB adopted low sulfur fuel requirements for marine main engines, auxiliary engines and auxiliary boilers within 24 nautical miles (nm) of the California coastline. As of July 1, 2009, the regulation required the use of marine gas oil (MGO) with a sulfur content less than 1.5% by weight or marine diesel oil (MDO) with a sulfur content of equal to or less than 0.5% by weight. The use of MGO or MDO with a sulfur content of equal to or less than 0.1 % will be required in all engines and boilers by January 1, 2012. The use of low sulfur fuel will reduce emissions of DPM, NOx and SOx.

CARB's Regulation Related to Ocean-Going Ship On-board Incineration
Starting in November of 2007, all cruise ships and ocean-going vessels of 300 gross registered tons or more are prohibited from conducting on-board incineration within 3 nm of the California coast. Enactment of this regulation reduced emissions of toxic air contaminants such as dioxins and public exposure to toxic metals. The regulation will reduce PM and hydrocarbon emissions generated during incineration.

Vessel Speed Reduction (VSR) Program
In May of 2001, a Memorandum of Understanding (MOU) between the POLA, POLB, USEPA Region 9, CARB, SCAQMD, the Pacific Merchant Shipping Association (PMSA), and the Marine Exchange of Southern California was signed. This MOU called for OGVs to voluntarily reduce speed to 12 knots at a distance of 20 nautical miles (nm) from Point Fermin. Although the terms of this MOU expired in 2004, a significant number of vessels visiting the ports continue to abide by the VSR and participate in the ports' incentive programs described in CAAP measure OGV1.

1.5.3 Cargo Handling Equipment

Emissions Standards for Non-Road Diesel Powered Equipment
USEPA's and CARB's Tier 1, Tier 2, Tier 3, and Tier 4 (interim Tier 4 and final) emissions standards for non-road diesel engines require compliance with progressively more stringent standards for DPM, NOx, hydrocarbon and carbon monoxide (CO). Tier 4 standards for non-road diesel powered equipment complement the 2007+ on-road heavy-duty engine standards which require 90% reductions in DPM and NOx compared to current levels. In order to meet these standards, engine manufacturers must produce new engines with advanced emissions control technologies similar to those already in place for on-road heavy-duty diesel vehicles. These standards for new engines will be phased in starting with smaller engines in 2008 until all but the very largest diesel engines meet NOx and PM standards in 2015. Currently, the interim Tier 4 standards include a 90% reduction in PM and a 60% reduction in NOx.

CARB's Cargo Handling Equipment Regulation
In December of 2005, CARB adopted a regulation designed to reduce emissions from cargo handling equipment (CHE) such as yard tractors and forklifts starting in 2007. The regulation calls for the replacement or retrofit of existing engines with engines that use BACT. Beginning January 1, 2007 the regulation requires newly purchased, leased, or rented yard tractors to be equipped with a 2007 or later on-road engine, or a Final Tier 4 off-road engine. Newly purchased, leased, or rented non-yard tractors must be equipped with a certified on-road or off-road engine meeting the current model year standards in effect at the time the engine is added to the fleet. If the engine is pre-Tier 4, then the highest level available VDECS must be installed within one year. In-use yard tractors are required to meet either 2007 or later certified on-road engine standards, Final Tier 4 off-road engine standards, or install verified controls that will result in equivalent or fewer DPM and NOx emissions than a Final Tier 4 off-road engine. In-use non-yard tractors must either install the highest level available VDECS and/or replace to an on-road or off-road engine meeting the current model year standards. For all CHE, compliance dates are being phased in beginning December 31, 2007, based on the age of the engine and number of equipment in each model year group.

1.5.4 Harbor Craft

Emission Standards for Harbor Craft Engines
On March 14, 2008, USEPA finalized the latest regulation establishing new emission standards for new Category 1 and 2 diesel engines rated over 50 horsepower (hp) used for propulsion in most harbor craft. The new Tier 3 engine standards phased in beginning in 2009. The more stringent Tier 4 engine standards (based on the application of high-efficiency catalytic after-treatment technologies) will phase in beginning in 2014 and apply only to commercial marine diesel engines greater than 800 hp. The regulation also includes requirements for remanufacturing commercial marine diesel engines greater than 800 hp.

CARB's Low Sulfur Fuel Requirement for Harbor Craft
In 2004, CARB adopted a low sulfur fuel requirement for harbor craft. Starting January 1, 2006 (in SoCAB) harbor craft are required to use on-road diesel fuel (e.g., ULSD), which has a sulfur content limit of 15 ppm and a lower aromatic hydrocarbon content. The use of lower sulfur and aromatic fuel has resulted in DPM and NOx reductions. In addition, the use of low sulfur fuel will facilitate retrofitting harbor craft with emissions control devices such as diesel particulate filters (DPFs) that have the potential to reduce PM by an additional 85%.

CARB's Regulation to Reduce Emissions from Diesel Engines on Commercial Harbor Craft [7]
As a part of both the Diesel Risk Reduction Plan and Goods Movement Plan, CARB adopted a regulation in November 2007 that will reduce DPM and NOx emissions from new and in-use commercial harbor craft operating in regulated California waters (i.e., internal waters, ports, and coastal waters within 24 nm of California coastline). Under CARB's definition, commercial harbor craft include tug boats, tow boats, ferries, excursion vessels, work boats, crew boats, and fishing vessels. This regulation requires stringent emission limits for auxiliary

[7] *http://www.arb.ca.gov/regact/2007/chc07/isor.pdf*

and propulsion engines installed in commercial harbor craft. All in-use, newly purchased, or replacement engines must meet USEPA's most stringent emission standards per a compliance schedule set by CARB. In addition, the propulsion engines on all new ferries, with the capacity of more than 75 passengers, acquired after January 1, 2009, will be required to install control technology that represents BACT, in addition to an engine that meets the Tier 2 or Tier 3 USEPA marine engine standard, as applicable, in effect at the time of vessel acquisition. For harbor craft that home port in the SoCAB, the compliance schedule is accelerated by two years (compared to statewide requirements) in order to achieve earlier emission benefits required in SoCAB. The in-use emission limits only apply to ferries, excursion vessels, tug boats and tow boats. The compliance schedule for in-use engine replacement began in 2009.

1.5.5 Railroad Locomotives

Emissions Standards for New and Remanufactured Locomotives and Locomotive Engines

In 1998, USEPA adopted Tier 0 (1973-2001), Tier 1 (2002-2004), and Tier 2 (2005+) emissions standards applicable to newly manufactured and remanufactured railroad locomotives and locomotive engines. These standards require compliance with progressively more stringent limits on allowable emissions of hydrocarbon, CO, NOx, and DPM. Although the most stringent standard, Tier 2, results in over 60% reduction in DPM and 40% reduction in NOx compared to Tier 0, the full potential of these reductions will not be realized in the next five years because of the long life of diesel locomotive engines. In March of 2008, the USEPA finalized a regulation[8] which established new standards for new and remanufactured locomotives. When fully implemented, this rule will cut DPM emissions from these engines by as much as 90% and NOx emissions by as much as 80%.

The regulation introduces two tiers of standards – Tier 3 and Tier 4 – which apply to new locomotives as well as standards for remanufactured locomotives, as follows:

- *Newly-Manufactured Locomotives:* The new Tier 3 emission standards will achieve 50% reduction in DPM beyond the Tier 2 standard and will become effective in 2012. The longer term Tier 4 emission standards which are based on the application of high efficiency catalytic after-treatment technologies for NOx and DPM will become effective in 2015 and will achieve about 80% reduction in NOx and DPM compared to Tier 2 standards.

- *Remanufactured Locomotives:* The regulation also establishes emission standards for remanufactured Tier 0, 1, and 2 locomotives which would achieve 50 to 60% reduction in DPM and 0 to 20%reduction in NOx.

[8] *http://www.epa.gov/otaq/regs/nonroad/420f08004.htm*

CARB's Low Sulfur Fuel Requirement for Intrastate Locomotives
In 2004, CARB adopted a low sulfur fuel requirement for intrastate locomotives. Intrastate locomotives are defined as those locomotives that operate at least 90% of the time within the borders of the state, based on hours of operation, miles traveled, or fuel consumption. Primarily applicable to switchers, starting January 1, 2006 statewide, intrastate locomotives are required to use CARB off-road diesel fuel which has a sulfur content limit of 15 ppm and a lower aromatic content. The use of fuel with lower sulfur and aromatics results in DPM and NOx reductions. In addition, use of low sulfur fuel facilitates retrofitting locomotives with emissions control devices such as DPFs that have potential to reduce DPM by 85%.

Statewide 1998 and 2005 Memoranda of Understanding (MOU)
In order to accelerate the implementation of Tier 2 engines in the SoCAB, the CARB and USEPA Region 9 entered into an enforceable MOU in 1998 with two major Class 1 freight railroads [Union Pacific (UP) and Burlington Northern Santa Fe (BNSF)] in California. This MOU requires by 2010, the fleet average for Class 1 locomotives operating in the SoCAB to average Tier 2 Standards, which will achieve a 65% reduction in NOx by 2010. In 2005, CARB entered into another MOU with UP and BNSF whereby the two railroads agreed to phase out non-essential idling and install idling reduction devices, identify and expeditiously repair locomotives that smoke excessively, and maximize the use of 15 ppm sulfur fuel.

In addition to the 1998 and 2005 MOUs between CARB and the Class 1 rail operators described above, in June 2010, CARB's Board proposed railyard-specific commitments with Class 1 operators to accelerate further DPM emission and risk reductions at four railyards in the South Coast Air Basin, including the ICTF located in the port area. The voluntary commitments would establish reporting and tracking mechanisms and deadlines to accelerate reductions of DPM emissions. The rail commitments would also require Class 1 operators to reduce DPM emissions by 85 percent by 2020 relative to 2005 emission levels within the fenceline of each of the four railyards.

1.5.6 AB 32 – The California Global Warming Solutions Act
Assembly Bill 32 (AB32), the California Global Warming Solutions Act of 2006, establishes a first-in-the world comprehensive program requiring CARB to develop regulatory and market mechanisms that will ultimately reduce GHG emissions to 1990 levels by the year 2020, and reduce emissions to 80% below 1990 levels by 2050. Mandatory caps will begin in 2012 for significant sources and ratchet down to meet the 2020 goals. In the interim, CARB will begin to measure the GHG emissions of industries determined to be significant sources of GHG emissions.

On October 25, 2007, CARB approved several emission reduction strategies to reduce GHG emissions as "early action measures." Early action measures pertaining to goods movement activities for ships, port drayage trucks, cargo handling equipment and transport refrigeration units include:

- Green Ports (Ship Electrification)
- SmartWay Truck Efficiency
- Tire Inflation Program
- Anti-idling Enforcement
- Refrigerant Tracking, Reporting, and Recovery Program
- Low Carbon Fuel Standard

In December 2008, CARB adopted their Climate Change Scoping Plan, which was designed to achieve the reductions in GHG emissions mandated in AB 32. The AB 32 Scoping Plan contains the main strategies California will use to reduce the GHGs that cause climate change. Several of these measures are targeted at goods movement, including ports, and are expected to achieve a combined 3.7 million metric tons of carbon dioxide equivalent (CO_2E) reduction. Measures in the Scoping Plan that affect port operations include:

- T-5: Ship electrification at ports (previously adopted as regulation in December 2007)
- T-6: Goods movement efficiency measures

1.5.7 Grant Funding Programs

Non-regulatory grant funding programs are also helping to significantly reduce emissions from sources including those associated with port operations. An example of these types of programs is the Carl Moyer Program. This program is a CARB administered grant program implemented in partnership with local air districts to fund the replacement of older, higher emitting engines or to cover the incremental cost of purchasing cleaner-than-required engines and vehicles. Under this program, owners/operators of mobile emissions sources can apply for incremental funding to reduce emissions. The program also includes a fleet modernization component. It is important to note that only emission reductions that are surplus to regulatory requirements are eligible for Carl Moyer Program funding.

In addition to the Carl Moyer Program, Proposition 1B (Prop 1B), the Highway Safety, Traffic Reduction, Air Quality and Port Security Bond Act of 2006 passed by voters in November 2006, authorized $1 billion in bond funding over four years for incentives to reduce diesel emissions associated with goods movement. Under this program, CARB will work in partnerships with local public agencies (i.e., air quality management districts and ports) to identify and fund qualified projects. CARB awards funding to local agencies, which in turn provide financial incentives to owners of equipment used in goods movement to upgrade to cleaner technologies. In June 2008, CARB and the ports of Long Beach and Los Angeles entered into an agreement for a $98 million award of Prop 1B grant funds to replace older diesel drayage trucks operating at the ports. In August 2008, the ports began moving forward with the Prop 1B grant program; however, on December 23, 2008 CARB issued a letter to all local air districts and seaports asking them to cease making any awards on Prop 1B applications due to California's fiscal budget crisis. Several months later, CARB was able to tap into the bond market, and in June 2009 reinstated the original $98 million under the Prop 1B grant program

In 2006, the SCAQMD committed $36 million to support the implementation of the HDV component of the CAAP, described in HDV-1, however, this funding to help the ports has been held up by administrative restrictions associated with the funding sources.

The USEPA, through the Diesel Emission Reduction Act (DERA), has provided grant funding to local governments for diesel emissions reduction projects. In 2009 and 2010, both ports were successful in receiving grant awards through DERA. The funding in 2009 was provided by the American Reinvestment and Recovery Act. The combined total of over $7 million was used for the replacement, repower or retrofit of cargo handling equipment and harbor craft projects.

1.5.8 CAAP Coordination with Regulatory Requirements

It is important to highlight that the CAAP works in conjunction with, and relies upon existing and anticipated federal, state, and local regulations. The CAAP will continue to report on new regulations and develop measures incorporating them at the Port in future updates. Working together, both regulatory and port efforts can produce combined emissions reductions that are greater than those that are likely to be achieved on an individual basis. In order to meet the immediate needs of our local communities in southern California, the ports' efforts can also expedite emissions reductions to be achieved by existing or proposed regulations and can provide greater assurance that emissions reductions which may be achieved by future regulations or standards (e.g., potential USEPA and IMO vessel standards) will actually occur. The ports believe however that broader scale regulations are necessary to help meet our air quality improvement goals while not putting our local port operators at a competitive disadvantage, and that eventually, the ports' efforts should be overtaken by regulatory actions at the state, national and international level.

1.6 Clean Air Action Plan Vision

The ports recognize that their ability to accommodate the projected growth in trade will depend upon their ability to address adverse environmental impacts (and, in particular, air quality impacts) that result from such trade. The ports are determined to accelerate efforts to reduce air pollution from all modes of goods movement through the San Pedro Bay area. The CAAP builds upon the ports' previous air quality mitigation efforts, as well as the efforts of regulatory agencies, business stakeholders, and concerned residents. The CAAP is designed to develop mitigation measures and incentive programs necessary to reduce air emissions and health risks while allowing port development to continue. The CAAP Update provides progress report on milestones completed to date and identifies strategies and programs to be pursued over the next five years to reduce air emissions and health risks while allowing port development to continue.

The ports share the goal of reducing air pollution from existing and future port operations to acceptable levels. The ports take full responsibility for pursuing the goals in this CAAP, and will continue to work in close coordination with the regulatory agencies to ensure that the CAAP Update goals are achieved.

This CAAP Update, like the 2006 CAAP, is based on the following principles:

1. The ports will work cooperatively to implement these strategies.
2. The Clean Air Action Plan will continue to build upon past efforts, and will be continually updated and improved.
3. The ports will remain open to and supportive of new technologies and other advancements to accelerate meeting the ports' emissions reduction goals.
4. The ports will achieve an appropriate "fair share" of necessary pollutant emission reductions in order to reduce health risks to the local communities.

The CAAP includes multiple strategies that will achieve real emissions reductions. Several of these strategies also provide co-benefits by reducing GHG emissions as well. These strategies include a nested set of standards; multiple implementation mechanisms; investment in the development and integration of new/cleaner technologies into port operations; and a comprehensive monitoring and tracking program that will document progress on all of these elements.

Finally, the CAAP Update provides near-term planning, with a view toward the future. The primary focus of this update to the CAAP is for implementation activities that will occur over the next five years. However, the ports recognize that to meet the long-term goals of emissions and health risk reductions, activities beyond the next five years will be necessary. Therefore, the ports will continue to support programs that will help to meet our long-term goals, such as development of new, clean technologies through our Technology Advancement Program. In addition, the ports will continue to update the CAAP, planning and forecasting for the five years following each update.

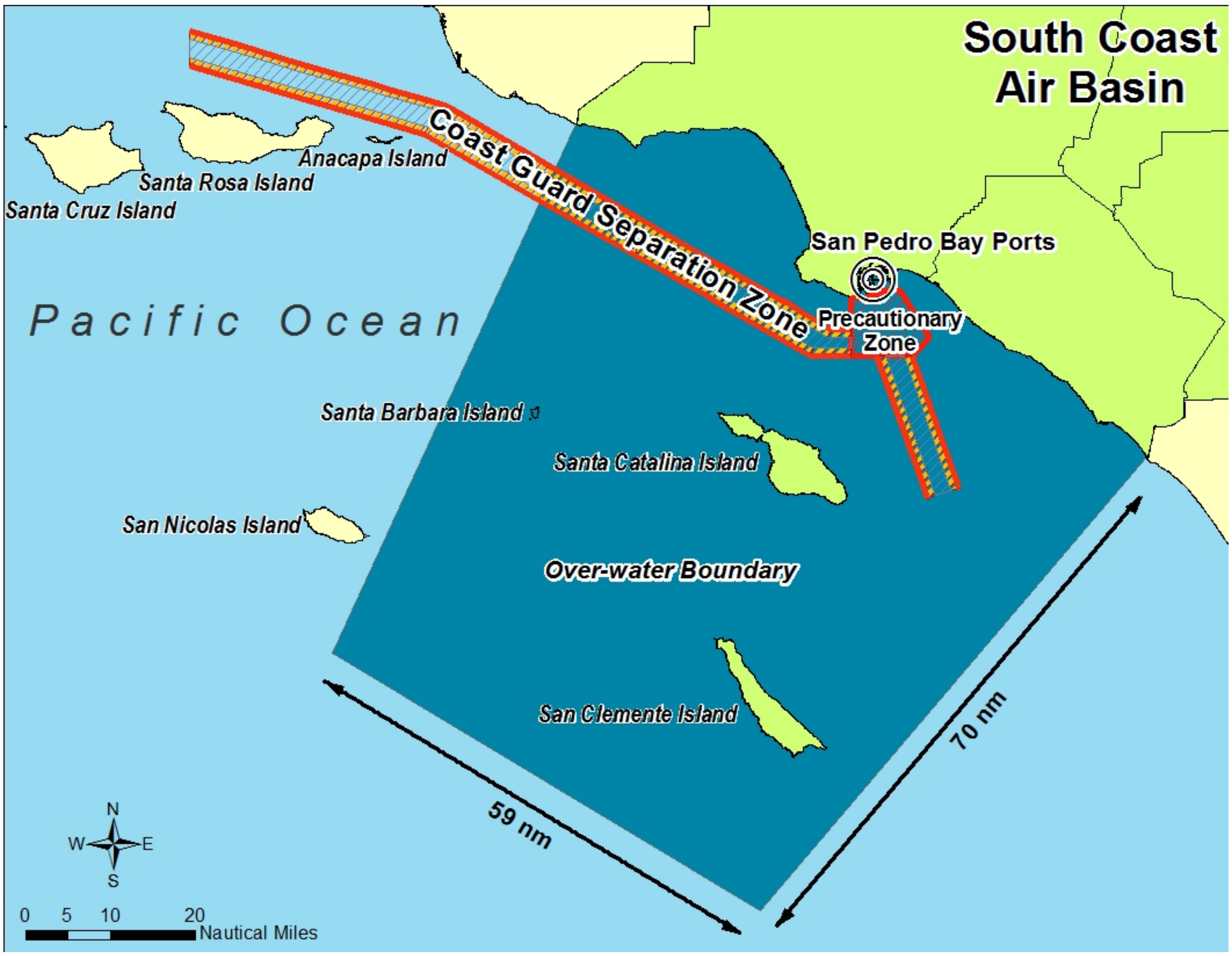
1.7 Air Quality Background

The CAAP Update targets the same port-related emissions sources identified in the emissions inventories prepared by the ports of Long Beach and Los Angeles. The geographical boundaries of the emissions inventories include the SoCAB and its associated over-water boundary (consistent with the boundaries established for the SCAQMD's Air Quality Management Plan [AQMP]). The landside boundary is presented in Figure 1.1 and the over-water boundary is presented in Figure 1.2. As in the emissions inventory, HDV operations are considered to be port-related only within the SoCAB boundary (which includes trips between the ports), the last point of rest prior to arriving at the ports and the first time the cargo is off-loaded after departing the ports (such as at a distribution center). Locomotive emissions are considered to be port-related between the port terminals and the edge of the SoCAB landside boundary.

Figure 1.1: Emissions Inventory Landside Boundary

The emission inventory over-water area is bounded in the north by the Ventura County line and to the south by the San Diego County line and extends perpendicularly out over water to the California Coastal Water designated coordinates.

Figure 1.2: Emissions Inventory Over-Water Boundary



Both ports finalized their 2009 Emissions Inventories in June 2010[9]. Using the emissions estimates from these inventories, the combined contribution of emissions by the five port-related source categories and their percentage share are presented in Figures 1.3 through 1.6 below. GHGs are presented as CO_2E.

[9] *http://www.polb.com/environment/air/emissions.asp*
http://www.portoflosangeles.org/environment/studies_reports.asp

Figure 1.3: 2009 Combined Port DPM Emissions Contributions by Source Category

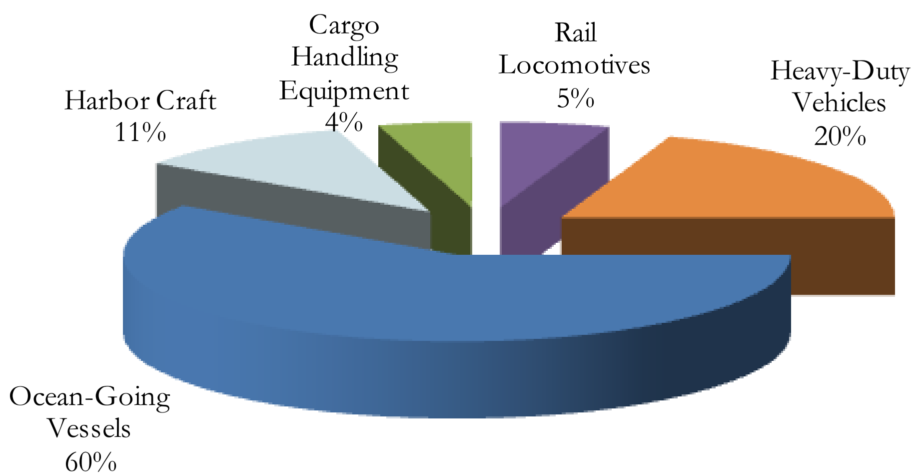


Figure 1.4: 2009 Combined Port NOx Emissions Contributions by Source Category

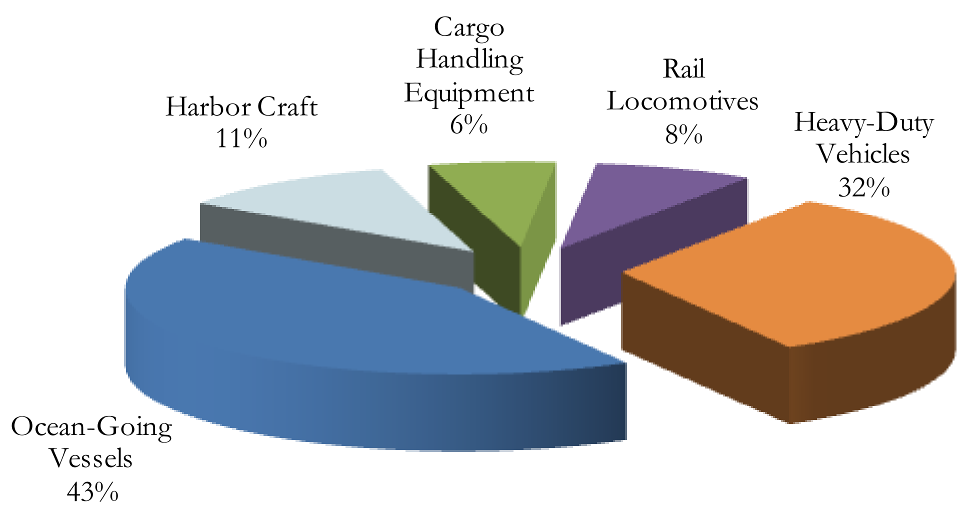


Figure 1.5: 2009 Combined Port SOx Emissions Contributions by Source Category

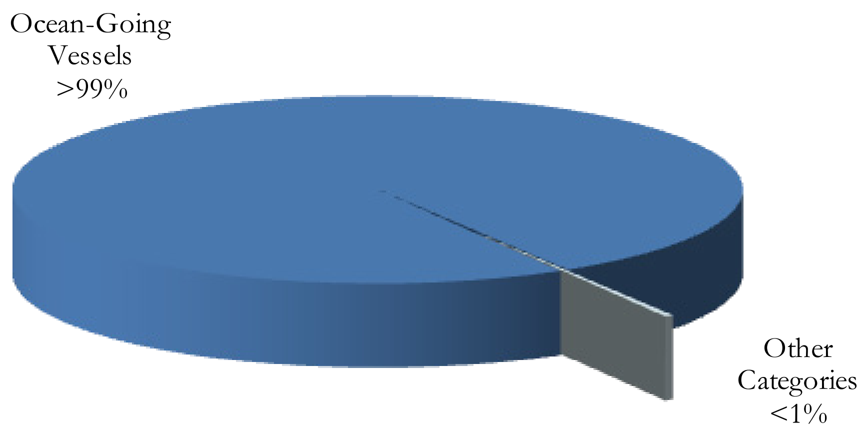
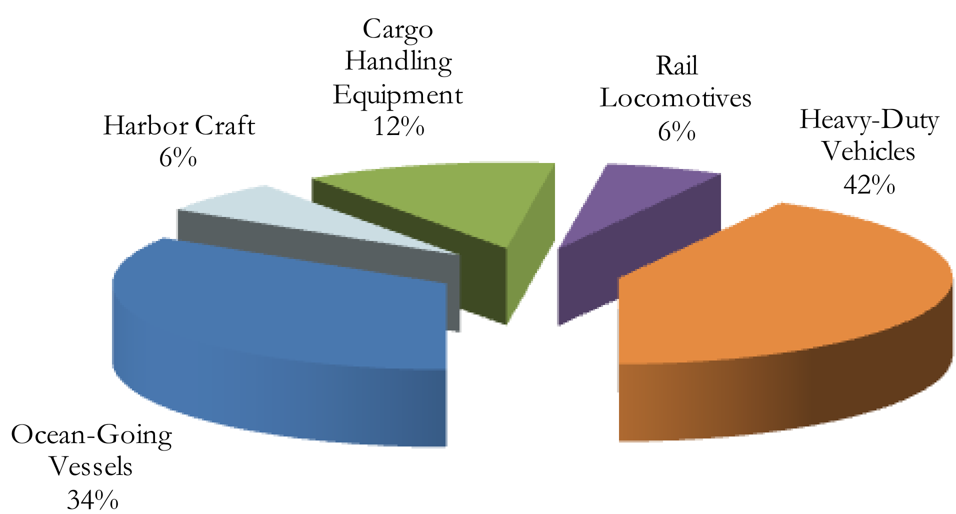


Figure 1.6: 2009 Combined Port GHG Emissions Contributions by Source Category



Figures 1.7 through 1.9 shown below compare the San Pedro Bay ports percentage contributions with the contributions from all the emissions sources in the SoCAB for 2009.[10] As existing and new regulations continue to take effect on stationary, area, and domestic mobile sources, the port-related percentage contribution to the total SoCAB emissions for DPM, NOx, and SOx is expected to increase significantly if these sources are not reduced. Further details are presented on the anticipated future percent contributions by port-related sources in Section 1.8.

Figure 1.7: Relative Contributions of Ports DPM Emissions to SoCAB in 2009

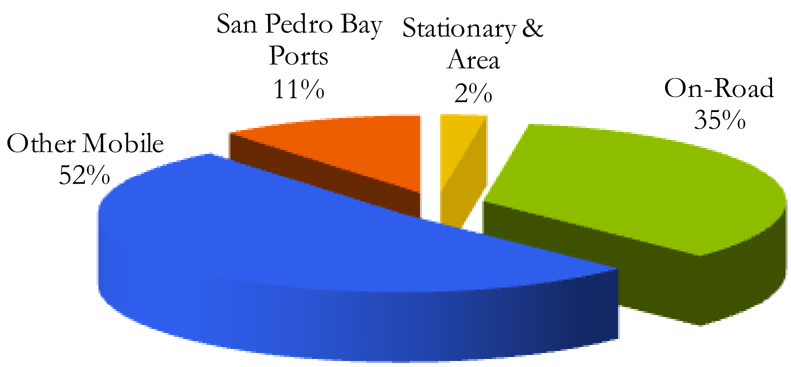
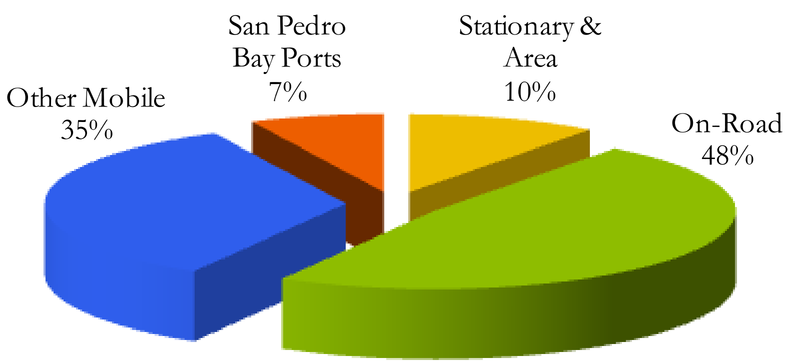
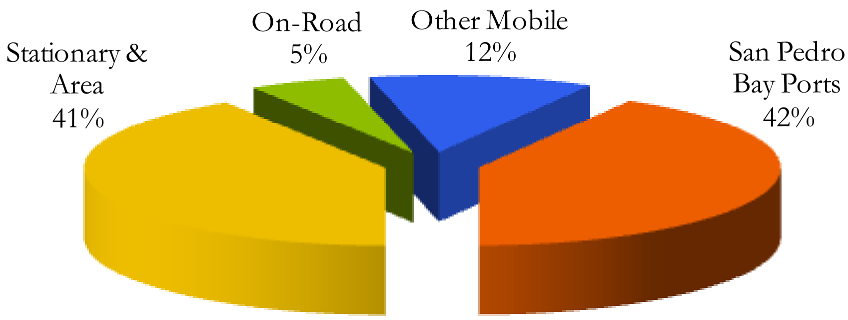


Figure 1.8: Relative Contributions of Ports NOx Emissions to SoCAB in 2009



[10] *Final 2007 AQMP, Appendix III, Base and Future Year Emissions Inventory, SCAQMD,* February 2007

Figure 1.9: Relative Contributions of Ports SOx Emissions to SoCAB in 2009



1.8 The Greater Challenge

The ports acknowledge that if port-related sources are not controlled to their "fair share" with respect to the other sources in the SoCAB by the CAAP's continued implementation and further state regulation, port-related contributions to the basin's total emissions (particularly with respect to OGVs) will increase significantly beyond the levels presented in Figures 1.7 through 1.9 above.

Figures 1.10 through 1.12 below show the forecasts for 2023 of the port-related sources compared to all other emission sources in the basin. The port-related forecasted emissions shown include ports assumed cargo growth in future and federal/state/local regulations that were adopted before October of 2005. It is important to note that some significant regulatory requirements that will reduce emissions from port-related sources were promulgated since this forecasting was completed. Even though these new requirements contribute to reducing port emission contributions, diligent effort is still required to ensure that the ports' fair share of regional emissions is reduced. Therefore, continued action must be taken in order to help the basin meet its air quality goals.

Figure 1.10: Contributions of Ports DPM Emissions to SoCAB in 2023 Assuming Pre-CAAP Controls

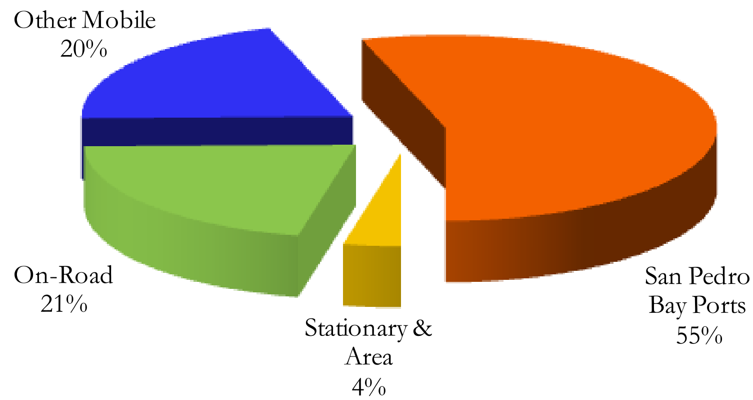


Figure 1.11: Contributions of Ports NOx Emissions to SoCAB in 2023 Assuming Pre-CAAP Controls

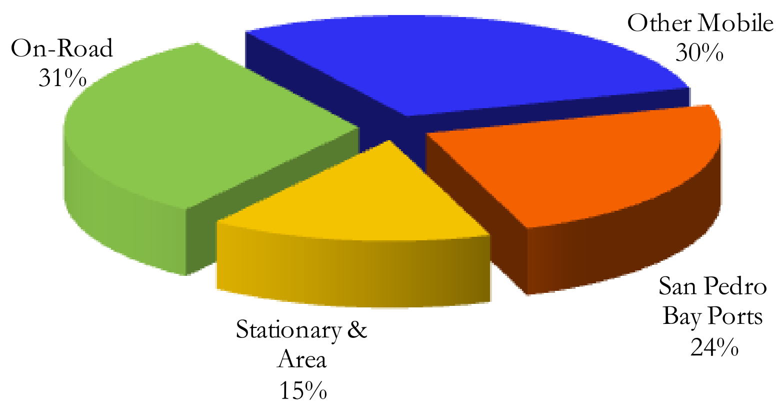
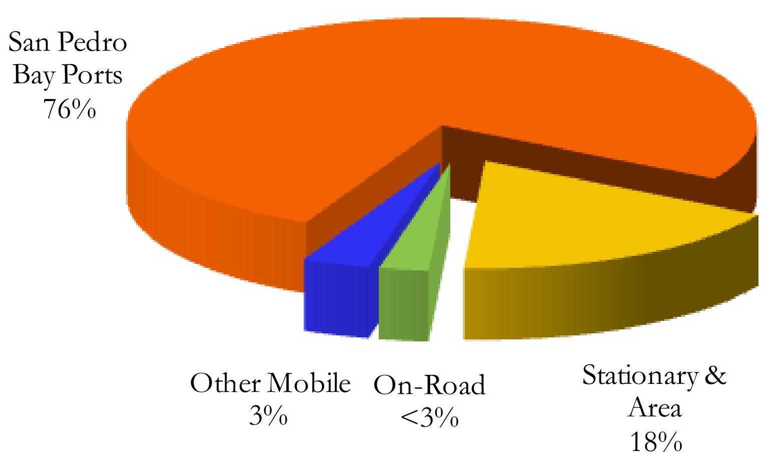


Figure 1.12: Contributions of Ports SOx Emissions to SoCAB in 2023 Assuming Pre-CAAP Controls



This CAAP Update focuses on control strategies, measures, and costs to deliver measurable progress towards the CAAP goals over the next five years. It is important to understand that a significant amount of work will still be needed beyond the next five years to ensure that plan goals are met and maintained. These challenges drive the need for continued re-evaluation, adjustment, and updates of the CAAP.

For the continued reduction of public health risk associated with port-related sources, the regulatory agencies will need to continue to apply tighter emissions reduction requirements in the future to ensure that growth does not reverse the desired trend of continual emissions reductions.

As stated previously, both ports are supportive of greater participation, action, and regulation by our agency partners as this creates a fair and level playing field for both industry and ports. As the two ports continue to implement the CAAP, it could put them at a competitive disadvantage with (in regard to cargo that is destined outside of the SoCAB) other California, west coast, and international ports. The ports have worked closely with CARB to make the strategies in the CAAP a standard that all California ports must meet, and further the ports continue to encourage USEPA to make the CAAP a standard that all ports in United States must meet. The CAAP should be considered a near-term strategy for meeting the immediate needs for local communities in the SoCAB, however ultimately, the CAAP should be surpassed by consistent and comprehensive regulation at the state, national, and international level.

Further, groundwork must be put in place today in order to secure emission reductions for the future. For example, the ports must continue to pursue development, demonstration, and integration of cleaner technologies and if feasible, "zero emission container mover systems" to ultimately replace the current systems. These "zero emission" transport systems should be near pollution-free and be powered by "green energy" sources and renewable fuels – contributing to both air quality improvement and GHG reduction goals. Perfecting the technology for a truly clean tomorrow is a critical element for achieving long-term goals. Early demonstration and implementation of these technologies today, will lead to benefits of a better and cleaner tomorrow.

Due to the enormity of the challenges ahead, specifically in the case of the Clean Trucks Program described in CAAP Measure HDV1 and infrastructure and operational efficiency programs, the ports simply cannot afford to fund these initiatives through their current operating budgets. Substantial additional funding must be secured. As mentioned earlier however, some of the funding assistance promised by the agencies has been curtailed due to administrative restrictions or the state budget crisis. Consequently, the majority of the funding for these programs must currently be borne by the port industry. By 2009, the estimated funding from POLA and POLB for Clean Air Action Plan programs was over $200 million. Estimated funding by the port industry for the Clean Trucks Program alone is over $600 million.

1.9 Clean Air Action Plan Update Report Organization

After this Introduction, the CAAP Update is organized into the following sections:

- Section 2: "San Pedro Bay Ports Clean Air Action Plan Goals" presents the goals associated with the CAAP Update over the next five fiscal years.

- Section 3: "Implementation Strategies" presents an update to the various strategies/options available to the ports for implementation of the CAAP Update.

- Section 4: "Clean Air Action Plan Initiatives" presents details and estimated emissions reductions of each of the initiatives proposed in the CAAP that will need to be pursued and implemented in order to make significant measureable progress toward the CAAP goals.

- Section 5: "CAAP Effectiveness Tracking" presents reductions to date and the affect of growth on the emissions reductions that are estimated to result from the implementation of the measures discussed in the previous section.

- Section 6: "Budget Summary" presents and discusses the estimated capital and incentive costs associated with implementing the measures described in Section 4. Costs are presented in terms of annual funding over the five-year CAAP Update period.

SECTION 2: SAN PEDRO BAY PORTS CLEAN AIR ACTION PLAN GOALS

The Clean Air Action Plan establishes the path by which the targeted control measures will be pursued and implemented in the short-term and provides for budget planning over a five year period. In addition, these measures implemented in the near-term will establish the pathway for achieving emissions reductions over the long-term. The Clean Air Action Plan will be reviewed on a regular basis in light of progress that has been made and implementation strategies will be adjusted to ensure that the goals for the Clean Air Action Plan are achieved. Additional measures may be specified in future Clean Air Action Plan updates to maintain progress towards a complete and timely achievement of the goals. Goals will be reviewed as part of the update cycle and new goals may be added as needed.

2.1 Foundations

The following foundations support the San Pedro Bay Ports Clean Air Action Plan.

- The San Pedro Bay ports are committed to expeditiously and constantly reduce the public health risk associated with port-related mobile sources, and implement programs in the near-term that will achieve this goal.
- The San Pedro Bay ports are committed to facilitate growth in trade while reducing air emissions.
- The San Pedro Bay ports will focus on lease amendments/renewals and California Environmental Quality Act (CEQA) evaluations as mechanisms to establish provisions and requirements in leases consistent with pursuing the Clean Air Action Plan goals.
- The San Pedro Bay ports will implement tariff changes as needed to affect activity changes that will result in emissions reductions.
- The San Pedro Bay ports will work with the international, national, state and regional regulatory agencies to influence changes in regulations that will implement uniform requirements to reduce emissions from port operations.
- The San Pedro Bay ports are committed to monitor, document, and report on performance of their efforts under the Clean Air Action Plan and will update the plan on a regular basis.

2.2 Standards

The San Pedro Bay ports established Standards to act as a guide for decision making. These Standards have been established at three levels (e.g. San Pedro Bay-wide for the two port complex, Project Specific for individual projects, and Source Specific for individual pieces of equipment), in order to provide direction for achieving overall long-term goals, but also to provide specificity on the emission reduction needs.

2.2.1 San Pedro Bay Standards

Since finalization of the 2006 CAAP, the ports of Long Beach and Los Angeles, along with the agency Technical Working Group (TWG), comprised of USEPA, CARB and SCAQMD staff, have been working to establish appropriate San Pedro Bay Standards. There are two components to the San Pedro Bay Standards: 1) reduction in health risk from port-related DPM emissions in residential areas surrounding the ports, and 2) "fair share" reduction of port-related mass emissions of pollutants. These components address the ports' primary air quality goals of reducing health risks to local communities from port operations and reducing emissions to assist the region in reaching attainment with health-based ambient air quality standards.

The San Pedro Bay Standards represent the health risk and emissions reduction goals for the ports through the year 2023. The Standards apply to the emissions and health risk associated with the operation of both ports and the transport of goods that flow to or from the ports. The Standards are tools for long-term air quality planning, which will help the ports and the agencies better understand and evaluate the long-term cumulative effects of future port projects in conjunction with implementation of CAAP measures and existing regulations. It is anticipated that compliance of port operations with the Standards would, over time, effectuate substantial reductions in emissions and health risk from port-related sources, relative to 2005 levels.

Similar to a statement made in CARB's 2006 Emission Reduction Plan for Ports and Goods Movement in California, achievement of these San Pedro Bay Standards will require concerted and cooperative effort "Successful implementation of the CARB emission reduction plan will depend upon actions at all levels of government and partnership with the private sector. No single entity can solve this problem in isolation."[11] The ports and partner air agencies are dedicated to aggressively pursue multiple mechanisms to achieve the Standards, including regulations, tariffs, leases, fees, incentives, and other means. The ports will use their mitigation authority, funds, and influence to support achievement of the Standards.

The ports' implementation of existing CAAP measures, and CARB's implementation of existing statewide regulations, will significantly reduce emissions and health risk from port operations. But existing measures alone may not be sufficient to achieve reductions consistent with state and local air quality goals. Therefore, the ports, in adopting the Standards, commit to cooperatively work toward achieving even greater emissions reduction in the future, beyond currently known CAAP measures, by pursuing implementation of additional forms of CAAP mitigation and stricter requirements when they become feasible and available, and to work with the agencies to implement aggressive emission reductions strategies within their regulatory authority. For the purposes of the CAAP, feasibility is defined as capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

[11] *Emission Reduction Plan for Ports and Goods Movement in California*, Executive Summary, ES-1, CARB, 2006.

San Pedro Bay Standards
The San Pedro Bay Standards are a statement of the ports' commitments to significantly reduce the air quality impacts from port operations. Achievement of the Standards listed below will require diligent pursuit of all of the known CAAP measures and aggressive action to seek out further emissions and health risk reductions from port-related sources from strategies that will emerge over time.

Health Risk Reduction Standard. To compliment the CARB's Goods Movement Emission Reduction Plan, the ports of Long Beach and Los Angeles have developed the following standard for reducing overall port-related health risk impacts, relative to 2005 conditions:

- By 2020, reduce the population-weighted residential cancer risk of port-related DPM emissions by 85%, in highly-impacted communities located proximate to port sources and throughout the residential areas in the port region.

Similar to CARB's Emission Reduction Plan, the Health Risk Reduction Standard does not contain an interim year target. However, diesel particulate matter (DPM) reductions are highly correlated with health risk reductions and, as presented in the Emission Reduction Standard below, a significant reduction in DPM emissions, and therefore health risk, is targeted for 2014.

Emissions Reduction Standard. Consistent with the ports' commitment to meet their fair share of mass emissions reductions, the ports of Long Beach and Los Angeles developed the following standards, for reducing air pollutant emissions of port-related activities, relative to 2005 levels:

- By 2014, reduce emissions by 72% for DPM, 22% for NOx, and 93% for SOx, and to support attainment of the federal fine particulate matter ($PM_{2.5}$) standards.

- By 2023, reduce emissions by 59% for NOx to support attainment of the federal 8-hour ozone standard. The corresponding DPM and SOx reductions in 2023 are 77%and 93%, respectively.

The ports will strive to exceed the 2014 NOx standard of 22% reduction, potentially exceeding 40% reduction, given the forecasted cargo volumes and efforts to implement new technologies.

Development of the San Pedro Bay Standards

The forecast years of 2014 and 2023 were selected for the ports' Emission Reduction Standards in order to coordinate with the federal ambient air quality standards attainment years for the SoCAB, which are achievement of the federal $PM_{2.5}$ standard by 2014 and attainment of the federal 8-hour ozone standard by 2023. $PM_{2.5}$ air quality is related to DPM emissions as well as NOx and SOx emissions. While the ports' Health Risk and Emission Reduction Standards are focused on reducing DPM emissions, progress in reducing DPM emissions will also provide reductions in $PM_{2.5}$ emissions, thus assisting with attainment of the federal $PM_{2.5}$ standard.

In addition, the forecast year of 2020 for health risk reduction generally aligns with CARB's statewide goal of reducing DPM health risk from the goods movement industry by 85% below 2001 levels by 2020. The ports closely evaluated the methodology used to establish this statewide goal, and reviewed the specific emissions and health risk reductions estimated by CARB. The ports have thoroughly discussed the establishment of the Health Risk Reduction Standard with the agency TWG. Establishment of an appropriate Health Risk Reduction Standard has been especially challenging, as such a standard has never before been promulgated for a goods movement complex as extensive and with as many facilities and mobile sources as the San Pedro Bay ports. Further, none of the agencies have identified a "safe" or "acceptable" level of exposure to DPM. The ports are committed to do their fair share to support achievement of the statewide risk reduction goal, in addition to the reductions that will be achieved for communities in the vicinity of the ports.

Further, the ports recognize that the communities located closest (i.e., within two kilometers) to the port boundaries and the major transportation corridors utilized by port-related trucks and locomotives are more highly impacted by port-related emissions. Therefore, the commitment of the Health Risk Reduction Standard is to reduce the health risk in these residential communities, in addition to reducing the health risk in the residential areas throughout the entire modeled ports region[12], by 85% by 2020.

Finally, similar to CARB's Emission Reduction Plan, the Health Risk Reduction Standard does not contain an interim year target. However, diesel particulate matter (DPM) reductions are highly correlated with health risk reductions and, as presented in the Emission Reduction Standard below, a significant reduction in DPM emissions, and therefore health risk, is targeted for 2014.

[12] A 20 mile by 20 mile area, as defined by the BWHRA Tool modeling domain, consistent with the CARB's exposure assessment of the Ports (CARB, 2006a).

Assessment of Current Progress Toward Achieving the Standards
To understand the ports current progress toward meeting the Emission Reduction Standards, the ports developed emissions forecasting that assumed implementation of the CAAP and all existing regulations as of the end of July 2008, and compared existing conditions in the CAAP baseline year (2005) with forecasted conditions in 2014 and 2023, assuming a conservative estimate of projected growth in the ports' operations (i.e. 2007 Cargo Forecast), as presented in Appendix A. Based on this methodology, it was estimated that the ports will achieve emissions reductions of 72% DPM, 19% NOx and 93% SOx by 2014, compared to 2005, and a reduction of 74% DPM, 18% NOx and 92% SOx by 2023, compared to 2005. A comparison of the Emissions Reductions Standards with the Emission Forecast is shown in Table 2.1.

Table 2.1: Comparison of Emissions Reductions Standards with Emissions Forecast

Emissions Reduction Standards			Emissions Reduction Forecast		
	2014	2023		2014	2023
DPM	72%	77%	DPM	72%	74%
NOx	22%	59%	NOx	19%	18%
SOx	93%	93%	SOx	93%	92%

In order to better understand the ports' current progress toward meeting the Health Risk Reduction Standard, the ports developed the Bay Wide Health Risk Assessment (BWHRA) Tool, a health risk assessment modeling tool. An estimate of health risk reductions in 2020 was developed by comparing health risk assessment modeling results based upon the 2005 baseline year port-related DPM emissions with health risk assessment modeling results based on an estimate of port-related DPM emissions using forecasted conditions in 2020, assuming implementation of all CAAP measures and existing regulations and a conservative estimate of projected growth in port operations.

Figure 2.1 shows the significant reduction in residential population-weighted cancer risk in the larger ports region of 74% by 2020 with implementation of presently feasible and available CAAP measures and existing emissions control regulations. Figure 2.2 shows the reduction in residential population-weighted cancer risk of 72% by 2020 in the areas within two kilometers of the port and transportation corridors serving the port with implementation of presently feasible and available CAAP measures and existing emissions control regulations[13].

Both the emissions forecast and the BWHRA Tool were extensively reviewed by the agency TWG.

[13] *Bay Wide Health Risk Assessment*, 2008, Environ; provided as Appendix B

Figure 2.1: Percent Reduction in DPM-Related Health Risk Between 2005 and 2020 for Ports Region

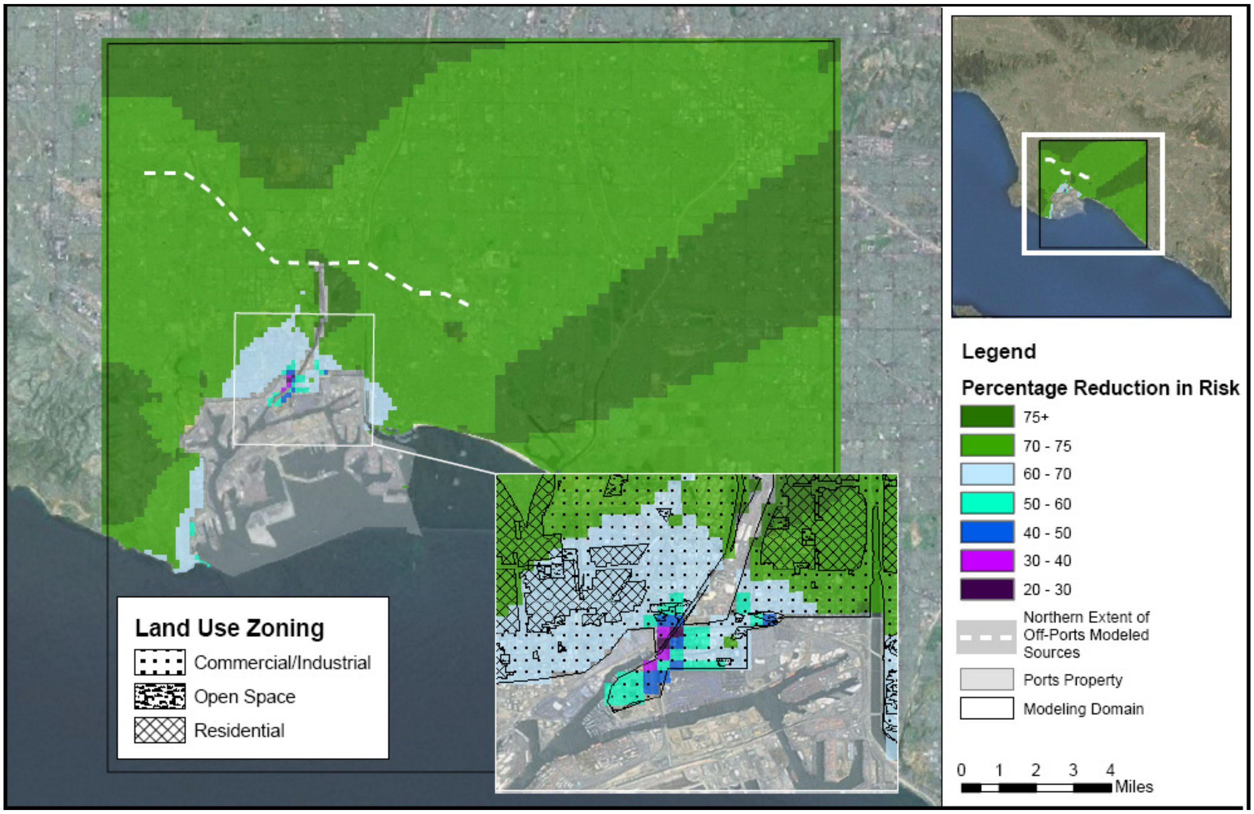
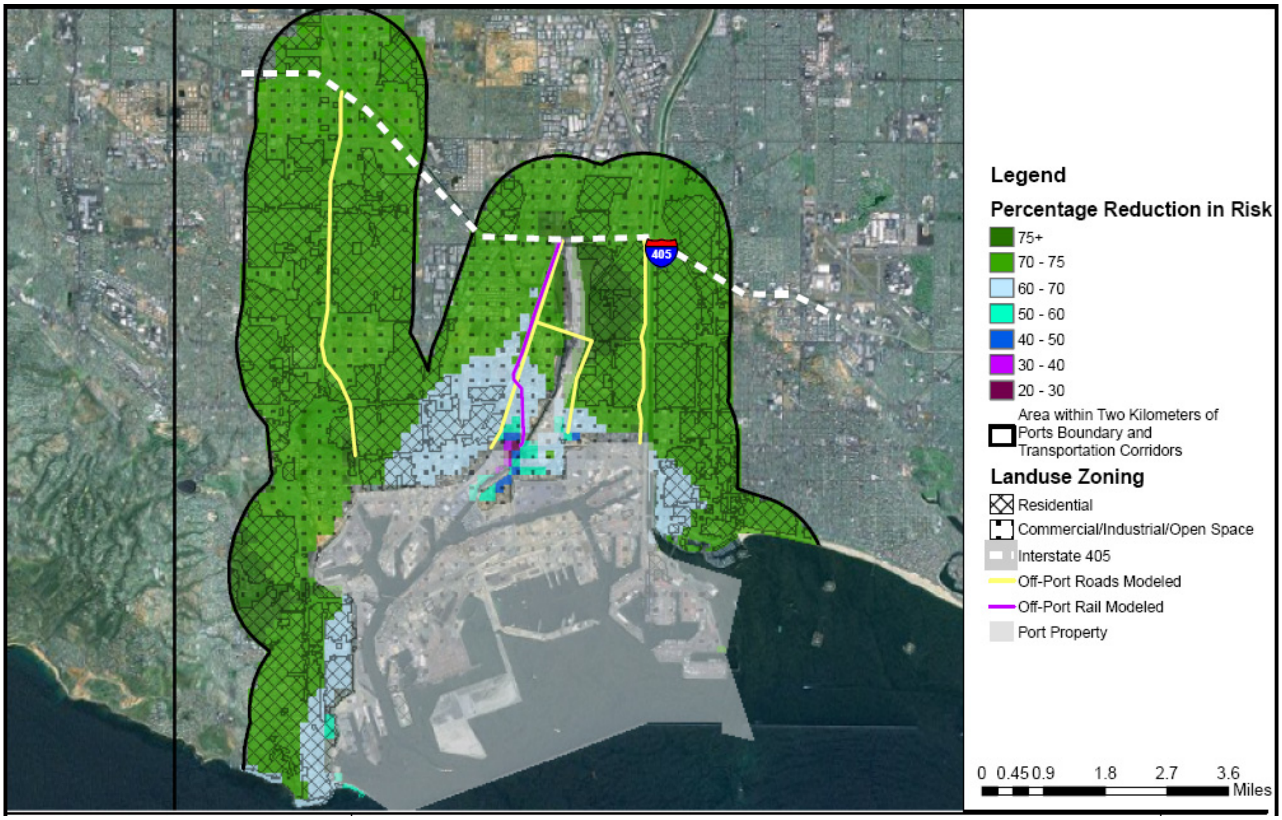


Figure 2.2: Percent Reduction in DPM-Related Health Risk Between 2005 and 2020 for Areas Located Closest to the Ports



Implementation of presently feasible and available measures and regulations would not be sufficient to achieve the Health Risk Reduction Standard or the Emission Reduction Standards for NOx and DPM. Nevertheless, it is expected that technological improvements and regulatory actions will make feasible and available, within the timeframes of the Health Risk Reduction and Emission Reduction Standards, additional CAAP measures whose implementation along with emission control regulations would achieve the Standards' goals. Such additional CAAP measures can only emerge if there are concerted efforts by the ports, regulatory agencies, and industry stakeholders to develop them. It must be emphasized that federal, state, and local air quality agencies will also play an essential role by identifying and pursuing future regulatory measures that will reduce emissions above and beyond currently allowable levels. As these technological improvements and regulatory measures emerge and are proven to be feasible, future editions of the CAAP will be revised to incorporate the new measures, and these new measures will be required in the ports' future leases and project approvals.

Although sufficient means for full achievement of the Health Risk Reduction Standard and all of the Emission Reduction Standards have not been identified at this time, the ports must move forward with port improvement projects in the near-term. These projects will significantly reduce emissions by incorporating all feasible and available technologies, as identified in the current version of the CAAP, and will ensure that the ports can at least achieve the currently forecasted emissions reductions and health risk reductions. At this time, a project will be determined consistent with the Health Risk Reduction Standard if it meets the Source Specific Performance Standards and Project Specific Standards contained in the then current version of the CAAP, which are defined in more detail later in this section. In addition, an evaluation must be conducted to identify new, available and feasible measures that can be added to the project to achieve emissions reductions beyond the existing Source Specific Performance Measures, and if so, the new measures will be included in the project. As the CAAP is revised in the future to include additional feasible and available emissions control technologies and regulatory measures, future projects will be determined consistent with the Health Risk Reduction Standard if they meet the revised CAAP requirements. The additional emission reductions from yet-to-be-developed CAAP measures on future ports' projects are expected to be sufficient to ensure that the ports ultimately achieve the Health Risk Reduction Standard's cumulative 85% DPM population-weighted average risk reduction goal by 2020 and the Emission Reduction Standards by the 2014 and 2023 timelines. A more complete discussion on the process through which discretionary actions, such as facility leases or CEQA actions, will be evaluated to determine project consistency with the Health Risk Reduction Standard, is presented later in this section.

Relationship of the Emissions Reduction Standards and the 2007 SIP

With regard to criteria pollutants, the 2007 SIP establishes emission reductions from all source categories which are necessary to attain the Federal $PM_{2.5}$ and 8-hour ozone standards in the SoCAB. The SIP proposes different and generally greater reductions from port-related sources, specifically for NOx, because port-related sources are generally less well-controlled than other sources. It is important to note that the SIP targets were developed prior to development of the San Pedro Bay Standard, and therefore were not informed by the extensive analysis conducted for the ports emissions forecast, the BWHRA Tool, the ports' most recent emissions inventories, and new developments following the adoption of the 2007 SIP. In the adopting resolution for the 2007 AQMP, the SCAQMD committed to continue working with the ports on port-related AQMP emissions targets.

The Emission Reduction Standards reflect the ports commitment to their fair share of reductions from port-related sources to support regional attainment. Again, it is critically important to note that achievement of these reductions particularly with regard to emissions from marine vessels and locomotives will require significant technological improvements and pursuit of regulatory strategies to control DPM and NOx emissions.

The Emission Reduction Standards reflect adjusted reduction targets from those originally contained in the 2007 SIP for port-related sources. The adjustments were made by the ports to reflect new information not available at the time the 2007 SIP was prepared, and have been extensively discussed with the agencies. It is important to note that in 2014 the Emission Reduction Standards for DPM and SOx substantially meet the ports reductions for the SoCAB identified in the 2007 State Implementation Plan (SIP). However, 2014 NOx reductions from port-related sources called for in the 2007 SIP are approximately twice the target shown in the Emission Reduction Standards. There are though two significant factors that are anticipated to occur through which the ports may move towards meeting the expectations under the SIP and potentially exceed the target identified in the 2014 Emissions Reduction Standards listed above.

1. In-Use Vessel Retrofits. As discussed below, the 2014 targets were largely established based on presently feasible and available CAAP measures and existing emissions control regulations. OGV main engines contribute 24% of uncontrolled NOx emissions in 2014 and proven control strategies for existing vessels (beyond speed reduction and low sulfur fuel) are currently very limited or in development only. Control Measure OGV6 in Section 4 is intended, in cooperation with our regulatory agency partners, to start systematically addressing this challenging issue. For the next CAAP Update, the effectiveness and feasibility of promising OGV main engine control technologies are expected to be evaluated and demonstrated, requirements for in-use vessel retrofits using these technologies progressively incorporated into new and re-negotiated leases, and an estimate of additional 2014 NOx reductions should be more well known.

2. Emissions Growth. Also discussed below, the emissions that ports estimated would need to be controlled in 2014 were projected from the 2005 baseline using the pre-economic crisis 2007 growth forecast. The reduction targets (which are percent reductions compared to 2005) contained in the Standards therefore assumes a significantly higher level of cargo throughput and associated emissions than is now considered probable. For example, throughput in 2015 is now estimated to be 38.5% lower than forecasted in 2007[14]. However, to be conservative in developing long-term air quality goals, the ports have retained the higher emissions growth assumptions for this CAAP Update. As it relates to meeting SIP expectations, based on current lower growth forecasts, uncontrolled NOx emissions in 2014 are expected to decline by approximately 20% compared to 2005 as opposed to the over 30% growth that was previously assumed. Consequently, with implementation of the strategies identified to achieve the 22% reduction for the NOx Emission Reduction Standard, coupled with the emissions decline due to currently anticipated lower growth, NOx emissions reductions could be 40% by 2014 which is in line with SIP expectations. Lower growth will have a similar positive effect on achievement of emission reduction targets

[14] *San Pedro Bay Container Forecast Update*, The Tioga Group, Inc., p. 20, July 2009.

for other pollutants, potentially resulting in the ports achieving the targeted emissions reductions earlier than anticipated.

It should be emphasized that CARB and USEPA, having direct regulatory authority over mobile sources, are identified as the main entities in the 2007 SIP responsible for achieving mobile source reductions, including port-related reductions, through regulations, programs, or incentive funding. The USEPA's approval of the 2007 SIP is contingent upon such enforceable strategies and reduction commitments. Therefore, for port-related sources, CARB has committed to an aggressive schedule of rule making and strategy development in the 2007 SIP including measures for ocean-going vessels, harbor craft, rail locomotives, and on-road diesel vehicles, including port trucks, some of which have recently been adopted by CARB. The reductions associated with regulations adopted as of July 2008 have already been incorporated in this CAAP Update and included in the emissions forecasting. In addition to the actions that have been undertaken already, CARB has recently proposed voluntary commitments with the Class 1 railroads to achieve further reductions from locomotives, a strategy to reduce emissions from vessel main engines, as well as identifying additional incentive funding for port-related sources. The 2007 SIP also includes reductions attributed to the USEPA for reducing emissions from locomotives through federal funding.

Therefore, achieving the 2007 SIP reductions identified for port-related sources is predicated on a number of key assumptions, the fulfillment of which is outside the ports control or jurisdiction. These important assumptions are briefly specified below:

1. CARB's adoption of regulations and enforceable agreements
   - Since 2007, CARB adopted four regulations affecting port-related sources. These include regulations for: a) auxiliary diesel engines on three classes of ocean-going vessels while at berth (container vessels, reefers, and cruise ships); b) low sulfur fuel for ocean-going vessels' main and auxiliary engines and auxiliary boilers; c) new and in-use harbor craft; and d) on-road diesel vehicles, including port drayage trucks.

   - In addition to these adopted strategies, CARB also proposed in the 2007 SIP four additional strategies or programs for port-related sources in the 2008-2009 timeframe including: a) OGV auxiliary engines for non-regulated classes of ocean-going vessels while at berth, b) OGV main engine controls, c) a statewide OGV vessel speed reduction program, and d) a commitment by CARB to pursue a new agreement with Class 1 railroads in order to accelerate the introduction of cleaner locomotives in the SoCAB, pending USEPA's adoption of Tier 4 locomotive standards (Tier 4 standards are about 70% cleaner than existing Tier 2 standards). It should be noted that in December 2009, CARB withdrew from its regulatory development calendar a measure to control OGV auxiliary engines for non-regulated classes of OGVs while at-berth. It should also be noted that the reductions assigned to the cleaner locomotive strategy were based on the assumption that the new federal regulation for locomotives (under development at the time of SIP process) would establish Tier 4 locomotive standards which would become effective beginning in 2012. However, the final federal regulation adopted in March 2008 by the USEPA established a 2015 date for introduction of Tier 4 locomotives in order to allow for adequate time for development and integration of advanced after-treatment technologies into these new locomotives. Therefore, with the deferral of a regulatory strategy to further control at-berth emissions and with no regulatory mechanism in place that would mandate the introduction of Tier 4 locomotives prior to 2015, reductions assigned under these SIP strategies will need to be re-examined and alternative strategies identified.

2. CARB's incentive funding programs
   - The 2007 SIP includes a strategy based on additional incentive funds to achieve an additional two tons per day of NOx reductions from harbor craft in 2014, above and beyond the anticipated reductions from the CARB's recently adopted regulation. These reductions are based on the assumption that joint funding from CARB and SCAQMD would be available and committed to the San Pedro Bay ports, with CARB being primarily responsible for achieving the targeted emission reductions.

3. USEPA's federal funding to mitigate locomotive emissions
   - The 2007 SIP also calls on the federal government to do its fair share of emission reductions by further mitigating locomotive emissions since locomotives are under the USEPA's direct authority and responsibility. Specifically, the 2007 SIP relies on federal funding to achieve 10 tons per day of NOx reductions from locomotives operating in SoCAB by 2014. This strategy in combination with CARB's voluntary commitments with the Class 1 railroads, or other equivalent strategy, would achieve reductions that would be equivalent to converting all locomotives operating in SoCAB to Tier 4 by 2014. However, the USEPA has not accepted this reduction responsibility.

It is clear that meeting the 2007 SIP targets for port-related sources depends heavily on CARB and USEPA's rulemaking activities, availability of state and federal incentive funding and development of enforceable strategies with the Class 1 railroads. It is also clear that some of the assumptions made in the 2007 SIP which were the basis for port-related emission reduction targets may have changed. To that end, the ports will work with our agency partners to help ensure their success on the regulatory front because as stated previously, "no single entity can solve this problem in isolation."

Thus, the ports have developed an aggressive Emission Reduction Standard in this CAAP Update derived from a combined understanding of the strategies that can be pursued in the near-term, and that development of state and federal regulations or programs is essential in order for these goals to be achievable. The ports are fully committed to do their fair share to help support these state and federal efforts and strive to achieve even greater reductions through existing and future CAAP strategies, limited only by the availability and feasibility of new technologies as well as ports' level of jurisdiction over its tenants and operators. Through the Technology Advancement Program (TAP), the ports are also fully committed to current and future evaluation, demonstration and integration of advanced control technologies which are anticipated to provide further reductions from port-related sources beyond existing regulations. To the extent that the TAP identifies such advanced control technologies, future updates of the CAAP may incorporate them if they have been proven to be feasible and available.

Given developments following the adoption of the 2007 SIP (e.g. final USEPA locomotive regulation, USEPA's rejection of funding/reduction assignment for locomotives, deferral of regulations to further control at-berth emissions), as well as uncertainty about CARB's specific control strategies for potential regulation of OGV main engines, the Emission Reduction Standard in the CAAP Update reflects the level of reductions from the 2007 SIP strategies which the ports currently anticipate will occur within the 2014 and 2023 timeframes.

For 2014, the Emission Reduction Standard reflects existing regulations (as of July 2008), CAAP strategies and assumed reductions from CARB's proposed strategy for OGV auxiliary engines at-berth for non-regulated vessel classes (i.e., 50% reduction in at-berth emissions by 2014). In the absence of CARB regulations to further control at-berth emissions, other reduction opportunities will be sought, but the ports cannot be held responsible for addressing this shortfall in the 2014 Emission Reduction Standard. As a partial offset, the 2014 Emission Reduction Standard does incorporate anticipated reductions associated with implementation of the most recent IMO standards which were not included in the 2007 SIP.

The ports have not incorporated the 2007 SIP reduction targets for locomotives, OGV main engines, or reductions associated with funding for harbor craft, in the 2014 Emission Reduction Standard. The reductions for locomotives associated with port operations weren't included since there is no regulatory mechanism which would mandate the development of Tier 4 locomotives by 2014 (i.e., earlier than required under USEPA final locomotive regulation) or accelerate the introduction of these locomotives such that an approximate 95% of locomotives operating at the ports will be Tier 4 by 2014, as discussed above. Therefore, the SIP reductions associated with Tier 4 locomotives used in port-operations do not appear achievable from this source as defined within the 2014 timeframe and are not included in the 2014 Emission Reduction Standard. However, because of the availability of Tier 3 locomotives within this timeframe (based on USEPA's final locomotive regulation), it is assumed that all off-port switchers will be emitting at the Tier 3 level. In addition, SIP reductions associated with CARB's strategy for OGV main engine controls have not been included since CARB has not initiated development of such a strategy, especially in view of the recent IMO standards. Finally, for harbor craft, the additional SIP reductions associated with incentive funding are also not considered because of uncertainties regarding CARB or AQMD funding commitments and any potential additional feasible reductions beyond CARB's existing in-use harbor craft regulation which might be achievable by 2014. The ports' are supportive of CARB's overall statewide efforts to achieve the SIP targets. While technologies and strategies have not materialized for the port-sector as was expected during the development of the 2007 SIP, CARB does have flexibility in making up for any shortfall by taking advantage of cost-effective opportunities that have developed in other sectors. In addition, in contrast to the ports, which focus on a small sub-set of the operations and population of a sector, CARB can also pursue additional opportunities for emissions reductions through focusing on other parts of the sector which can make up for any projected deficits when averaged over the entire sector fleet.

As identified previously (using the 2007 Cargo Forecast), implementation of presently feasible and available CAAP measures and existing emission control regulations thus far would achieve a 72% reduction in DPM, 19% reduction in NOx emissions, and 93% reduction in SOx emissions by 2014 compared to 2005 emissions. When comparing these projected emissions reductions with the 2014 Emissions Reduction Targets, the forecasted DPM and SOx will achieve the Emission Reduction Standards, while the NOx reductions fall short of the Standard by a small margin of 3% in 2014. This reduction shortfall is expected to be addressed with use of Tier 3 off-port switcher locomotives, CARB's adoption of alternative control measures to make up for the reductions initially anticipated for OGV at-berth auxiliary engines for non-regulated vessel classes, implementation of ECA starting in August of 2012, and implementation of the IMO NOx standards for vessels, and the ports' efforts to identify new technologies to reduce at-berth emissions from non-regulated vessels, among other sources.

For 2023, the Emission Reduction Standards are based on the assumption that 2007 SIP reduction targets for port-related sources in 2023 are achievable within that timeframe. For instance, the introduction of Tier 4 locomotives in 2015 could allow for fleet turnover prior to 2023, and therefore achievement of the SIP reductions, predicated on the assumption that regulatory or other mechanisms by CARB or USEPA will be developed and implemented to achieve these reductions. It is also conceivable that CARB or USEPA, along with efforts by the ports through requirements in leases for near-dock railyards, may pursue additional control measures for OGVs, strengthening and/or accelerating IMO regulations that would achieve the SIP targets by 2023. In addition, the reductions in 2023 also assume a strengthening of auxiliary engine controls at berth for all vessel classes to achieve an 80% control, and implementation of the statewide on-road diesel vehicles rule adopted by CARB in December 2008. The ports are fully committed to work with USEPA, CARB and AQMD to accelerate the implementation of all feasible strategies in the 2007 SIP and strive to exceed SIP reductions where possible through cooperative efforts with the port industry and aggressive development and commercialization of new technologies.

In 2023 using 2007 Cargo Forecast, implementation of presently feasible and available CAAP measures and existing emissions control regulations would achieve 74% reduction in DPM emissions, 18% reduction in NOx emissions, and 92% reduction in SOx emissions compared to 2005 conditions. Although the currently achievable SOx reductions are consistent with the 2023 Emission Reduction Standard, the projected DPM and NOx reductions currently fall short of the Standard primarily because the anticipated reductions associated with future CARB and USEPA control strategies and programs have not yet been developed and adopted. However, the ports are fully committed to work closely with agencies to identify and pursue new CAAP strategies and state and federal measures to meet the Emission Reduction Standard and close the reduction gap.

It should also be noted that over the last several years, the ports have fully participated and supported the development and implementation of port-related CARB and USEPA regulations, and actions by the IMO, as they provide a "level playing field" throughout California, the nation, and internationally. Several of these regulations were based on initiatives that the ports were already implementing as part of the 2006 CAAP (e.g., Clean Trucks Program, shore power for ships, low sulfur fuel for ships, and cargo handling equipment requirements). The ports will continue to support future regulatory efforts and strive to accelerate or exceed the reductions associated with these regulations through lease requirements or other mechanisms specified in the CAAP.

Inconsistencies in Emissions Estimations between the Ports and 2007 SIP

It should be noted that a number of fundamental differences remain in emissions baseline and forecasting methodologies between the 2007 SIP and the ports' emissions estimates. Whereas these differences have not been addressed in establishing the Emission Reduction Standard, the ports have worked very closely with agency staff to understand the differences and are confident that these enhancements will be incorporated into the 2010 SIP, resulting in better alignment of the SIP reduction targets with the Emission Reduction Standard. Specifically, these enhancements include:

1. 2005 Emissions Baseline - Over the last several years, the ports have spent a significant amount of resources to develop a comprehensive and detailed annual inventory of the port-wide emissions in consultation with the agency TWG consisting of USEPA, CARB, and SCAQMD. The ports' 2005 emissions inventory represents the actual operating data for all five port-related mobile source categories (ocean-going vessels, harbor craft, cargo handling equipment, heavy-duty trucks, and rail locomotives) and emission calculation methodologies that have been agreed upon with TWG. In contrast, the 2005 port-specific inventory in the 2007 SIP is generally derived from the statewide inventory, and assumptions made to the SoCAB regional inventory (where a portion of the regional inventory is assigned to the ports), or interpolation of inventory data is conducted between various years.

2. Emissions Forecasting Methodologies – Different emissions forecasting methodologies were used in the 2007 SIP and the ports' emission forecast. While the ports' emissions forecast is focused on only the port sources and reflects the conservative 2007 cargo growth projections and methodologies developed in close consultation with the TWG, the 2007 SIP relies on regional growth factors and differing methodologies to estimate future emissions.

As stated above, in order to accurately compare the Emission Reduction Standard to the SIP reduction targets, it is imperative that the inconsistencies in the emissions baseline and forecasting methodologies be reconciled. Work is already underway to resolve these discrepancies to properly identify the ports' contribution to regional attainment goals and to use the more detailed port-wide inventory in the next SIP update.

Implementation of Existing Mechanisms to Achieve the Goals of the San Pedro Bay Standards

The ports commit to design and implement emission control strategies under the CAAP, and future amendments to this plan that will help to achieve the goals set in the Standards. Such strategies include:

- Port-wide tariffs to reduce emissions by accelerating stringent emissions standards;
- Infrastructure modifications to be implemented by the ports;
- Enforceable conditions in ports' leases or agreements concerning terminal or other operations;
- Incentive programs, as appropriate, to produce quantifiable emission reductions;
- Other strategies to be implemented by the ports to achieve quantifiable emission reductions; and
- Redevelopment of existing ports facilities and new port projects anticipated in the CAAP, which will incorporate existing and later-revised CAAP emission reduction strategies.

Achieving the Standards will also require adopted enforceable regulations, funded incentive programs, and funded infrastructure modifications be implemented by government agencies other than the ports.

Future Implementation of Newly Feasible and Available Mechanisms to Achieve the Goals of the San Pedro Bay Standards

It is expected that ultimate achievement of the Standards will require some of the future emissions and health risk reductions to be achieved through new measures and identification of new technologies that would be required in future port tariffs or leases. However, as has been emphasized, federal, state, and local air quality agencies will also play an important role in identifying and implementing future regulatory measures that will further reduce emissions. The ports commit to work with air agencies to pursue significant additional emission reductions from port-related sources by facilitating or implementing new strategies. The ports and agencies will evaluate and support programs to:

- Implement an increasingly more efficient and cleaner transportation system to move cargo both within the ports and to/from the ports to reduce diesel emissions and exposure and reduce criteria pollutants.
- Further reduce emissions from new and existing ships through the use of cost-effective techniques.
- Further reduce emissions from port-related locomotives and rail operations, including at on-port facilities, and at the near-dock rail yard (e.g., ICTF).
- Further reduce emissions from future port projects incorporating yet-to-be-developed CAAP measures or regulations.

Methods to Evaluate Project-Specific Consistency with the Standards

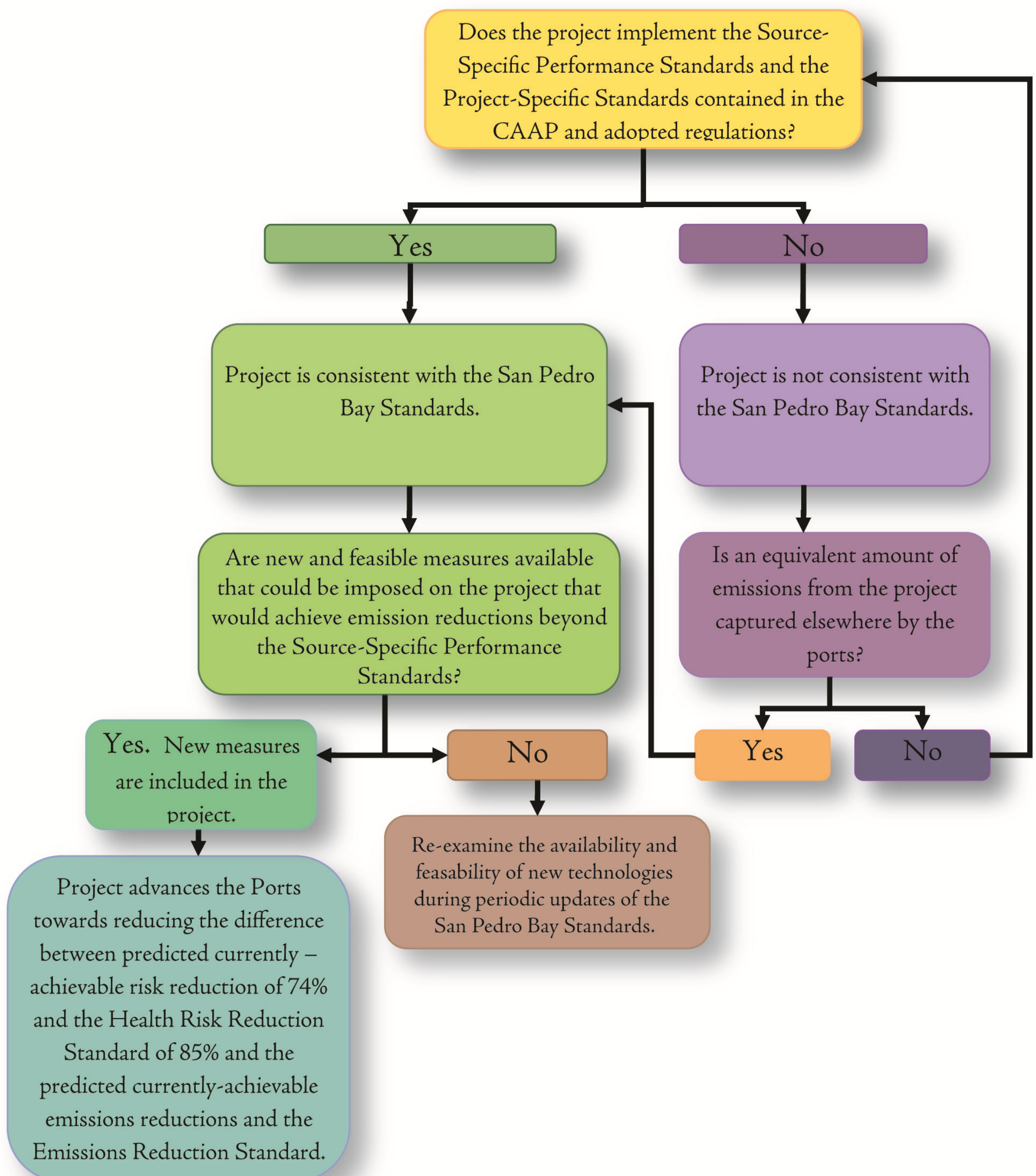
As noted earlier, the ports need to move forward with near-term projects that address demand for modern marine terminals and transportation infrastructure, subject to the existing requirements of the CAAP. Implementation of existing CAAP measures will dramatically reduce emissions in the near-term based upon the current suite of available emissions reduction strategies. As discussed above, the emissions forecast indicates that the ports will at a minimum achieve emissions reductions of 72% DPM, 19% NOx, and 93% SOx, by 2014, at least a 74% reduction in overall DPM-related health risk by 2020, and emissions reductions of 74% DPM, 18% NOx, and 92% SOx by 2023, based upon implementation of CAAP measures, anticipated regulatory programs and strategies that are known today. Additionally, by adopting the Standards, the ports commit to revise the CAAP to require implementation of additional emissions control measures as soon as they are determined feasible and available, with the intention of achieving the 85% risk reduction goal of the Health Risk Reduction Standard by 2020 and the 2014 and 2023 emission reduction goals of the Emission Reduction Standards. Environmental analysis of each proposed port project will include a review of newly feasible and available project-related emission control technologies, if any, that if imposed on the proposed project, would contribute to achievement of the 85% risk reduction goal of the Health Risk Reduction Standard and the various emission reduction goals of the Emission Reduction Standards.

As discretionary actions such as CEQA project approvals, leases, or infrastructure programs come before the ports' respective Boards of Harbor Commissioners, each of these discretionary actions will need to be evaluated for consistency with the San Pedro Bay Standards. The evaluation process is represented in Figure 2.3. As shown, a proposed project will be deemed to be consistent with the risk and emission reductions required by the Standards if:

- The project complies with all then-applicable air quality-related laws and regulations,
- The project will implement all applicable Project-Specific and Source Specific Standards in the then-existing version of the CAAP, and

- The supporting environmental analysis assesses any relevant potentially practicable new emission reduction technologies beyond those required under the then-existing version of the CAAP, and imposes a requirement that the project use any such technologies found to be feasible, available, and effective at reducing emissions as needed to achieve the Standards.

Figure 2.3: Evaluation of Project Consistency with the San Pedro Bay Standards



In addition, the 2008 BWHRA Tool, which was developed to help establish and to monitor progress toward compliance with the Standards, provides vital information to enable more detailed characterization of the health-risk impacts of the ports' operations in environmental review documents. The BWHRA Tool includes an exposure assessment for the baseline year 2005, and compares estimated cancer risks from that year with those estimated in 2020, assuming the ports' growth projections, implementation of adopted regulations, and implementation of additional control measures identified in the original CAAP. The BWHRA Tool assesses the cancer-risk impacts of DPM emissions from existing and anticipated mobile sources within the ports' boundaries, as well as nearby port-related truck, locomotive and vessel emissions outside those boundaries. It focuses solely on cancer risk impacts from port-related DPM emissions, as past studies indicate that those sources may be the most significant single contributors of toxic air contaminant (TACs) to regional cancer risk. To facilitate comparisons with CARB's exposure assessment of the ports[15], the BWHRA Tool assesses sub-regional, rather than local, impacts of DPM on a population-weighted risk basis, and uses the same geographic area (domain) of air dispersion modeling for estimation of DPM exposure point concentrations as that used by CARB (discussed further below).

However, the 2008 BWHRA Tool was not intended to, and cannot fully describe cumulative health-risk impacts for purposes of CEQA or National Environmental Policy Act (NEPA) review of individual port projects, for several reasons. First, the BWHRA Tool includes only DPM emissions, and includes only emissions from on-port operations and port-related activity along transportation corridors. Therefore, the BWHRA Tool cannot supply certain other information that must be included when evaluating cumulative health-risk impacts under CEQA and NEPA, such as TAC emissions from cumulative non-port sources, or TAC emissions from cumulative non-diesel sources. Second, because the BWHRA Tool was used to evaluate the effect of CAAP implementation over a broad sub-regional area, the BWHRA Tool employed certain inputs that are different than those used to model localized project-specific health-risk impacts under CEQA and NEPA. These different inputs include a more generalized representation of emission source locations, agglomerated spatial allocation of emissions sources, fleet-average versus project-specific modeling source parameters, coarser Cartesian grids to represent off-site receptors, and certain model inputs based on information available today that is likely to change in the future as scientific understanding progresses and/or new data become available. The result is that the BWHRA Tool does not provide the highly detailed information about incremental, project-specific changes at individual points of maximum health risk impact that is used to assess health-risk impacts under CEQA and NEPA. Third, because the BWHRA Tool focuses on emissions in only two milestone years (the baseline year 2005, and the target year 2020), it does not provide accurate information regarding cumulative emissions or cancer-risks in interim years, and so will not accurately describe baseline cumulative conditions surrounding port projects proposed in those interim years. Finally, the 2008 BWHRA Tool evaluates risk based on discrete DPM emissions rates established for 2005 and 2020, and held constant over the subsequent respective 70-year

[15] *Diesel Particulate Matter Exposure Assessment Study for the Ports of Los Angeles and Long Beach*, CARB, April 2006.

averaging times. In contrast, project analyses utilize emissions rates calculated for each year of a project's life. These distinct methodological differences do not support direct comparisons between the two approaches.

For these reasons, CEQA and NEPA documents prepared for port projects will determine consistency of individual proposed projects with the Standards, and will disclose information from the BWHRA Tool as part of their description of cumulative impacts, but will not rely solely on the BWHRA Tool to describe those cumulative impacts. In addition, although consistency of individual port projects with the Standards will advance achievement of the substantial cancer-risk reductions identified by the BWHRA Tool, environmental review of ports projects will not treat consistency with the Standards as determinative of whether a proposed project would make a cumulatively considerable contribution to cumulative health risk impacts, as defined by CEQA or NEPA.

Methods to Assess Progress Against Health Risk and Emission Reduction Standards

The ports will periodically evaluate progress towards achieving the Health Risk and Emission Reduction Standards, as part of the CAAP updates, and will report the results to the public and to the Harbor Commissions of each port. These updates will reflect changes to emissions attributable to new projects, adoption of new regulations, implementation of newly feasible and available emission control technologies, plus other benefits that result from the ports' actions to reduce emissions/exposure and efficiency improvements. At the time of each CAAP update, the necessity of these updates will be determined based upon continuing dialogue between the ports and their regulatory partners. Because the rate of development of regulations, technology, and other factors cannot be predicted, and because the quantitative assessment of progress towards the Standards requires significant resources, assessment updates will be conducted when one or more of the following elements are identified, and whose implementation could significantly enhance reductions in emissions and in risk:

- Significant new feasible technologies become available
- Important new regulations are adopted
- A major new project is approved which has substantial changes in the operations of a tenant from the operations evaluated in the emissions forecast and BWHRA Tool, with respect to the type, number, or distribution of sources, and these changes will have a significant effect on the overall ports-wide emissions forecasting and health risk assessment results

Achievement of the Health Risk Reduction Standard will be affected by the overall reduction in port-related DPM emissions and the relative location of emissions sources and off-port residences. In contrast, criteria pollutant standards can only be met by reducing overall port-related emissions. It is essential that local municipalities make informed land use planning decisions in the areas surrounding the ports in order to avoid aggravating potential health risk impacts. In addition, the ports will evaluate the affect of proposed project locations on community health risk impacts when considering new projects.

When conducting periodic evaluations to assess the status of the ports' efforts to reduce health risks, the ports will first evaluate emissions forecasting results, using DPM reductions as a surrogate for health risk reductions, since they are highly correlated. If significant changes in DPM reductions are expected to occur as a result of greater effectiveness of strategies or implementation of new, advanced technologies, the ports anticipate using the assessment methodology followed in the BWHRA Tool. This approach has the benefit of relying on methodologies that were developed collaboratively between the ports and their regulatory partners. Further, it provides the ports with ability (albeit limited by methodological constraints) to quantify percentage of reduction in overall port-related risk attained by implementation of the emission reduction strategies outlined in this statement. As such, it provides the ports and regulatory agencies the most direct assessment methodology for characterizing emission and risk reduction achievements. Risk reductions calculated in these periodic updates will be determined by comparison to the 2005 baseline year, and will address DPM emissions from ports' sources within the boundaries identified in the BWHRA Tool. Risk reductions will be calculated as population-weighted average risk over that same geographic domain, and will utilize 2000 census data. Updates will rely on the air dispersion model AERMOD and the health risk assessment methodologies used in the BWHRA Tool. Specific parameters used in the BWHRA Tool that may also be utilized in the periodic updates include, but are not limited to, the 2005 baseline year emissions factors, ports growth rate, meteorological data sets, and source spatial distributions.

In addition, through implementation of the Standards for port-related sources, the ports will contribute to achievement of state and federal ambient air quality standards demonstrated at air quality monitoring stations at both ports. Evaluation of port-related compliance with the state and federal ambient air quality standards will be based-upon monitoring data from the ports' six air monitoring stations. It is ultimately the goal of the ports to be able to demonstrate a downward trend in ambient air pollutants, consistent with the reductions in emissions from port-related sources and to prevent port-related violations, allowing timely achievement of the NAAQS and California Ambient Air Quality Standards (CAAQS) in advance of, or on schedule with, the attainment schedule for the SoCAB. The air quality results will be published in the ports' annual air quality monitoring reports. It is important to note, however, that concentrations at monitoring stations will include not only the ports' sources but all emissions sources in the vicinity of the monitors. Therefore, part of the evaluation to identify port-related violations of the NAAQS and CAAQS will include comparison of the concentrations observed at the ports' stations with the regional air quality trends. Further, when scientifically-proven and accepted methods for apportioning pollutants to specific port-related sources become available, the ports will use this information in their evaluations.

Summary and Conclusion

In summary, the primary purpose of the San Pedro Bay Standards is to provide a valuable tool for long-term air quality planning, aiding the ports and the agencies in their effort to achieve substantial reductions in the long-term cumulative air quality impacts of emissions from ongoing and future port operations over time. The forecasting used to develop the Health Risk Reduction and Emission Reduction Standards was based upon implementation of the CAAP through the specified implementation mechanisms and implementation of existing regulations. As long as the project proposed for approval by one of the ports meets assumptions used to develop the San Pedro Bay Standards, including all then-applicable CAAP measures and regulatory requirements, as well as any new emissions control measures determined to be feasible, available and effective at reducing emissions covered under the Standards, then the project can be deemed consistent with the San Pedro Bay Standards.

The San Pedro Bay Standards will also provide a mechanism for the ports to better communicate with the public on the long-term benefits of implementing the CAAP, and the resulting reduction in the ports' overall health risk impacts and criteria pollutant emissions over time. This communication will be further supported by the annual emissions inventory reports, the availability of the ports' air monitoring data on the CAAP publicly accessible website and release of summary information in the ports' annual air monitoring reports.

It is important to emphasize that the ports are making a commitment to achieve the San Pedro Bay Standards as described above. In addition, the ports will strive in the future to achieve greater emissions reductions and health risk reductions than are currently feasible. The San Pedro Bay Standards will push the ports to continue seeking additional emission reduction strategies until health risks to the local communities have been adequately minimized. This has already been evidenced by the ports' decisions to adopt a more stringent Clean Truck Program than originally anticipated in the 2006 CAAP; to implement the Vessel Main Engine Fuel Incentive Program to accelerate and expand CAAP measures; and to pursue the Technology Advancement Program, which will lead to greater emission reduction options in the future. That said, however, it is important to note that the San Pedro Bay Standards are not regulatory thresholds and do not place a cap on the ports' growth. Further, the San Pedro Bay Standards do not provide long-term goals beyond 2023. The ports will need to review the San Pedro Bay Standards over time and update them as necessary to incorporate the latest information on significant newly feasible and available emission reduction strategies or regulations, and also to include the latest information on the ports' cargo growth forecasts.

2.2.2 Project Specific Standards

Project Specific Standards lay out the particular requirements for individual port development projects. The ports regularly develop new facilities and redevelop existing facilities to support the changes in the market and increased demand for imports. The ports will evaluate each project against the following standards:

Project Specific Standards –

- Projects must meet the 10 in 1,000,000 excess residential cancer risk threshold, as determined by health risk assessments conducted subject to CEQA statute, regulations and guidelines, and implemented through required CEQA mitigations associated with lease negotiations.
- Projects that exceed the SCAQMD CEQA significance threshold for criteria pollutants must implement the maximum available controls and feasible mitigations for any emissions increases.
- The contribution of emissions from a particular project to the cumulative effects, in conjunction with CAAP and other adopted/implemented control measures, will allow for the timely achievement of the San Pedro Bay Standards.

As stated above, Project Specific Standards require all new projects to meet or be below acceptable health risk standards (10 in 1,000,000 excess residential cancer risk threshold). Projects that exceed the applicable and appropriate CEQA significance thresholds for criteria pollutants must implement the maximum available controls and feasible mitigations for any emission increases. The Project Specific Standards do not limit the types of impacts that will be considered or mitigated pursuant to CEQA. For example, while the 10 in a million project standard for cancer risks applies to residential risks, the ports will continue to evaluate and, if required by CEQA, mitigate all impacts. Additionally, the ports will evaluate and mitigate, where required by CEQA, non-cancer health impacts.

The emissions from an individual project will be analyzed based upon its contribution to cumulative effects. The project contribution will be evaluated in conjunction with the CAAP and other federal, state and local adopted and/or implemented control measures to ensure that the contribution to cumulative effects will allow for the timely achievement of the San Pedro Bay Standards. As stated above, when evaluating projects, a consistency analysis with the assumptions used to develop the health risk and criteria pollutant San Pedro Bay Standards will be performed in order to ensure that the proposed project is contributing to attainment of the San Pedro Bay Standards.

2.2.3 Source Specific Performance Standards

This section lays out particular strategies for individual port-related emission sources to attain the ultimate goals of the CAAP. The strategies are considered generally feasible/achievable in most port-related applications, and therefore should be considered in all decisions related to equipment purchase or operational changes. The ports are not establishing emission or fuel standards through these strategies. Emission and fuel standards are established by the appropriate regulatory agencies. The intent of these CAAP source specific strategies or requirements is to maximize the use of technologies that meet the most stringent regulatory standards as established by the applicable regulatory authority, such as USEPA, CARB, or IMO. For example, USEPA established the 2007 On-Road Heavy-Duty Vehicle engine emissions standards and CARB adopted the 2007 USEPA standard for California HDV use. The Ports require drayage trucks entering Port property to use trucks with engines meeting these USEPA-established and CARB-adopted standards according to a timetable published in CAAP HDV-1. These source specific strategies will be used by the ports in environmental reviews on both new development and substantial redevelopment projects. The ports encourage innovation and will accept equivalent strategies, once proven. The requirements by source category are:

Heavy-Duty Vehicles/Trucks

- By January 1, 2012, all trucks calling at the ports will meet or be cleaner than the USEPA 2007 on-road engine standard.
- The ports will support development of alternative fuel infrastructure in the port-complex.

Ocean-Going Vessels

- Compliance with the Vessel Speed Reduction Program out to a distance of 40 nm from Point Fermin
- The use of ≤0.2% sulfur MGO or MDO fuel in vessel auxiliary and main engines, and auxiliary boilers, at berth and during transit out to a distance of 40 nm from Point Fermin. By 2012, sulfur content in MGO or MDO fuel used in auxiliary and main engines and auxiliary boilers within 24 nm of the coast will not exceed ≤0.1%, in compliance with the CARB regulation. Starting in August of 2012, 1.0% sulfur MGO or MDO fuel in vessel auxiliary and main engines, and auxiliary boilers will be used up to 200nm per IMO's ECA requirement.
- The use of shore power (or equivalent) for hotelling emissions implemented at all major container and cruise terminals and one liquid bulk terminal in POLA, and at all container terminals, one crude oil terminal, and one bulk terminal in POLB by 2014.

Cargo Handling Equipment

- Beginning 2007, all CHE purchases will meet one of the following performance standards:
  - Cleanest available off-road or on-road NOx standard alternative-fueled engine, meeting 0.01 g/bhp-hr PM, available at time of purchase, or
  - Cleanest available off-road or on-road NOx standard diesel-fueled engine, meeting 0.01 g/bhp-hr PM, available at time of purchase.
  - If there are no engines available that meet 0.01 g/bhp-hr PM, then must purchase cleanest available engine (either fuel type) and install cleanest CARB Verified Diesel Emissions Control Strategy (VDECS) available.
- By the end of 2010, all yard tractors operating at the San Pedro Bay Ports will meet, at a minimum, the USEPA 2007 on-road or Tier 4 off-road engine standards.
- By the end of 2012, all pre-2007 on-road or pre-Tier 4 top picks, forklifts, reach stackers, rubber tired gantry (RTG) cranes, and straddle carriers <750 hp will meet, at a minimum, the USEPA 2007 on-road engine standards or Tier 4 off-road engine standards.
- By end of 2014, all CHE with engines >750 hp will meet, at a minimum, the USEPA Tier 4 off-road engine standards. Starting 2007 (until equipment is replaced with Tier 4), all CHE with engines >750 hp will be equipped with the cleanest available CARB VDECS.

Harbor Craft

- By 2008, Harbor Craft home-based at San Pedro Bay Ports will meet USEPA Tier 2 for harbor craft or equivalent reductions.
- After Tier 3 engines become available between 2009 and 2014, within five years HC home-based at San Pedro Bay Ports will be repowered with the new engines.
- All tugs will use shore power while at their home fleeting location.

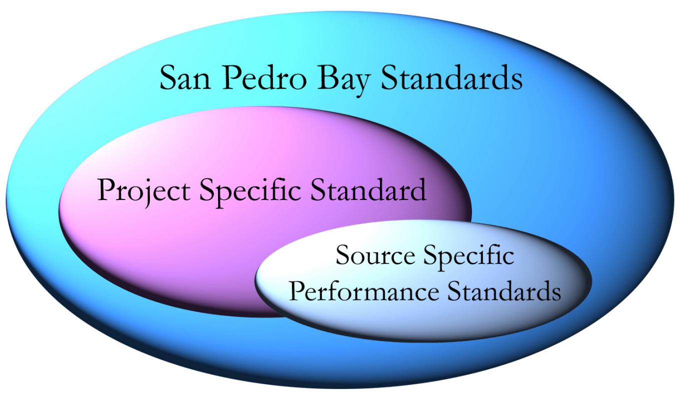
Railroad Locomotives

- By 2007, 80% of fuel supplied to locomotives fueled in California will be ULSD.
- By 2008, all existing Pacific Harbor Line switch engines in the ports will be replaced with Tier 2 engines equipped with 15-minute idling limit devices, retrofitted with either DOCs or DPFs, and shall use emulsified or other equivalently clean alternative diesel fuels available.
- By 2010, all BNSF and UP locomotives shall use 15-minute idle restrictors.
- By 2010, the fleet average for Class 1 locomotives operating in the SoCAB will be Tier 2 Standards.
- By the end of 2011, contingent upon receipt of grant funding PHL will repower its sixteen Tier 2 switch locomotive engines with "Tier 3-plus" engines to meet Tier 3 NOx emission standard of 5.0 g/bhp-hr and Tier 4 PM emission standard of 0.03 g/bhp-hr).
- By 2020, goal for 95% of Class 1 line-haul locomotives entering the ports to meet Tier 4 locomotive standards.

Relationships of the Standards

The three levels of CAAP Standards are inter-related. Compliance with the Project Specific Standards may require that an individual terminal go beyond the Source Specific Performance Standards or advance the date of compliance with those performance standards. In addition, projects that meet the Project Specific Standard associated with health risk, must also meet the criteria pollutant emissions reductions identified in the Source Specific Performance Standards, which may require them to implement greater levels of control than would be necessary to meet the health risk standard alone. Projects must include compliance with the Source Specific Performance Standards in order to achieve the ports "fair share" of regional emissions reductions, and health risk reductions, as stated in the San Pedro Bay Standard. The relationships between these three standards are illustrated below.

Figure 2.4: Relationships of the Standards



Greenhouse Gases

The ports do not include greenhouse gas (GHG) emission reduction standards in the CAAP since reductions in GHG emissions from all harbor department, tenant, and shipping line activities are being addressed separately in each port's comprehensive GHG programs currently being developed in partnership with their respective cities. As the CAAP is focused on a sub-set of the GHG emissions sources, it does not address the entire array of strategies that will be deployed to address these emissions reductions, and therefore only represents a portion of the overall picture. Through each port's efforts with their cities, the ports will endeavor to establish comprehensive goals and strategies for achievement of GHG emissions reduction in accordance with, or exceedance of, AB 32 requirements.

SECTION 3: IMPLEMENTATION STRATEGIES

To implement the CAAP, several strategies are being utilized to maximize the reduction of public health risk and criteria pollutant mass emission reductions, and to meet CAAP goals. The implementation approach continues to evolve so that strategies may be added, changed, or superseded based on the accumulated experience as the CAAP moves forward.

This chapter provides a general overview of these implementation strategies. Specific implementation strategies by control measure are detailed in the measure narratives provided in Section 4.

3.1 Overview of Implementation Strategies

Since adoption of the CAAP, the ports evaluated numerous implementation strategies and options. The strategies that have proven to be most effective include:

- Lease Requirements
- Tariff Changes
- Port Funded Incentives
- Grants
- Voluntary Measures and Recognition Programs
- Requirements Imposed by Regulatory Agencies

Each of the above strategies requires sound monitoring, recordkeeping, and reporting. Procedures and recordkeeping requirements are developed to monitor and review participation levels at a frequent interval to determine the effectiveness of the implemented strategy.

3.1.1 Lease Requirements

Facilities Required by Lease to Meet Emissions Reduction Requirements

This strategy offers the opportunity for the Ports, as proprietary landlords, to negotiate and require control measures in a terminal's lease that would reduce emissions, increase performance on voluntary or incentive-based measures, or require customers to implement specific emission reduction measures. This opportunity exists for renegotiated, amended, and new leases.

All new significant development projects or modifications to existing facilities require a detailed CEQA and/or NEPA review prior to project approval. Along with these reviews comes an affirmative duty under State law to mitigate significant environmental impacts as a condition to project approval.

Through the Environmental Impact Review (EIR) process, air emissions and health risk levels are assessed and applicable mitigations included in a project to reduce significant environmental impacts (on a project by project basis). These mitigations are then incorporated, along with applicable CAAP requirements, as provisions in any lease or permit for the project.

One benefit of the lease strategy is that placing a requirement in a lease provides a legally binding mechanism for ensuring that the desired action is achieved and provides remedies for noncompliance (because noncompliance would constitute a breach of the lease terms). Another benefit is that, since leases are negotiated on a terminal-by-terminal basis, the mix of requirements can be tailored to terminal-specific considerations. For example, break bulk terminals might be less able to employ shore power (cold ironing) than a container terminal having vessels that call repeatedly throughout the year, so a break bulk terminal's lease may contain an alternative emission reduction requirement. A limitation of this strategy is that all leases have different renewal dates and terms, so the implementation is phased over time as leases come due or are renegotiated. However, all terminals will indeed be considered for renewal so this is a strategy that will reach far beyond the initial five-year CAAP.

Most facility leases are issued for long periods (e.g., 20 years). It is expected that new emission reduction technologies will emerge over the course of a lease and it may be important to incorporate these new technologies into tenant operations in order to meet the San Pedro Bay-wide Standards. To achieve this objective, both ports are requiring in new leases a protocol of periodic review of new technologies. At prescribed intervals (e.g., five years for POLB and seven years for POLA), the tenant and responsible port will conduct a comprehensive feasibility and availability review of emission-reduction technologies, assessing cost, benefits, technical and operational feasibility and availability. New air quality technological advances that are identified shall be implemented by the tenant, subject to mutual agreement on operational feasibility and cost sharing. If a tenant requests future project changes that would require environmental clearance and a lease amendment, all control technologies deemed by the ports to be feasible, available, and effective at reducing emissions would be incorporated into the new lease terms.

3.1.2 Tariff Changes

Tariffs Changed to Influence Activity

A port tariff is the published set of rates, charges, rules and regulations for those doing business with a port. Each port publishes its own tariffs. A tariff is generally applicable to all tenants and users of port facilities. However, individual operating leases may set requirements to a specific version of the tariff (i.e., later changes don't apply). All potential tariff changes undergo legal evaluation prior to being enacted.

This strategy could be used to implement uniform rules affecting most or all port users. A potential scenario for this strategy could be a tariff item that sets discounted rates to activities that provide an air quality benefit (like discounted dockage for vessel speed reduction). Alternatively, a tariff item might prohibit certain kinds of activities (such as a prohibition from dumping into harbor waters). In general, a tariff could allow more uniform application of resources to customers of a port. However, application of the tariff approach to implementation can only be used in selected instances and, as ordinances, must be developed following specific procedures.

Some of the measures pursued under the CAAP may be under-funded. As a result, the ports are continuously exploring various mechanisms to achieve the goals outlined in the CAAP. One mechanism that could alleviate potential funding shortfalls is the application of impact fees associated with the movement of cargo or sources (i.e., trucks, locomotives, vessels, etc.), which would be applied through a port tariff. Staff is committed to continue to evaluate the use of fees to accelerate emission reductions from all source categories. However, for fees to achieve the desired results, they must be structured appropriately. Outlined below are principles that the ports will consider when crafting any fee with the goal of reducing air pollution.

1. The fee should target the source of pollution, not cargo in general, and the fee must be higher for those individual sources that cause the greatest impact, while bypassing those sources that meet clearly defined goals/standards. For instance, a truck that does not meet the tariff requirements of the Clean Truck Program could be assessed a fee based on how old and/or "dirty" that truck was; while a clean truck meeting the requirements could be assessed no fee or a small administrative fee necessary to cover the costs of monitoring compliance. Fees collected should be used to clean up the source that generated the fee (i.e., fees assessed against a "dirty" truck should fund a retrofit or replacement truck). Under the current CTP, starting in the fourth quarter of 2008, the Port of Los Angeles and the Port of Long Beach began collecting a cargo fee of $35 for each loaded 20-foot container ($70 for each 40-foot container). The two ports use different criteria to collect the fees. The criteria used are such that they encourage early introduction of cleaner trucks and private investments to replace older trucks with cleaner trucks. No fee is assessed if the cleaner trucks are privately funded.

2. Costs should ultimately be borne by those who benefit from goods movement. To the extent possible, fees should be shifted to the beneficial cargo owners (BCO). Under the CTP, the truck fee is collected from the BCO. Programs similar to the successful PierPass and CTP provide examples of how this can be done.

3. When a specific program achieves its goal, the fee must end. Broad-based fees that have no defined "conclusion" may fail to garner sufficient support to be successful. In addition, they undermine the goals of the program by not rewarding those who achieve the goals. Under the CTP the fees end in 2012 when all trucks meet the USEPA's 2007+ emissions standards.

These principles establish a framework for the successful use of fees. They ensure success in two ways. First, the program generates the funding necessary to achieve the emission reduction goals. Second, it holds the BCO accountable for their shipping decisions, assessing the externalized costs for more polluting modes of shipping and financially encouraging them to make more environmentally sound shipping decisions. While these principles are not absolute, adherence to them will more likely result in reduced emissions and increase the chances of broad-based support.

3.1.3 Port Funded Incentives

Incentive Funding Targeted Toward Specific Sources to Accelerate Emissions Reductions

Incentive-based measures provide a business incentive for the participant to reduce emissions beyond what is currently required by regulation or lease requirements. Incentive funding is targeted at "buying" emission reductions ahead of regulation milestones or lease renewals. Incentive funding can come from several sources including the ports, local and state regulatory programs, federal agency programs and grants, or an additional use fee that generates money to be used to incentivize emissions reductions. An incentive based approach makes the adoption of the various strategies cost-neutral for the participant, or provides just enough incentive for a participant to enter the program.

Several of the emission reduction measures implemented by the ports to date have been incentive-based and have utilized port and local/state funds. The advantages of this strategy are that it can accelerate implementation of control measures that will become lease requirements or proposed regulations, and it avoids regulatory authority control issues. The disadvantage is that there is not adequate funding to support all measures, either in the ports' operating budgets or in regional, state, or federal grant programs.

Examples of successfully implemented incentive-based programs at the ports include: POLB's Green Flag Program and POLA's companion incentive program to encourage increasing levels of VSR compliance, and the Vessel Main Engine Fuel Incentive Program to encourage use of low-sulfur fuel in main engines.

3.1.4 Grants

National Clean Diesel Funding Assistance Program, Carl Moyer Program and Air Quality Mitigation Improvement Program

Grant programs can offer significant encouragement and can be used to spur early action by port operators to move forward with replacement, repower or retrofit projects in advance of regulatory or port requirements. The USEPA, through their National Clean Diesel Funding Assistance Program, has offered funding to local governments, including the ports, for diesel emissions reduction projects. Both ports have been successful in receiving funding from this program on behalf of their port operators for cargo handling equipment and harbor craft projects. The state Carl Moyer Program, dispersed by local air agencies like the SCAQMD, has been available since 1998, to provide grants for early emission reductions from diesel sources. Over the years, Carl Moyer Program funding has been used by port operators to replace, retrofit or repower cargo handling equipment, harbor craft and rail switcher locomotives.

In accordance with the 2004 Amended Stipulated Judgment between the Natural Resources Defense Council *et al*. and the City of Los Angeles, the POLA established the Air Quality Mitigation Incentive Program (AQMIP) and committed $20 million over five years to pay for air quality mitigation projects that would: (1) reduce DPM and NOx emissions from port operations in the communities of San Pedro and Wilmington; or (2) develop emission reduction technologies that may be applied in the San Pedro Bay. Additional funding of approximately $8 million was deposited into the AQMIP account as a result of container throughput overages at the China Shipping Terminal. To qualify for funding under the AQMIP, projects and/or programs were voluntary and not mandated by law. Since adoption of the CAAP in 2006, over $14.5 million has been awarded for repower and retrofit of CHE and HC, resulting in an estimated reduction in 610 tons per year of NOx and PM combined. Over $10 million has been awarded for new technology research and development.

3.1.5 Voluntary Measures and Recognition Programs

Voluntarily Emission Reduction Actions Encouraged

Voluntary measures are non-compensated actions agreed to and undertaken by operators, and are used or implemented by the participants without legal obligation. There are already many examples of voluntary actions taken by operators that have resulted in a decrease in emissions, including procedural efficiency increases, purchase of new lower-emitting equipment, and use of alternative fuels in equipment. This strategy is generally specific to measures that provide win-win situations for participants, which could include positive public relations press about the programs, regulatory agency or port recognition, environmental awards, etc. A notable example was the decision of Maersk Line to use low sulfur fuel in the engines of its vessels within 24 nm of California ports and while docked, thus paving the way for widespread use of cleaner fuels in vessel main and auxiliary engines and boilers, a highly significant emission reduction measure.

Both ports believe it's important to recognize efforts that go beyond existing federal, state, and local regulations and that meet both ports' definition of a "green" terminal or operation. To that end, the annual Clean Air Action Plan Air Quality Awards was developed to recognize industry efforts to reduce port-related air pollution consistent with CAAP goals. Since development, three awards ceremonies have been held, in 2008, 2009 and 2010, and a total of 18 awards have been distributed.

3.1.6 Requirements Imposed by Regulatory Agencies

International Treaties, Federal and State Rules and Regulations

As stated previously, the CAAP was developed by the ports to achieve the near-term emission reductions needed for the local communities and the region. Eventually, these local requirements should be overtaken by regulations from state, federal or international regulatory agencies, in order to level the playing field and minimize any competitive disadvantage experienced by operators doing business in the San Pedro Bay. Since the CAAP was adopted, several regulations have been promulgated that support the CAAP measures, including CARB's cargo handling equipment and vessel low sulfur fuel regulations. The ports work very closely with the regulatory agencies and will continue to provide comments and input into the regulatory process to ensure that regulatory requirements will be effective at reducing emissions and appropriate for port operations.

3.2 Implementation

All control measures and implementation strategies are subject to ongoing legal analysis by the City Attorneys of the two ports. Encouragement of voluntary efforts and the recognition program strategy will be implemented as part of the CAAP independent of which additional strategies are used to implement the various measures.

As stated above, the ports have found that the most effective combination of implementation strategies includes a mix of lease requirements, tariff changes, incentives, grants, and voluntary efforts with an ultimate backstop of regulatory requirements. This combination provides redundancy in implementing the Source Specific Performance Standards should any one of the other specific strategies fail to be applied.

Tariff changes offer an opportunity to affect a broader range of tenants but have potential implementation issues. Lease requirements may be able to go further than tariffs, but requirements can generally only be negotiated when the lease is reopened, such as when:

- A redevelopment of an existing terminal results in the opening of a lease and a CEQA review
- A new lease is sought
- An existing lease comes up for renewal

Therefore, renegotiation of leases continues to be a key component in forecasting opportunities for implementation of CAAP control measures.

Table 3.1 presents the Port of Los Angeles' currently anticipated upcoming Board action dates related to Environmental Impact Reports and/or lease actions.

Table 3.1: POLA Leases Status

Land Use	Grantee	Anticipated Board Action
Container	POLA Container Terminal (berths 206-209)	After 2014
Container	Eagle Marine Services, Ltd.	4th Quarter of 2011
Container	APM Terminals Pacific, Ltd	After 2014
Container	China Shipping Holding Company, Ltd.	4th Quarter of 2010
Container	Evergreen Marine Corporation, LTD.	After 2014
Container	TraPac	Completed
Container	Yang Ming Marine Transport Corporation, Ltd.	After 2014
Container	Yusen Terminals Inc.	After 2014
Passenger	Disney	Completed
Passenger	Princess	4th Quarter of 2010
Automobile	WWL	4th Quarter of 2011
General Cargo	Rio Doce Pasha Terminal, L.P. (berths 174-181)	After 2014
General Cargo	Stevedoring Services of America (berths 54-55)	After 2014
Dry Bulk	SA Recycling	After 2014
Dry Bulk	Former Los Angeles Export Terminal Corporation	After 2014
Liquid Bulk	Equilon (berths 167-169)	After 2014
Liquid Bulk	Exxon Mobil Corporation (berths 238-240)	After 2014
Liquid Bulk	Pacific Energy Marine Oil (pier 400)	4th Quarter of 2010
Liquid Bulk	ConocoPhillips (berths 148-151)	After 2014
Liquid Bulk	Ultramar Inc. (berth 164)	After 2014
Liquid Bulk	Vopak (berths 187-191)	After 2014
Liquid Bulk	Former Westway Terminal Company, Inc. (berths 70-71)	After 2014
Liquid Bulk	GATX Tank Storage (berths 118-119)	After 2014
Liquid Bulk	Amerigas (berth 120)	After 2014
Liquid Bulk	Valero (berth 163)	After 2014
Rail Yard	ICTF/JPA	After 2014
Rail Yard	SCIG	2nd Quarter 2012

Table 3.2 presents the Port of Long Beach's currently anticipated upcoming Board action dates related to Environmental Impact Reports and/or lease actions.

Table 3.2: POLB Leases Status

Land Use	Grantee	Anticipated Board Action
Container	PCT	After 2014
Container	SSAT - Pier C	Complete
Container	SSAT Long Beach - Pier A	After 2014
Container	TTI	After 2014
Container	CUT (Middle Harbor)	Complete
Container	LBCT (Middle Harbor)	Complete
Container	ITS	Complete
Container	Pier S	1st Quarter 2013
Auto	Toyota	3rd Quarter 2010
Break Bulk	Cooper/T. Smith	4th Quarter 2010
Break Bulk	Crescent Terminals	After 2014
Break Bulk	Fremont	After 2014
Break Bulk	Crescent Warehouse	Complete
Break Bulk	Pacific Coast Recycling	After 2014
Break Bulk	Weyerhaeuser	1st Quarter 2011
Dry Bulk	BP West Coast Products	After 2014
Dry Bulk	CEMEX Pacific Coast Cement	After 2014
Dry Bulk	Koch Carbon	After 2014
Dry Bulk	MCC (Mitsubishi)	After 2014
Dry Bulk	Metropolitan Stevedore	After 2014
Dry Bulk	Morton	4th Quarter 2010
Dry Bulk	NGC	After 2014
Dry Bulk	Oxbow (East)	After 2014
Dry Bulk	Oxbow (Pad 14)	After 2014
Dry Bulk	Oxbow (South)	After 2014
Dry Bulk	Oxbow (West)	After 2014
Other	Sea Launch	1st Quarter 2013
Liquid Bulk	BP/ARCO	After 2014
Liquid Bulk	ATSC	4th Quarter 2014
Liquid Bulk	Chemoil	3rd Quarter 2010
Liquid Bulk	Tosoro	3rd Quarter of 2010
Liquid Bulk	Petro-Diamond	4th Quarter 2022

3.3 Tracking and Monitoring

To track, monitor, and demonstrate the progress of the CAAP, both ports enhanced their monitoring programs to encompass the breadth of actions encompassed in the CAAP. These include:

- A comprehensive expansion of the port-wide real-time air monitoring network to improve continued monitoring of actual air pollution concentrations in and around the two-port area.
- Updating port-wide air emissions inventories annually to track control measure compliance and emission reductions from the 2005 baseline year.
- The development and tracking of the San Pedro Bay Standard, which establishes long term goals for health risk and emission reductions, including development of a comprehensive emissions forecast and a port-wide health risk assessment in coordination with USEPA, CARB and SCAQMD, using the latest health risk assessment estimates.
- Tracking CAAP progress on implementation of programs and associated expenditures for each port.
- Reporting on overall progress of the CAAP to each port's Board annually and additionally as required.
- Posting progress reports prepared for each port's Board on the CAAP website.

Progress related to each of the source specific standards is tracked and monitored to determine CAAP implementation progress. Regular updates to each port's Board are made on the various elements of the program. Upgrades to the emissions inventory and implementation databases were completed in order to facilitate regular monitoring and updating of the Boards and public. The CAAP website[16] provides the public the status of the implementation progress, links to the ports' Annual Emissions Inventories, and other key elements including what is happening in the Technology Advancement Program. This website is also a clearinghouse for CAAP related documents, fact sheets, schedules, and provides links to Board meeting schedules and agendas.

For further specific details on monitoring and tracking on a per measure basis, are presented in Section 5.

[16] *www.cleanairactionplan.org*

3.4 Integration of New Technologies into Existing Operations

New emission reduction technologies are constantly emerging. The Technology Advancement Program (see Section 4.7) seeks to support development of these new technologies in the port environment. Technologies that are determined to be feasible and available today can be incorporated into terminal leases as they are renegotiated or amended and at technology review milestones in recently approved leases. Further, there may be opportunities to require or incentivize tenants to adopt these technologies through tariffs (i.e., requirements and/or fees), incentives or other mechanisms.

The ports will continue to work to identify and implement mechanisms to ensure implementation of needed control technologies that are identified through the Technology Advancement Program, and proven to be feasible and available, after execution of long-term leases. The technology review condition in new leases will allow the ports and the terminal operators and other lessees an opportunity to identify how to incorporate these new technologies into existing operations prior to the end of the lease term. The ports will also consider fee mechanisms under the framework identified in Section 3.1 above. Under this structure, operations which have already adopted the new technologies would be exempt from the fee.

Through the Technology Advancement Program, staff will develop technical information detailing the status of various emissions control technologies, and make that information available on the CAAP website. This information will contain details such as links for verification status of various emissions control devices and results of demonstration of alternatively fueled equipment or other new technologies aimed at reducing emissions.

New technologies identified through this process would be evaluated for integration into existing operations based on the mechanisms identified by the ports described above.

SECTION 4: CLEAN AIR ACTION PLAN INITIATIVES

Since the original CAAP was adopted in late-2006, staff of both ports have been diligently working together to develop, implement and operate the various ground breaking measures and initiatives of the CAAP. This section presents the revisions to, and details the progress of, the CAAP initiatives that the Port of Los Angeles and the Port of Long Beach have been working on together since the adoption of the 2006 CAAP. In addition, this section details the control measures that the ports will continue to endeavor to implement over the next five years. This section organizes these initiatives in the following subsections:

- 4.1 Heavy-Duty Vehicles Control Measures
- 4.2 Ocean-Going Vessels Control Measures
- 4.3 Cargo Handling Equipment Control Measures
- 4.4 Harbor Craft Control Measures
- 4.5 Railroad Locomotive Control Measures
- 4.6 Construction Activity
- 4.7 Technology Advancement Program
- 4.8 Emissions Inventory Improvements
- 4.9 Zero Emission Container Movement
- 4.10 Infrastructure and Operational Efficiency Improvement Initiatives
- 4.11 The Port of Los Angeles' China Shipping Settlement

Specific source category control measures and programs were proposed in the original 2006 CAAP report and have been updated through 2009. Emission benefits to date and future emission benefits have been updated and incorporated into the measure descriptions listed throughout this section, as well as the summary emission reduction information presented in Section 5.

4.1 Heavy-Duty Vehicle Control Measures

In the 2006 CAAP, significant emphasis was placed on heavy-duty vehicle (HDV, or truck) emission reductions. This was due to their significant contribution of pollutant emissions, their proximity to, and health risk impact on surrounding communities. One particular challenge to addressing this source is the diffuse nature of ownership of the trucks (many, if not most, trucks are owned and operated by individuals rather than by a centralized company).

After the adoption of the 2006 CAAP by the Boards of Harbor Commissioners of the two ports, the Clean Truck Program was the first major control element of the CAAP to be developed and implemented by the two ports. Some modifications were made to the implementation approach for HDV1, as originally outlined in the 2006 CAAP, which focused on requirements for frequent and semi-frequent callers and assumed the final fleet would be a mix of trucks meeting the USEPA 2007 on-road standards and trucks installed with Level 3 retrofit devices. The Clean Truck Program ultimately adopted goes further than originally planned by placing requirements on all trucks, including infrequent callers, and requires all trucks to meet the 2007 on-road standards by 2012. As a result, the Clean Truck Program exceeds the emissions reduction goals outlined in the 2006 CAAP.

In the 2006 CAAP, the ports had originally considered implementing measure HDV2 by constructing the alternative fuel infrastructure as a port project, and selecting the operator and fuel supplier through a request for proposals (RFP). It was later determined that the best mechanism for expediting the availability of the fueling facility would be to issue an RFP for a lease on port property, where the fuel provider would construct and operate the facility. As a result, the fueling station has been operational since 2nd quarter 2009.

The HDV source category is addressed through a combination of measures that include truck replacements, control device retrofits for the interim period, and a research and development initiative to help identify and demonstrate cleaner engines types and modes of transportation that can be used in the movement of containerized cargo.

4.1.1 Control Measure Number HDV1

Measure Title: ***Performance Standards for On-Road Heavy-Duty Vehicles***

This measure requires that all trucks servicing both ports comply with 2007 USEPA heavy-duty on-road emissions standards, in addition to safety and security requirements, by January 1, 2012. Incentives, grants and financing were provided to support the required fleet turnover. This comprehensive program will maximize the associated emissions reductions and greatly reduce health risk concerns associated with trucks. The measure is being implemented through port tariffs and lease agreements.

Initiation Year:	*2008*
Key Milestone Dates:	*October 1, 2008, ban oldest trucks from port terminals; January 1, 2010, second ban on older, more polluting trucks; January 1, 2012, require all trucks to meet 2007 or newer truck standards; see details below*
Criteria Pollutant Reduction:	*By 2012, the average drayage truck servicing the ports will emit at least 90% less DPM and 70% less NOx emissions than before implementation of bans*
GHG Impact:	*Due to the uncertainty of the impact of 2007+ truck technology on fuel economy, CO_2E reduction or increase cannot be quantified*

Implementation Strategies: Tariffs and Lease Agreements

Background

On-road heavy-duty trucks are used to move containers from the ports to other locations in the SoCAB and beyond. Almost all of these trucks have a gross vehicle weight of greater than 33,000 pounds. For 2007, over 4,000,000 license plate records were received from the terminals, which yielded about 218,000 unique license plate numbers. Registration information was requested from the California Department of Motor Vehicles and 54,493 unique truck records accounting for more than 3,000,000 trips (75% of total trips) were returned with model year information. The population weighted average age of the drayage truck fleet servicing the ports in 2007 was determined to be 12.2 years. This is in reasonable agreement with CARB's estimate of 11.6 years for heavy-duty diesel trucks in operation within the SoCAB. CARB's estimate is based on its on-road emissions inventory model, known as EMFAC. While the average age is similar, the EMFAC distribution included a greater proportion of trucks in the newest age range (up to six years old) and correspondingly fewer trucks in the eight to 13-year age range. A similar license plate analysis performed for 2008 suggested that the population weighted average age of the port-related fleet was 12.1 years which is similar to the 2007 fleet and the 2008 EMFAC population weighted fleet average age of 11.6 years for the trucks operating within SCAB region. For 2009, the population weighted average age for trucks was 10.9 years whereas population weighted average fleet for EMFAC in 2009 was 11.6 years.

It should be noted that in each port's published 2009 emissions inventories, HDV emissions are based on call weighted HDV age distribution which resulted into average HDV age of 6.9 years. Recent implementation of the Ports' Clean Truck Program (CTP), requiring accelerated introduction of cleaner trucks serving the ports, suggested that the methodology used to derive the age distribution for ports trucks should be revisited. Two phases of the progressive bans under the CTP were implemented by January 1, 2010, and more importantly, the container fee went into effect in February 2009, which created a disincentive to move cargo with pre-2007 trucks. Analysis of the 2009 HDV call data clearly indicated that increased number of trips made by 2007+ trucks as compared to older trucks. However, in order to keep the consistency with SPBP 2014 and 2023 emissions standards calculations which utilized population based HDV age distribution, HDV emission estimates for the purposes of CAAP update are calculated based on population weighted age distribution. According to the 2009 Emissions Inventories prepared for the ports of Los Angeles and Long Beach, on-road heavy-duty vehicles operating at both ports contributed 20% of DPM and 32% of NOx when compared to emissions from all five port related sources.

According to the 2008 Emissions Inventories prepared for the ports of Los Angeles and Long Beach, on-road heavy-duty vehicles operating at both ports contributed 33% of DPM and 39% of NOx when compared to emissions from all five port related sources.

Measure Description

The 2006 CAAP outlined several potential implementation scenarios for reducing emissions from frequent and semi-frequent caller trucks, based upon varying levels of replacements with either diesel- or LNG-fueled trucks, or retrofits with exhaust after-treatment devices. These various scenarios were presented as preliminary concepts for comparison purposes, with the actual implementation measure specifics to be developed for decision by each port's Board of Harbor Commissioners.

Since adoption of the CAAP in November 2006, the ports have developed the program details and implementation mechanisms for this measure. During 2007 and 2008, the ports developed the following key components: (1) fleet modernization through a progressive truck ban; (2) Clean Truck Fees collected on older trucks and used to fund new truck replacements, (3) incentives, grants and financing programs for funding replacement trucks; and (4) port agreements with licensed motor carriers regarding conditions of drayage truck entry to port terminals. The first staff proposal for the program was finalized with input from each port's Executive Director in late March 2007, consistent with the original CAAP commitment date, and released on April 12, 2007, at a CAAP stakeholder meeting. After the release of the draft program elements, the ports held two additional stakeholder meetings to discuss the proposal, and hosted Licensed Motor Carrier (LMC) workshops and two driver workshops. Over 15,000 letters, e-mails, and public comments were received on the proposed program. Based upon the significant level of concerns raised regarding several of the proposed program elements, two studies were commissioned in order to gain a better understanding of the potential economic impacts to the drayage industry and the potential for container diversion based upon increased drayage costs. The results of these analyses were finalized and released in September 2007, during an additional CAAP stakeholder meeting. Following the release, the Port of Long Beach and Port of Los Angeles Boards held a joint meeting to solicit input in October 2007. The proposed program details were updated, and in November of 2007 each port's Board of Harbor Commissioners approved the first step in the groundbreaking "Clean Trucks Program" (CTP). Additionally, POLA commissioned a further study to analyze different models of CTP motor carrier agreements, which was presented at the public POLA Board of Harbor Commissioners meetings on March 6 and March 20, 2008 prior to the POLA Board's adoption of the Concession model. The CTP has following elements:

Port Truck Fleet Modernization

The CTP targets 80% emission reductions by 2012 from all drayage truck fleets serving both ports. This will be accomplished through a port tariff that gradually limits port terminal access to all but the cleanest on-road trucks meeting the USEPA's 2007+ on-road truck emissions standards. Older trucks will be banned according to the following schedule:

- Phase 1: Effective October 1, 2008, all pre-1989 MY engines were banned from operation in the ports.
- Phase 2: Effective January 1, 2010, all 1989 to 1993 MY engines were banned from operation in the ports. Furthermore, all 1994-2003 MY engines will be required to achieve an 85% DPM reduction and a 25% NOx reduction through the use of a CARB approved Level 3 plus NOx VDECS.
- Phase 3: By January 1, 2012, all drayage truck engines that do not meet 2007 federal on-road standards will be banned from the ports.

In the 2006 CAAP version of measure HDV1, it was assumed that only trucks that made 3.5 or more trips per week would be required to be replaced or retrofitted. The final version of measure HDV1 eliminated the distinctions between levels of frequency of truck visits and applied the fleet modernization requirement to all trucks entering the port terminals, based upon engine model years. The CTP as implemented will achieve emission reductions beyond the original goal by banning all trucks with pre-2007 engines from port service by January 1, 2012. As a result, the adopted CTP will achieve significantly greater emission reductions than estimated by the original version of HDV1.

The clean truck requirements of the ports tariffs (i.e. 2007 USEPA on-road heavy-duty truck emission standard) are fuel neutral. Any truck that can meet the emissions standard is eligible to participate in the program. In order to encourage the introduction of alternative-fueled vehicles into the port drayage fleet however, the ports adopted a 50% liquefied natural gas (LNG) truck goal for their funding awards. In the future, as new technologies become available that will meet or exceed the CTP emissions requirements (e.g. hybrid or electric trucks), they will also be eligible for use in the ports' program.

All trucks operating at the ports of Long Beach and Los Angeles must be registered with the Ports' Drayage Truck Registry (DTR). This registry is a database containing information about the truck such as make, model, engine year, truck owner and LMC permit under which the truck is driven. The CTP ban is administered by the marine terminal operators using information from the DTR and their preferred identification technology. For container terminal operators, an electronic identification system such as Radio Frequency Identifications (RFID) tags on trucks are being used to identify trucks while preventing congestion at marine terminal gates. RFID tag readers are installed at the terminal gates to ensure access only for trucks that comply with the CTP. Other terminals, such as break bulk facilities are using other strategies including a ports-approved sticker system.

The ban schedule for the ports' CTP is consistent with the CARB's drayage truck regulation adopted in December 2007; however the ports' schedule is more aggressive. In 2008, CARB adopted a regulation for in-use on-road diesel vehicles that goes beyond both the CTP bans and CARB's drayage truck regulation requiring all trucks operating in California to meet USEPA's 2010+ emissions standards starting January 1, 2021[17].

Clean Truck Fee

The ambitious schedule for truck replacements and retrofits required by the CTP results in significant costs. Initial estimates showed that this program could cost over $2 billion dollars. In order to generate the necessary additional funding, the ports of Los Angles and Long Beach amended their CTP tariffs in December 2007 to include a cargo fee.

Starting in the February of 2009, the Port of Los Angeles and the Port of Long Beach began collecting a Clean Truck Fee of $35 for each loaded 20-foot (or less) container ($70 for each container longer than 20 feet). This fee does not apply to containerized cargo entering or leaving the port terminals via train, or containerized cargo that is simply moved from one terminal to another. The fee is charged to cargo owners and collected by marine terminal operators. The fee has generated funds to help finance

[17] *http://www.arb.ca.gov/msprog/onrdiesel/documents/TBOverviewFS.pdf*

the replacement of eligible trucks with trucks meeting the CTP requirements, which include diesel, LNG, or other approved alternative–powered vehicles that meet the 2007 USEPA on-road truck standards.

The ports of Los Angeles and Long Beach established additional exemptions to the cargo fee, for among other reasons, to encourage early action to modernize the port-related truck fleets. There are minor differences in the cargo fee exemptions for the ports of Los Angeles and Long Beach. More information about cargo fee exemptions can be obtained from the "Clean Truck Program" tariffs posted at:

http://www.portoflosangeles.org/Tariff/SEC20.pdf
http://www.polb.com/cleantrucks

Truck Grants, Incentives and Financing Programs

Grants. The Ports of Los Angeles and Long Beach, CARB, and the AQMD jointly administered a $98 million California Proposition 1B grant program that provided $50,000 grants to applicants toward the purchase of 2007 compliant trucks. In addition, the Port of Long Beach provided a one-time grant of one million dollars towards the purchase of retrofit equipment for model year 1994 – 2003 trucks in 2009.

Incentives. The Port of Los Angeles provided $44 million in separate $20,000 incentives to stimulate the deployment of privately funded 2007 (or newer) USEPA compliant drayage trucks in the San Pedro Bay ports. The Ports of Long Beach and Los Angeles and AQMD jointly administered a $25 million program to incentivize the purchase of 500 LNG trucks. The trucks had to qualify for a Prop 1B award, and then once they qualified for that, they became eligible for an additional $50,000 incentive to purchase an LNG truck.

Financing. The Port of Long Beach provided $37.5 million in lease-to-own financing for 2007 (or newer) USEPA compliant drayage trucks in the San Pedro Bay ports. Under the lease to own program, applicants were provided 7-year lease agreements with a financial institution selected by the ports.

It is important to note that the drayage industry has made a major, direct investment in the success of the CTP. As a result of this investment, the majority of clean trucks that have been deployed recently to serve the ports have been privately funded. It is estimated that the cost to industry for this upgrade was over $600 million.

Additional details of the ports' financing programs can be found at:

http://www.portoflosangeles.org/environment/ctp.asp
http://www.polb.com/cleantrucks

Motor Carrier Agreements

Each of the ports has established contractual agreements with the licensed motor carriers accessing the ports through a Concession Agreement (POLA) and Registration Agreement (POLB).

The purpose of the motor carrier agreements is to establish a relationship between the ports and the trucking companies or LMCs and to hold them responsible for ensuring that the trucks calling at the ports meet the ports' terminal access requirements, including safety and security compliance. The agreements include requirements that drayage trucking firms:

- Maintain a motor carrier license
- Register their trucks and drivers in the port drayage truck registry and equip their trucks with compliance tags specified by the marine terminal operators,
- Ensure that trucks comply with motor vehicle safety requirements
- Ensure that drivers have federal Transportation Worker Identification Credentials (TWIC) and comply with all security requirements,
- Ensure that LMCs meet insurance requirements

The ports have also developed a Temporary Access Pass in lieu of a motor carrier agreement for infrequent visitors.

For more details on the agreement and temporary access pass requirements for the Ports of Los Angles and Long Beach, refer to:

http://www.portoflosangeles.org/environment/ctp.asp
http://www.polb.com/cleantrucks

Air Quality Benefits

<u>*Benefits to Date*</u>

Starting in October of 2008, the first compliance date for the ports Clean Trucks Programs came into effect, whereby all trucks 1988 and older were banned from the ports. Analysis of the actual 2008 license plate data collected indicates that trucks meeting the 2007+ standards had started entering port service, representing a little over 4% of the drayage truck fleet operating at the ports. The emission benefits from these changes to the fleet are included in the 2008 emissions inventories.

Future Benefits

The implementation of the CTP has accelerated the turnover of older, higher polluting trucks to newer, cleaner trucks. As of February 2010, more than 75%of the trips are made with trucks meeting 2007+ standards. In 2012, when the last phase of the CTP will be implemented and all trucks meet at least the 2007 USEPA on-road standard, the average age of trucks in the fleet is expected to be six years or less resulting in a fleet that on average emits more than 90% less DPM emissions and 70% less NOx emissions compared to a twelve-year old truck fleet. CO_2E emissions benefits are unknown at this time due to uncertainty in new truck technologies.

Financial Costs

Costs to Date:

The financial costs of HDV1 from November 2006 through end of 2009 consist of program development, implementation planning, and initial startup costs. These costs are presented in Table 4.1 below.

Table 4.1: Costs-to-Date for HDV1

HDV1	Funding Source	2006	2007	2008	2009	Total
	POLA	$0	$0	$23,317,485	$59,457,232	$82,774,717
	POLB	$0	$0	$15,585,307	$28,856,000	$44,441,307
	SCAQMD	$0	$0	$0	$7,500,000	$7,500,000
	CARB Prop 1B Funding	$0	$0	$0	$49,000,000	$49,000,000
	Measure Totals	**$0**	**$0**	**$38,902,792**	**$144,813,232**	**$183,716,024**

Future Costs:

The financial costs for the program detailed in Table 4.2 include all currently known funding sources, from the ports, regulatory agencies, and bond funding. Additional potential costs to be borne by the industry were not estimated.

Table 4.2: Estimated Future Costs for HDV1

HDV1	Funding Source	2010	2011	2012	2013	2014	Total
	POLA	$24,683,088	$2,398,030	$5,000,000	$0	$0	$32,081,118
	POLB	$16,279,000	$7,698,000	$3,709,000	$3,672,000	$3,672,000	$35,030,000
	SCAQMD	$0	$0	$0	$0	$0	$0
	CARB Prop 1B Funding	$49,000,000	$0	$0	$0	$0	$49,000,000
	Measure Totals	**$89,962,088**	**$10,096,030**	**$8,709,000**	**$3,672,000**	**$3,672,000**	**$116,111,118**

Completed Milestones
The following list identifies major milestones for implementation of CAAP measure HDV1:

1. Staff will develop program details and an implementation plan to achieve the ambitious fleet turnover and retrofit goals proposed in the Clean Air Action Plan. The plan will be approved by each port's Board of Harbor Commissioners.

   Schedule: Completed.

2. Staff will meet with the regulatory agencies to discuss implementation of the ports' program, with the goal of ensuring that the ports' measure will not conflict with any current or proposed agency regulations.

   Schedule: Completed.

3. Award CTP agreements to trucking companies that provide drayage services at the ports.

   Schedule: Applications were made available in July 2008.

4. Launch Drayage Truck Registry for enrollment of drayage trucks servicing the ports.

   Schedule: Completed.

5. Develop truck financing options and launch program for awarding grants and leasing options for truck replacements and retrofits.

   Schedule: Completed.

6. Begin collecting cargo fee to provide a funding source for the Clean Truck Program.

   Schedule: Completed. Fee was initiated in February 2009.

7. All drayage trucks with pre-1989 engines are to be banned from operation in the ports.

   Schedule: Completed. Pre-1989 ban implemented as of October 1, 2008.

8. All drayage trucks with 1989 to 1993 engines are banned from operation in the ports. Furthermore, all trucks with 1994-2003 engines will be required to achieve an 85% DPM reduction and a 25% NOx reduction through the use of a CARB approved level 3 plus NOx VDECS.

   Schedule: Completed. Ban initiated on January 1, 2010.

Upcoming Milestones

1. All drayage trucks with engines that do not meet 2007 federal on-road standards will be banned from the ports.

   Schedule: By January 1, 2012.

Elements to be Tracked

The ports commit to provide regular updates on the progress of implementing this measure. These updates will be provided in quarterly progress reports, which detail significant progress for implementation of all CAAP measures.

Specifically for the CTP, the ports will provide regular updates on the number of enrollments in the Drayage Truck Registry, number of agreements executed, number of grants and leases awarded through the ports' financing programs, amount of funding collected through the cargo fee, amount of funding received from other sources, including Proposition 1B bond funding, emission reductions, as part of the ports' annual emissions inventories, and any other significant updates, as needed.

Looking Forward

The ports' Clean Trucks Programs provide near term emissions reductions, in advance of state regulations. Once the state drayage truck requirements come into full effect in 2014, the ports programs will essentially be overtaken by the state rule. Further, the state on-road truck and bus rule will place further requirements on the trucks operating at the ports, requiring 2010+ standards by 2021.

The ports' ultimate goal is to achieve near zero emissions from all port operations. As new advanced technologies such as hybrid diesel or alternative fueled (electric and hydrogen) drayage trucks become commercially viable options, the two ports will seek to integrate those technologies into the fleet of trucks serving the ports. In addition, starting with calendar year 2009, more accurate emission estimates are being made for port-related truck operations because, under the CTP, all trucks operating at the ports are required to be registered in the DTR and equipped with RFID tags which will provide more accurate and up to date population and mileage information.

4.1.2 Control Measure Number HDV2

Measure Title: ***Alternative Fuel Infrastructure for Heavy-Duty Natural Gas Vehicles***

In order to encourage use of alternative fueled trucks, the ports will support development of alternative-fuel infrastructure in the port complex.

Initiation Year:	*2007*
Key Milestone Dates:	*LNG fueling facility is operational starting in March 2009*
Criteria Pollutant Reduction:	*Not applicable; supports reductions in HDV1*
GHG Impact:	*Not applicable; supports reductions in HDV1*
Implementation Strategies:	**Lease Requirements**

Background

While the clean truck standards for CAAP measure HDV1 applies to all fuel types, each port's Board adopted a 50% LNG truck goal for their funding awards, in order to maximize potential health risk reductions from on-road trucks.

LNG fueling and maintenance facilities in the port area are limited. In order to make LNG trucks a viable option for port drayage, the ports began working with fuel providers in 2007 to make a public facility available in the port area. The original commitment of HDV2 was completed with the construction of the LNG refueling facility at the ports.

In February 2007, the Port of Long Beach solicited proposals to enter into a lease to provide LNG fueling infrastructure. The ports jointly selected a fuel provider, Clean Energy, to lease the parcel near the Anaheim Street Grade Separation, in the City of Los Angeles owned by the Port of Long Beach. A small portion of the property is also owned by the Port of Los Angeles. At no cost to the ports, Clean Energy has constructed the station on the leased property, with LNG storage tanks and four fueling dispensers. The station is open 24-hours per day, seven days per week. It was agreed through the selection process that currently existing maintenance facilities would be utilized until a LNG truck fleet exists within the ports and the market develops for a new maintenance facility. Construction of the station began in October 2008 and the station has been operational since March 2009. It is noteworthy that the facility constructed by Clean Energy on port property offers CNG fuel, in addition to LNG fuel.

Since the ports' Board adopted of a goal that 50% of all port-funded trucks be LNG, two truck vendors have also begun offering commercial drayage trucks that operate on compressed natural gas (CNG) in addition to LNG. With the potential increased use of CNG drayage trucks, HDV2 is proposed to be enhanced to support development of CNG fueling at the ports and to lay the foundation for the development of infrastructure for other alternative fuels such as hydrogen.

Measure Description

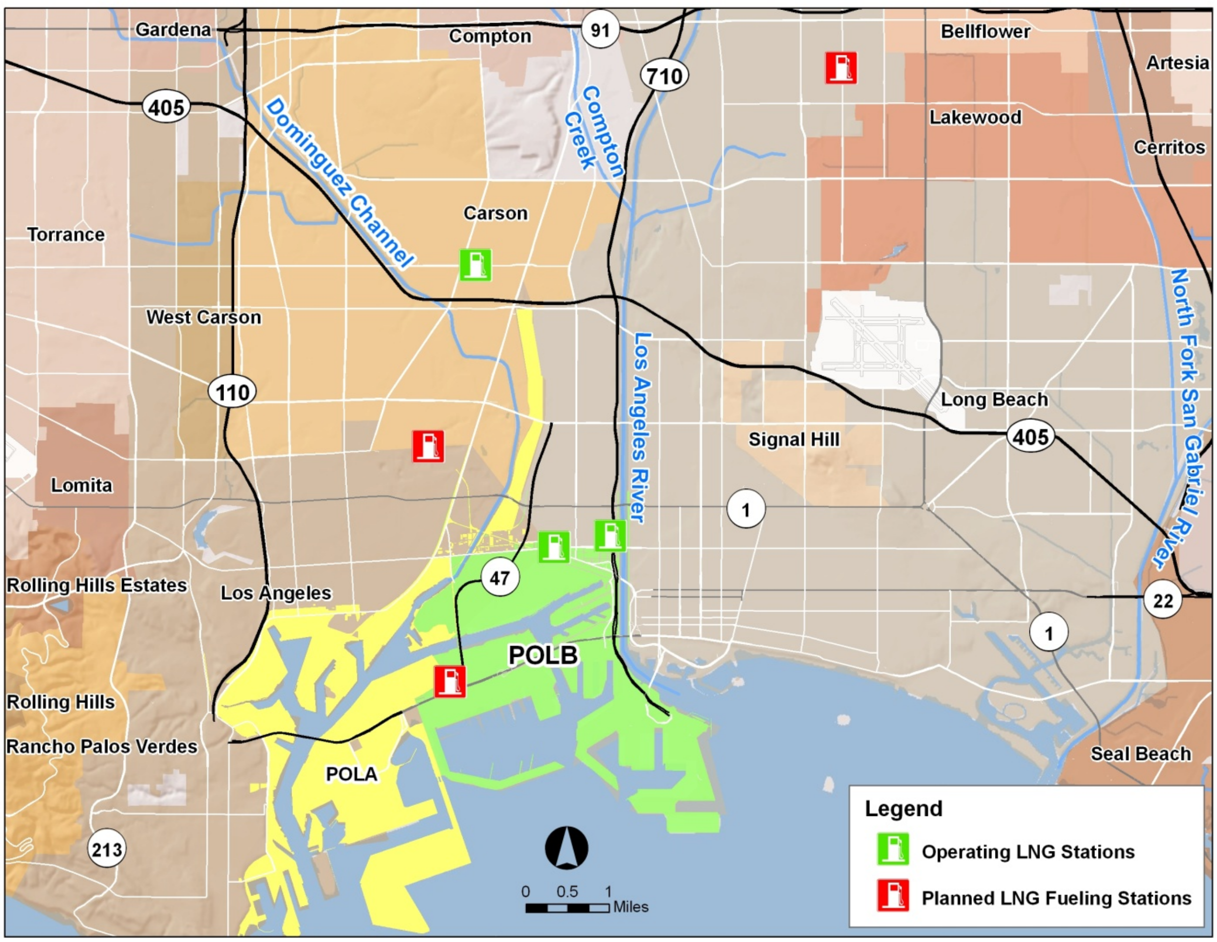
Next to the differential in purchase and maintenance costs, the decision to convert from conventional diesel-powered trucks to cleaner alternative-fueled trucks is also impacted by the availability of fueling infrastructure. The ports have been working with fuel providers and other stakeholders to identify key locations throughout the South Coast Air Basin to expand the natural gas refueling infrastructure to facilitate the deployment of natural gas trucks. Key locations include trucking facilities and the destinations where containers are drayed such as rail yards and warehouse distribution centers. Fuel providers should focus their efforts in expanding the natural gas refueling infrastructure at these locations while the ports focus on addressing the need for refueling infrastructure on port property. Currently, there are LNG and CNG refueling facilities in the City of Commerce and Ontario with plans to construct stations in key transportation corridors such as Interstate 5, 10 and 15. In addition, several LMCs are proposing to develop on-site refueling capabilities for their own trucks.

The objective of this measure is to provide continued support in the development of an alternative fuel infrastructure in the port area. To maximize the utilization of fueling facilities, they should be available for public use.

In 2008, one of the LMCs operating at the ports ordered a small number of CNG powered trucks for their operations. It is anticipated that additional LMCs will choose the CNG option. CNG fuel can be provided in two ways. One approach is to augment current LNG facilities to dispense CNG through a L/CNG process. The LNG stored at the facility for dispensing is vaporized into CNG directly into the truck's tank. Such systems are utilized at several locations in the SoCAB; most notably, at the San Bernardino Omnitrans facility. Alternatively, a second site could be identified where a full CNG station would be constructed. The station could have storage for CNG that is delivered from the pipeline. One of the potential tasks of this measure could be to solicit proposals for the most cost-effective approach. Currently, the facility constructed by Clean Energy on port property offers CNG fuel, in addition to LNG fuel.

In order to further expand the availability of LNG fuel in the port area, the ports have worked with the SCAQMD to provide incentive funding for the construction of two additional publically available LNG fueling stations. Both facilities will be located at California Cartage Company sites: one in Wilmington and one in North Long Beach. These stations are expected to become operational by June 2010. Finally, plans are being considered for the development of an LNG fueling station on Terminal Island within the port complex. In addition, in June 2010, Applied LNG Technologies began offering LNG fuel at the Speedy Fuel location in the port area. All together, this represents a significant expansion of LNG fueling capacity in port area. Figure 4.1 shows the locations of operational and planned LNG fueling stations in the vicinity of the ports.

Figure 4.1: Locations of Operational and Planned LNG Fueling Stations in the Vicinity of the Ports of Long Beach and Los Angeles



Air Quality Benefits

There are no emission reductions directly related to the performance of this control measure; however this measure is critical to the successful implementation of HDV1, which itself results in significant emission reductions.

Financial Costs

Costs to Date:

In order to support development of the fueling infrastructure, the Port of Long Beach negotiated a reduced rate with the fuel provider for the first five years of the lease. There are no port capital costs to date associated with this measure.

Future Costs:

The future funding commitments related to additional alternative fuel structures at the ports are detailed in Table 4.3.

Table 4.3: Estimated Future Costs for HDV2 by Funding Source

HDV2	Funding Source	2010	2011	2012	2013	2014	Total
	POLA	$266,250	$0	$0	$0	$0	**$266,250**
	POLB	$266,250	$0	$0	$0	$0	**$266,250**
	SCAQMD	$532,500	$0	$0	$0	$0	**$532,500**
	CARB	$0	$0	$0	$0	$0	**$0**
	Measure Totals	**$1,065,000**	**$0**	**$0**	**$0**	**$0**	**$1,065,000**

Completed Milestones

The following list identifies major milestones for implementation of CAAP measure HDV2:

1. Staff will develop specifications and an RFP for the lease to provide LNG infrastructure.

   Schedule: Completed.

2. The ports will select a lessee from the RFP process.

   Schedule: Completed.

3. The lessee will begin construction of the fueling facility.

   Schedule: Started in October 2008.

4. Fueling station will be completed and operational.

   Schedule: Completed and operational in March 2009.

Upcoming Milestones

1. LNG truck maintenance facility will be constructed.

   Schedule: When justified, due to market demand in the port area.

2. Additional alternative fuel infrastructure needs will be evaluated and the ports will support further development of additional alternative fuel dispensing stations as needed. This could include enhancing the existing LNG fueling station to dispense CNG fuel.

   Schedule: As needed.

Elements to be Tracked

The ports commit to provide regular updates on the progress of implementing this measure. These updates will be provided in quarterly progress reports, which detail significant progress for implementation of all CAAP measures. Specifically for measure HDV2, the ports will provide updates on the construction of additional alternative fueling facilities and the beginning of operations.

Looking Forward

As future CAAP updates are made, this measure would seek to continue to enhance the port's refueling facility capabilities to provide dispensing for other cleaner fuels such as hydrogen or hydrogen blends. Several natural gas engine manufacturers are evaluating the blending of hydrogen with natural gas as a transportation fuel. Such blending would further reduce emissions from natural gas trucks in the future and would be the bridge to a future hydrogen economy where trucks and other equipment such as yard tractors would utilize hydrogen fuel. Other fuels that may have substantial air toxics and GHG benefits over conventional diesel fuel may also be identified and evaluated.

4.2 Ocean-Going Vessels Control Measures

Ocean-going vessels (OGVs) represent the second major source category where emissions reduction efforts were focused in the 2006 CAAP. This is because of their significant contribution to overall port emissions and their proximity and health risk impact to surrounding communities while at berth.

The ports are moving forward with implementation of the OGV measures as identified in the original 2006 CAAP. Each port is implementing their incentive programs to encourage greater participation in the vessel speed reduction program, as described under OGV1. Each port is also constructing shore power infrastructure to meet the implementation schedule outlined in OGV2. For measures OGV3 and OGV4, the ports developed and implemented a one-year incentive program, which hadn't been anticipated during development of the 2006 CAAP, to encourage greater use of low sulfur fuel in vessel main engines. In addition, since the 2006 CAAP was adopted, CARB adopted two regulations which support the CAAP measures for shore power and low sulfur vessel fuels. These regulations are described in more detail in Section 1.

The OGV source category is addressed through a combination of measures that include operational controls, shore power, cleaner fuels, preferential deployment of cleaner vessels, and a research and development initiative to help identify and demonstrate new technologies to reduce emissions. This final component is being implemented with support of the Technology Advancement Program.

4.2.1 Control Measure Number OGV1

Measure Title: ***OGV Vessel Speed Reduction (VSR)***

This measure reduces emissions from OGVs during their approach and departure from the ports, by slowing vessel speed to 12 knots at a distance of 20 nm and 40 nm from Point Fermin.

Initiation Year:	*2001*
Key Milestone Dates:	*Voluntary program initially established in 2001; POLB Green Flag Program adopted in 2005 and amended to include 40 nm compliance starting in January 2009; POLA VSR incentive program adopted in 2008 and amended to include 40 nm compliance starting in September 2009; requirements implemented as leases are negotiated.*
Criteria Pollutant Reduction:	*On an average per OGV call basis, 100% compliance with VSR will achieve 19% reduction of DPM, NOx and SOx within the 20 nm zone, and 48% of DPM, NOx and SOx reduction within the 40 nm zone.*
GHG Impact:	*On an average per OGV call basis, 100% compliance with VSR will achieve 5% reduction of CO_2E within the 20 nm zone and 10% reduction of CO_2E within the 40 nm zone.*

Implementation Strategies: Lease Requirements, Incentive Tariffs, & Voluntary Participation

Measure Description

Under the Vessel Speed Reduction (VSR) program, participant vessels are requested to slow down to 12 knots as they approach or depart the ports. The primary objective of the VSR program is to reduce emissions from OGVs during vessel transit near the ports. When ships slow down, the load on the main engines decreases considerably compared to the engine load when transiting at higher speeds, leading to a decrease in the total energy required to move the ship through the water. This energy reduction in turn reduces emissions for this segment of the transit. Since the load on the main engines affects power demand and fuel consumption, this strategy significantly reduces all pollutants including DPM, NOx, SOx, and GHG emissions.

There are several ongoing and proposed VSR efforts/initiatives affecting vessel transit operations at the ports of Los Angeles and Long Beach.

1. A voluntary VSR program has been in place since 2001 under which vessels slow to 12 knots when they are within 20 nm of Point Fermin.

2. Under the Port of Long Beach Green Flag Program, adopted in 2005, Green Flags are awarded to vessel operators that are 100% compliant with the program for the previous year. Carriers with at least 90% compliance by their vessels receive a 15% dockage fee reduction. Starting on January 1, 2009, this program has been extended to include an additional compliance level to 40 nm. Carriers with at least a 90% compliance rate for all of their vessels within 40 nm qualify for the green-plus rate, which is a 25% dockage fee reduction. In early 2010, POLB adopted the G-40 Plan, which increased the dockage fee reduction to 50%, from April 1, 2010 through March 31, 2011, for carriers with 90% compliance for their vessels within 40 nm.

3. In 2008, the Port of Los Angeles adopted a VSR Incentive Program in the 20 nm zone to provide a financial incentive equivalent to 15% of first day dockage to vessel operators who reduce their speed on approach or departure. On September 29, 2009, this program was expanded to provide an increased incentive equal to 30 of first day dockage to carriers for compliance to 40 nm.

4. In order to meet the mandates of AB 32, the California Global Warming Solution Act, implementation of VSR has been identified as one of the early action plan measures. CARB staff is currently developing a program to implement this measure.

Compliance with the voluntary VSR program has steadily increased over the years since it was originally adopted. Compliance is tracked by individual ship call and reported monthly to the shipping lines. Overall compliance for all calls at the ports during the CAAP baseline year of 2005 was 67%. In 2007, the overall VSR compliance rate had increased to 84%. In 2008, the compliance rate for all vessels calling at POLB was 92% and the compliance rate for vessels calling at POLA was 89%. In 2009, the compliance rate for all vessels calling at POLB was 95% to 20 nm and 72% to 40 nm; the compliance rate for vessels calling at POLA was 90% to 20 nm and, for the period of September 29, 2009 through December 31, 2009, 53% to 40 nm. In the first half of 2010, the compliance rate for all vessels calling at POLB was 96% to 20 nm and 74% to 40 nm; the compliance rate for vessels calling at POLA was 90% to 20 nm and 60% to 40 nm.

In late-2007, a survey on the VSR Program was administered to vessel companies that call at the Port of Long Beach and the Port of Los Angeles. The purpose of the survey was to obtain feedback from vessel companies on the voluntary VSR program and on the proposed extension of the VSR zone to 30 nm or 40 nm. The VSR survey was administered to vessel companies representing tankers, bulk, cruise and container ships. All of the respondents were participating in the VSR program and 52% felt the current program was beneficial. When asked about extending the VSR zone to 30 or 40 nm from Point Fermin, 76% of the respondents felt the program would pose a negative impact on their business. Most felt the increase would result in scheduling conflicts and would increase costs associated with fuel and labor. In addition, 86% felt they would have to increase their vessel speed at other legs of the voyage to make up for the extra time spent in the VSR zone. If this were to occur, the unintended consequence would be higher emissions and higher fuel consumption outside of the 40 nm zone, potentially along the California coast. However, though most of the respondents felt expanding the VSR zone would have negative effects, 76% said they would comply with the new program.

Feedback from the surveys also provided insight on a number of challenges that could result with extending the VSR zone such as possible wear and tear on the engine; ability to order longshoreman labor properly; and potential increase in emissions due to increased speeds outside of the port VSR zone. Survey responses also suggested alternative incentives to promote VSR compliance, for example, reducing port fees or offering incentives to offset additional fuel costs. The results from this survey helped to inform the ports decision to expand the VSR programs to 40 nm.

Shipping lines that can demonstrate alternative compliance plans (using controls surplus to the Clean Air Action Plan) that meet or exceed the emissions reductions from VSR at 12 knots are able to petition to the ports for changes for specified vessels. This could include requesting approval of an alternative speed for a particular vessel if supporting information can be provided that the alternative speed will result in greater emissions reductions than traveling at 12 knots. The alternative compliance plans will be reviewed by port staff for validation and recommendations will be presented to the applicable Executive Director for action.

The ports receive complete vessel speed data to 40 nm from Point Fermin from the Marine Exchange of Southern California. Marine Exchange has expanded their vessel tracking hardware, and with the support of the ports, the software has been upgraded to collect and transmit the data in a format that can be used to determine compliance with the ports' programs. The expanded datasets started to be transmitted to the ports for activity in June 2008 and for each month thereafter. Additional upgrades to the system were implemented through the end of 2008 to provide complete data coverage.

Implementation Approach

There are five key elements to implementing this control measure:

1. Require participation in the VSR program to 40 nm from Point Fermin through conditions negotiated into new or renegotiated leases.

2. Increase emissions reduction benefits through implementation of a two-tiered incentive for voluntary compliance with the speed reduction to 20 nm or 40 nm from Point Fermin.

3. As needed, work with the shipping lines to address any ongoing issues associated with participation to 40 nm from Point Fermin.

4. Coordinate with CARB on the development of a statewide VSR program.

5. The benefits of the VSR program are quantified and reflected in the annual updates to the ports' emissions inventories and reported annually to the Executive Director and the Board of Harbor Commissioners for each port.

There are three primary implementation approaches for this measure: 1) continuation of the voluntary program, 2) incorporation of VSR requirements in new leases, and 3) CARB's VSR strategy. Parallel to the voluntary, incentive based strategies, compliance with the VSR program to 40 nm from Point Fermin will be negotiated into new and re-negotiated lease requirements. In addition, the ports will also work closely with CARB to facilitate a statewide VSR program and ensure that the programs are aligned.

To facilitate the transition to the lease requirements for compliance with the VSR program to 40 nm from Point Fermin, or the upcoming statewide VSR program along the California coastline, the ports have expanded their VSR programs to include incentives for compliance to 20 nm or 40 nm from the Point Fermin. The extended VSR program has been in place since January 2009 for Port of Long Beach and September 2009 for Port of Los Angeles. The extended incentive program is tiered to offer greater incentives to the carriers whose vessels participate over the longer distance and therefore produce the greatest emissions benefits.

Air Quality Benefits

The net reduction of all pollutants from slowing ship speeds has been recognized by CARB as an effective control strategy, and hence an early action measure under the State's GHG reduction plans. The VSR program has been generating significant emissions reductions since starting in 2001.

Benefits to Date

The voluntary VSR program started in late 2001 and has been increasing in participation ever since. The estimated reductions in DPM, NOx, SOx, and GHGs in terms of CO_2E associated with this measure, since the CAAP baseline year of 2005, are reflected in both ports' annual EI reports.

Future Benefits

If an average individual OGV complies with the VSR speed of 12 knots or less during arrival and departure from the ports, emissions of DPM, NOx and SOx will be reduced by 19%, within the 20 nm zone, and by 48% within the 40 nm zone. Additionally, CO_2E emissions will be reduced by 5% in the 20 nm zone and by 10% in the 40 nm zone. Overall emissions reduction from all vessels will depend on the compliance rate.

Financial Costs

The costs to date and projected funding costs for the measure are associated with ports' tariff incentive funding, data acquisition, compliance tracking and reporting, and administrative costs associated with the control measure.

Costs to Date

Table 4.4 provides the financial costs to date for each port in support of this measure.

Table 4.4: Costs-To-Date for OGV1 by Funding Source

OGV1	Funding Source	2006	2007	2008	2009	Total
	POLA	$0	$0	$1,400,000	$1,900,000	**$3,300,000**
	POLB	$1,615,000	$1,727,500	$1,834,600	$1,728,501	**$6,905,601**
	SCAQMD	$0	$0	$0	$0	**$0**
	CARB	$0	$0	$0	$0	**$0**
	Measure Totals	**$1,615,000**	**$1,727,500**	**$3,234,600**	**$3,628,501**	**$10,205,601**

Future Costs

Table 4.5 provides the expected budgetary requirements needed to continue the program as described in this measure.

Table 4.5: Estimated Future Costs for OGV1 by Funding Source

OGV1	Funding Source	2010	2011	2012	2013	2014	Total
	POLA	$3,000,000	$3,000,000	$3,000,000	$3,000,000	$3,000,000	**$15,000,000**
	POLB	$4,637,000	$2,500,000	$2,500,000	$2,500,000	$2,500,000	**$14,637,000**
	SCAQMD	$0	$0	$0	$0	$0	**$0**
	CARB	$0	$0	$0	$0	$0	**$0**
	Measure Totals	**$7,637,000**	**$5,500,000**	**$5,500,000**	**$5,500,000**	**$5,500,000**	**$29,637,000**

Completed Milestones

1. Staff from both ports will meet and confer with the Marine Exchange, the USEPA Region 9, CARB, SCAQMD and PMSA to revise and renew the VSR Memorandum of Understanding (unless replaced or superseded by regulation).

   Schedule: Completed. It was determined by the agencies that a renewed MOU is not necessary to continue to monitor the benefits of the VSR programs.

2. Staff from the ports of Los Angeles and Long Beach will work with the Marine Exchange to update equipment and software needed to track vessel speeds out to 40nm from Point Fermin.

   Schedule: Upgrade completed in 2008.
3. Staff will prepare a presentation and/or fact sheet outlining the air quality benefits of the VSR program. The final fact sheet will be posted on the CAAP website.

   Schedule: Completed.[18]

4. Amend the existing tariff incentive programs to implement a two-tiered approach, offering incentives for compliance to 20 nm and/or 40 nm from Point Fermin.

   Schedule: Completed in late 2008 for POLB and September 2009 for POLA.

Upcoming Milestones

1. Staff from the ports of Long Beach and Los Angeles will continue to work with the carriers to any address barriers to participation in the VSR programs to 40 nm from Point Fermin.

   Schedule: Ongoing.

2. As leases are opened through the EIR process or for renegotiation, or as new leases are negotiated, the ports will include provisions for compliance with the VSR program to 40 nm from Point Fermin.

   Schedule: As leases are opened.

3. The benefits of the VSR program will be quantified and reflected in the periodic updates to the ports' emissions inventories and reported annually to the Executive Director and the Board of Harbor Commissioners for each port.

   Schedule: Ongoing.

[18] *http://www.cleanairactionplan.org/strategies/vessels/vsr.asp*

Elements to be Tracked

The ports commit to provide regular updates on the progress of implementing this measure. These updates will be provided in quarterly progress reports, which detail significant progress for implementation of all CAAP measures.

Specifically for the OGV1 measure, the ports track compliance with the VSR programs on a monthly basis. In addition, the emissions benefits of OGV1 will be compiled each year in the annual emissions inventories.

Looking Forward

The ports will continue to work with carriers to increase participation in the VSR programs to 40 nm from Point Fermin. Currently, as part of their Diesel Risk Reduction Plan, Goods Movement Emissions Reduction Plan and Assembly Bill 32 (Global Warming Solutions Act of 2006), CARB is evaluating a strategy for ships to observe VSR speeds within 24 nm or 40 nm from the California coastline along major shipping channels. The ports will work closely with CARB to facilitate the development of a statewide VSR program.

4.2.2 Control Measure Number OGV2

Measure Title: ***<u>Reduction of At-Berth OGV Emissions</u>***

The use of shore power to reduce hotelling emissions implemented at all container and cruise terminals and one liquid bulk terminal at the Port of Los Angeles and all container, one crude, and one bulk terminal at the Port of Long Beach by 2014. Through the Technology Advancement Program, demonstration and application of alternative emissions reduction technologies will be evaluated and implemented for ships that are not good candidates for shore power.

Initiation Year:	*2004*
Key Milestone Dates:	*First shore-powered berth at POLA in June 2004; first shore-powered berth at POLB in 2007; CARB regulation adopted in December 2007; design, construction and operation of other berths at both ports to be phased-in through 2013; CARB regulation requires 50% of all container, cruise and reefer vessels to use shore power by 2014; port requirements implemented as leases are negotiated*
Criteria Pollutants Reduction:	*Use of shore power at-berth will reduce OGV hotelling emissions of DPM, NOx and SOx by 95% per vessel call*
GHG Impact:	*Use of shore power at-berth will reduce hotelling emissions of CO_2E by 95% per vessel call. Estimate does not account for power plant emissions*

Initial Implementation Strategies: Lease Requirements, Regulatory Requirements, & Incentives

Measure Description

This measure focuses on reducing hotelling emissions from OGVs while at berth. The measure focuses on two primary approaches for reducing at-berth emissions: (1) shore power (transferring the electrical generation needs for OGVs while at berth from onboard diesel-electric generators to the cleaner shore-side power grid, which generates power through regulated/controlled stationary sources) and (2) hotelling emissions reduction requirements through alternative technologies, for ships that do not fit the shore power model. The shore power approach is generally best suited for vessels that make multiple calls per year, require a significant power demand while at berth (a function of hotel load and time at berth), and vessels that will continue to call at the same terminal for multiple years. The most common ship types that are good candidates for shore power are large string-service containerships, cruise ships, reefer ships, and specially designed crude tankers that have diesel-electric engines.

Shore power requires extensive infrastructure improvements on-board vessels that would use the system, as well as on the terminal side for supplying the appropriate level of conditioned electrical power. The on-board infrastructure costs are dependent upon the candidate vessel's current configuration, conduit space, and electrical panel space.

Alternative hotelling emissions reduction technologies are in various stages of development and verification. These technologies may be applied to vessels that do not fit the shore power model and include but are not limited to:

- Exhaust gas scrubbing technologies that capture vessel stack emissions while at berth and "scrubs" exhaust streams either on-shore or on a barge.
- Shore-powered dockside electrical pumps for tankers, which reduce onboard pumping loads (typically these pumps are driven by steam power).
- Dockside portable distributed generation systems, which utilize LNG generators to supply power.

Emerging OGV emissions reduction technologies are being evaluated, demonstrated, and implemented through the Technology Advancement Program or other demonstration programs. Some of these technologies have demonstrated the potential to achieve equivalent emissions reductions of shore power while others have the potential for significant reductions (though not at the same level of shore power) of hotelling emissions. As an example, a short-term pilot test of the Advanced Maritime Emission Control System (AMECS) was successfully completed under the TAP in May and July of 2008. Results indicate at least a 95% DPM, SOx, and NOx emissions at-berth were captured from use of the system. AMECS is an emission control system that uses a mechanical articulating arm along with a soft-sealing exhaust intake bonnet to capture stack emissions from an OGV while at berth. Exhaust from the vessels is then transported to a multi-stage emission control system (consisting of a scrubber and selective catalytic reduction reactor) to reduce SOx, DPM, and NOx emissions. As a result of the successful pilot tests, POLB is planning to conduct a more extensive, longer-term demonstration in 2010. The longer-term demonstration testing is intended to evaluate the operational feasibility of the technology on an ongoing basis and establish the operational costs of the system.

Both ports have separate and distinct shore power programs; however, they share the common ultimate goal of transitioning all frequent visitors such as container and cruise ship operations calling at the ports to shore power, and to transition other vessel types toward alternative hotelling emissions reduction technologies. The Port of Long Beach's program is referred to as shore-side power or cold ironing, while the Port of Los Angeles' program is called Alternative Maritime Power (AMP™). With regard to shore power, the ports are in significantly different positions from an infrastructure standpoint. Generally, the Port of Los Angeles has the main electrical trunk lines in place from which to "step-down" and condition power for use by ships. The Port of Long Beach, on the other hand, needs to bring new electrical service lines from Interstate 405 into the Harbor District in order to supply the appropriate power, which will require significant infrastructure improvements and thus somewhat delay implementation timelines, and significantly increase the costs, compared with the Port of Los Angeles. One other difference between the two ports is the relationship with the cruise terminals. The Port of Los Angeles has a leasing relationship with their cruise terminal operators. The cruise terminal at the Port of Long Beach is leased by another department at the City of Long Beach and therefore is not directly under the control of the Port.

CARB adopted a regulation in December 2007 to reduce emissions from diesel auxiliary engines on OGVs while at-berth for container, cruise and reefer vessels[19]. The regulation requires that auxiliary diesel engines be shut down (i.e., use shore power) for specified percentages of fleet visits. In addition the fleet's at-berth auxiliary engine power generation (kW-hrs) must be reduced by the same percentages. As an alternative, vessel operators may employ any combination of technologies to achieve equivalent reductions. Specifically, by 2014, vessel operators relying on shore power are required to shut down their auxiliary engines at-berth for 50% of the fleet's vessel visits and also reduce their onboard auxiliary engine power generation by 50%. The specified percentages will increase to 70% in 2017 and 80% in 2020. For vessel operators choosing the emission reduction equivalency alternative, the regulation requires a 10% reduction in OGV hotelling emissions starting in 2010 increasing in stringency to an 80% reduction by 2020. The timelines presented in this measure will allow for compliance with the CARB regulation, but will accelerate the schedule and the level of use of shore power where possible.

In addition, CARB has proposed developing a second phase of the at-berth regulation, for vessels that are not captured by the first regulation. It was anticipated that this regulation would rely on the use of alternative technologies, and would result in 50% reduction of emissions from these additional vessels by 2014 and an 80% reduction by 2020. In December 2009 however, CARB stated that they would not be pursuing the second phase of the regulation. If cost-effective and commercially-available technologies did emerge in the future, CARB would revisit the issue.

Implementation Plan

The ports' implementation of this measure consists of two paths: use of shore power and alternative hotelling emissions reduction technologies for non-shore power candidate vessels/terminals. Shore power implementation will be different for each port due to the existing infrastructure differences cited above. In addition to making the terminal infrastructure available, it is imperative that requirements be placed on individual terminals to ensure that vessels use the shore power facilities. Lease requirements include specific performance requirements for maximum feasible utilization of the available shore power infrastructure. The phase-in schedule for those use requirements is dependent upon several factors, including how many berths at the terminal are equipped with shore power, retrofit and assignment of vessel strings to use the available infrastructure, and the phase-out of vessels that are not candidates for shore power (e.g. steamships). As soon as a berth is equipped with

[19] *http://www.arb.ca.gov/regact/2007/shorepwr07/shorepwr07.htm*

shore power infrastructure, that berth will be used to the maximum extent feasible. Ultimately, after all berths at a terminal are electrified, the goal is 100% utilization of shore power by candidate vessel calls at that terminal.

Port of Los Angeles AMP™ Implementation

The Port of Los Angeles has eight major container terminals and one cruise terminal (with three berths that can accommodate two large cruise ships). Over the next five years, the Port of Los Angeles will implement a massive infrastructure improvement program to make AMP™ available at a number of berths at container, one liquid bulk terminal, cruise terminals, and dredge plug-in locations. The implementation strategy focuses on terminal infrastructure improvements based on upcoming lease negotiations or EIR dates and will be implemented primarily by lease requirements to use AMP™ once the infrastructure is in place and operational. The schedules presented within the measure are preliminary and were developed with the port's Engineering Department based on assumptions regarding when projects will be cleared through the CEQA process.

Table 4.6 presents the berths at the Port of Los Angeles that are planned to be improved and operational within the next five years.

Table 4.6: POLA AMP™ Infrastructure by Berth Over Next Five Calendar Years

Berths (Terminal)	Number of Installations	Date Operational
B90-93 (Cruise Terminal)	3 Berths	2 Berths 2010; 1 Berth 2011
B100-102 (China Shipping)	2 Berths	1 Berth 2004; 1 Berth 2011
B121-131 (WBCT)	2 Berths	2013
B136-147 (TraPac)	3 Berths	2011
B175-181 (Pasha)	2 Berths	2011
B206-209 (LTT)	-	(Note: No Tenant)
B212-218 (YTI)	2 Berths	1 Berth 2006; 1 Berth 2013
B224-236 (Evergreen)	2 Berth	1 Berth 2010; 1 Berth 2014
Pier 300 (APL)	5 Berths	1 Berth 2012; Others 2013
Pier 400 (APM)	2 Berths	2 Berths 2014
Pier 400 Liquid Bulk	1 Berth	2012
Total	**24 AMP Berths**	

A preliminary aggressive lease requirement-based rollout scenario was developed in conjunction with POLA Engineering for the AMP™ program. Under this scenario, POLA would have AMP™ capabilities at 24 berths (3 cruise, 18 container, 2 breakbulk, and one liquid bulk) at a cost of approximately $85 million before the end of 2014. The resulting scenario would translate into the following number of AMP™ ship calls, presented below in Table 4.7.

Table 4.7: POLA Estimated AMP™' Ship Calls by Calendar Year

Berths (Terminal)	2010	2011	2012	2013	2014
B90-93 (Cruise Terminal)	12	84	84	84	157
B100-102 (China Shipping)	148	155	161	168	174
B121-131 (WBCT)	0	0	0	30	62
B136-147 (TraPac)	0	0	80	166	190
B175-181 (Pasha)	0	0	0	0	0
B206-209 (LTT)	0	0	0	0	0
B212-218 (YTI)	21	22	51	53	110
B224-236 (Evergreen)	25	52	52	52	138
Pier 300 (APL)	0	0	52	52	142
Pier 400 (APM)	0	0	0	0	211
Pier 400 Liquid Bulk	0	119	123	126	129
Total AMP'd Calls	**206**	**432**	**603**	**731**	**1,313**
AMP Container Calls versus Total Container Calls	11%	22%	30%	35%	60%
AMP Cruise Calls versus Total Cruise Calls	4%	29%	28%	28%	50%
AMP Tanker Calls versus Total Tanker Calls	0%	35%	35%	35%	35%

One berth at the China Shipping terminal and one berth at the YTI terminal are currently AMP™ equipped. At those terminals there were 40 AMP™ vessel calls in 2005, 63 AMP™ vessel calls in 2006, 59 AMP™ vessel calls in 2007, 50 AMP™ vessel calls in 2008, and 60 AMP™ vessel calls in 2009. The rollout of AMP™ as shown above will require significant terminal infrastructure improvements for both container and cruise terminals. The pre-construction activities include developing engineering plans and specifications, bid packages, contracting, etc. The shore side infrastructure improvements include installation of 34.5 kV to 6.6 kV transformers, connections ~200' apart along the berth, terminal trenching, etc. In the case of the cruise terminal, shore infrastructure improvements will include a shore based cable management system. The extremely aggressive AMP™ rollout program presented above is based on the following key assumptions/limitations:

- All EIRs/EISs remain on schedule.
- Customer vessels will be ready to use AMP™ shortly after berth infrastructure is completed and operational.
- With the exception of Evergreen, no other temporary AMP™ installations will be constructed. Evergreen is the exception because they already have AMP™ capable vessels.
- The port can complete AMP™ installations as assumed in the schedule.
- Weekly services call at each berth using AMP™.
- There will be enough AMP™ equipped vessels to reach 100% of all vessel calls at an AMP™-ready berth.
- Enough berths will be available to accept vessels either 6.6kV or 11kV systems.
- Although, all berths at the cruise terminal will be AMP ready by 2011, the projected number of cruise vessels calls that will utilize AMP™ as shown in table 4.7 are based on the fact that not all cruise terminal berths can accept vessels with 6.6kV and 11kV systems. .
- For Disney Cruise Line, all cruise vessel calls are assumed to utilize AMP™.
- At this time, there are no lease or CARB requirements through 2014 that would result in the mandatory use of Pasha's 2 anticipated AMP™ berths, therefore zero calls were assumed in Table 4.7.

Port of Long Beach Shore Power Implementation

During the next five years, the port will be undergoing a massive electrical infrastructure improvement program to construct an additional 6.6 kV sub-transmission line to serve the POLB Harbor District, and complete infrastructure improvements for the remaining container terminals, electric dredge plug-ins, and additional infrastructure for electrification of certain types of yard equipment.

Background: The Port of Long Beach Harbor Commission adopted a Green Port Policy in January 2005 that guides all port operations and future development to achieve significant air quality improvements. Key elements of the Green Port Policy that are being enacted over time are the port's commitment to implement shore power; the encouragement of terminal operators to electrify yard equipment; and the conversion to electric dredging for all port deepening projects. To undertake the large-scale improvements to the electrical system required to support these goals, the port has established an Electrical Infrastructure Program with primary responsibility to manage the strategic planning, development and improvement of the port's electrical infrastructure. In addition to air quality improvements, the program also has a goal of reducing the cost of electrical power for port tenants by simplifying the existing electrical distribution system and by upgrading the source voltage.

Priorities: Manage the strategic planning, development, and improvement of the port's electrical infrastructure.

Goals:

- Satisfy future electrical demand due to shore power, yard electrification and terminal development
- Preserve competitiveness
- Position the port to take advantage of future electrical service opportunities

POLB is actively implementing its shore power program. In 2006, the port began improvements on the shore power infrastructure at the BP terminal at berth T121. Construction is completed and since mid-2009, the shore power infrastructure has been operational and is being used. In 2006, shore power requirements were included in the terminal leases for the container terminals at Piers G and C. Since adoption of those leases, design and development of the infrastructure has proceeded, and in November of 2008, the shore power infrastructure at berth G232 became operational. Construction of shore power infrastructure at Pier C is underway. In 2007, almost 80% of the calls at the Berth F208 Mitsubishi Cement (MCC-Dry Bulk) facility utilized shore power when visiting the Port of Long Beach. Over 23 berths at container terminals at the Port of Long Beach are scheduled to be shore power ready by the end of 2014. These projects are discussed in greater detail below.

Table 4.8 presents the berths that are expected to be improved and operational with shore power within five years including the expected initial operational date. Table 4.9 summarizes the number of annual vessel calls.

Table 4.8: POLB Shore Power Infrastructure by Berth Over Next Five Calendar Years

Terminal	Number of Berths	Date Operational
PCT - Pier J South	3 Berths	1 Berth 2013; 2 Berths 2014
SSAT - Pier C	2 Berths	2010
SSAT Long Beach - Pier A	3 Berths	2013
TTI - Pier T	4 to 5 Berths	1 Berth 2012; Others 2013
CUT & LCBT - Pier E	2 Berths	2013
ITS - Pier G	4 Berths	1 Berth 2008; Others 2014
Pier S	2 to 3 Berths	2013
BP/ARCO - Berth T121	1 Berth	2009
Mitsubishi Cement (MCC) - Berth F 208	1 Berth	2007
Total	**22 to 24 Berths**	

Table 4.9: POLB Estimated Shore Power Ship Calls by Calendar Year

Terminal	2010	2011	2012	2013	2014
PCT - Pier J South	0	0	0	0	226
SSAT - Pier C	27	63	77	125	192
SSAT Long Beach - Pier A	0	0	0	0	113
TTI - Pier T	0	0	0	0	201
CUT & LCBT - Pier E	0	0	0	100	140
ITS - Pier G	50	100	150	200	200
Pier S	0	0	0	235	235
BP/ARCO - Berth T121	12	12	12	12	12
Mitsubishi Cement (MCC) - Berth F 208	34	35	36	37	37
Total Shore Power Calls	**123**	**210**	**275**	**709**	**1,356**
AMP Container Calls versus Total Container Calls	5%	9%	12%	30%	57%
AMP Cruise Calls versus Total Cruise Calls	1%	1%	1%	1%	1%
AMP Tanker Calls versus Total Tanker Calls	7%	7%	7%	7%	6%

The estimated calls are based upon the assumption that, for terminals with weekly services, at least 50 calls per year will be required through lease requirements, at each shore power berth. Once all berths at the terminal are equipped with shore power infrastructure and there is reasonable assurance that shore power ready vessels are available, all calls will be shore powered. As shown in Table 4.8, there will be shore power ready berths available for terminals PCT, J South, SSAT Long Beach, and TTI. However, there is no mechanism available to require ships calling at these shore power ready berths to utilize shore power until 2014. In 2014, CARB's at-berth regulation requires 50% of the container, cruise, and reefer vessel calls to utilize shore power. The port will work with these operators to encourage their use of the shore power facilities on a voluntary basis in excess of and in advance of the regulatory requirement.

The following list outlines the shore power capital improvement plan at the Port of Long Beach over the next five years. In preparation for this program, the Port of Long Beach developed a draft Electrical Master Plan to evaluate electrical needs for shore power and yard equipment electrification.

- Pier G/J Container Terminals 66 kV Power Transmission Infrastructure. Installation of approximately 3.5 miles of 66 kilo-volt power lines, over 50 high-mast 100 foot-plus power poles, and related power distribution facilities from Pico and Seabright SCE Substations to Piers G and J.
- Pier G Container Terminal Power Infrastructure. Provide container terminal 66kV/12kV substations, conduit, cables, and related distribution facilities.
- Pier G Container Terminal. Retrofit three existing berths for shore power to reduce diesel emission from ships while at berth.
- Pier J Container Terminal. Retrofit four existing berths for shore power at 6.6 kV to reduce diesel emission from ships while at berth by shutting down auxiliary diesel ship generators.
- Pier T Container Terminal. Retrofit four existing berths for shore power at 6.6 kV to reduce diesel emission from ships while at berth by shutting down auxiliary diesel ship generators.
- Pier A Container Terminal. Retrofit three existing berths for shore power at 6.6 kV to reduce diesel emission from ships while at berth by shutting down auxiliary diesel ship generators, plus power transmission infrastructure.
- Pier E Container Terminal. Build shore power for new berths at 6.6 kV to reduce diesel emission from ships while at berth by shutting down auxiliary diesel ship generators.

- Pier E Container Terminal Power Infrastructure. Provide container terminal 66kV/12kV substations, conduit, cables, and related distribution facilities.

- Pier S Container Terminal. Build shore power for new berths at 6.6 KV to reduce diesel emission from ships while at berth by shutting down auxiliary diesel ship generators.

- Pier S Container Terminal Power Infrastructure. Provide container terminal 66kV/12kV substations, conduit, cables, and related distribution facilities.

- Pier C Container Terminal. Retrofit two existing berths for shore power to reduce diesel emission of ships while at berth.

Standardization of AMP/Shore Power Systems

The International Organization of Standards (ISO) Technical Committee (TC) 8 and Sub-Committee 3 provided an environment and work platform that allowed the ports to take a leadership role in developing a shore power standard. The development of an international standard involved close cooperation between industry, industry associations, and the ports. The Port of Los Angeles, Port of Long Beach, and the Port of Rotterdam agreed to lead in this effort. Five draft committees were formed according to vessel/berth type: tankers/LNG, bulkers, containerships and roll-on/roll-off (ro/ro), cruise ships, and ferries.

Draft guidelines, which include the ports input, have been finalized by the ISO and are being reviewed by the International Electrotechnical Commission (IEC). The draft report is now publically available from ISO.

Alternative Hotelling Emissions Reduction Technologies Implementation

This path focuses on alternative emissions reduction technology strategies for hotelling emissions from vessels that are not good candidates for shore power. Currently there are no verified, commercially-available emissions reductions technologies for direct use on ship auxiliary emissions other than shore power. However, as mentioned earlier, the Technology Advancement Program (described in Section 4.7) has successfully demonstrated the Advanced Maritime Emissions Control System (AMECS) in short-term testing on two bulk vessels. The testing of the system has confirmed that emission reductions equivalent to those of shore power could potentially be achieved through the use of this alternative technology.

In addition to the AMECS system, there are other measures that can be implemented to reduce the loads required during hotelling for some ships, such as traditional bulk liquid tankers. One such option is the use of shore side electrical pumps for discharging the vessel. Under certain operational parameters, shore-side pumps can assist in reducing the load required by the ship's steam driven pumps. The ship's steam pumps would only be required to run at a load that moves the liquid over the "rail" or side of the ship; the rest of the liquid pipeline transport is powered by electrically powered on-shore pumps.

Testing of the Clean Air Logix DFMV Cold Ironing™ (DFMV) system was conducted in July 2007 on a container vessel at the Port of Oakland. The DFMV system was also demonstrated on a container vessel at the TraPac terminal at the Port of Los Angeles in October 2008. The results of these tests indicate that the system has the potential to reduce 90% or greater of at-berth DPM, NOx and SOx emissions. Clean Air Logix has developed a newer generation technology, called Flex-Grid, which utilizes dockside portable LNG generators to supply power directly to AMP-ready ships. It is designed to be used as a "bridge technology" until grid-based power is installed or as backup if grid-based power is temporarily unavailable. The Port of Los Angeles recently received a $1.2 million from USEPA to demonstrate Flex-Grid at one of its container terminals.

While these alternative technologies are potentially promising, additional information is needed to understand the operating costs of operation and to determine how they could be integrated into port operations.

Air Quality Benefits

This measure will result in significant reductions of DPM, NOx and SOx emissions. GHG emissions will also be significantly reduced due to the use of shore power and the associated reduced fuel consumption in auxiliary diesel engines. The emission benefits from this measure will be achieved earlier than those anticipated under CARB's regulation.

Benefits to Date

There were 59 AMP™ container vessel calls in 2007, 50 AMP™ container vessel calls in 2008, and 60 AMP™ container vessel calls in 2009 at the Port of Los Angeles. There were 19 shore powered dry bulk ship calls in 2007, 9 shore powered dry bulk ship calls in 2008 and 70 container, dry bulk and liquid bulk calls in 2009 at the Port of Long Beach. In addition, the two United States Maritime Administration's Ready Reserve Fleet vessels use shored-power while domiciled at the Port of Long Beach. The emissions benefits for all of these calls are included in 2007, 2008, and 2009 emissions inventories.

Future Benefits

A 95% reduction in DPM, NOx, SOx, and CO_2E will occur as a result of each OGV call utilizing shore power while at berth. Overall emissions reductions will depend upon the number of calls that utilize shore power, and will be documented in each port's Emissions Inventory.

Financial Costs

The financial costs associated with this measure include engineering designs, planning/coordination, electrical hardware procurement, contracting, construction, and testing of the shore power systems for each berth. Research and development costs associated with alternative at-berth emissions control systems are funding through the TAP. The financial costs to date and the anticipated future costs associated with this measure are presented below for each port.

Costs to Date

The costs to date for each port on shore power infrastructure are presented in Table 4.10 below.

Table 4.10: Costs-To-Date for OGV2 by Funding Source

OGV2	Funding Source	2006	2007	2008	2009	Total
	POLA	$0	$5,395,900	$17,072,800	$5,932,474	**$28,401,174**
	POLB	$5,533,900	$6,313,100	$8,078,900	$3,749,468	**$23,675,368**
	SCAQMD	$0	$0	$0	$0	**$0**
	CARB	$0	$0	$0	$0	**$0**
	Measure Totals	**$5,533,900**	**$11,709,000**	**$25,151,700**	**$9,681,942**	**$52,076,542**

Future Costs

The costs associated with the POLA AMP™ and POLB shore power programs are:

- Capital costs associated with the terminal infrastructure improvements.
- Engineering planning/evaluation of bringing required trunk lines down to the terminals.
- Permitting and construction management.
- Coordination with the Port's electrical service provider.

Port of Los Angeles AMP™ Order of Magnitude Costs

The majority of the costs to implement AMP™ at Evergreen, China Shipping and YTI were spent prior to the current CAAP planning cycle. The costs in Table 4.11 represent budget planning for the period of 2010 through 2014.

Port of Long Beach Shore Power Order of Magnitude Costs

The costs associated with the shore power program are:

- Capital costs associated with the terminal infrastructure improvements.
- Engineering planning/evaluation of bringing required trunk lines down to the terminals.
- Permitting and construction management.
- Coordination with the port's electrical service provider.

The majority of the costs for the BP Terminal Improvements at T121 and ITS Berth G232 were expended prior to the current CAAP planning cycle. The costs in Table 4.11 represent budget planning for the period of 2010 through 2014.

The estimated costs of the measure, by port, are presented in the following table. It should be noted that it is the intention of the ports to largely recapture the infrastructure costs over time through the financial terms in the lease. In addition, the ports will seek grant funding as available to offset the shore-side costs.

Table 4.11: Estimated Future Costs for OGV2 by Funding Source

OGV2	Funding Source	2010	2011	2012	2013	2014	Total
	POLA	$34,500,000	$16,900,000	$5,200,000	$42,000	$260,000	**$56,902,000**
	POLB	$36,495,369	$38,250,000	$56,933,477	$43,802,275	$14,749,202	**$190,230,323**
	SCAQMD	$0	$0	$0	$0	$0	**$0**
	CARB	$0	$0	$0	$0	$0	**$0**
	Measure Totals	**$70,995,369**	**$55,150,000**	**$62,133,477**	**$43,844,275**	**$15,009,202**	**$247,132,323**

Upcoming Milestones

1. Conduct pilot test of Alternative Maritime Emissions Control System (AMECS) including emissions reduction evaluation at Port of Long Beach.

   Schedule: Short-term emissions testing of AMECS was successfully completed through a joint port TAP funded demonstration on May 26, 2008 and July 16, 2008. The final report was completed in the 3rd quarter of 2008. Further demonstration of the AMECS will be necessary to evaluate operational considerations, cost, and durability of the system.

2. Ports to participate in the effort to standardize cold ironing infrastructure and connection equipment through the ISO committees and IEC.

   Schedule: The IEC/ISO Publicly Available Specifications have been available for purchase since April of 2009. The full international standards are scheduled to be published by 4th quarter of 2011.

3. As leases are opened through the EIR process or for renegotiation, or as new leases are negotiated, the ports will include provisions for use of shore power infrastructure.

   Schedule: As leases are opened.

4. Shore-side infrastructure in place and operational as presented above.

   Schedule: As shown above in Tables 4.6and 4.8

5. The benefits of this program will be quantified and reflected in the periodic updates to the port's emissions inventories.

   Schedule: Ongoing.

Elements to be Tracked

The ports commit to provide regular updates on the progress of implementing this measure. These updates will be provided in quarterly progress reports, which detail significant progress for implementation of all CAAP measures.

Specifically for the OGV2 measure, the ports will track the status of shore side infrastructure being developed to facilitate use of shore power by ships calling at those berths. The current schedule is shown in tables 4.6 and 4.8. In addition, the emissions benefits of OGV2 will be compiled each year in the annual emissions inventory. In order to reflect the emissions benefits, ports will track the number of ship calls that utilized shore power and their hotelling duration.

Looking Forward

In conjunction with CARB's at-berth emissions reduction regulation and the CAAP requirement, the ports are committed to provide shore power infrastructure to all container terminals, cruise terminal (POLA only) and selected liquid bulk terminals. The goal is for 100% of container calls to utilize shore power while at berth instead of operating auxiliary engines on diesel fuel. In addition, the ports are actively pursuing alternative emissions reduction technology strategies for hotelling emissions from vessels that are not good candidates for shore power. Any port funded demonstrations of alternative technologies would be conducted through the TAP, in coordination with the agency TWG.

4.2.3 Control Measure Number OGV3

Measure Title: ***OGV Low Sulfur Fuel for Auxiliary Engines and Auxiliary Boilers***

This measure reduces emissions from the auxiliary engines and auxiliary boilers of OGVs during their approach and departure from the ports, by switching to ≤0.2% sulfur distillate fuel (MGO or MDO) within 40 nm from Point Fermin. Compliance with the CARB rule limit of ≤0.1% sulfur distillate fuel (MGO or MDO) starts on January 1, 2012.

Initiation Year:	*2007*
Key Milestone Dates:	*CARB rule mandating ≤0.5% sulfur MDO or ≤1.5% sulfur MGO fuel for auxiliary engines and boilers used in California waters took effect initially on January 1, 2007 and was reinstated on July 1, 2009; CARB requirement for ≤0.1% sulfur MGO or MDO fuel will be effective January 1, 2012; IMO enforcing ECA requirement for 1.0% sulfur MGO or MDO fuel on August 1, 2012 up to 200 nm; ports' requirements per CAAP will be implemented as leases are renewed*
Criteria Pollutant Reduction:	*On a per OGV call basis, reduction of 83% DPM, 6% NOx, and 96% SOx will be achieved in 2013 due to switching fuel from IFO to MGO or MDO with 0.1% sulfur content over the distance the fuel is used.*
GHG Impact:	*Approximately 5% reduction in CO_2 and possible reduction in CH_4 associated with fuel switch from IFO to distillate fuels (MGO or MDO)[20]. However, there may be an increase in CO_2 emissions due to additional processing of fuel to produce MGO or MDO. Therefore, no CO_2 emissions benefits are assumed for this measure.*
Implementation Strategies:	**Lease Requirements & CARB Regulation**

Measure Description

This measure is designed to require all vessels to use lower sulfur distillate fuels in the auxiliary engines and auxiliary boilers of OGVs, within 40 nm of Point Fermin and while at berth. Traditionally, OGVs calling on the ports have burned heavy fuel oil (HFO), most commonly Intermediate Fuel Oil (IFO) 380 that has a sulfur content ranging from 1.0 to 4.5%. Substantial reductions in DPM and SOx can be achieved if these vessels use distillate fuels that have a lower sulfur content of ≤0.2%. There are also modest NOx reductions associated with the use of lower-sulfur fuels. This measure, as well as OGV4 (OGV Low Sulfur Fuel for Main Engines), targets vessel fuel quality with the goal of synchronizing the auxiliary and main

[20] Appendix D, *http://www.arb.ca.gov/regact/2008/fuelogv08/fuelogv08.htm*

engines, as well as auxiliary boilers to use distillate fuel of ≤0.2% sulfur in near-shore waters. This synchronization of fuel requirements is expected to reduce logistical and operational hurdles for the carriers. It should be noted that Maersk, the world's largest shipping line, has been voluntarily using ≤0.2% low-sulfur marine distillate fuel since 2006 in their vessel auxiliary and main engines on approach to California ports. Starting in 2007, all carriers used low sulfur distillate fuels in their auxiliary engines near the California coast under a statewide regulation adopted by CARB.

The ports have made assertive efforts to work with ports around the Pacific Rim, fuel suppliers, shipping lines, and others to emphasize the need for available supplies of ≤0.2% sulfur distillate fuels. It is critical to both this measure and OGV4 that cleaner fuels become more widely available as soon as possible. In an effort to better understand the current availability of ≤0.2% MGO at bunkering ports frequented by vessels that call on the ports of Long Beach and Los Angeles, the two ports jointly conducted a study, which was finalized in April 2008. This study concluded that the low sulfur MGO fuel supply at the major bunkering ports is likely to be sufficient to meet the demand in 2008 and 2009 if measures OGV3 and OGV4 are implemented through lease conditions. If the vessel main and auxiliary engine requirements were implemented immediately for all vessels operating up to 40 nautical miles from Point Fermin however, obtaining low-sulfur fuel at the time the study was completed could have been a problem in China, Japan, Korea, Central and South America, and North America-West Coast in 2008 and 2009.[21] It is expected that as demand for low sulfur marine fuel increases through the ports' programs and state and international regulations, fuel supplies will increase. The ports intend to update the low sulfur marine fuel availability study as necessary to support continued implementation of these measures.

CARB adopted a low sulfur marine fuel regulation for auxiliary engines in December 2005, which required the use of ≤1.5% sulfur MGO or ≤0.5% sulfur MDO beginning January 1, 2007. This regulation was legally challenged by the Pacific Merchant Shipping Association (PMSA). As a result, the U.S. District Court issued an injunction preventing CARB from enforcing the regulation. Through the appeal process, the regulation was enforced off and on throughout 2007 and 2008; however enforcement of the regulation was finally discontinued in May 2008. It is important to note that although CARB was enjoined from enforcing the requirements of the regulation, an informal survey conducted by PMSA indicated that all of those surveyed continued to voluntarily use low-sulfur distillate fuel in their auxiliary engines.

[21] Low Sulfur Marine Fuel Availability Study, Final Report, April 14, 2008. *http://www.cleanairactionplan.org/strategies/vessels/fuel.asp*

In July of 2008, CARB adopted a new regulation for fuel sulfur requirements for OGVs within 24 nm of the California coastline which affects auxiliary and main engines and boilers. Phase 1 of the regulation, which became effective on July 1, 2009, requires the use of ≤1.5% sulfur MGO or ≤ 0.5% sulfur MDO in auxiliary and main engines, and auxiliary boilers. Under Phase 2, the fuel sulfur limit for use in auxiliary and main engines and boilers will be 0.1% for MGO or MDO beginning January 1, 2012.

For those vessel calls that are subject to this measure due to new lease agreements or renewal, taken in combination with OGV4, the benefits of measure OGV3 will initially surpasses the benefits of CARB's regulation in the region near the ports by requiring ≤0.2% sulfur MGO or MDO within 40 nm of Point Fermin. However, by January 1, 2012, CARB's regulation will surpass the CAAP measures, requiring the use of MGO or MDO with a sulfur content limit of 0.1% by weight in the main and auxiliary engines and boilers of all OGVs within 24 nm of the California coastline.

As a further backstop to the ports programs and the CARB regulation, the IMO adopted international requirements under MARPOL Annex VI in October 2008. These place a global limit within 200 nm of the coast line on marine fuel sulfur content of 3.5% by 2012, down from 4.5% currently, which will be further reduced to 0.5% sulfur by 2020, or 2025 at the latest, pending a technical review in 2018. In Emissions Control Areas (ECAs), sulfur content will be limited to 1.0% starting in August of 2012, and further reduced to 0.1% sulfur in 2015.

Under OGV3, vessels that are subject to a lease requirement, that operate within 40 nm from Point Fermin are required to use ≤0.2% sulfur MGO or MDO fuels in auxiliary engines and auxiliary boilers (until superseded by the CARB and ECA regulation in 2012). The ports are trying to minimize the requirements for the use of multiple fuels due to on-board tankage limitations in some vessels. Therefore, the auxiliary engine and auxiliary boiler fuel requirement is the same as the main engine requirement in OGV4.

The fundamental elements of this control measure are:

1. The ports are securing near-term benefits over and above the existing CARB regulation, for vessel calls that are subject to this measure due new lease agreements, by requiring the accelerated introduction of ≤0.2% sulfur MGO or MDO fuels used in auxiliary engines and auxiliary boilers between 2006 and 2012.

2. The ports will continue to monitor implementation of this measure and will quantify the emissions benefits in their annual emissions inventories.

Implementation Plan

The Clean Air Action Plan provides for the active engagement by both ports to accelerate the availability of the ≤0.2% sulfur MGO or MDO fuels at key ports throughout the Pacific Rim. Through implementation of OGV3 and OGV4, in combination with upcoming regulatory requirements, the ports believe low sulfur marine fuel supplies will increase to meet the demand.

Currently, this measure is being implemented through lease requirements. The fuel requirement applies to vessel transits within 40 nm from Point Fermin and during hotelling. In addition, under the ports' Vessel Low Sulfur Fuel Incentive Program, implemented between July 2008 and June 2009, as described in OGV4, use of low sulfur (≤0.2% S MGO/MDO) fuel in vessel auxiliary engines while at berth was required in order to receive an incentive for use of the fuel in the vessel main engines.[22]

Air Quality Benefits

As OGV operators start using low sulfur MGO or MDO instead of IFO when arriving and departing from ports, there will be significant reductions of DPM and SOx emissions, with additional NOx benefits.

Benefits to Date

In 2007, 100% of OGV calls at both ports used low sulfur fuel in their auxiliary engines to comply with CARB's regulation adopted in 2005. In 2008, between January 1 and April 30, 100% OGV calls at both ports used low sulfur fuel in their auxiliary engines to comply with CARB's regulation, however after April 30th enforcement of the regulation was suspended and accurate voluntary compliance rates are unknown. Later in 2008, between July 1 and December 31, 14% of all OGV calls at the Port of Los Angeles and 6% of all OGV calls at the Port of Long Beach voluntarily switched to low sulfur fuel in their auxiliary engines at berth under the port funded Fuel Incentive Program. In 2009, between January 1 and June 30, 13 % of all OGV calls at the Port of Los Angeles and 5% of all OGV calls at the Port of Long Beach voluntarily switched to low sulfur fuel in their auxiliary engines at berth under the port funded Fuel Incentive Program. Starting July 1, 2009, all vessels that came to ports of Los Angeles and Long Beach were using 0.5% sulfur fuel to comply with CARB's regulation. The emissions benefits for all of the calls that switched fuel is included in 2007, 2008, and 2009 emissions inventories.

[22] *http://www.cleanairactionplan.org/strategies/vessels/fuel.asp*

Future Benefits

Currently, under the CARB regulation, all OGVs are required to use maximum 0.5% sulfur MDO or 1.5% sulfur MGO in their auxiliary engines and boilers when operating within 24 nm of the coast. OGVs subject to lease requirements will use maximum 0.2% sulfur MGO or MDO within 40 nm of Point Fermin. By 2012, maximum emissions benefits will be achieved when all OGV auxiliary engines and auxiliary boilers will be required to use MDO or MGO with a sulfur content limit of 0.1% by weight within 24 nm from coast line or 40 nm from point Fermin and 1.0% sulfur fuel up to 200 nm. On a vessel call basis, switching from high sulfur fuels (with an average sulfur content of 2.6%) to a low sulfur fuel at 0.1% sulfur will achieve an 83% reduction in DPM emissions, a 6% reduction in NOx emissions and a 96% reduction in SOx emissions.

Overall emission reductions will depend on the number of vessel calls, geographical boundaries of fuel switching (e.g., within 24 or 40 nm) and the sulfur content of fuel used prior to switch. CO2 emissions benefits are uncertain at this time.

Financial Costs

Costs to Date

There are no port related costs to date for this measure.

Future Costs

There are no anticipated port costs for this measure in the future.

Upcoming Milestones

1. Staff will survey fuel suppliers, shipping lines, and refineries to assess low sulfur fuel availability at major bunkering ports used by vessels calling at the ports of Long Beach and Los Angeles.

   Schedule: In early 2008, staff released a "Fuel Availability Study" which looked into the estimate of fuel demand from ships calling the ports of Long Beach and Los Angeles and assessed the availability of adequate quantities of ≤0.2% sulfur MGO necessary to supply those vessels through 2009. This study to be updated as needed.

2. Staff will monitor concerns raised by carriers and vessel operators regarding technical and safety issues associated with fuel switching in auxiliary engines and auxiliary boilers.

   Schedule: Ongoing.

3. Port staff will meet and work with other U.S. and international port authorities, including the Pacific Ports Air Quality Collaborative, in an effort to harmonize ship fuel requirements among the various ports.

   Schedule: Ongoing.

4. As leases are opened through the EIR process, or as new leases are negotiated, the ports are including provisions for use of low sulfur fuel in vessel auxiliary engines and auxiliary boilers.

   Schedule: As leases are opened.

5. The benefits of this program will be quantified and reflected in the periodic updates to each port's emissions inventories.

   Schedule: Ongoing.

Elements to be Tracked

The ports commit to provide regular updates on the progress of implementing this measure. These updates will be provided in quarterly progress reports, which detail significant progress for implementation of all CAAP measures.

Specifically for the OGV3 measure, the ports will provide updates to the low sulfur fuel availability study as needed. In addition, as part of the annual emissions inventories, the ports will provide updates on the number of vessels using low sulfur fuel in their auxiliary engines, auxiliary boilers, and the annual emissions from those sources.

Looking Forward

Recently, the IMO adopted stringent fuel sulfur content limitations which is a first major step towards controlling exhaust emissions from both U.S. flagged and ships of foreign origin. The USEPA along with Coast Guard, Navy, National Oceanic and Atmospheric Administration, Maritime Administration and the State Department were closely involved during the negotiation process for the final IMO standards. Later, in order to accelerate and achieve the full benefits of the most stringent fuel sulfur standards, the USEPA sought and received IMO approval for the Emissions Control Area (ECA) designation for the U.S. coastline.

Starting on July 1, 2009, CARB implemented fuel quality and sulfur content limits (13 CCR Section 2299.2) for use in auxiliary and main engines, and boilers, for all vessels operating within 24-nautical miles from the coast of California. Under this regulation, use of 0.1% S MGO or 0.1% S MDO will be required starting in January, 1 2012.

4.2.4 Control Measure Number OGV4

Measure Title: *OGV Low Sulfur Fuel for Main Engines*

This measure reduces emissions from main engines of OGVs during their approach and departure from the ports, by switching to ≤0.2% sulfur distillate (MGO or MDO) fuel within 40 nm from Point Fermin; Compliance with the CARB rule limit of ≤0.1% sulfur distillate fuel (MGO or MDO) starts on January 1, 2012

Initiation Year:	*2007*
Key Milestone Dates:	*Ports' voluntary fuel incentive in effect between July 1, 2008 and June 30, 2009; CARB's rule mandating low sulfur fuel use in main engines of vessel operating in California waters took effect on July 1, 2009; CARB requirement for ≤0.1% sulfur MGO or MDO fuel effective January 1, 2012; ports' requirements per CAAP implemented as leases are renewed; IMO enforced ECA requirement for 1.0% sulfur MGO or MDO fuel will be effective August 1, 2012 up to 200 nm;*
Criteria Pollutant Reduction:	*On a per OGV call basis, reduction of 83% DPM, 6% NOx, and 96% SOx from main engine operation will be achieved in 2013 due to switching fuel from IFO to MGO or MDO with 0.1% sulfur content over the distance the fuel is used.*
GHG Impact	*Approximately 5% reduction in CO_2 and possible reduction in CH_4 associated with fuel switch from IFO to distillate fuels (MGO or MDO)[23]. However, there may be an increase in CO_2 emissions due to additional processing of fuel to produce MGO or MDO. Therefore, no CO_2 emissions benefits are assumed for this measure.*

Implementation Strategies: Lease Requirements, Incentive Tariffs, & CARB Regulation

Measure Description

As implemented through leases, this program is designed to require all vessels to use lower sulfur fuels (≤0.2% sulfur MGO or MDO) in the main propulsion engines of OGVs within 40 nm of Point Fermin. During July 2008 through June 2009, the ports encouraged early use of the low sulfur fuel through a voluntary incentive program. Since July 1, 2009, use of low sulfur fuel has been required statewide under a CARB regulation.

[23] Appendix D, *http://www.arb.ca.gov/regact/2008/fuelogv08/fuelogv08.htm*

Typically vessels use bunker fuels in their main engines, such as IFO380, that have substantially higher sulfur content (i.e., 2.5% sulfur by weight). Substantial reductions in DPM and SOx can be achieved when these vessels use distillate fuels that have a lower sulfur content of ≤0.2%. There are also modest NOx reductions associated with the use of lower sulfur fuels. This measure is harmonized with measure OGV3 to minimize the need for vessels to carry multiple fuels (due to the limited tankage available on board OGVs). It should be noted that Maersk began voluntarily using low-sulfur marine distillate fuel in 2006 in both their auxiliary and main engines on approach to California ports. Several other carriers also began using the low sulfur fuel in July 2008, under the ports' incentive program. Since July 1, 2009, all vessels operating within 24 nm of the California coastline have been using maximum 1.5% S MGO or 0.5% S MDO fuel as required under the CARB regulation.

As mentioned in OGV3, the ports have made assertive efforts to work with other ports around the Pacific Rim, fuel suppliers, shipping lines, and others to emphasize the need for available supplies of ≤0.2% sulfur distillate fuels. It is critical to both this measure and OGV3 that cleaner fuels become available as soon as possible. As stated in OGV3, the two ports jointly conducted a study, finalized in April 2008, on the availability of low sulfur MGO fuels at the major bunkering ports frequented by the vessels that call on the ports of Long Beach and Los Angeles. This study concluded that the low sulfur MGO fuel supply at the major bunkering ports is likely to be sufficient to meet the demand in 2008 and 2009 if measures OGV3 and OGV4 are implemented through lease conditions. If the vessel main and auxiliary engine requirements were implemented immediately for all vessels operating up to 40 nautical miles from Point Fermin however, at the time the study was completed, it was identified that obtaining low sulfur fuel could be a problem in China, Japan, Korea, Central and South America, and North America-West Coast in 2008 and 2009[24]. It is expected that as demand for low sulfur marine fuel increases through the ports' programs and state and international regulations, fuel supplies will increase. The ports intend to update the low sulfur marine fuel availability study as necessary to support continued implementation of these measures.

In July of 2008, CARB adopted a regulation for fuel sulfur requirements for OGV auxiliary and main engines and auxiliary boilers within 24 nm from the California coastline. Phase 1 of the regulation, which went into effect on July 1, 2009, requires the use of ≤1.5% sulfur MGO or ≤0.5% sulfur MDO for auxiliary and main engines and boilers. Under Phase 2, the fuel sulfur limit will drop to 0.1% for MGO or MDO beginning January 1, 2012.

[24] Low Sulfur Marine Fuel Availability Study, Final Report, April 14, 2008. *http://www.cleanairactionplan.org/strategies/vessels/fuel.asp*

For those vessel calls that are subject to this measure due to new lease agreements or renewal, or those that participated in the fuel incentive program, taken in combination with OGV3, the benefits of this measure will initially surpasses those of CARB's regulation by requiring the use of ≤0.2% sulfur MGO or MDO within 40 nm of Point Fermin. However, by January 1, 2012, CARB's regulation will surpass those of the CAAP requiring the use of MGO or MDO with a maximum sulfur content of 0.1% by weight in the main and auxiliary engines and boilers of OGVs within 24 nm of the California coastline.

As a further backstop to the ports' programs and the CARB regulation, the IMO adopted international requirements under MARPOL Annex VI in October 2008. These place a global limit within 200 nm of the coast line on marine fuel sulfur content of 3.5% by 2012, down from 4.5% currently, which will be further reduced to 0.5% sulfur by 2020, or 2025 at the latest, pending a technical review in 2018. In ECAs, starting in August of 2012, sulfur content will be limited to 1.0% in 2012, and further reduced to 0.1% sulfur in 2015.

Vessel operators and carriers have raised concerns over the use of very low sulfur fuel in vessel main engines. While switching to low sulfur distillate fuel in vessel main engines is standard practice when vessels are serviced, concerns have been raised that operating the engines on the low sulfur fuel for extended periods of time may cause engine damage. The major vessel engine manufacturers, MAN B&W and Wärtsilä, have both stated that vessel main engines can be operated on the low sulfur distillate fuel with no differences in engine performance and without damaging the engines, as long as proper precautions are taken. Both engine manufacturers have published operating procedures for fuel switching. In addition, MAN B&W is also commercializing an automated fuel switching procedure for their engines. When operating the main engines on distillate fuel for extended periods of time, minor modifications are necessary, such as changing to a more compatible cylinder lube oil, however, over the distances required by the ports programs, this is likely not an issue.

The fundamental elements of this control measure are:

1. The ports will encourage early adoption of the use of low sulfur MGO or MDO fuel in vessel main engines through a port incentive program.

2. The ports are securing near-term benefits over and above the existing CARB regulation for vessel calls that are subjected to this measure via new lease agreements or renewal, or participation in the fuel incentive program, by requiring the accelerated introduction of ≤0.2% sulfur MGO or MDO fuel use in main engines between 2006 and 2012.

3. The ports will work with carriers, vessel operators, and engine manufacturers to facilitate discussions on the proper procedures for performing fuel switching in order to ease the transition to the low sulfur fuel requirements.

4. The ports will continue to monitor implementation of this measure and will quantify the emissions benefits in their annual emissions inventories.

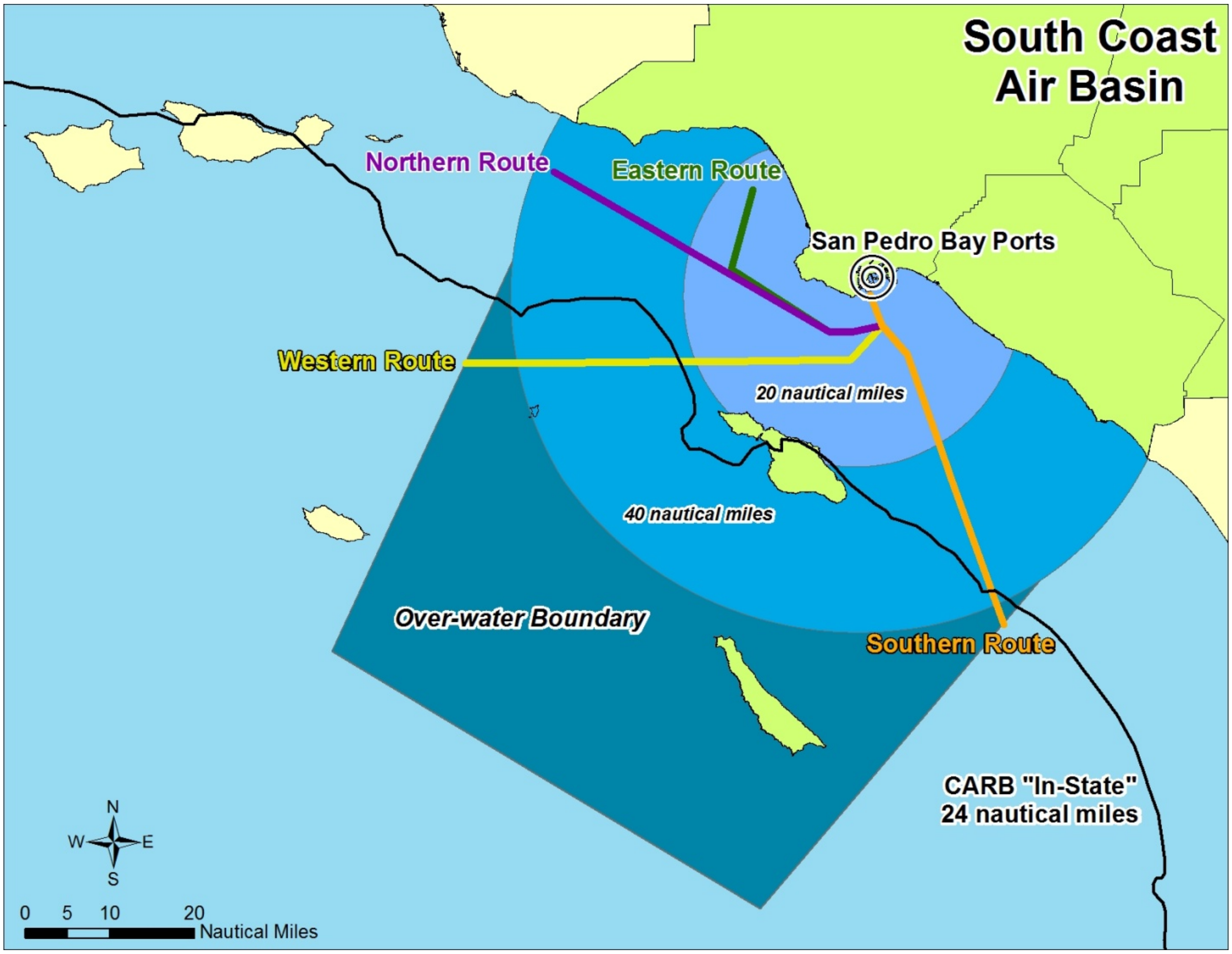
Implementation Plan

The Clean Air Action Plan provides for the active engagement by both ports to accelerate the availability of the ≤0.2% sulfur MGO or MDO fuels at key ports throughout the Pacific Rim. Through implementation of OGV3 and OGV4, in combination with upcoming regulatory requirements, the ports believe that low sulfur marine fuel supplies will increase to meet the demand.

Currently, this measure is being implemented through lease requirements and incentive tariffs. For leases, the use of low sulfur distillate fuel (≤0.2% sulfur MGO or MDO), will be required in main engines between 40 nm of Point Fermin and berth. In addition, in March 2008, at a joint Board of Harbor Commissioners meeting for the ports of Long Beach and Los Angeles, the ports adopted a tariff establishing the Vessel Low Sulfur Fuel Incentive Program. Under the program, which was in effect from July 2008 through June 2009, operators were reimbursed for the additional cost of using ≤0.2% sulfur MGO or MDO instead of IFO380 in their main vessel engines while within 20 or 40 nm of the ports. Also operators were required to comply with the vessel speed reduction speed limit of 12 knots, over the same distance that they used the low sulfur fuel, and use the low sulfur fuel in their auxiliary engines while at berth. This Program encourages the early use of low sulfur fuel, prior to the statewide requirement under the CARB regulation[25]. This program also offered an opportunity for the vessel operators to refine their procedures for switching fuels, prior to implementation of the CARB regulation, without having to pay for the added cost of the low sulfur fuel. A map of the various vessel requirement zones (i.e., 24 nm from the California coastline, and 20 or 40 nm from Point Fermin) is shown in Figure 4.2.

[25] *http://www.cleanairactionplan.org/strategies/vessels/fuel.asp*

Figure 4.2: Map of the Vessel Requirement Areas near the Ports of Long Beach and Los Angeles



Air Quality Benefits
As OGV operators start using low sulfur MGO or MDO instead of IFO when arriving and departing from ports, there will be significant reductions of DPM and SOx emissions.

Benefits to Date

In 2007, 26% of all OGV calls at the Port of Los Angeles and 6% of all OGV calls at the Port of Long Beach used low sulfur fuel in their main engines. In 2008, between July 1 and December 31, 14% of all OGV calls at the Port of Los Angeles and 6% of all OGV calls at the Port of Long Beach voluntarily switched to low sulfur fuel in their main engines under ports Fuel Incentive program. In 2009, between January 1 and June 30, 13 % of all OGV calls at the Port of Los Angeles and 5% of all OGV calls at the Port of Long Beach voluntarily switched to low sulfur fuel in their auxiliary engines at berth under the port funded Fuel Incentive Program. Starting July 1, 2009 all vessels that came to ports of Los Angeles and Long Beach were using 0.5% sulfur fuel to comply with CARB's regulation. The emissions benefits for all of these calls that switched fuel is included in the 2007, 2008 and 2009 emissions inventories.

Future Benefits

Currently, under the CARB regulation, all OGVs are required to use maximum 0.5% sulfur MDO or 1.5% sulfur MGO in their main engines when operating within 24 nm of the coast. OGVs subject to lease requirements will use maximum 0.2% sulfur MGO or MDO within 40 nm of Point Fermin. By 2012, maximum emissions benefits will be achieved when all OGV main engines will be required to use MDO or MGO with a sulfur content limit of 0.1% by weight within 24nm from coast line or 40 nm from point Fermin and 1.0% sulfur fuel up to 200 nm. On a vessel call basis, switching from high sulfur fuels (with an average sulfur content of 2.6%) to a low sulfur fuel at 0.1% sulfur will achieve an 83% reduction in DPM emissions, a 6% reduction in NOx emissions and a 96% reduction in SOx emissions. Overall emission reductions will depend on the number of vessel calls, geographical boundaries of fuel switching (e.g., within 24 or 40 nm) and the sulfur content of fuel used prior to switch. CO2 emissions benefits are uncertain at this time.

Financial Costs

Costs to Date

Port costs to date associated with this measure are presented in Table 4.12, below. These costs are associated with the development and operation of the fuel switch incentive program.

Table 4.12: Costs-to-Date for OGV4 by Funding Source

OGV4	Clean Fuels Main Engine	2006	2007	2008	2009	Total
	POLA	$0	$0	$354,000	$204,000	**$558,000**
	POLB	$0	$0	$120,800	$90,000	**$210,800**
	SCAQMD	$0	$0	$0	$0	**$0**
	CARB	$0	$0	$0	$0	**$0**
	Measure Totals	**$0**	**$0**	**$474,800**	**$294,000**	**$768,800**

Future Costs

The ports' costs for the fuel switch incentive program ended in July 2009 when the new CARB fuel switch regulation becomes effective; there are no port costs after 2009.

Completed Milestones

1. In order to monitor vessel speeds for the Vessel Main Engine Fuel Incentive Program to 40 nm from Point Fermin, the ports will coordinate with Marine Exchange to upgrade the necessary vessel tracking hardware and software.

   Schedule: Complete. Vessel tracking by Marine Exchange was upgraded in 2008.

2. The ports will implement an incentive program to encourage early use of low sulfur fuel within 20 nm or 40 nm of Point Fermin.

   Schedule: The Program was adopted during a joint port Board of Harbor Commissioner's meeting in March 2008. The Program was available for one year, starting July 1, 2008 and ending June 30, 2009, after which the statewide requirement came into effect.

Upcoming Milestones

1. Staff will survey fuel suppliers, shipping lines, and refineries to assess low sulfur fuel availability at major bunkering ports used by vessels calling at the ports of Long Beach and Los Angeles.

   Schedule: In early 2008, staff released a "Fuel Availability Study" which looked into the estimate of fuel demand from ships calling the ports of Long Beach and Los Angeles and assessed the availability of adequate quantities of ≤0.2% sulfur MGO necessary to supply those vessels through 2009. This study to be updated as needed.

2. Staff will meet and work with carriers, vessel operators and engine manufacturers to facilitate discussions on the proper procedures for performing fuel switching in order to address the technical and safety concerns and to ease the transition into the low sulfur fuel requirements.

   Schedule: The ports held a workshop for carriers and vessel operators in early 2008 which included presentations by MAN B&W, Wärtsilä, and Maersk. The ports will continue to facilitate discussions, as needed.

3. Staff will meet and work with other U.S. and international port authorities, including the Pacific Ports Air Quality Collaborative, in an effort to harmonize ship fuel requirements among the various ports.

   Schedule: Ongoing.

4. As leases are opened through the EIR process, or as new leases are negotiated, the ports are including provisions for compliance with the Main Engine Fuel Standard.

   Schedule: As leases are opened.

5. The benefits of this program will be quantified and reflected in the periodic updates to the port's emissions inventories.

   Schedule: Ongoing.

Elements to be Tracked
The ports commit to provide regular updates on the progress of implementing this measure. These updates will be provided in quarterly progress reports, which detail significant progress for implementation of all CAAP measures.

Specifically for the OGV4 measure, the ports will provide updates to the low sulfur fuel availability study as needed. In addition, as part of the annual emissions inventories, the ports will provide updates on the number of vessels using low sulfur fuel in their main engines, and the annual emissions from those engines.

Looking Forward
Recently, the IMO adopted more stringent fuel sulfur content limitations which are a first major step towards controlling exhaust emissions from ocean going vessels from both U.S. and foreign ships. The USEPA along with Coast Guard, Navy, National Oceanic and Atmospheric Administration, Maritime Administration and the State Department were closely involved in the negotiation process for the final IMO standards. Later, in order to accelerate and achieve full benefits of these standards, the USEPA sought and received IMO approval for the ECA designation for U.S. coastlines. .

Starting on July 1, 2009, CARB implemented fuel quality and sulfur content limits (13 CCR Section 2299.2) for use in auxiliary and main engines, and boilers, for all vessels operating within 24-nautical miles from the coast of California. Under this regulation, use of 0.1% S MGO or 0.1% S MDO will be required starting in January, 1 2012.

4.2.5 Control Measure Number OGV5

Measure Title: ***Cleaner OGV Engines***

Measure seeks to maximize the number of vessels meeting the IMO NOx limit of 3.4 g/kW-hr that visit the ports.

Initiation Year:	*2008*
Key Milestone Dates:	*IMO's NOx engine standards for OGVs adopted in October 2008; IMO Tier 2 NOx standards come into effect January 1, 2011 for new vessels; IMO Tier 3 NOx standards come into effect January 1, 2016 for new vessels operating in Emission Control Areas*
Criteria Pollutants Reduced:	*On an individual OGV basis, 15% reduction in NOx emissions will result from compliance with the IMO Tier 2 standard compared to Tier 1 standard and 80% reduction in NOx emissions will result from compliance with the IMO Tier 3 standard compared to Tier 1 standard*
GHG Impact:	*Dependent upon the technology used by IMO compliant vessels that frequent the ports; cannot be quantified at this time*

Initial Implementation Strategies: Regulatory Strategies, Lease Requirements, & Tariff Incentives

Measure Description

This measure focuses on the early introduction and preferential deployment of vessels that comply with the Annex VI NOx and SOx standards for ECAs into the fleet that calls at the ports of Long Beach and Los Angeles. OGVs are the greatest single contributors of emissions from port of Long Beach and Los Angeles operations. Securing emission reductions from these sources remains a priority and presents a significant challenge due, not in small part, to the fact that the stringency of OGV main engine emission standards has not kept pace with other source categories such as HDVs and CHE.

Annex VI of MARPOL 73/78, the Regulations for the Prevention of Air Pollution from Ships, requires that all ships of 400 gross rated tonnage or above obtain an International Air Pollution Prevention (IAPP) certificate. The Annex became effective May 19, 2005 and applies to all ships constructed (keel laid) on or after that date. Ships constructed before May 19, 2005 are required to comply with Annex VI on the first scheduled dry-docking after the date of entry into force, but in no case later than May 19, 2008. Finally, starting in 2010, existing ships built between 1990 and 2000, will be required to retrofit their engines to meet the Tier 1 NOx standard upon first engine rebuild (See Section 1 of this report for a detailed description of the Annex VI requirements).

In October 2008, the IMO approved amendments to the NOx Technical Code of Annex VI which resulted in additional NOx limits for new engines, additional sulfur content limits for marine fuel, methods to reduce PM emissions, and NOx limits for existing engines.

The Annex VI amendments follow a three-tier structure for new engines which would set progressively tighter NOx emission standards for new Category 3 engines (the large engines used for vessel propulsion, with per-cylinder displacement at or above 30 liters) depending upon their date of installation (See Table 4.13). Annex VI will require vessels operating within an ECA that were constructed on or after January 1, 2016 to achieve an 80% reduction in NOx emissions compared to those vessels constructed prior to 2011. The United States was the 53rd country to ratify Annex VI of the International Convention for the Prevention of Pollution from Ships, with the deposition of an instrument of ratification with IMO in October of 2008.[26]

Table 4.13: MARPOL Annex VI NOx Emission Limits

Ship Construction Date	NOx g/kW-hr
On or After January 1, 1990 and prior to January 1, 2000*	17.0
On or After January 1, 2000 and prior to January 1, 2011	17.0
On or After January 1, 2011 and prior to January 1, 2016	14.4
On or After January 1, 2016 for Emissions Control Area	3.4

*If not built to this standard originally, must meet this standard upon first rebuild.

[26] eNewsUSA, "U.S. ratifies & New International Ship Pollution Regulation Adopted", *http://enewsusa.blogspot.com/2008/10/us-ratifies-new-international-ship.html, October 10, 2008*

In addition to NOx controls for Category 3 engines, the IMO Annex VI amendments place a global limit on marine fuel sulfur content of 3.5% (35,000 ppm) by 2012, from the current level of 4.5%, which will be further reduced to 0.5% (5,000 ppm) by 2020, or 2025 at the latest, pending a technical review in 2018[27]. In ECAs, the sulfur content will be limited to 1.0% (10,000 ppm) in 2010, and further reduced to 0.1% [1,000 ppm (a 90% reduction)] in 2015 from the current limit of 1.5%. In California, CARB's Vessel Fuel Rule, which requires the use of MDO or MGO with the sulfur content limit of 0.1% beginning January 1, 2012, will accelerate the benefits of the Annex VI lower sulfur fuel requirement in ECAs.

Under the Clean Air Act, on December 22, 2009, USEPA announced final emission standards for new marine diesel engines with per-cylinder displacement at or above 30 liters or Category 3 marine diesel engines installed on U.S.-flagged vessels. The final engine standards are equivalent to IMO's latest MARPOL standards as described above. The emission standards apply in two stages: near-term standards for newly-built engines will apply beginning in 2011, and long-term standards requiring an 80 percent reduction in NOx beginning in 2016. USEPA has also adopted MARPOL Annex VI standards for existing engines built between 1990 and 2000. The USEPA also applied to IMO to designate U.S. coasts as an Emissions Control Area (ECA), and forbid the production and sale of fuel with greater than 0.1% sulfur for use in waters within a U.S. ECA. The application to designate a North American ECA was approved by IMO on March 26, 2010.

It is estimated that measures previously implemented by the USEPA, CARB, and the CAAP, including the additional benefits of the latest Annex VI standards, and establishment of an ECA for North America, will result in significant reductions in NOx, SOx, and DPM compared to 2005 levels. However introduction of new and rebuilt vessels complaint with the Annex VI NOx requirements into the fleet is not expected to be fast enough to meet the CAAP goals. Therefore, the ports seek to encourage early introduction of these vessels with cleaner engines, at a rate that is faster than would occur naturally due to fleet turnover.

Implementation Plan

The ports shall require through lease requirements and CEQA mitigations that vessels built on or after the effective date of January 1, 2016 show evidence of compliance with the MARPOL Annex VI standards. In addition, as described in measures OGV3 and OGV4, the ports will implement lease requirements for vessels to use ≤0.2% sulfur marine distillate fuel within 40nm of Point Fermin, which will step down to ≤0.1% sulfur fuel in 2012, upon implementation of the second phase of the CARB regulation. Further, the ports shall also consider developing a targeted outreach program and/or establishing of an incentive program geared toward facilitating the early introduction of lower emitting OGVs and their preferential deployment to the ports of Long Beach and Los Angeles. In support of this effort, port staff will work with vessel builders and shipping lines to determine the best combination of mechanisms, including incentives, to accelerate turnover of the vessel fleet to Annex VI compliant ships.

[27] *http://www.epa.gov/otaq/regs/nonroad/marine/ci/mepc58-5noxsecretariat.pdf*

The ports have strongly encouraged the USEPA to adopt NOx emission standards for Category 3 engines on OGVs that are at the least equivalent to the Annex VI standards. In addition, the ports have recommended that DPM standards be included in promulgated rules and that USEPA work with IMO to incorporate DPM standards as amendment to Annex VI, so that these standards will apply to all vessels (U.S. and foreign). Finally, the ports have been strong supporters of the USEPA in its application to the IMO to establish a North American ECA. Now that the application has been approved by IMO, the ports will continue to support implementation of the requirements that the most stringent engine NOx emissions standards and lowest sulfur content fuels be met by vessels calling on the ports on or prior to the established schedule.

Air Quality Benefits

<u>*Benefits to Date*</u>

The air quality benefits associated with this measure do not begin until 2011, when the IMO Tier 2 NOx limit is implemented. There are no benefits to date.

<u>*Future Benefits*</u>

OGVs complying with the IMO Tier 2 standard (i.e., built after January 1, 2011) will achieve about a 15% reduction in NOx emissions compared to an OGV meeting the IMO Tier 1 standard. Similarly, OGVs complying with the IMO Tier 3 standard (built after January 1, 2016 and operating in an ECA) will achieve an 80% NOx reduction compared to those vessels complying with a Tier 1 standard. Overall emissions reductions will depend on the number and types of IMO compliant vessels visiting the ports in 2013.

Financial Costs

The port costs for this measure are currently limited to the study of the most effective methods of promoting the early introduction and deployment of Annex VI compliant vessels to the ports. No specific cost estimates are available at this time.

Upcoming Milestones

1. To facilitate the near-term deployment of cleaner vessels, the ports will bring the issues of expedited production and preferential deployment forward in international venues such as the International Association of Port and Harbors, International Maritime Organization and the Pacific Ports Air Quality Collaborative.

   <u>Schedule:</u> The ports will continue to discuss the need for accelerated introduction of cleaner OGV engine technologies during discussions with various international port and regulatory organizations.

2. The ports will communicate with shipping lines and ship builders regarding the need for new ship builds to be, at a minimum, compliant with MARPOL Annex VI NOx standards for vessels operating in ECAs. In addition, the ports will meet with representatives of the shipping industry and vessel engine manufacturers to better understand issues underlying existing vessel deployment strategies in order to identify opportunities for preferential deployment of vessels that comply with the 2016 MARPOL Annex VI emissions standards.

   Schedule: Meetings initiated in 2010.

3. The ports shall determine through communication with shipping line operators and through analysis of historic vessel call information, the past and projected age distribution of ships calling on the ports. By concentrating efforts on those vessel classes and lines which most frequently call on the ports, the benefits of this strategy may be optimized.

   Schedule: Vessel call tracking is an ongoing element of the periodic updates to the ports' emissions inventories. It is from these data that call frequency by terminal, vessel class and age will be tracked.

4. The ports will work with the regulatory agencies to provide support for implementation of a North American ECA, which will require that the most stringent engine emissions standards and lowest sulfur content requirement in fuel be met by vessels calling on the ports.

   Schedule: Ongoing.

5. As leases are opened through the EIR process or for renegotiation, or as new leases are negotiated, the ports will include provisions for the compliance with Annex VI NOx standards for vessels operating in ECAs.

   Schedule: As new leases are opened or existing leases are renewed.

6. Staff will evaluate the development of a program to encourage accelerated deployment of vessels compliant with Annex VI NOx standards for ECAs to the ports (e.g. targeted outreach campaign, incentive program, etc.) and will bring appropriate recommendations for consideration to each port's Board.

   Schedule: Board consideration anticipated in 2011.

7. The benefits of this program will be quantified and reflected in the periodic updates to each port's emissions inventories.

   Schedule: Ongoing.

Elements to be Tracked

The ports commit to providing regular updates on the progress of implementing this measure. These updates will be provided in quarterly progress reports, which detail significant progress for implementation of all CAAP measures.

Specifically, for vessel main engine emissions improvements, the ports will provide updates on the new leases that are adopted that include provisions for compliance with Annex VI standards. If an incentive program is deemed an effective and appropriate tool for encouraging early introduction of Annex VI compliant vessels and preferential deployment to the ports, ports' staff will provide updates on the participation rates within the incentive program. Finally, emission reductions from vessels complying with the MARPOL Annex VI standards will be tracked in the ports' annual emissions inventories.

Looking Forward

The ports will continue to support USEPA on their implementation of an ECA for North America. Since the ECA was approved in March 2010, vessels calling at ports in the United States, including the ports of Long Beach and Los Angeles, will be required to meet the cleanest NOx engine standards and use ≤0.1% sulfur fuel. In addition, the ports will encourage the early introduction of Annex VI compliant vessels and will seek opportunities to have these lower emitting vessels selectively deployed to the San Pedro Bay.

4.2.6 Control Measure Number OGV6

Measure Title: <u>OGV Engine Emissions Reduction Technology Improvements</u>

This measure seeks to encourage demonstration and deployment of cleaner OGV engine technologies that are validated through the Technology Advancement Program (TAP) or by the regulatory agencies. The goal of this measure is to reduce DPM and NOx emissions of in-use vessels.

Initiation Year:	*2006*
Key Milestone Dates:	*Port's TAP Program initiated in 2007*
Criteria Pollutant Reduction:	*Slide valve technology implemented for MAN B&W engines may reduce 25% DPM and 30% NOx; technology reductions due to other technologies cannot be quantified at this time*
GHG Impact:	*Dependent on the effectiveness of the demonstrated technology; cannot be quantified at this time*

Initial Implementation Strategies: Technology Advancement Program, Lease Requirements, Tariff Changes, & Incentives

Measure Description

This measure focuses on reducing DPM and NOx emissions from the existing fleet of vessels. This measure is coupled with the Technology Advancement Program (TAP) in that the technologies vetted through the TAP might be utilized to reduce OGV engine emissions upon determination and verification of their emissions control efficiencies.

Some examples of potential methods of reducing emissions from large marine diesel engines include:

- Direct Water Injection (DWI)
- Fuel Water Emulsion (FWE)
- Humid Air Motor (HAM)
- Exhaust Gas Recirculation (EGR)
- Selective Catalytic Reduction (SCR)
- Continuous Water Injection (CWI)
- Slide Valves

Many of these technologies are being evaluated for integration into vessel new builds to meet the upcoming regulatory standards, however use of these technologies as a retrofit for existing vessels should also be explored. In addition, the list of technologies mentioned above is not all-inclusive. Although limited tests of the emission reduction potential of each of the technologies has been performed, these strategies must still be verified through the TAP process in order to assess their applicability as retrofits for OGV engines.[28] The ports will continue to seek to demonstrate additional emerging technologies through the TAP, which would then be included as options for further reductions upon verification.

The ports, along with several other funding partners, including the USEPA and CARB, have been participating in a demonstration of the use of slide valve retrofit and fuel water emulsion on a vessel calling at the ports. The emissions tests were completed in 2008. Preliminary results from the demonstration indicate that the use of slide valves as a retrofit technology may not provide the same emission reductions as originally anticipated. The manufacturer, MAN B&W, has indicated that slide valves have produced reductions of 30% NOx emissions and 25% DPM emissions when the technology is optimized in new engines, however this level of reduction may not be universal. The results from the slide valve retrofit demonstration are inconclusive. More information is needed to understand the potential benefits of slide valves as a retrofit and as installed in new builds. For example, the earlier testing was completed using bunker fuel, not distillate fuel, which is currently being used in vessels complying with the CARB Vessel Fuel Rule within 24 nm of the California coast. In addition, the effect of engine optimization following installation of the retrofit should be evaluated. The ports may seek to conduct an additional evaluation of this technology as appropriate.

Implementation Plan

The ports will actively engage the shipping industry to identify and evaluate technologies that may have the potential to reduce emissions from the in-use fleet of vessels. These demonstrations will be conducted under the ports' TAP. In addition, the ports will monitor demonstrations and verification of technologies outside of the TAP, that undergo evaluation and verification by the regulatory agencies. The ports will work with the shipping industry to deploy proven technologies as soon as possible, following validation of emission reduction benefits.

[28] Emission Control Technologies for Ocean Going Vessels (OGVs) presented by H.R. Rahai, PhD. and H. Hefazi, Ph.D. Center for Energy and Environmental Research and Services (CEERS), California State University, Long Beach.

Air Quality Benefits
The estimated reductions in DPM and NOx associated with this measure are discussed below.

Benefits to Date
15% of the total port calls in 2007 were made by vessels equipped with slide valves. In 2008, 21% of the total calls at the Port of Los Angeles and 34% of the total calls at the Port of Long Beach were made by vessels equipped with slide valves. In 2009, 27% of the total calls at the Port of Los Angeles and 38% of the total calls at the Port of Long Beach were made by vessels equipped with slide valves. The benefits of the use of this technology are included in annual inventory updates.

Future Benefits
Slide valves installed in OGV main engines can potentially achieve a 25% reduction in DPM and 30% reduction in NOx emissions. However, the potential benefits for new engines and retrofits should be further evaluated.

Financial Costs
Costs to Date
To date the cost of this measure has been limited to participation in the demonstration project to evaluate slide valves and emulsified fuel. Costs to date are included in the TAP budget.

Future Costs
The projected costs to the ports for this measure are associated with those of the TAP to evaluate and verify technologies and are included in the costs shown in Section 4.7. Additional costs could be incurred if financial incentives for early introduction and deployment of slide valve and other technologies are considered. These additional costs cannot be quantified at this time.

Completed Milestones
1. The Ports will publish fact sheets or other information that describe the emission reduction technologies available and those emerging through the TAP and the ports' needs (in terms of reductions from the current fleet) in order to achieve CAAP goals.

   Schedule: Fact sheets were initially completed in 1st quarter 2008. These fact sheets or any other relevant information will be updated periodically, as needed.

Upcoming Milestones

1. Further explore the potential DPM and NOx emission reduction benefits from slide valves installed as a retrofit or on a new build, using distillate fuel, with and without engine optimization.

   Schedule: The testing of the slide valve retrofit was completed in August 2008, however the results were inconclusive and additional testing is needed to quantify the emission reduction benefits when the engines are optimized and the vessels are using distillate fuel. The port will further investigate the benefits of using slide valves, and if necessary, will seek to perform further testing of the technology

2. The ports will convene detailed technical meetings with stakeholders (including vessel operators, engine manufacturers, regulatory agencies) with the goal of developing a strategic plan for reducing emissions from in-use vessels. The strategic plan will prioritize the technology options using cost, feasibility, operational integration and will identify the performance standard(s) that may be achievable. In addition, the plan will identify technology gaps. The ports and the stakeholders will also commit to collaborative demonstration projects to evaluate the effectiveness of new or emerging technology options. The ports will incorporate technologies that have been identified, through demonstrations or verification testing, as feasible and cost effective into lease requirements and/or incentive programs. In addition, the ports will work with USEPA to seek to amend the Category 3 rule to include performance standards for in-use vessels.

   Schedule: The ports will initiate meetings with the stakeholders in 2010.

3. Staff will meet and work with international venues such as International Association of Port Authorities, International Maritime Organization and the Pacific Ports Air Quality Collaborative in an effort to provide/share information on vessel technologies and to advance engine emissions improvements.

   Schedule: Ongoing.

4. For retrofit technologies that prove to be cost effective and feasible for reducing emissions from vessel engines, require the use of that technology through port leases, as appropriate.

   Schedule: Ongoing.

5. The benefits of this program will be quantified and reflected in the periodic updates to the ports' emissions inventories.

   Schedule: Ongoing.

Elements to be Tracked

The ports commit to providing regular updates on the progress of implementing this measure. These updates will be provided in quarterly progress reports, which detail significant progress for implementation of all CAAP measures.

Specifically the ports will track the status of emerging emission reduction technologies through the TAP and through discussions with engine manufacturers and vessel operators. Finally, emissions reductions from vessels employing these technologies will be tracked and the reductions reflected within the ports' emissions inventory updates.

Looking Forward

The ports will work to streamline the evaluation process under TAP and verification process through CARB in order to ensure that time between concept and application is shortened to the greatest extent practicable in order to achieve the greatest level of emission reduction from ocean going vessels as quickly as possible.

4.3 Cargo Handling Equipment Control Measure

Cargo handling equipment (CHE) is another of the five port-related emissions source categories that contribute toward the adverse impact on air quality. The operation of this equipment is confined within the ports' boundaries. Despite growth, the emissions contribution from this category is projected to decline largely due to the in-use emissions control regulations adopted by the CARB and CAAP measure CHE1, which further encourages the implementation of new technologies and standards into the ports' fleets, when they become feasible and available. Implementation of this measure demonstrates the ports' determination to accelerate ongoing efforts to reduce air pollution from all modes of goods movement.

4.3.1 Control Measure Number: CHE1

Measure Title: ***Performance Standards for CHE***

This measure calls for the following CHE improvements:

- *Beginning 2007, all CHE purchases will meet one of the following performance standards:*
  - *Cleanest available on-road or off-road NOx standard alternative-fueled engine, meeting 0.01 g/bhp-hr DPM, available at time of purchase, or*
  - *Cleanest available on-road or off-road NOx standard diesel-fueled engine, meeting 0.01 g/bhp-hr DPM, available at time of purchase.*
  - *If there are no engines available that meet 0.01 g/bhp-hr DPM, then must purchase cleanest available engine (either fuel type) and install cleanest CARB verified diesel emission control strategy (VDECS) available.*
- *By the end of 2010, all yard tractors will meet, at a minimum, the USEPA 2007 on-road or Tier 4 off-road engine standards.*
- *By the end of 2012, all pre-2007 on-road or pre Tier 4 off-road top picks, forklifts, reach stackers, RTGs, and straddle carriers <=750 hp will meet, at a minimum, the USEPA 2007 on-road engine standards or Tier 4 off-road engine standards.*
- *By end of 2014, all CHE with engines >750 hp will meet at a minimum the USEPA Tier 4 off-road engine standards. Starting 2007 (until equipment is replaced with Tier 4), all CHE with engines >750 hp will be equipped with the cleanest available CARB VDECS.*

Initiation Year:	*2006*
Key Milestone Dates:	*Implementation through leases with requirements phased-in between 2007 and 2014*
Criteria Pollutant Reductions:	*The average CHE meeting CHE1 requirements will emit at least 80% less DPM and at least 50% less NOx*
GHG Impact:	*Reduction in GHGs depends upon the technology used to meet future emissions standards; cannot be quantified at this time*

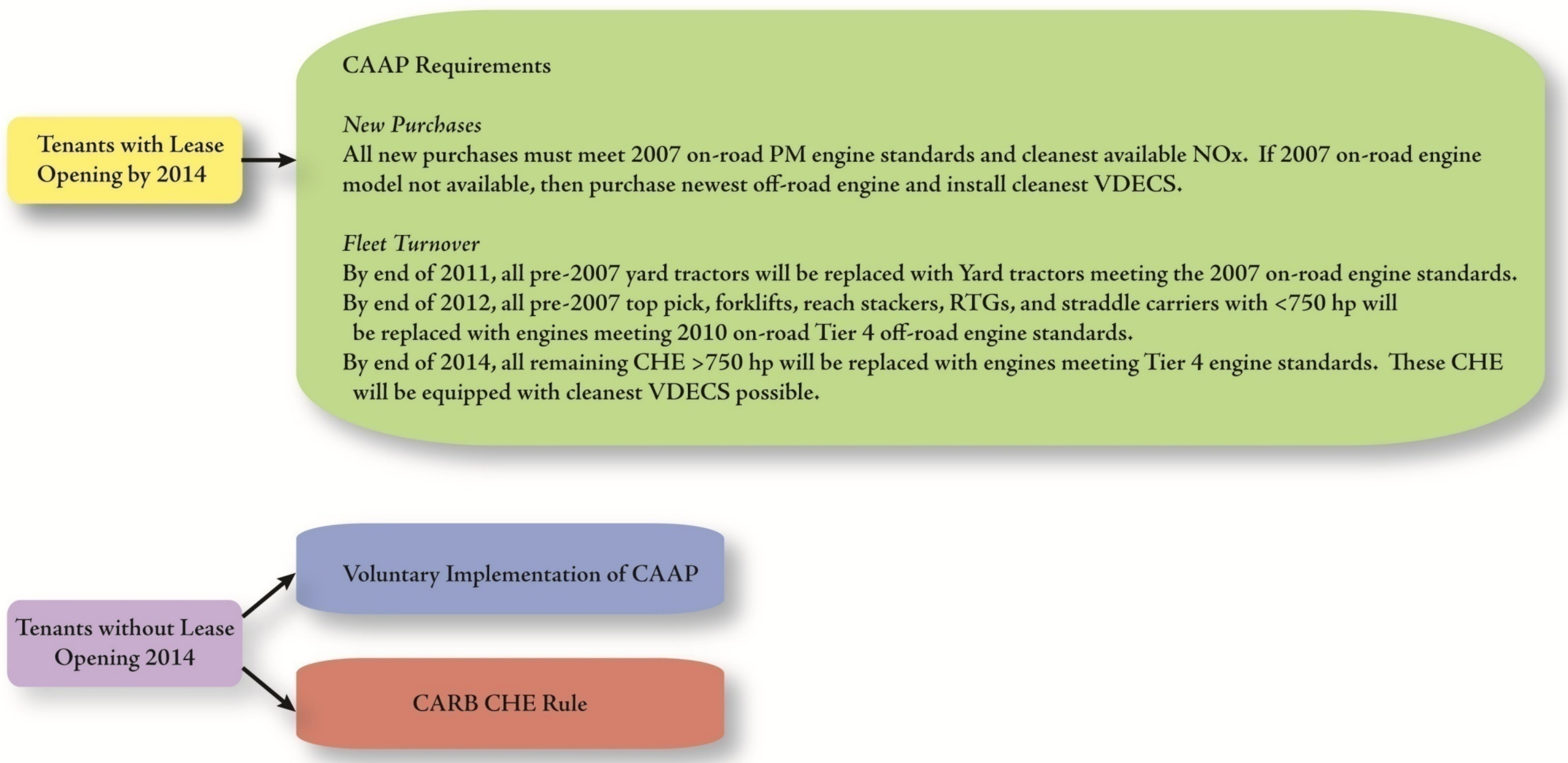
Implementation Strategies: CARB Regulation & Lease Requirements

Measure Description

This measure is designed to achieve the maximum possible emission reductions from cargo handling equipment operating at the port over the next several years by accelerating CARB's CHE regulation requirements. The standards include requirements for the purchase of new CHE and timetables for the replacement of all pre-2007 engines. Through conditions negotiated into new and revised leases, this measure requires that any new yard tractors (which in 2006 made up ~46% of total DPM plus NOx CHE emissions) meet the 0.01 g/bhp-hr DPM and the cleanest available on-road or off-road NOx standard engines (for either alternative or diesel fueled engines), with all yard tractors meeting the standard by the end of 2010. This measure also requires that all other pre-2007 or pre-Tier 4 CHE with engines <750 hp (which makes up ~48% of total 2006 DPM plus NOx CHE emissions) will, at a minimum, meet the 2007 on-road or Tier 4 engine standards by the end of 2012. Finally, this measure requires all other CHE (which made up ~6% of total 2006 DPM plus NOx CHE emissions) to, at a minimum, meet the Tier 4 off-road engine standards by the end of 2014. In addition, through conditions negotiated into new and revised leases, until all CHE with engines >750 hp are replaced with Tier 4 engines, they must be equipped with the cleanest available CARB verified diesel emissions control system (VDECS).

Figure 4.3 provides a summary of the CAAP requirements on a lease requirement basis.

Figure 4.3: CHE1 Requirements



The CARB CHE regulation adopted in December 2005 requires the replacement or retrofit of existing engines with the cleanest available VDECS and requires, beginning January 1, 2007, that newly purchased, leased or rented CHE meet low DPM and NOx limits. The requirements in CARB's regulation are phased-in, and are focused on 2002 and older engines in the 2007–2013 timeframe and 2003–2006 engines and equipment in the 2010-2016 timeframe. The CAAP control measure further accelerates the CHE modernization schedule, by requiring replacement of all engines on a faster timeline.

Implementation Plan

The performance standards will be phased in through lease requirements. Terminals would be required to meet the standards listed above as part of conditions negotiated into new or amended leases or when leases are reviewed through the EIR process.

Air Quality Benefits

This measure will result in additional reductions of DPM, NOx and GHG (depending upon the technology) beyond those achieved by CARB's CHE regulation since the requirements of this measure are more stringent than CARB's regulation. Depending upon the technology installed on the future CHE used by terminal operators, there is potential for GHG reductions.

Benefits to Date

Emission reduction benefits for this measure began in 2007 through lease agreements with the requirement for all new CHE purchases to employ the cleanest available NOx alternative- or diesel-fueled engines, meeting 0.01 g/bhp-hr DPM, or install best available VDECS on cleanest engines available. The emission reductions due to fleet turnover and implementation of CHE emission control technologies employed by various terminal operators have reduced CHE emissions. The reductions are included in the 2007, 2008, and 2009 emissions inventories.

Future Benefits

Full implementation of CHE1 will result in replacement of diesel yard tractors with yard tractors that are conforming to the USEPA's 2007 on-road standards or Tier 4 off-road diesel engine standards. CHE1 will also result in replacement of non-yard tractor diesel equipment with units meeting the interim Tier 4 off-road diesel engine standards. Full implementation of this measure will result in an average CHE emitting at least 80% less DPM emissions and at least 50% less NOx emissions compared to the CHE fleet without CHE1 and CARB's regulation. Overall emission reductions will depend upon the lease renewal schedule of terminals at both ports and the phase-in compliance schedule of CARB's regulation.

Financial Costs

Since this measure will be implemented as a lease requirement, there will be no direct costs to either port.

Completed Milestones

1. Develop a technical fact sheet detailing the CAAP requirements and the status of various emissions control technologies or alternative fueled CHE. This fact sheet will contain information on CARB verified emission control devices and results of technology demonstrations conducted under the ports' Technology Advancement Program.

   Schedule: Completed and posted on the Clean Air Action Plan website[29]. To be updated as needed.

2. Staff to conduct an outreach meeting for terminal operators to present the requirements for CHE, funding incentives, federal tax credits, compliance schedule, and status of technology as outlined in the fact sheet mentioned above. This will also be an opportunity for staff to gather questions and concerns from customers so they can be addressed prior to lease negotiations.

   Schedule: Completed. Workshop for all tenants in the ports of Long Beach and Los Angeles held in 2007. Additional support on requirements provided one-on-one to tenants, as requested. Information on grant funding opportunities sent to tenants, as available.

Upcoming Milestones

1. Staff will collect information from each of the tenants on the number of pieces of equipment in operation by each tenant and the emission reduction strategies being used, such as on-road engines, retrofit devices, alternative fuels, etc. Emissions from cargo handling equipment operations will be compared to 2005 emissions (CAAP baseline) in order to quantify the effectiveness of the emissions reduction strategies being used.

   Schedule: Ongoing, as part of each port's annual emissions inventory. In addition, CARB also collects data on CHE as a part of their CHE regulation adopted in 2005.

2. As leases are opened through the EIR process or for re-negotiation, or as new leases are negotiated, the ports will include requirements for CHE fleet modernization.

   Schedule: As leases are opened.

[29] *http://cleanairactionplan.org/tech/factsheets/default.asp*

Elements to be Tracked

The ports commit to providing regular updates on the progress of implementing this measure. These updates will be provided in quarterly progress reports, which detail significant progress for implementation of all CAAP measures.

Specifically for the CHE1 measure, the ports will provide updates on the approvals of any new leases where the cargo handling equipment requirements apply. The ports will also provide regular updates, as part of the annual emissions inventories, on the number of pieces of equipment in operation, the control strategies employed, and the annual emissions. In addition, as new control strategies are demonstrated through the ports Technology Advancement Program, information will be made available on the Clean Air Action Plan website.

Looking Forward

In addition to complying with the CHE standards listed in this measure, tenants will be encouraged to purchase and use lower emitting equipment where feasible. In some instances, where necessary to meet the Project Specific Standards as described in Section 2 for newly proposed projects, cleaner equipment may be required. Examples include equipment that utilizes electric, hybrid, or other alternative fuel technologies. Through the Technology Advancement Program, the ports are committed to provide support for the demonstration of new technologies needed to further reduce emissions beyond currently available technologies. As new technologies are developed and demonstrated, they will be incorporated into the future updates of the CHE1 measure, as appropriate.

4.4 Harbor Craft Control Measure

Since the adoption of the 2006 CAAP, CARB and USEPA have adopted regulations for the control of emissions from existing and new harbor craft engines. The implementation of these recently adopted CARB and USEPA regulations will significantly reduce DPM and NOx emissions from commercial harbor craft. In addition, the ports are encouraging all tugs to utilize shore power while at berth.

4.4.1 Control Measure Number HC1

Measure Title: ***Performance Standards for Harbor Craft***

All harbor craft operating in the ports of Long Beach and Los Angeles are required to comply with the CARB harbor craft (HC) regulation. This measure seeks to further reduce emissions by encouraging compliance with the following goals

- ✓ *By 2008, all HC home-ported in the San Pedro Bay will meet USEPA Tier 2 standards for harbor craft, or equivalent reductions.*
- ✓ *After Tier 3 engines become available between 2009 and 2014, within five years all HC home-based in the San Pedro Bay will be repowered with the new engines.*
- ✓ *All tugs will use shore power while at their home port location.*

Initiation Year:	*2001*
Key Milestone Dates:	*Implementation of CARB's In-Use HC regulation starts in 2009 through 2020*
Criteria Pollutant Reduction:	*Depending upon the horsepower of the engine and replacement of Tier 0 or Tier 1 engines to Tier 2 or Tier 3 engines, the NOx emissions reduction will vary from 25% to 62% and DPM emissions reduction will vary from 44% to 78%.*
GHG Impact:	*GHG reduction depends upon the technology used to meet future emissions standards; cannot be quantified at this time*

Implementation Strategies: CARB Regulation, Voluntary, & Incentives

Measure Description

According to data collected by the ports in 2008, over 35% of all harbor craft engines have been repowered. Over 80% of these were repowered with the help of various incentive programs, including the SCAQMD (under the Carl Moyer Program) and the Port of Los Angeles Air Quality Mitigation Incentive Program. There are approximately 120 fishing related vessels that have not been repowered although their numbers are expected to stay flat or decline due to the cyclical nature of the fishing industry. This control measure focuses on harbor craft that are home-ported at either port and could potentially be repowered with cleaner engines or retrofitted with verified emissions control devices. This would occur through compliance with the CARB Commercial Harbor Craft regulation, or where eligible, through the assistance of the Carl Moyer Program, USEPA's Diesel Emission Reduction Act funding, the Proposition 1B Funding program, or other similar incentive program.

As part of its Diesel Risk Reduction Plan and Goods Movement Plan, CARB adopted a regulation in November 2007 that will reduce DPM and NOx emissions from new and in-use commercial harbor craft operating in Regulated California Waters (i.e., internal waters, ports, and coastal waters within 24 nm of California coastline). Under CARB's definition, commercial harbor craft include tug boats, tow boats, ferries, excursion vessels, work boats, crew boats, and fishing vessels; however, work boats, crew boats and fishing vessels are only subject to the regulation's reporting requirements at this time. This regulation requires that auxiliary and propulsion engines installed in commercial harbor craft meet stringent emission limits. All in-use, newly purchased, or replacement engines must meet USEPA's most stringent emission standards per a compliance schedule set by CARB for in-use engines and from new engines at the time of purchase. In addition, the propulsion engines on all new ferries, with the capacity of more than 75 passengers, acquired after January 1, 2009, will be required to install control technology that represents the best available control technology in addition to an engine that meets the Tier 2 or Tier 3 USEPA marine engine standards in effect at the time of vessel acquisition. For harbor craft that home port in SoCAB, the compliance schedule is accelerated by two years (compared to statewide requirements) in order to achieve earlier emission reductions required in the SoCAB. The in-use emission limits apply to ferries, excursion vessels, tug boats and tow boats only. The compliance schedule for in-use engine replacement began in 2009. At a minimum, harbor craft subject to CARB's regulation and operating in the ports will be required to modernize their vessels in accordance with the state regulation.

In addition, USEPA recently adopted more stringent Tier 3 and Tier 4 emission standards for new Category 1 and 2 marine diesel engines rated over 37kW used for propulsion and auxiliary engines in harbor craft. Tier 3 engine standards begin to phase in starting in 2009 with engines >75kW between 2012 and 2014. The more stringent Tier 4 engine standards (based on the application of high-efficiency catalytic after-treatment technologies) would phase in beginning in 2014 and apply only to commercial marine diesel engines greater than 597kW.

There are three fundamental elements to this control measure:

1. All harbor craft operating in the ports will modernize their vessels in accordance with the CARB's Commercial Harbor Craft regulation.

2. To achieve early emission reductions, the ports will encourage harbor craft operators to modernize their equipment in advance of state regulation. Through the emissions inventory update process, the ports will identify propulsion and auxiliary harbor craft engines that are good candidates for accelerated repower or retrofit and qualify under the Carl Moyer or other similar grant programs (i.e., reductions would exceed the requirements of the existing regulations). In addition, the ports will identify and provide information on available funding programs, such as USEPA Diesel Emission Reduction Act, SCAQMD, Carl Moyer Program, Proposition 1B and other available

funds and criteria, and will assist harbor craft owners in applying for grant funding, as needed.

3. The ports will work with tug boat operators to facilitate development of shore power infrastructure and encourage the use shore power while at their home port locations.

Implementation Approach

In order to successfully identify candidate harbor craft for potential incentive program funding, the harbor craft emissions inventory will continue to be updated by each port on an annual basis. Emission inventories track the population of harbor craft engines by model year, type of engines (mechanical versus electronically controlled) and their emissions contribution compared to total harbor craft emissions. Since some of the assist tugboats are common to both ports, it is important that staff work together to identify the candidate vessel projects that will provide the greatest benefits.

Every year, SCAQMD receives a share of the state's Carl Moyer Program funds to reduce emissions from mobile source engines faster than required by state regulations. In addition, funding may be made available locally through the Proposition 1B funding program with a total allocation of $1 billion in state bond funds over four years for reducing emissions from goods movement categories (i.e., heavy-duty trucks, ocean-going vessels, locomotives, and commercial harbor craft). Further, , through the American Recovery and Reinvestment Act, National Clean Diesel Funding Assistance Program, USEPA has provided funding to both ports in 2009 for diesel emissions reductions from harbor craft, for projects to be implemented prior to September 2010. Both ports will continue to coordinate with agency staff to solicit these funds to clean harbor craft engines. Staff will provide assistance as needed to identify candidate vessel owner/operators in applying for grant funding.

In addition, the ports support the development of new, emission reduction technologies for harbor craft through their joint Technology Advancement Program. In 2008, the ports provided funding assistance for the demonstration of a hybrid tug boat and a tug boat that utilizes a modified engine design which is expected to be more efficient than the traditional tug boat designs. The ports are hopeful that these demonstrations will prove to be effective at meeting the anticipated emissions reductions and that, following demonstration; these technologies will be commercialized and implemented throughout the harbor. In addition, once these technologies have been demonstrated and proven to be effective, the goal is that these technologies would also be eligible for funding awards from the various grant programs. Finally, the ports remain committed to evaluating additional harbor craft technologies through their Technology Advancement Program, which may provide even greater benefits and offer additional options for harbor craft operators.

Finally, the ports will encourage tug operators to use shore power when berthed at their home-port locations. Tug boats at the Crowley terminal at the Port of Los Angeles currently use shore power, rather than idling their engines, when tied up. In 2009, the Port of Long Beach began construction of electrical infrastructure improvements at the Foss terminal to allow tug boats to use shore power. The shore power had the added benefit of providing battery recharge for the hybrid tugboat, which will decrease the need to recharge the batteries using the tug's on-board diesel engines.

Air Quality Benefits

Implementation of the recent CARB and USEPA regulations will significantly reduce DPM and NOx emissions from commercial harbor craft. GHG reductions are also expected to be achieved due to implementation of more fuel efficient engines. The emission reduction benefits associated with implementation of this measure, primarily associated with repowers thus far are reflected in the annual emissions inventory updates.

Benefits to Date

Harbor craft engine repowering and replacements are tracked as part of the annual inventories and the emission benefits are included in the results.

Future Benefits

Per CARB's harbor craft engine replacement schedule, by 2013 most of the Tier 0 and Tier 1 engines will be replaced with Tier 2 or Tier 3 engines. On an average, replacement of Tier 0 engine to Tier 2 will reduce NOx emissions by 49% and DPM emissions by 44%; replacement of Tier 0 engine to Tier 3 will reduce NOx emissions by 62% and DPM emissions by 78%. On an average replacement of Tier 1 engine to Tier 2 will reduce NOx emissions by 25% and DPM emissions by 44%; replacement of Tier 1 engine to Tier 3 will reduce NOx emissions by 44% and DPM emissions by 78%. Overall emission reductions will depend on CARB's replacement schedule and the types of harbor craft that are subjected to the CARB regulation.

Financial Costs

The Port of Long Beach incurred a cost of $92,180 in 2009 as shown below in Table 4.14. At this time there are no anticipated future costs associated with this measure.

Table 4.14: Costs-to-Date for HC1 by Funding Source

HC1	Funding Source	2006	2007	2008	2009	Total
	POLA	$0	$0	$0	$0	**$0**
	POLB	$0	$0	$0	$92,180	**$92,180**
	SCAQMD	$0	$0	$0	$0	**$0**
	CARB	$0	$0	$0	$0	**$0**
	Measure Totals	**$0**	**$0**	**$0**	**$92,180**	**$92,180**

Completed Milestones

1. The ports will provide information on various funding programs available to assist harbor craft operators to modernize their equipment in advance of regulatory requirements.

   Schedule: Completed. A grants page was added to the Clean Air Action Plan website to provide links to the relevant federal, state and local funding sources. The page can be accessed at: *http://cleanairactionplan.org/tech/grants.asp*. In addition, the ports provide information on available grant programs to harbor craft operators, as available.

2. Develop a technical fact sheet detailing CAAP goals; regulatory requirements and the status of various emissions control technologies, engine standards, and engines available (including alternative fuels). This fact sheet will contain details on agency verification of various emissions control devices and availability of low emitting engines. In addition, the fact sheet will include results of demonstrations conducted under the ports' Technology Advancement Program.

   Schedule: Completed. The fact sheet is available on the Clean Air Action Plan website (*http://cleanairactionplan.org/tech/factsheets/hc.asp*) and will be updated as needed.

3. Staff to conduct an outreach meeting for the harbor craft operators to present information on the various grant funding processes and funding levels, program flexibility and status of technology as outlined in the technical/fiscal fact sheets mentioned above. This will provide an opportunity for staff to gather questions and concerns from the operators so that these can be addressed prior to lease negotiations. In addition, staff will provide information to harbor craft operators on the availability of grant funding opportunities.

   Schedule: Completed. Funding workshops targeted at harbor craft operators have been held concurrent with available funding opportunities, such as Carl Moyer and POLA's Air Quality Mitigation Incentive Program (AQMIP). Since 2006, the Port of Los Angeles has awarded over $11 million in AQMIP funding to repower or retrofit harbor craft. Additional workshops will be held as new funding opportunities become available.

Upcoming Milestones

1. The ports will provide assistance to harbor craft operators in applying for various funding programs to modernize their equipment in advance of regulatory requirements.

   Schedule: As needed. In 2009 and 2010, POLB was awarded grant funding for harbor craft operated by tenants, through the USEPA Diesel Emission Reduction Act funding program. Harbor craft operating in each port have been awarded funding through the Carl Moyer Program. The ports and the vessel operators will continue to seek funding through such opportunities in the future.

2. The ports will provide assistance to tug boat operators, as appropriate, to install shore power infrastructure to reduce emissions from tugboats when tied up at home-port.

   Schedule: Ongoing. Port of Long Beach began construction on shore power infrastructure for the Foss terminal in 2009.

3. The benefits of this program will be quantified and reflected in the periodic updates to the ports' emissions inventories.

   Schedule: Ongoing.

Elements to be Tracked

The ports commit to provide regular updates on the progress of implementing this measure. These updates will be provided in quarterly progress reports, which detail significant progress for implementation of all CAAP measures.

Specifically for the HC1 measure, the ports will provide updates on the installation and utilization of shore power for tug boats. In addition, the ports will provide regular updates, as part of the annual emission inventories, on the number of vessels in operation, the types of engines, control strategies employed, and the annual emissions. In addition, as any new control strategies are demonstrated through the ports Technology Advancement Program, information will be made available on the Clean Air Action Plan website.

Looking Forward

Besides the implementation of CARB's In-Use Harbor Craft regulation and the USEPA's recently adopted Tier 3 and 4 standards, the ports are working to accelerate harbor craft emission reductions through emerging technologies such as the hybrid tug, new more-efficient engine configurations, alternative fuels and shore power for tugs at-berth and at the staging areas, through incentives or voluntary measures.

4.5 Railroad Locomotive Control Measures

The railroad locomotive control measures are designed such that each measure focuses on individual rail operation related to port activities. RL1 focuses on port switching operations, operated under an agreement with the ports by Pacific Harbor Line (PHL). Most of the goals set forth under RL1 when the 2006 CAAP was adopted have already been achieved.

RL2 focuses on Class 1 locomotive operations related to the ports and requires the implementation of clean technologies as required by USEPA regulation and an agreement with CARB.

RL3 focuses on setting standards through new or redeveloped near-dock rail yard facility projects that require the most stringent achievable emissions control operations for rail, CHE and HDVs.

Since the 2006 CAAP, measures RL2 and RL3 have been updated to reflect new information available on the timeline for implementation of new clean engine standards, as adopted by USEPA since the original CAAP was completed. In addition, the scope and the implementation measures have been clarified and updated.

4.5.1 Measure Number RL1

Measure Title: ***PHL Rail Switch Engine Modernization***

This measure will be implemented through each respective ports' operating agreements with Pacific Harbor Line (PHL), which call for the following:

- *By 2008, PHL's entire fleet will be replaced by sixteen Tier 2 engines. Any new switch locomotive acquired by PHL after the initial replacement must be equipped with engines that meet at a minimum, USEPA Tier 3 standards for the switch duty-cycle of 5.0 g/bhp-hr NOx and 0.10 g/bhp-hr PM.*
- *All switch engines will have 15-minute idling limit devices installed and operational and use emulsified fuels as available or other equivalently clean alternative diesel fuel.*
- *PHL will conduct a series of feasibility tests including: Demonstration of an LNG locomotive, a hybrid locomotive, and DOC or DPF retrofits. Based on successful demonstration of a locomotive DPF or DOC retrofit on a Tier 2 engine, all of the Tier 2 engines will be retrofitted with the DPF, or with the DOC retrofit depending on which demonstration was conducted.*
- *By December 31, 2011, contingent upon receipt of grant funding PHL will repower its sixteen Tier 2 switch locomotive engines with "Tier 3-plus" engines to meet Tier 3 NOx emission standard of 5.0 g/bhp-hr and Tier 4 PM emission standard of 0.03 g/bhp-hr).*

Initiation Year:	*2005*
Implementation Schedule:	*Hybrid locomotive demonstration completed in 2007; All switch locomotives upgraded to Tier 2 engines equipped with idle-limit devices as of 2nd Quarter 2008; LNG demonstration completed in 2nd quarter 2009; all new locomotive purchases to meet Tier 3 equivalent or better. Contingent upon award of grant funding, PHL will repower current Tier 2 switch locomotives with engines meeting "Tier 3-plus" emissions standards by December 31, 2011.*
Criteria Pollutant Reductions:	*Replacement of the baseline fleet of older switch locomotives with locomotives meeting Tier 2 engine standards results in 54% reduction in DPM emissions and 66% reduction in NOx emissions. Replacement of the Tier 2 switch locomotive engines with "Tier 3-plus" switch locomotive engines will achieve an 85% reduction in DPM emissions and 38% reduction in NOx emissions over the existing Tier 2 engines, or a reduction of 95% DPM and 72% NOx compared to the baseline fleet.*

GHG Impact: *GHG reductions possible due to increased fuel efficiency of new locomotives and reduced idling; cannot be quantified at this time due to lack of data*

Initial Implementation Strategies: Operating Agreements

Measure Description

This measure implements the switch locomotive engine modernization and emission reduction requirements included in the operating agreements between the ports and PHL. The fundamental elements associated with this control measure are:

1. In accordance with the terms of the second amendment to the operating agreements between PHL, and the Port of Los Angeles and the Port of Long Beach, PHL is required to replace its entire fleet of older technology locomotives with sixteen Tier 2 diesel switch locomotives equipped with 15-minute idle control devices. Any additional locomotives added to the PHL fleet are required to meet Tier 3 emission standards. Since the operating agreement has been in effect, PHL has not only replaced and modernized its fleet with sixteen Tier 2 diesel switch locomotives by mid-2008, but it added six Tier 3 compliant gen-set switch locomotives to its fleet as well.

2. Under the second amendment, PHL is required to use emulsified diesel fuel or other clean alternative diesel fuel in its fleet when it is available. Since emulsified fuels have been unavailable for PHL's use since January 2007, PHL currently uses ultra-low sulfur diesel (ULSD) to power its fleet.

3. Under the second amendment, PHL committed to demonstrate both hybrid and LNG switch locomotive sat the ports. PHL completed the hybrid locomotive demonstration in 2007 and the LNG locomotive demonstration by mid-2009.

4. Under the second amendment, PHL is required to test a locomotive DOC. The ports and PHL also discussed a demonstration of a DPF instead of a DOC, which would result in greater emissions reductions. If the DOC or DPF testing is successful, DOCs or DPFs would be installed on all of the Tier 2 locomotives.

Alternatively, PHL proposed to upgrade its fleet to meet "Tier 3-plus" emission standards, to be accomplished with the use of a Tier 3 switch engine with an installed DPF, resulting in greater emission reductions than the addition of a DOC or DPF to the current Tier 2 engines. This alternative proposal was incorporated into the third amendment to the operating agreements between the ports and PHL. If PHL is successful in receiving grant funding and upgrading its fleet to "Tier 3-plus", PHL will be relieved of its requirements under the second amendment to test a locomotive DOC or DPF and to use emulsified fuel.

Implementation Approach
This measure required PHL to replace its older fleet of switch locomotives with new switch locomotives meeting Tier 2 standards. PHL's baseline locomotive fleet included older, unregulated, higher-polluting diesel engines, some dating back to the 1950's. PHL began taking delivery of the new locomotives in 2007 and by mid-2008; PHL replaced all of the older switch locomotives with new units meeting or exceeding Tier 2 standards.

This measure also required any additional locomotives being purchased by PHL, beyond the sixteen Tier 2 locomotives, to meet at least Tier 3 emissions standards. From May 31, 2006 to September 30, 2006, PHL conducted its own independent demonstration project of a multiple engine generator set locomotive. The four month demonstration project was considered successful and PHL leveraged Carl Moyer Program funding to purchase six additional multiple engine generator set locomotives that achieve Tier 3 standards. These locomotives have been in service since April 2008.

As required by the second amendment to the operating agreements with the ports of Los Angeles and Long Beach, PHL conducted a one-year demonstration of a hybrid-electric locomotive in 2007 and a demonstration of an LNG locomotive, which was completed in 2nd quarter 2009. PHL has prepared reports for each of the locomotive demonstrations documenting the operational parameters and performance of the engines.

PHL is also required to use emulsified fuels or an equivalently clean alternative diesel fuel in their locomotives. Unfortunately, emulsified diesel fuel is no longer domestically available. In its place, PHL has been using ULSD.

In addition, PHL is required to demonstrate the use of a DOC on one of the new Tier 2 locomotives. In an effort to achieve greater emissions reductions however, PHL has worked with the ports and the SCAQMD to develop a demonstration of the use of a DPF. If a demonstration of a DPF is successful, DPFs would be required on the remaining Tier 2 locomotives. If PHL is unable to test a DPF, a DOC test would be conducted and upon successful demonstration DOCs would be installed on the remaining Tier 2 locomotives.

As an alternative to the DOC or DPF demonstration, in 2009, PHL submitted a proposal to the ports to further upgrade the existing sixteen Tier 2 switch locomotives with new engines meeting "Tier 3-plus" standards. The "Tier 3-plus" standards are achieved through the use of a Tier 3 engine with an integrated DPF. This equipment upgrade is contingent upon PHL's ability to secure grant funding. If PHL is awarded the funding and is successful in upgrading its fleet, PHL will be relieved of its previous requirements under the second agreement to test a locomotive DOC or DPF and use emulsified fuel.

Air Quality Benefits

This measure will produce significant reductions of DPM and NOx emissions, in the range of 54% to 95% reduction of DPM and 66% to 72% reduction in NOx. In addition, the use of ULSD in the locomotives will reduce emissions of SOx by over 95%. GHG emissions will be reduced due to increased fuel efficiency of the new locomotives compared with the old locomotives as well as idling controls on new locomotives. However due to lack of data, the GHG reductions cannot be quantified.

Benefits to Date

Emission reduction benefits began accruing in 2007 as sixteen new Tier 2 switch locomotives were placed into service and the old locomotives were phased out. By mid-2008, all sixteen Tier 2 switch locomotives were in operation, in addition to six gen-set switch locomotives meeting Tier 3 standards. The emissions benefits from the cleaner locomotives are tracked in the ports' annual air emissions inventories.

Future Benefits

The potential repower of the sixteen Tier 2 engines with engines meeting "Tier 3-plus" standards will result in an 85% reduction in PM and 38% reduction in NOx emissions compared to the Tier 2 engines, or 95% DPM reduction and 72% NOx reduction compared to the baseline fleet. GHG emissions benefits associated with Tier 2 and Tier 3 switch locomotives are not certain at this time.

Financial Costs

Through the second amendment to PHL's operating agreements, the ports provided $10 million to support the modernization of PHL's older fleet with sixteen Tier 2 switch locomotives. All of these funds have been expended. Carl Moyer Program grant funds, $3.2 million, were also awarded by SCAQMD to PHL for a portion of the fleet modernization costs. PHL funded the remaining approximately $10 million to complete the Tier 2 upgrade. The ports are working to secure additional funding, through the ports' Technology Advancement Program, SCAQMD and others, to assist PHL with the costs associated with the DPF demonstration test.

Additionally, the third amendment to PHL's operating agreements with the ports is structured to be contingent upon PHL's ability to secure grant funding from SCAQMD in order to upgrade the sixteen Tier 2 switch locomotives with engines meeting "Tier 3-plus" standards. The total cost of this transaction is estimated to be $13 million. PHL is seeking to receive $10.5 million from SCAQMD through the Carl Moyer Program. PHL will be responsible for funding the balance of the transaction.

Costs to Date

To date, the funding shown in Table 4.15 for replacement locomotives has been expended on RL1 (exclusive of any funding provided by PHL).

Table 4.15: Costs-To-Date for RL1 by Funding Source

RL1	Funding Source	2006	2007	2008	2009	Total
	POLA	$0	$2,500,000	$2,500,000	$0	**$5,000,000**
	POLB	$2,500,000	$2,500,000	$0	$0	**$5,000,000**
	SCAQMD	$0	$1,600,000	$1,600,000	$0	**$3,200,000**
	CARB	$0	$0	$0	$0	**$0**
	Measure Totals	**$2,500,000**	**$6,600,000**	**$4,100,000**	**$0**	**$13,200,000**

Future Costs

Future funding for this measure associated with the potential repowering of the existing fleet of Tier 2 switch locomotives or co-funding of the DPF demonstration project (through TAP) is not yet determined.

Completed Milestones

1. Multiple Engine Generator Set locomotive demonstration.

   Schedule: Completed in 2006.

2. Hybrid locomotive demonstration.

   Schedule: Completed in 2007.

3. All Tier 2 locomotive engines operational.

   Schedule: Completed. All sixteen Tier 2 locomotives in operation as of 2nd Quarter 2008.

4. LNG locomotive demonstration.

   Schedule: Completed in mid-2009.

5. Any new locomotives purchased by PHL will meet a Tier 3 equivalent standard or better.

   Schedule: PHL has purchased six gen-set locomotives that meet Tier 3 off-road standards.

Upcoming Milestones

1. Replace existing Tier 2 diesel engines with new engines that meet "Tier 3-plus" emissions standards (contingent upon PHL's ability to secure grant funding).

   Schedule: Complete fleet upgrade by December 31, 2011.

   Or, if PHL is unable to secure grant funding, demonstrate a DPF/DOC on a Tier 2 locomotive. If the demonstration is successful then the Tier 2 locomotive retrofits will follow. In addition, use emulsified fuel in all locomotives.

   Schedule: Completion date for the retrofit demonstration to be determined following a determination of PHL's grant request. Use of emulsified fuel is dependent upon commercial availability of the fuel.

2. Any new locomotives purchased by PHL will meet a Tier 3 standard, or once available, will meet a Tier 4 standard.

   Schedule: Ongoing, for any additional purchases.

3. The benefits of this program will be quantified and reflected in the periodic updates to the port's emissions inventories.

   Schedule: Ongoing.

4. The ports will continue to work with PHL to explore opportunities to demonstrate new, clean technologies.

   Schedule: Ongoing.

Elements to be Tracked

The ports commit to provide regular updates on the progress of implementing this measure. These updates will be provided in quarterly progress reports, which detail significant progress for implementation of all CAAP measures.

Specifically for measure RL1, the ports will provide updates on the implementation of the technology demonstrations and the status of grant funding programs pursued to upgrade the sixteen Tier 2 locomotives to "Tier 3-plus" standards. The ports will also provide regular updates, as part of the annual emissions inventories, on the operation of the switch locomotives and the annual emissions.

Looking Forward

All of the original commitments of this measure are fulfilled, with the exception of the emulsified fuel requirement and the demonstration and installation of DOC or DPF units on the Tier 2 locomotives. Contingent on PHL's ability to secure grant funding, the sixteen Tier 2 locomotives will be upgraded with Tier 3-plus engines, and PHL would be relieved of the emulsified fuel requirement and the requirement to demonstrate and install DOC or DPF units on its locomotives. The ports will also continue to work with PHL to explore future opportunities to integrate cleaner locomotive technologies into their operations, as they become available.

4.5.2 Measure Number RL2

Measure Title*: Class 1 Line-haul and Switcher Fleet Modernization*

This is a long term measure affecting all Class 1 line-haul and switcher operations used for the goods movement in and out of the ports. The focus of this measure is to identify the emission reductions associated with the CARB Class 1 railroads MOU and the 2008 USEPA locomotive engine standards. The key requirements and expectations from these regulatory efforts are:

- *By June 30, 2008, phase-out all non-essential idling*
- *By December 31, 2006, at least 80% of the fuel supplied to locomotives operating in California meets the specifications for ULSD fuel*
- *By 2010, all Class 1 locomotives operating in the SoCAB will have a fleet average emissions equivalent to Tier 2 locomotive standards*
- *By 2023, all Class 1 locomotives entering the ports will meet emissions equivalent to Tier 3 locomotive standards*

Initiation Year:	*2005*
Key Milestone Dates:	*By 2010, all Class 1 locomotives operating in the SoCAB must meet a Tier 2 equivalent fleet average under the CARB MOU. By no later than 2013 and thereafter, at the time of major overhaul, Tier 2 locomotives must be rebuilt to Tier 3 standards, under the USEPA rule.*
Criteria Pollutant Reduction:	*Replacement of the average 2005 on-port and off-port line haul locomotives and off-port switcher locomotives with Tier 2 locomotives using ULSD will result in reductions of 38% DPM, 41%NOx, and 99% SOx.*
GHG Impact:	*Cannot be quantified*

Initial Implementation Strategies: CARB MOUs and Voluntary Commitments & USEPA Rule

Background

In the 1998 Memorandum of Mutual Understandings and Agreements (MOU), CARB and the Class 1 railroads (BNSF and UP) entered into an agreement that would set the fleet average for locomotives operating in the South Coast nonattainment area at 5.5 g/hp-hr (equivalent to the Tier 2 locomotive NOx standard included in the Final USEPA National Locomotive Rule). The Tier 2 engine standards require approximately 58% NOx control for new locomotives. Under a subsequent 2005 MOU the Class 1 railroads agreed to:

1. Phase-out all "non-essential" idling (by June 30, 2008 for all California-based locomotives)

2. Install idling reduction devices (limiting idling to 15 minutes) on California-based locomotives within three years (June 30, 2008)

3. Maximize the use of ULSD (15 ppm) after December 31, 2006, by requiring that at least 80% of the fuel supplied to locomotives operating in California meets the specifications for ULSD fuel

The 1998 MOU focuses on fleet averaging for locomotives operating in the South Coast nonattainment area. Fleet averaging means that not all locomotives will meet the 5.5 g NOx/hp-hr target, however taking the fleet as a whole, the fleet average must meet the target. In addition, for early action to implement cleaner technologies, the Class 1 rail operators receive "credit" toward implementing the Tier 2 fleet average. Therefore, the Class 1 operators can meet the requirements through a combination of replacements with locomotives that meet Tier 2, plus early action "credits."

On March 27, 2008, USEPA adopted and published their long awaited locomotive and marine diesel engine standards[30]. This rulemaking tightened DPM and NOx standards for remanufactured locomotives, defined Tier 3 standards for newly-built locomotives, and defined longer-term Tier 4 standards. These standards cover line-haul locomotives >2,300 hp, switcher locomotives ≤2,300 hp, and all passenger locomotives. A summary of the locomotive standards that affect port operations is provided in Table 4.16 (for switch locomotives) and Table 4.17 (for line-haul locomotives), below:

Table 4.16: 2008 USEPA Switch Locomotive Standards

Locomotive Group	Date	DPM (g/hp-hr)	NOx (g/hp-hr)	HC (g/hp-hr)
Remanufactured Tier 0	2008 as available; 2010 required	0.26	11.80	2.10
Remanufactured Tier 1	2008 as available; 2010 required	0.26	11.00	1.20
Remanufactured Tier 2	2008 as available; 2013 required	0.13	8.10	0.60
New Build Tier 3	2012	0.10	5.00	0.60
New Build Tier 4	2015	0.03	1.30	0.14

[30] *http://www.epa.gov/OMS/locomotv.htm#2008final*

Table 4.17: 2008 USEPA Line-Haul Locomotive Standards

Locomotive Group	Date	DPM (g/hp-hr)	NOx (g/hp-hr)	HC (g/hp-hr)
Remanufactured Tier 0 & Tier 1	2008 as available; 2010 required	0.22	7.40 (8.0 w/o SLAC)	0.55 (8.0 w/o SLAC)
Remanufactured Tier 2	2008 as available; 2013 required	0.1	5.50	0.30
New Build Tier 3	2012	0.10	5.50	0.30
New Build Tier 4	2015	0.03	1.30	0.14

Note: SLAC - separate loop intake air cooling

In addition to engine standards, starting in 2008, idle controls are to be phased in on all locomotives (covering all tiers).

While significant, these adopted EPA engine standards were not as aggressive as the ports had understood they would be at the time of the original CAAP development. Therefore, implementation schedules in measures RL2 and RL3 have changed in this 2010 update to the CAAP.

In addition to the 1998 and 2005 MOUs between CARB and the Class 1 rail operators described above, in June 2010, CARB's Board proposed railyard-specific commitments with Class 1 operators to accelerate further DPM emission and risk reductions at four railyards in the South Coast Air Basin, including the ICTF located in the port area. The voluntary commitments would establish reporting and tracking mechanisms and deadlines to accelerate reductions of DPM emissions. The rail commitments would also require Class 1 operators to reduce DPM emissions by 85 percent by 2020 relative to 2005 emission levels within the fenceline of each of the four railyards. Specific strategies to achieve this level of reduction are up to the discretion of the Class 1 operators, and could include a combination of cleaning up their fleet of cargo handling equipment, drayage trucks, switcher locomotives or line haul locomotives. Emission reduction efforts implemented at the ICTF will directly benefit the ports. Upgrades to the fleet of line-haul locomotives to meet the emission reduction requirements at any of the other railyards could also provide benefits to the ports, since a line haul locomotives that service nearby railyards are also likely to service the ports. Therefore, compliance with the June 2010 voluntary commitments may accelerate the turnover and upgrade of the locomotive fleet beyond the existing MOU and EPA rule requirements thus accelerating emissions reductions. The exact effect of these voluntary commitments as it relates to port specific operations however is not known at this time, and therefore details about any specific implementations strategies have not been incorporated into this measure. As more details become available in the future, they will be incorporated into future updates to the CAAP.

Measure Description

Through implementation of regulatory and contractual mechanisms already in place, this measure ensures introduction of cleaner switchers and long haul locomotives for port operation. Under the CARB MOU, the Class 1 rail operators are moving forward aggressively with engine and locomotive replacements to meet the required Tier 2 fleet average by 2010. As required under the USEPA rule, at the time of major engine overhaul, Tier 2 locomotives must be rebuilt to meet the Tier 3 standards. This requirement will become effective as soon as a Tier 3 kit is available, but no later than 2013. Given the typical time between major overhaul for locomotives, it is forecast that the entire fleet of Tier 2 locomotives will be rebuilt to Tier 3 standards by 2023, which, according to USEPA, will result in a reduction in DPM emissions from these engines by as much as 90% and NOx emissions by as much as 80%.

The ports will continue to monitor progress towards achieving cleaner Class 1 rail operations into the future under the existing regulatory and voluntary requirements. In addition, the ports will work with the Class 1 rail operators as needed through the Technology Advancement Program to help fund and demonstrate the use of new cleaner locomotive technologies, such as early development of a retrofit kit to allow Tier 2 locomotive engines to meet Tier 3 standards.

Implementation Plan

Implementation of this measure will be through the requirements of the MOUs and voluntary commitments between CARB and the Class 1 rail operators and implementation of the USEPA rule establishing engine standards for locomotives.

Air Quality Benefits

Benefits to Date

The air quality benefits associated with this measure to date result from the use of ULSD, idle reduction, and phase-in of new, cleaner, locomotives in preparation for the 2010 Tier 2 fleet average deadline, as required by the CARB MOU. The emissions reductions are reflected in ports' annual emissions inventories.

Future Benefits

By 2014, fleet wide reductions of 38% DPM, 41% NOx, and 99% SOx will be achieved from on-port and off-port line haul operation and off-port switching operations. Replacement of the average off-port line haul operations from 2005 levels to Tier 2 levels will result in a 35% reduction in DPM and a 38% reduction in NOx. Replacement of an average on-port line haul operations from 2005 levels to Tier 2 levels along with idle restriction will result in a 41% reduction in DPM and a 43% reduction in NOx. Switching from high sulfur fuel with average sulfur content of 1,915 ppm in 2005 to ULSD with sulfur content of 15 ppm results in a99% reduction of SOx emissions for line haul locomotives.

Financial Costs

At this time there are no anticipated port-related costs associated with the control measure other than potential administrative costs and demonstration projects which could be covered by the TAP budget.

Upcoming Milestones

1. Meet and work with representatives of the Class 1 rail companies to identify opportunities to accelerate emissions reductions from the locomotives that operate at the ports.

   Schedule: Meetings with the Class 1 railroads began in late 2007 and are still ongoing.

2. Provide input on any federal, state or local action to regulate or reach agreement with the Class 1 rail companies to seek to accelerate emissions reductions from rail operations.

   Schedule: As needed.

3. The benefits of this program will be quantified and reflected in the annual updates to the ports' emissions inventories.

   Schedule: Ongoing.

Elements to be Tracked

Specifically for progress on the RL2 measure, fleet information will be tracked through annual emissions inventory updates. Any potential technology demonstration projects involving the ports and the Class 1 rail operators will be tracked through the TAP. In addition, CARB tracks compliance with the MOUs and the voluntary commitments.

Looking Forward

Requiring compliance with the new, more stringent USEPA's Tier 3 and 4 locomotive emission standards should prove to be an effective strategy for reducing locomotive emissions. The ports will encourage the early introduction of these locomotives at the earliest opportunity. The ports will continue to monitor progress by the Class 1 rail operators to expedite the deployment of these new, lower emitting locomotives into port service.

4.5.3 Measure Number RL3

Measure Title: *New and Redeveloped Near-Dock Rail Yards*

This measure focuses on new and redeveloped near-dock rail facilities located on port properties. These facilities are intended to be utilized for intermodal operations. The goal of this measure is to incorporate the cleanest locomotive, CHE, and HDV technologies into near-dock rail operations. This measure will be in near-dock rail projects, in support of CARB's goals for emission reductions from locomotives statewide. The performance requirements for these rail yards include

- ✓ *By 2020, with the assistance of the ports' regulatory agency partners and in concert with CARB's stated goals, the ports will support achievement of the goal of accelerating the natural turnover of the line-haul locomotive fleet resulting in a state-wide fleet comprised of at least 95% Tier 4 line-haul locomotive engines.*
- ✓ *Idling restrictions*
- ✓ *Use of ULSD or alternative fuels*
- ✓ *Clean CHE and HDVs*
- ✓ *Evaluation of new cleaner technologies*

Initiation Year:	*Dependant on schedule for any new or redeveloped near-dock rail yard projects.*
Key Milestone Dates:	*To be determined through any new or redeveloped near-dock rail yard projects.*
Criteria Pollutant Reduction:	*Not quantifiable at this time.*
GHG Impact:	*Minor GHG reductions possible due to reduced idling. Minor increases possible due to decreased fuel efficiency of newer Tier locomotives resulting from after-treatment devices. Not quantifiable at this time.*

Initial Implementation Strategy: ***Regulatory Agency Strategies, Incentive Funding, Lease Requirements, & CEQA***

Background

As described in Measure RL2, Class 1 rail operations in California are subject to the requirements of the 1998 and 2005 MOUs and the voluntary commitments between the Class 1 rail operators and CARB. In addition, locomotives nationwide are also subject to the requirements of the USEPA locomotive engine standards adopted in 2008. While these requirements will help to reduce the emissions from rail operations, additional emissions reductions may be necessary to meet the ports' San Pedro Bay Standards and the state and regional attainments needs.

In September 2009, CARB adopted its "Staff Recommendations to Provide Further Locomotive and Railyard Emission Reductions"[31], which identified several high priority near-term strategies for reducing emissions from locomotive operations in California, as well as long-term strategies, including providing support for the ports "to accelerate the turnover of cleaner Tier 4 line-haul locomotives serving port properties as expeditiously as possible following their introduction in 2015, with the goal of 95% Tier 4 line-haul locomotives serving the ports by 2020."

Emissions from rail operations are a significant contributor to localized health risk. The ports' future estimates of the health risk in specific areas near rail facilities indicate that locomotive emissions could be a dominant factor driving health risk in those locations. Therefore, aggressive action is needed to reduce those impacts, achieve the ports' San Pedro Bay Standards, and meet the CARB statewide goals. Emissions from Tier 4 line haul locomotives are over 70% lower than Tier 2 line-hail locomotives. Therefore, a transition to a Tier 4 fleet will provide significant emissions reduction benefits.

As discussed in Measure RL2, CARB recently approved voluntary rail commitments that may assist in directing cleaner locomotives to the ports. This effort may support the goal of a 95% Tier 4 fleet by 2020, however, implementation of this measure will remain a significant challenge. The rail companies operate a national line-haul locomotive fleet. Dedicating a smaller population of cleaner locomotives to a specific geographic region presents logistical challenges, however the Class 1 rail companies have been able to demonstrate that some prioritization of specific locomotives to a certain area is possible through their compliance with the 1998 MOU conditions.

For the rail lines to dedicate a fleet of cleaner locomotives to service the ports, it is estimated by CARB and SCAQMD that approximately 750 locomotives would be required to be directed to the ports from the national fleet. Since Tier 4 locomotive engines aren't required by USEPA to be manufactured until 2015, this will require that the rail companies make a significant investment in Tier 4 locomotives after 2015 and dedicate the majority of those purchases to port service.

The cost to purchase a dedicated port locomotive fleet is significant, at approximately $3 million per locomotive (50% higher than the cost of Tier 2 locomotives) or $2.25 billion. A portion of these locomotive upgrades are likely to occur as part of the normal fleet turnover, however additional costs are anticipated above normal turnover for the rail companies to provide a port fleet and still meet the equipment needs for other regions.

If the rail lines must dedicate Tier 4 locomotives to statewide service in California, according to CARB Staff Recommendations document, the rail companies would need approximately 4,800 Tier 4 locomotives as a subset of the national fleet at an estimated cost of $15 billion.

[31] *http://www.arb.ca.gov/railyard/ted/drftrec090909.pdf*

Measure Description
A goal of this measure is to achieve significant reductions in locomotive emissions through the accelerated turnover of the existing locomotive fleet to newer, lower emitting models. The ports will work with regulatory agencies: USEPA, CARB and SCAQMD toward the goal of achieving a line-haul and switcher locomotive fleet with an emissions equivalent of 95% Tier 4 compliant engines operating within the ports, and state-wide, as expeditiously as possible.

Achieving this goal will require a significant investment by the rail companies and will likely require significant funding assistance from the regulatory agencies. This goal cannot likely be achieved without a coordinated effort by all parties, including regulatory strategies by the agencies, cooperation by the rail companies, and assistance at the local level on individual rail yard projects.

While the goal is for a 95% Tier 4 fleet by 2020, the ports, as part of the environmental review process for the upcoming near-dock rail yard projects, such as the Intermodal Container Transfer Facility (ICTF) and Southern California International Gateway (SCIG), will use a minimum performance requirement of an emissions equivalent of at least 50% Tier 4 line-haul locomotives and 40% Tier 3 line-haul locomotives to be operating on port properties by 2023 in the environmental analysis. This minimum performance requirement will be incorporated as a minimum requirement to be achieved for the project, which may be implemented as mitigation for an identified impact through the CEQA environmental process or as a contractual lease requirement above what would be required strictly based upon identified impacts in the environmental analysis. While this performance requirement represents the minimum acceptable requirement for the near-dock rail yard projects, the ports will seek all feasible means to achieve the goal of a 95% Tier 4 fleet by 2020.

Following approval of the environmental analysis for any new or modified near-dock rail yard, lease negotiations will be initiated with the proposed rail operator. Through this process, the ports will make every feasible effort to implement requirements that will achieve the 95% Tier 4 line-haul locomotive goal by 2020. Further, as stated by CARB staff, achievement of this goal should be consistent with, and therefore aided by, the voluntary rail commitments entered into by CARB and the Class 1 rail operators in June 2010.

Rail facilities include many emission-producing activities for switcher and long-haul locomotives, including switching, idling, loading/unloading of railcars by CHE, and truck emissions during movement of containers to, from and within the rail yard. Under this measure, new rail facilities, or modifications to existing rail facilities, will incorporate clean, low emitting equipment for all operations. A list of such technologies will be provided for project proponents to consider in developing new facilities, and the requirements will be formalized in project approvals and facility leases. The initial expectations for cleanest rail yard technologies include the following:

- By 2007, maximize the use of ULSD fuels in locomotives.
- By 2010, all BNSF and UP locomotives shall use 15-minute idle restrictors.
- By 2010, the fleet average for Class 1 locomotives operating in the SoCAB will be an emissions equivalent of the USEPA Tier 2 emissions standards.
- By 2011, with co-funding through the ports' Technology Advancement Program (TAP), demonstrate the use of a technology with the goal of reducing emissions from a Tier 2 line-haul locomotive to achieve an emissions equivalent of at least a Tier 3 line-haul locomotive standard.
- By end of 2015 all Class 1 switcher locomotives operating on port property will meet USEPA Tier 4 off-road standards.
- Class 1 helper locomotives will be turned off while on port properties. If, for safety reasons, helper locomotives need to be on then they will meet similar controls as line-haul locomotives.
- By 2020, goal for 95% of Class 1 line-haul locomotives entering the ports to meet Tier 4 standards. For a minimum performance requirement, by 2023, Class 1 line-haul locomotives entering the ports will meet an emissions equivalent of 40% USEPA Tier 3 line haul locomotive standards and 50% Tier 4 line haul locomotive standards, which may be implemented as mitigation for an identified impact through the CEQA environmental process or as a contractual lease requirement above what would be required strictly based upon identified impacts in the environmental analysis.
- New and modified rail facilities will, at a minimum, be subject to the conditions of CHE measure CHE1, and will have provisions requiring service by clean trucks as defined by measure HDV1.

Commercial availability of Tier 4 locomotive engines in 2015 that fully meet USEPA emission standards (1.3 g/bhp-hr NOx and .03 g/bhp-hr PM) is essential to achieving both the minimum performance requirement and advancing toward the goal of 95% Tier 4 by 2020. To that end, the ports will conduct a Tier 4 technology development status review in 2012 and 2014, or participate in technology status evaluations by USEPA and/or CARB, to benchmark research and development, prototype testing, product compliance with standards, manufacturer production plans and procurement forecasts by the Class 1 railroads. Participants in the status review will include, at minimum, the ports, rail companies, agency partners and engine manufacturers. All review findings and recommendations will be documented and presented to each port's Board. Participation in a technology review and agreement to meet to negotiate on terms that could strengthen or augment the minimum performance requirement would be required as a commitment into any near dock rail yard lease subject to RL3.

Further, the ports' plan is to maximize the use of on-dock rail as an effective way to limit emissions associated with operation of on-road trucks and rail yards near residential areas. Several factors affect use of on-dock rail, such as: shipper and steamship line logistics (transloading, transportation costs, etc.), railroad operations (equipment availability, train schedules, and steamship line contracts/arrangements), terminal operations/congestion, and on-dock rail yard capacity. To accommodate projected increases in intermodal traffic and maximize rail movement of cargo, greater efficiencies in on-dock rail operations, and additional rail infrastructure will need to be planned by the ports. Consistent with such goals, the ports have plans to increase the on-dock rail capacity in the ports, and also to construct on-dock rail support, including additional rail infrastructure and trackage outside the marine terminals to better connect the on-dock rail yards with the Alameda Corridor. This additional rail capacity is important to maximize the use of the Alameda Corridor, and consequently reduce truck trips. The ports have maximized the size of planned/proposed on-dock railyards and support rail infrastructure via detailed master planning (which includes detail container terminal and rail system computer modeling/simulation), preliminary engineering, and final design for some of the infrastructure.

Some of the rail infrastructure improvements can be constructed within the existing land area to increase capacity. Capacity of the existing on-dock rail yards can also be increased through expanded hours of operations and improved efficiency in operational procedures. However, these physical improvements and operational changes may not be sufficient to accommodate the long-term growth forecasts of both ports. Existing rail yards will need to be made more efficient and expanded, and new yards will need to be evaluated and planned to minimize their impacts on communities. The existing rail yards cannot be expanded without additional land area and it is important to note that although rail yard expansions are needed in the face of projected cargo volumes, there is also a practical limit to the total size of on-dock rail facilities.

The ports will take all opportunities to maximize on-dock rail, and explore any other alternatives, in order to (1) reduce the need for truck drayage and (2) minimize the need for rail yard operations outside of the ports that are in relatively close proximity to residential and other receptors. However, near/off-dock infrastructure is needed, in addition to on-dock rail, to accommodate intermodal containers. As on-dock rail becomes maximized, near-dock rail facilities could further increase the capacity of moving cargo out of the port-area by rail and limit the distance of truck drayage. The community impacts around these facilities require the cleanest technologies and operational controls. This is why the ports are proposing strict performance requirement in this measure. In addition, the ports are also evaluating long term options. One of the major technology advancements being evaluated by the ports is development of a new zero emission container mover system, as discussed later in Section 4 of the CAAP, to move containers to near-dock rail yards in a manner that reduces the impacts on communities, fuel consumption, and the environment, while assuring that the lowest feasible percentage of discretionary cargo is drayed inland by trucks.

Implementation Plan

The ports' mechanism for implementing these strategies with Class 1 rail operations is through the CEQA process and the discretionary project approval for new near-dock rail facilities or modifications to existing near-dock rail facilities. The requirements identified for those near-dock rail projects will apply at the project site, as well as on all port tracks. The ports will also continue to work closely with regulatory agencies and rail companies to support achievement of the overall goals to maximize Tier 4 locomotives statewide, through the technology development status review process outlined above, implementation of regulatory strategies, securing incentive funding, and through cooperative agreements.

Air Quality Benefits

The air quality benefits of this measure will accelerate the improvements to be gained from locomotive and CHE regulations and from the MOU between the Class 1 railroads and CARB.

Benefits to date

Because no new rail facilities have been developed, there have been no air emission benefits to date from this measure.

Future Benefits

Since the measure will affect new or modified near-dock rail facilities that have not yet been designed, estimating the level of emission reductions is not possible at this time. However, the measure will result in reduction of emissions of DPM, NOx, other criteria pollutants, and other diesel-related pollutants beyond what will be achieved by upcoming regulations and the railroad/CARB MOU. More efficient use of on-dock rail versus truck drayage, and other improvements that reduce fuel consumption, will also likely result in a decrease in GHG emissions.

Financial Costs

At this time there are no anticipated costs to the ports associated with this control measure.

Costs to Date

There have been no costs incurred to date in association with this measure.

Future Costs

At this time there are no anticipated future costs associated with this measure, but there may be TAP-related costs in the future associated with technology advancements sought under the measure.

Upcoming Milestones

1. The elements of this measure will be included in any new or modified near-dock rail facilities.

Schedule: To be completed through EIR development and leases; ongoing.

2. The benefits of this program will be quantified and reflected in the periodic updates to the ports' emissions inventories.

Schedule: Ongoing.

Elements to be Tracked

Specifically for progress on the RL3 measure, any new or redeveloped near-dock rail yard projects will be evaluated under CEQA and all project information will undergo public review. Tier 4 product availability in 2015 meeting USEPA emission standards will be tracked and documented through the structured technology review process described above, all locomotive fleet information will be tracked through annual emissions inventory updates, and demonstration projects will be tracked and reported through the TAP. In addition, CARB tracks compliance with the MOU.

Looking Forward

The ports will also continue to work with their agency partners, USEPA, CARB and SCAQMD, and will continue discussions with the Class 1 rail operators, to explore future opportunities to integrate cleaner locomotive into their operations as soon as they become available.

4.6 Construction Activity

In the 2006 CAAP, the ports committed to develop Best Management Practices (BMPs) for port-related construction activity. To meet this commitment, the Port of Los Angeles adopted its "Sustainable Construction Guidelines for Reducing Air Emissions" and the Port of Long Beach developed guidelines for reducing air emissions from construction operations. These BMPs will be evaluated on a project-specific basis and applicable practices will be incorporated into construction project contracts.

Below is a list of key BMPs common to both ports.

- All dredging equipment shall be electric powered.
- All ships and barges used primarily to deliver construction related materials to a construction site shall comply with the expanded VSR Program (12 knots from 40 nm).
- All category 1 and 2 engines in harbor craft used for construction projects must meet U.S. USEPA Tier 2 off-road marine engine standards.
- All on-road heavy-duty trucks must meet the requirements of the Clean Truck Program.
- Off-road construction equipment must meet Tier 2 standards in the period prior to 12/31/2011, Tier 3 standards in the period between 1/1/2012 to 12/31/2014, and shall meet Tier 4 standards after 1/1/2015.
- As applicable, off-road construction equipment shall be equipped with a CARB-verified Level 3 diesel emission control system.
- Construction equipment idling is limited to five minutes when not in use.
- Full compliance with SCAQMD Rule 403, Fugitive Dust, including an approved Control Plan is required.

It should be noted that there are provisions for certain exemptions, which are considered on a case-by-case basis.

Additional emissions control strategies are being explored. For example, the Port of Los Angeles is developing a concept that would include emission limits and controls in their bid packages. Bidders would receive a "calculator," which they would fill out and submit with their bids. "Emissions calculators" may be developed prior to the bid solicitation package going public and would incorporate that project's emissions limitations, control strategies applicable to construction equipment, and other limitations/specifications developed under the CEQA analysis. The calculator would be simplified to the extent that dredge/construction companies would not need to hire air quality expertise to fill out the calculator to determine whether their bid meets the specific project requirements. In addition, contract specification language would be developed and incorporated into the construction contracts stating the reporting, recordkeeping requirements, and penalties (should any requirement not be met).

4.7 Technology Advancement Program

Introduction

To ensure effective air pollution reduction strategies are commercially available to facilitate implementation of CAAP measures, the ports developed and are currently implementing the Technology Advancement Program (TAP). The purpose of the TAP is to identify and demonstrate new technologies or new applications for existing technologies that have significant potential to reduce air pollution emissions from the CAAP source categories and meet CAAP goals.

The TAP implementation process adopted by the ports is thoroughly outlined in the TAP Guidelines[32]. TAP offers financial support for the demonstration of advanced technologies that: a) have a high probability of achieving significant reductions in criteria pollutants and CARB classified air toxic pollutants, specifically, DPM, NOx and SOx, and; b) are seeking verified technology status from CARB; and c) present a strong business case for future successful technology commercialization. In the simplest terms, the purpose of TAP is to add additional, effective air pollution reduction strategies to the CAAP "toolbox."

The TAP's primary focus is on the demonstration, verification, and commercialization of technologies that reduce criteria air pollutants from the major source categories identified in the CAAP. While TAP primarily focuses on technology demonstrations with a high potential to reduce DPM, NOx and SOx, the technologies demonstrated under TAP often reduce greenhouse gases (GHG) and fine particulate matter (i.e., particle sizes on the order of 2.5 micron in diameter or smaller). As a matter of practice, the reduction potential of GHG is considered in the evaluation for each technology proposed for TAP demonstration.

TAP Funding

<u>*Costs to Date*</u>

Table 4.18 summarizes TAP funding to date.

Table 4.18: Technology Advancement Program Funding to Date

TAP	Funding Source	2006	2007	2008	2009	Total
	POLA	$0	$1,737,420	$830,104	$487,668	**$3,055,192**
	POLB	$0	$1,434,000	$830,104	$107,334	**$2,371,438**
	SCAQMD	$0	$271,500	$1,557,125	$476,250	**$2,304,875**
	CARB	$0	$783,628	$0	$130,130	**$913,758**
	USEPA	$0	$375,000	$100,000	$0	**$475,000**
	Measure Totals	**$0**	**$4,601,548**	**$3,317,333**	**$1,201,382**	**$9,120,263**

[32] *http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2211*

Future Costs

TAP is funded on an annual basis by both ports. The annual minimum contribution from each port is $1.5M. Port financial support of TAP is shown below in Table 4.19.

Table 4.19: Technology Advancement Program Future Funding

TAP	Funding Source	2010	2011	2012	2013	2014	Total
	POLA	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000	**$7,500,000**
	POLB	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000	**$7,500,000**
	SCAQMD	$0	$0	$0	$0	$0	**$0**
	CARB	$0	$0	$0	$0	$0	**$0**
	Measure Totals	**$3,000,000**	**$3,000,000**	**$3,000,000**	**$3,000,000**	**$3,000,000**	**$15,000,000**

As discussed in the TAP Guidelines, the ports maximize the effectiveness of TAP by leveraging the ports' investment. As a policy, TAP funds a maximum of 50% of a project's total cost. As noted in Table 4.19, TAP leverages the ports' funding commitments with contributions from stakeholder agencies, including the USEPA Region 9, CARB, and SCAQMD. Co-funding contributions are also offered by the project proponents.

The original CAAP identified a funding commitment by each port over the five year CAAP planning period. The ports remain committed to the TAP and anticipate continued funding allocations in each port's budget, which is adopted each year by the Boards of Harbor Commissioners, over the CAAP Update five year planning horizon.

Advisory Committee

TAP implementation is guided by the management and staff of the ports of Long Beach and Los Angeles, as well as by an Advisory Committee comprised of recognized experts from the CAAP agency partners, the USEPA Region 9, CARB, and SCAQMD. The Advisory Committee was established by invitation from the ports during the first quarter of 2007; a list of current Advisory Committee members is included in the TAP Annual Reports[33].

The Advisory Committee serves in an advisory capacity to the ports for screening, evaluating, and recommending meritorious projects. The Advisory Committee members also provide information related to co-funding from their agencies that could potentially be used to move projects toward implementation. In addition, the Advisory Committee members receive regular updates on the TAP projects being conducted in the ports. The Advisory Committee process also serves as the mechanism for member agencies and the ports to reach consensus on the level of emission reductions achieved by the candidate technologies undergoing evaluation.

TAP Accomplishments

TAP has met all milestones and exceeded goals originally established by the CAAP. These include: a) the development and publication of guidelines describing how the program will be implemented; b) formation of the TAP Advisory Committee; and c) evaluation, selection, and award of projects

[33] *http://www.cleanairactionplan.org/tech/default.asp*

received under both the port-sponsored and unsolicited proposal elements of the TAP Guidelines. A description of TAP funded projects is included in the TAP annual reports.[34]

Additional Technology Pursuits

In addition to the TAP, the ports are also supportive of other technology development and implementation efforts. The TAP's primary focus is identifying, verifying, and preparing technologies for commercialization. Products that have already been proven technically feasible and commercially viable increase the ports' options and allow the ports to be more aggressive in pursuing CAAP measure implementation. In certain cases, technologies have been pursued under separate and distinct technology implementation programs. Examples include the Port of Los Angeles' electric Class 8 drayage truck program and the electrified rubber tired gantry crane projects at each port.

Additionally, other initiatives have been created to compliment the TAP, such as the Port Technology Development Center (PTDC). The PTDC assists companies, providing an "incubator" for their developing products that are in the concept or research and development stage and are not yet ready for the TAP. In addition, the PTDC provides support for companies that have moved beyond the TAP stage, but still need business assistance.

Completed Milestones

1. Develop guidelines for the TAP, which identify the program goals, and procedures for evaluating proposals.

   Schedule: Completed.

2. Establish an Advisory Committee comprised of representatives of the ports agency partners, USEPA, CARB and SCAQMD.

   Schedule: Completed.

Upcoming Milestones

1. Publish TAP Annual Report, including a budget review, ongoing project status and any program revisions or updates.

   Schedule: End of first quarter of 2009, annually thereafter.

2. Upon completion of a TAP project, post information on the results of the project to the CAAP website.

   Schedule: Upon completion of TAP projects.

[34] *http://www.cleanairactionplan.org/civica/filebank/blobdload.asp?BlobID=2301*

3. Update the TAP Guidelines as needed to continually improve program implementation.

   Schedule: Updates to occur as needed.

Looking Forward

While the Technology Advancement Program will continue to seek emission reductions from all source categories identified in the CAAP, the current programmatic and technical TAP priorities are as follows:

- Expand outreach to port tenants, industry groups, and equipment operators regarding the TAP opportunity as well as other available grant funding opportunities, including but not limited to those offered by the SCAQMD and USEPA;
- Increase coordination and the level of communication with other domestic and world ports regarding to air quality improvement technologies and the potential for inclusion in the Clean Air Action Plan;
- Streamline TAP implementation and identify strategies to improve the efficiency of reviewing candidate technologies and processing proposals;
- Partner with TAP Advisory Committee member agencies, other agency stakeholders, and project proponents in an effort to leverage TAP funding and maximize program effectiveness.

4.8 Emissions Inventory Improvements

The ports will continue to identify opportunities to improve the accuracy of key monitoring and tracking elements used in development of the ports' emissions inventories. The emissions inventories are the ports measurement tool for evaluating and reporting on progress toward meeting the San Pedro Bay Standards. Therefore, it is important that this measurement tool be as accurate as possible.

Emissions inventory improvements potentially include:

- Scrutinizing emissions factors and conducting source testing to improve the accuracy of emissions loading for port-related sources;
- Evaluating duty-cycles/load factors through increased use of data logging to improve their accuracy;
- Determining OGV actual speeds from 20 to 40 nautical miles from Point Fermin using the enhanced radar system identified in OGV-1;
- Evaluating the use of Automatic Identification System (AIS) data into the emissions estimates for OGVs;
- Inclusion of ultrafines in the emissions inventories when emissions estimating methodologies are approved;
- Evaluating direct data uploads to the emissions inventory database to facilitate data gathering;
- Evaluating critical highway speed data to better improve the accuracy of HDV emissions estimates;
- Updating the origin destination study used to estimate truck routing; and

- Discussions with OGV engine manufacturers to evaluate their test data and understanding of the emissions profiles of their engines at different loads and determine if improvements can be made to better represent what the engines are producing (emissions) at various loads encountered during transit and maneuvering.

4.9 Zero Emission Container Movement Systems

The ports' Technology Advancement Program is focused on the development and implementation of near-term emission reduction technologies. In a separate effort, the ports are also exploring longer-term solutions for cleaner movement of cargo.

Activities Near the Port Complex

Over the past several years, the ports have been evaluating various Zero Emission Container Movement Systems (ZECMS) for potential application at the ports. The short term goal is to determine if ZECMS are feasible for the ports and if so, demonstrate innovative technologies that can be utilized for more efficient and greener movement of cargo. The ultimate goal is to handle the anticipated cargo throughput growth with pollution-free technologies and strategies.

In June 2007, the ports of Long Beach and Los Angeles embarked upon an evaluation of ZECMS from the port complex to near-dock rail facilities. The evaluation included a preliminary assessment and a technical review of various alternatives. Fourteen alternative container movement systems were evaluated including linear induction motor systems, magnetic levitation container conveyor systems, electric freight shuttle systems, elevated monorail systems based upon people-mover technology, and wheeled shuttle cars operating on guideways. The results of the evaluation were published in May 2008[35].

On June 3, 2009, the Port of Long Beach, in collaboration with Port of Los Angles and the Alameda Corridor Transportation Authority (ACTA), issued a Request for Concepts and Solutions (RFCS) to potential vendors, system integrators, and investors, which outlined the goals and requirements of a ZECMS Project to move containers between docks and the International Container Transfer Facility near West Long Beach, potentially eliminating thousands of daily short-haul diesel truck trips and reducing air pollution. The following conditions apply to the Project:

1. The proposed Project is intended to support the necessary movement of containers between the port terminals and existing and proposed near-dock rail facilities. The Project is not intended to diminish or replace on-dock rail loading at the marine terminals.

2. The system will compete with trucking to the near-dock rail facilities; it is assumed that the ports would not ban trucks from transporting cargo to the near-dock rail facilities.

3. The respondents were required to assume that the Project would be a stand-alone project that would be financed without contribution or subsidy from the ports or ACTA.

[35] Port of Long Beach and Port of Los Angeles, *Alternative Container Transportation Technology Study*, May 2008.

The purpose of the RFCS was to (a) determine the technical and financial viability of available ZECMS technologies submitted by each respondent and the feasibility of employing that technology for completion of the Project; (b) evaluate the capabilities of each respondent's management teams to provide and present detailed design criteria and construction capability for a possible future RFQ/RFP for the Design, Build, Finance, Operate, and Maintenance (DBFOM) of a ZECMS Project; and (c) assess the respondent's current financial plan for funding the Project at no net cost to the ports, including operating costs for a proposed long-term leasehold initiative for the ZECMS Project and respondent management teams.

By the October 23, 2009 submittal deadline, a total of seven written responses to the RFCS were received. These responses fell in three technological categories:

1. Magnetic Levitation Systems:
   - American Maglev Technology of Florida (AMT), Inc.
   - Bombardier

2. Other Fixed Guideways:
   - Flight Rail Corp.
   - Freight Shuttle Partners
   - Magna Force, Inc.
   - Innovative Transportation Systems Corporation (presented two options)

3. Rubber-Tired, Zero Emission Concepts
   - Innovative Transportation Systems Corporation (presented two options)
   - Tetra Tech, Inc.

POLB assembled an evaluation team comprised of POLB and POLA staff, legal counsel, ACTA, and a panel of experts chosen by the USC Keston Institute of USC. The Keston panel completed its initial review in early April 2010. The evaluation team and Keston met to discuss preliminary findings and agreed that an interview would be necessary to obtain additional information and clarification from each of the respondents. A set of supplemental questions was forwarded to all respondents on May 12, 2010. Written answers were submitted and interviews were conducted on the campus of USC on May 24, 2010. At the conclusion of the interviews the panel evaluated each respondent's written submissions and oral interview.

Keston noted that none of the systems proposed are sufficiently mature to move to a full-scale operational deployment in a port application at this time. Further, Keston concluded that prior to the selection and deployment of any guideway system, additional testing needs to be carried out in an environment that replicates actual container handling and transportation operations. In addition, Keston concluded that in light of the capital intensive nature of fixed guideway systems and the best case assumptions regarding growth in container volume, market share, capital costs, and system availability used in many of the respondents' analyses, a ZECMS will have difficulty competing economically with conventional truck drayage.

While the Keston panel has concluded that none of the systems proposed are sufficiently mature for full-scale operational deployment in the ports at this time, port staff will coordinate on developing an approach for increasing technology readiness and demonstrating such a system in a port environment.

Other Related Planning Activities in the Region

The ports continue to coordinate with the efforts by other regional organizations with interest in this area, including ACTA, the Gateway Cities Council of Governments (COG), the Southern California Association of Governments (SCAG), Caltrans and Los Angeles Metro. For instance, to support the preparation of the I-710 Corridor EIR/EIS, studies of market, technology assessment, system requirements, and engineering feasibility were completed in early and mid-2009[36]. The ports and ACTA participated in these efforts, and provided input accordingly.

For the I-710 EIR/EIS, the various technologies evaluated in the ports' ZECMS study were narrowed down to two families of alternative technologies: automated fixed-track/guideway systems (e.g., maglev) and electric/battery (zero emission) trucks. In light of the property requirements and cost for deployment of an automated fixed-guideway technology on the ports and intermodal rail facilities, a concept which entails the propulsion of electric/battery trucks was developed. This technology would interface with ports and rail terminals as conventional trucks do today, but would operate on a dedicated guideway subject to controls that safely optimize capacity. Such a technology does not exist as a commercial product today, but would incorporate characteristics of a range of existing freight and passenger technologies. Trucks powered by electric motors could draw wayside electric power on the line-haul segment and operate on battery power at the ports and intermodal rail facilities. Individually-operated electric trucks would interface with existing container handling systems and would not otherwise consume limited capacity at either the ports or intermodal rail facilities.

The alternative technology (or ZECMS) and project alternatives screening analyses for the I-710 corridor yielded an alternative (to be carried forward for further detailed analyses) that consist of an exclusive freight movement corridor (truck lanes) that can accommodate conventional trucks as well as the aforementioned electric/battery-powered trucks. This alternative will assume design and usage of the freight movement corridor by zero emission trucks. This technology would include, but not be limited to, battery powered trucks as well as trucks powered by overhead electrical lines, linear induction motor or linear synchronous motor systems (or other concepts), or future zero emission

[36] URS, *Final Report, Alternative Goods Movement Technology Analysis – Initial Feasibility Study Report*, January 2009; URS, *Final Technical Memorandum – Alternatives Screening Analysis*, May 2009.

technologies to be developed designed as part of the Freight Movement corridor. The design of the freight corridor will also assume possible future conversion, or initial construction, as feasible, (which may require additional environmental analysis and approval) of a fixed track guideway family of alternative technologies (e.g. Maglev).

The I-710 EIR/EIS funding partners (which includes the ports) will continue to encourage the goods movement industry to explore different options for Advanced Technology for ZECMS that can serve the minimum required future container volumes to be moved in the Freight Movement lanes using a fixed track guideway family of alternative technology systems as an initial element of the project, or as a future option with zero emission trucks (or zero emission transportation methods to move trucks) assumed at this time. New ZECMS concepts or methods that are adequately developed or demonstrated by other agencies or others in the future may be considered for subsequent analysis as part of a supplemental environmental report (including other alignments) to be prepared in the future for application and effects for the I-710 Corridor Project.

In addition, the SCAG has commenced a study titled "Comprehensive Regional Goods Movement Plan and Implementation Strategy." This study includes a conceptual plan for ZECMS between the north end of the I-710 Corridor and the eastern boundary of the SCAG region.

4.10 Infrastructure and Operational Efficiency Improvement Initiatives

This initiative identifies projects at the San Pedro Bay ports that improve infrastructure and operational efficiencies that also have an air quality benefit. The types of projects that are included in this element of the Clean Air Action Plan are generally initiated primarily as transportation or operational improvements; however, an air quality benefit does result from completing these projects. Projects examples include, but are not limited to:

- Grade separations
- OCR/RFID gates at terminals
- Terminal cargo handling/configuration efficiency improvements
- Evaluation of other potential operational efficiencies approaches that would reduce emissions associated with the port-related source categories

The emissions reduced from these projects would be quantified and reported under this measure. This initiative will most likely be undertaken by the same group and structure as the Technology Advancement Program.

4.11 The Port of Los Angeles' China Shipping Settlement

The City of Los Angeles Harbor Department (Harbor Department) joined environmental and Harbor-area community groups in a settlement agreement in 2003 and amended in 2004 that included a series of environmental programs designed to improve the area's air quality and quality of life. As part of this Amended Stipulated Judgment, the Harbor Department committed $29 million over five years to pay for air quality mitigation projects that reduce DPM and NOx emissions from port operations in the communities of Wilmington and San Pedro. This program is known as the Air Quality Mitigation Incentive Program (AQMIP). The primary purpose of this program is to provide financial incentives to assist in the implementation of projects that will accomplish two objectives: (1) reduction of DPM and NOx emissions associated with port operations in the communities of San Pedro and Wilmington, and (2) research and development of specific technologies that can be applied in the San Pedro Bay Port area to achieve the first objective.

A wide range of projects were awarded funding on a variety of port equipment from this program, including repowers, retrofits, after-market technologies and new engine purchases for the following categories:

- On-road heavy-duty vehicles
- Off-road heavy-duty equipment and engines
    - Specialty port equipment (i.e., top-pick, side-pick, yard hostlers, etc.)
    - Marine engines and equipment on ships (ocean-going vessels and line-haul tugs) that regularly call at the Port
    - Marine engines and equipment on tugs and harbor craft
- Research and development (R&D), including technology demonstrations.

To date, the implemented projects have resulted in the reduction of over 21 tons per year of DPM and over 616 tons per year of NOx emissions.

SECTION 5: CAAP EFFECTIVENESS TRACKING

Background

The original CAAP was published in November of 2006, prior to the establishment of the San Pedro Bay Standards detailed in Section 2 of this CAAP update. At the time of adoption, the effectiveness of the plan was estimated based on forecasted growth of uncontrolled emissions as compared with forecasted growth of controlled emissions after implementing CAAP measures and applicable regulations. In Section 3.3 of the original CAAP, the ports identified several methods for tracking and measuring CAAP progress which included the annual emissions inventory updates.

In the original CAAP, the 2005 emissions were based on the 2001 POLA and 2002 POLB OGV and HDV emissions grown to 2005, and the draft 2005 CHE emissions from both ports. It is important to note that the CAAP was released prior to publishing of the 2005 emissions inventories, and only the draft 2005 CHE emission estimates were available at that time. Rail and harbor craft emissions were not included because of uncertainties in both fleet characteristics and control strategy implementation. Estimated controlled and uncontrolled emissions were forecasted for the years 2007, the first year of CAAP measure implementation, through 2011. Controlled emissions in the original CAAP were estimated with the application of CAAP measures and regulations adopted through May 2005. Uncontrolled emissions were forecasted with adopted regulations through May 2005, but without the effects of CAAP measures. The original comparisons of controlled and uncontrolled emissions have been widely publicized in the media, and it is commonly quoted that the CAAP will reduce 2011 DPM emissions by 47%, NOx emissions by 45%, and SOx emissions by 52%.

Since the publication of CAAP, there have been a number of developments in regulatory programs and inventory updates. Specifically, CARB has adopted several aggressive regulations controlling port-related sources. Also, the 2005 emissions inventories for both ports have been published along with updates in 2006, 2007, and 2008. Finally, with this CAAP Update, the San Pedro Bay Standards are established based on out-year emissions changes compared to the 2005 baseline of actual emissions from both ports.

Therefore, the original comparisons of controlled to uncontrolled emissions within each outer year, based on preliminary baseline information and adopted regulations through May 2005, are no longer applicable. However, for completeness, a detailed evaluation of the CAAP's progress against the original comparisons is provided in Appendix C.

2009 CAAP Update Effectiveness

Now that the San Pedro Bay Standards have been established, ongoing CAAP progress and effectiveness will be measured against these Standards which consist of the following reductions as compared to the 2005 published inventories:

- Health Risk Reduction Standard: 85% reduction by 2020
- Emissions Reduction Standard:
  - By 2014, reduce emissions by 72% for DPM, 22% for NOx, and 93% for SOx
  - By 2023, reduce emissions by 77% for DPM, 59% for NOx, and 93% for SOx

Both of these Standards are represented as a percentage reduction from the total published 2005 Emissions Inventories, based on grown activity and control measures that includes all five source categories, not just the original three source categories used in the original CAAP. The San Pedro Bay Standards are developed based on the published 2005 emissions, grown to 2014 and 2023 using the 2007 San Pedro Bay cargo forecast, and controlled with CAAP measures and applicable regulations.

The following sections present the CAAP's effectiveness with respect to the San Pedro Bay Standards based on the 2005 published inventory methods and 2007 San Pedro Bay cargo forecast. Reductions in future year emissions are compared to the 2005 CAAP baseline.

5.1 Emissions Reduction Standard Progress

As stated above, one of the primary goals of the CAAP is to reduce mass emissions associated with port-related operations. For this CAAP Update, progress is determined by applying the 2005 published inventory methods to applicable years. It is, however, the intention of the ports moving forward to track the CAAP's effectiveness and progress through annual updates to both ports' published emissions inventories using the latest emissions estimating methodologies, activity data, and assumptions, which are reviewed by the Technical Working Group. With each new inventory publication, there is a detailed discussion on what improvements have been made to the emissions estimation methodology from the previous year. Port activity from previous years is then re-modeled using the latest methods and assumptions.

It is important to note that when updating emission estimating and forecasting methodologies and assumptions, the absolute values of the mass emissions numbers may change when the previous activity data is run using the new method. However, as long as all years are modeled in the same manner, it is the difference in emissions between the modeled and baseline year that is important since the Standards are stated as percent reductions over the baseline. Modeling all years with the same methods and assumptions allows for apples-to-apples comparison of annual emissions and the effectiveness of the CAAP, while incorporating the latest methodologies and data.

In the annual inventory updates completed since the 2005 published inventory, the 2005 baseline emissions have changed due to improved methodologies and assumptions across all five source categories. However, these changes have been modest.

The following two subsections present the progress to-date and the projected future benefits from the implementation of the CAAP and applicable regulations.

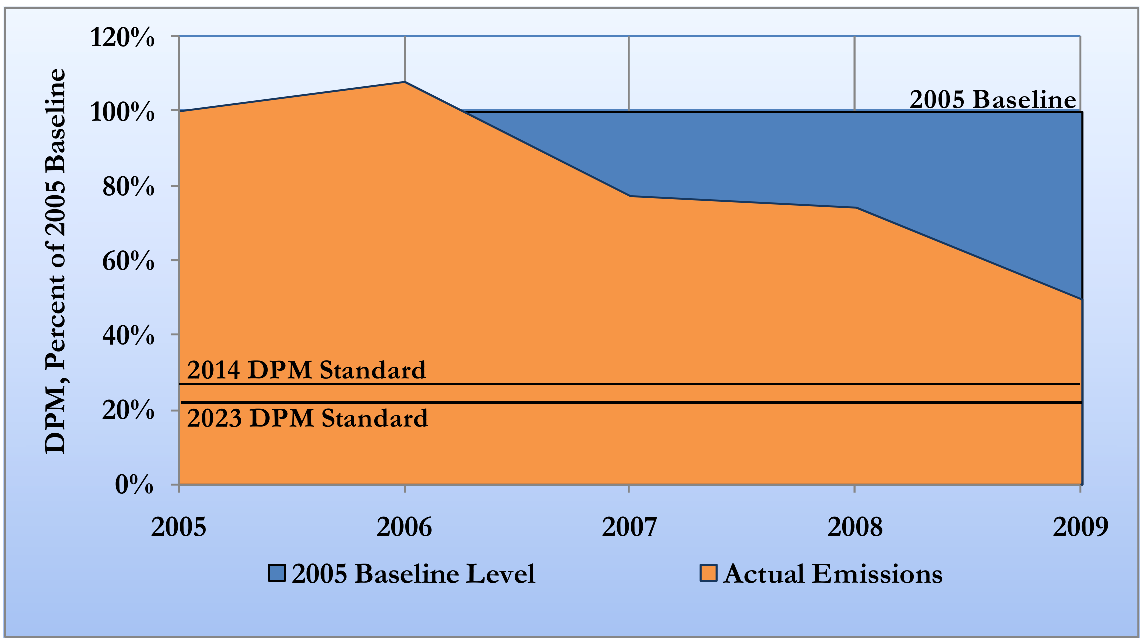
5.1.1 Progress to Date

To be consistent with the methods used in the emissions forecasting for the Standards, the progress to date for this CAAP update is shown based on the 2005 inventory methods and assumptions with the exception of HDV emissions where actual call weighted emissions are included. For calendar year 2005 there was no significant difference in call weighted versus population weighted HDV emissions. However, this difference became more pronounced in recent years due to the implementation of ports' Clean Truck Program and the disincentive for using older trucks. Accordingly, for determining progress to date for this CAAP update, actual annual activity data for 2006 through 2009 from both ports were modeled using the 2005 methodology and assumptions to develop comparable emissions for these years. Tables 5.1 to 5.3 show the normalized estimates of emissions by source category for calendar years 2005 through 2009. Figures 5.1 through 5.3 present the 2005 baseline emissions and the year to year percent change in emissions with respect to the 2005 baseline emissions. This is different from those in the published annual inventories where previous years' activities are modeled with the latest methods to update the emission estimates.

Table 5.1: Emissions by Calendar Year and Source Category Using the 2005 EI Methodology (DPM in tons/year)

Source Category	2005	2006	2007	2008	2009
OGV	1,189	1,283	811	870	649
HC	68	60	60	59	54
CHE	117	115	109	90	61
Rail	101	119	108	75	56
HDV	551	608	476	408	185
Total	**2,025**	**2,185**	**1,565**	**1,503**	**1,004**
% Cumulative Reduction		**-8%**	**23%**	**26%**	**50%**

Figure 5.1: DPM Reductions - Progress to Date

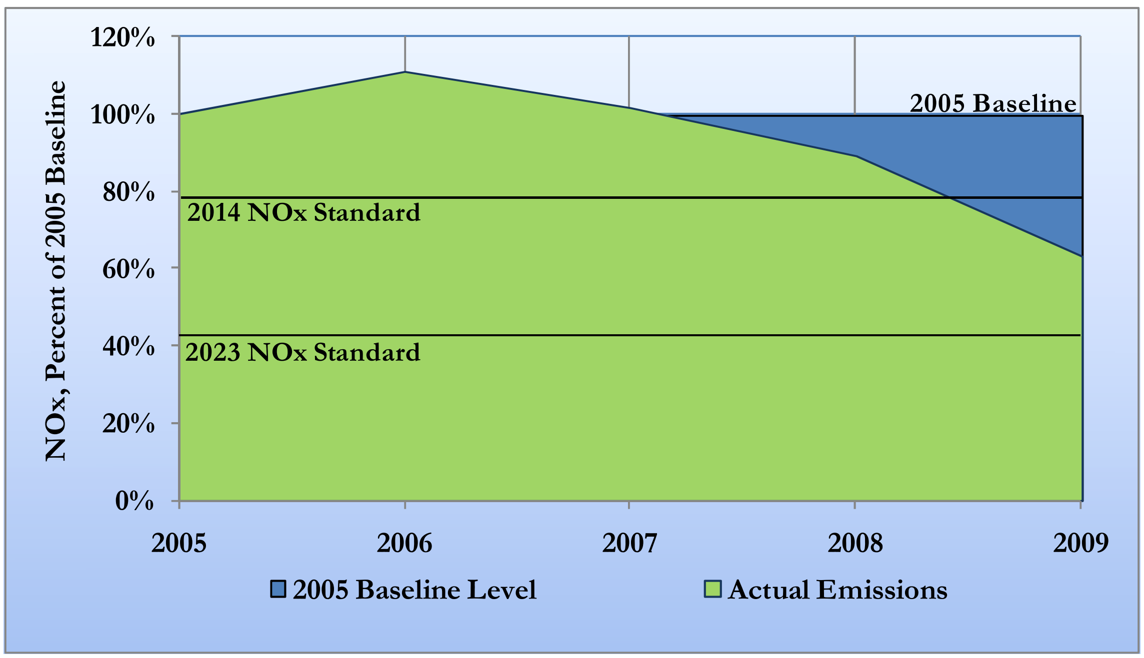


As presented above, by 2009 the ports were over half of the way to meeting the 2014 and 2023 DPM Emission Reduction Standards.

Table 5.2: Emissions by Calendar Year and Source Category Using the 2005 EI Methodology (NOx in tons/year)

Source Category	2005	2006	2007	2008	2009
OGV	13,132	13,949	12,664	10,985	9,660
HC	2,263	2,146	2,187	2,095	1,851
CHE	3,773	4,250	3,926	3,104	1,855
Rail	3,097	3,428	3,011	2,469	1,509
HDV	12,179	14,436	13,188	12,040	6,882
Total	34,444	38,209	34,975	30,693	21,755
% Cumulative Reduction		-11%	-2%	11%	37%

Figure 5.2: NOx Reductions - Progress to Date

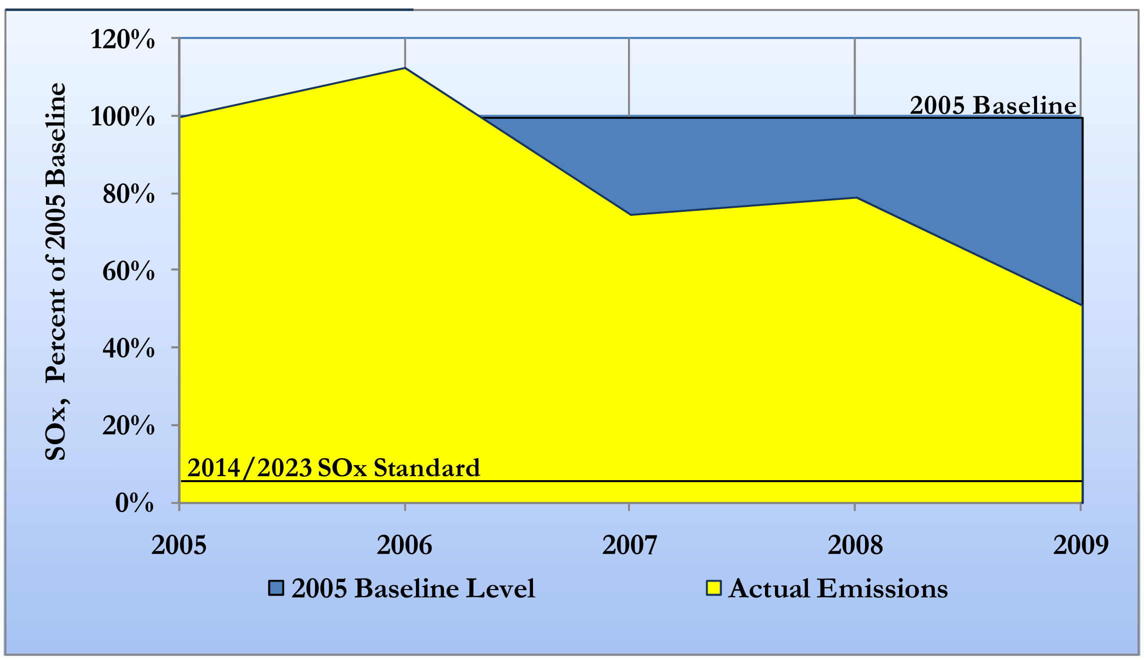


As presented above, in 2009, the ports' NOx emissions have been reduced beyond the 2014 NOx standard and over half of the way to meeting the 2023 standard.

Table 5.3: 2005 Emissions by Calendar Year and Source Category Using the 2005 EI Methodology (SOx in tons/year)

Source Category	2005	2006	2007	2008	2009
OGV	12,110	13,677	9,123	9,767	6,333
HC	12	1	1	1	1
CHE	31	46	42	41	4
Rail	173	218	101	17	12
HDV	94	71	11	9	8
Total	**12,421**	**14,013**	**9,279**	**9,836**	**6,358**
% Cumulative Reduction		**-13%**	**25%**	**21%**	**49%**

Figure 5.3: SOx Reductions - Progress to Date



As presented above, by 2009 the ports were over half of the way to meeting the 2014 and 2023 SOx Emission Reduction Standards.

As stated above, each year the ports update their annual emissions inventories utilizing the latest emission estimating methods, data, and assumptions, and compare the resulting emissions estimates to the 2005 CAAP baseline (this is the primary method for tracking CAAP progress). The approach and findings are reviewed by the TWG. In Section 9 of the POLA Emissions Inventory reports, the comparison includes the current year, the previous year and the 2005 baseline, using the activities from each year, modeled with the current year's methodology and assumptions. POLB provides a similar comparison in Section 8 of their Emissions Inventories. POLB's inventory compares the current year's emissions with the 2005 baseline emissions, based upon the activity data for each year and using the current year's methodology and assumptions.

5.1.2 Projected Future Benefits

In order to determine the projected benefits from the CAAP and applicable regulations, emissions are forecasted through 2014 based on the 2005 emissions inventory assumptions and the 2007 San Pedro Bay cargo forecast, consistent with the forecasting that was used to establish the San Pedro Bay Standards. Comparing the forecasted out-years to the 2005 baseline provides the projected benefits from 2010 through 2014. Benefits for 2005 through 2009 are based on the actual annual activity and the 2005 inventory methodology.

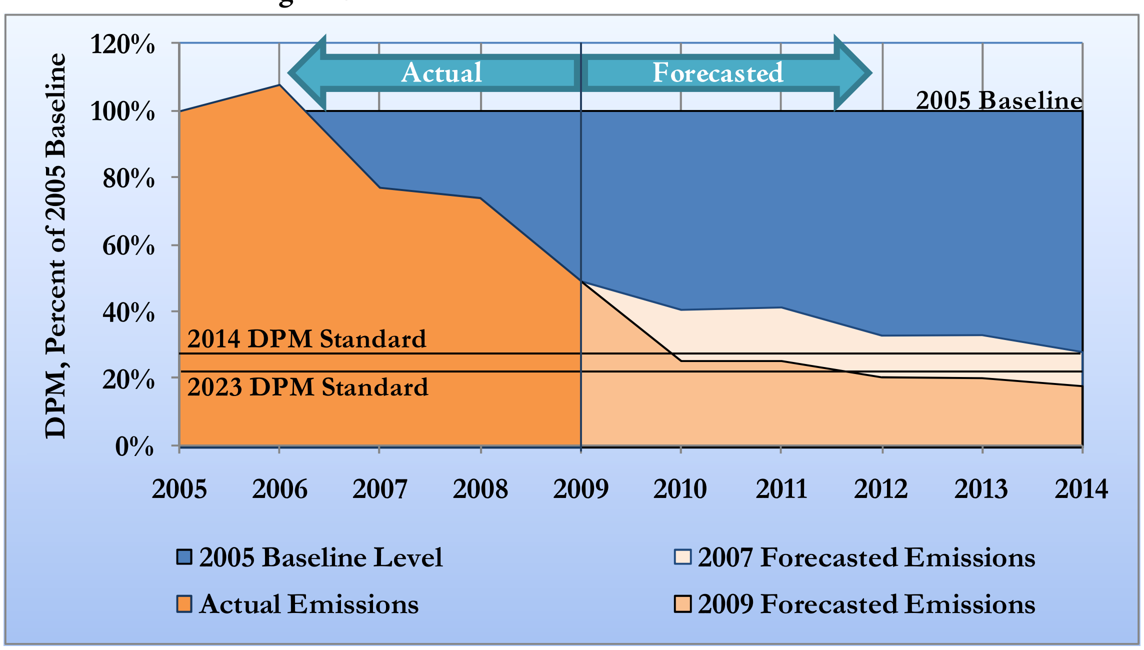
For further information, the projected emissions using the lower growth 2009 cargo forecast have also been determined through 2014. It should be noted that cargo forecasts vary along with changes in the financial markets. The 2007 San Pedro Bay cargo forecast used to establish the San Pedro Bay Standards was developed and published before the market collapse and ensuing recession and was based on previous year's cargo throughput changes. However, the forecasted volumes for 2007 through 2009 have not been realized at the ports. In fact, all the ports on the U.S. west coast have experienced significant cargo reductions during those two years due to the massive reductions in international trade volumes. The 2007 cargo forecast utilized for development of the Standards projected that the ports would continue to experience steady growth and reach cargo capacity (over 42 million twenty-foot equivalents (TEUs)) by 2023. In actuality however, the TEUs at the San Pedro Bay ports were flat in 2007 and reduced in 2008 and 2009. In 2009, the ports developed a revised growth forecast which takes into account the down turn that started in 2008 and predicts significantly slower growth in the out years. While the more conservative 2007 growth forecast has been used for planning purposes, both the 2007 (considered a "high-growth" forecast), and 2009 (considered a "low-growth" forecast) are represented in the forecasting of future CAAP benefits. It is most likely that actual growth will be somewhere between these two forecasts.

Tables 5.4 through 5.6 present the projected benefits of the CAAP measures and applicable regulations. Figures 5.4 through 5.6 present the 2005 baseline and the year to year percent change in the magnitude of emissions with respect to 2005 for the San Pedro Bay ports.

Table 5.4: Actual and Forecasted DPM Emissions & Benefits Using the 2005 EI Methodology

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
DPM, tons	*Based on Actual Activity Data*					*Based on Forecasted Activity Data*				
OGV	1,189	1,283	811	870	649	464	465	355	366	261
HC	68	60	60	59	54	71	72	71	60	59
CHE	117	115	109	90	61	79	75	65	51	31
Rail	101	119	108	75	56	106	115	124	133	142
HDV	551	608	476	408	185	111	119	60	68	82
Total	2,025	2,185	1,565	1,503	1,004	831	846	676	679	576
DPM Reductions Compared to 2005, ton	*Based on Actual Activity Data*					*Based on Forecasted Activity Data*				
OGV	0	-94	377	318	540	725	724	833	822	928
HC	0	8	8	9	14	-3	-4	-3	8	9
CHE	0	2	8	27	56	38	42	52	66	86
Rail	0	-19	-7	26	45	-5	-14	-23	-32	-42
HDV	0	-57	74	142	366	440	432	491	483	469
Total	0	-160	460	522	1,021	1,194	1,179	1,349	1,346	1,449
DPM Reductions Compared to 2005	*Based on Actual Activity Data*					*Based on Forecasted Activity Data*				
OGV	0%	-8%	32%	27%	45%	61%	61%	70%	69%	78%
HC	0%	12%	11%	13%	20%	-5%	-5%	-4%	12%	13%
CHE	0%	2%	7%	23%	48%	33%	36%	44%	56%	73%
Rail	0%	-18%	-7%	25%	45%	-5%	-14%	-23%	-32%	-41%
HDV	0%	-10%	14%	26%	66%	80%	78%	89%	88%	85%
Total	0%	-8%	23%	26%	50%	59%	58%	67%	66%	72%

Figure 5.4: DPM Baseline & Forecasted Benefits

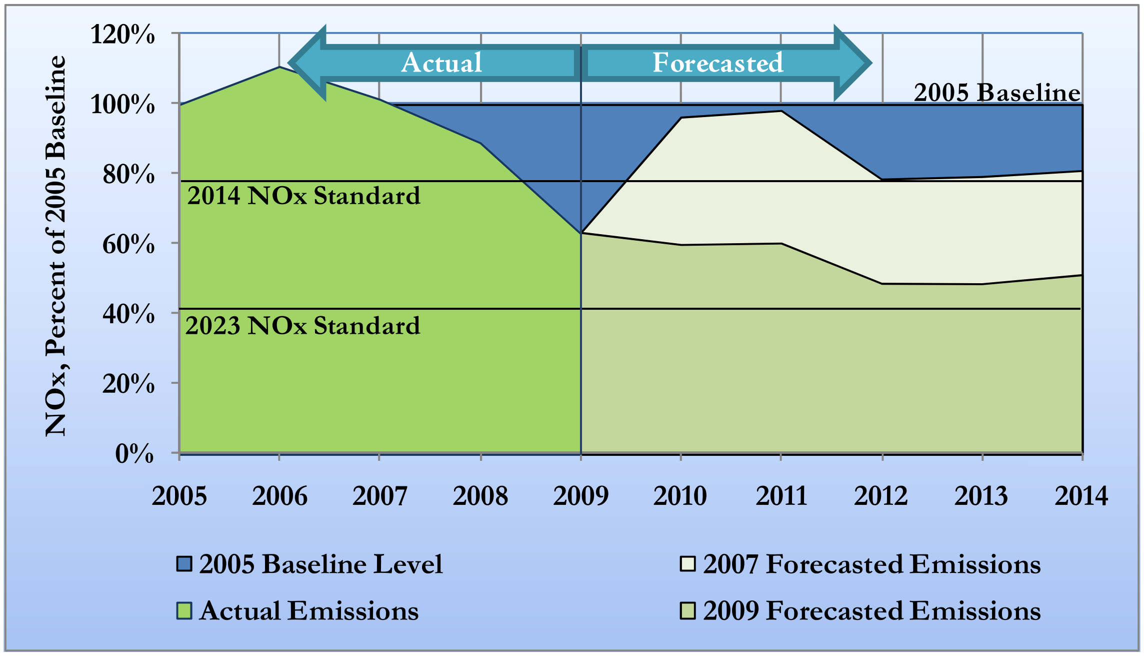


As presented above, with the implementation of additional CAAP measures coming on line, the ports' 2008/2009 OGV fuel switch incentive program, CARB's OGV fuel switch regulation implemented in mid-2009, and the Clean Truck Program, it is anticipated that the reduction trend observed through 2009 will continue through 2010. In 2014, the ports are anticipated to achieve their 2014 DPM Emissions Reduction Standard. Though significant progress has been made, significant challenges remain to achieve the 2023 goals.

Table 5.5: Actual and Forecasted NOx Emissions & Benefits Using the 2005 EI Methodology

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
NOx, tons	*Based on Actual Activity Data*					*Based on Forecasted Activity Data*				
OGV	13,132	13,949	12,664	10,985	9,660	14,495	14,608	14,623	15,018	15,036
HC	2,263	2,146	2,187	2,095	1,851	2,130	2,054	1,912	1,695	1,759
CHE	3,773	4,250	3,926	3,104	1,855	3,259	3,199	2,826	2,326	1,660
Rail	3,097	3,428	3,011	2,469	1,509	3,012	3,268	3,523	3,779	4,034
HDV	12,179	14,436	13,188	12,040	6,882	10,215	10,637	4,139	4,457	5,376
Total	34,444	38,209	34,975	30,693	21,755	33,111	33,765	27,024	27,275	27,865
NOx Reductions Compared to 2005, tons	*Based on Actual Activity Data*					*Based on Forecasted Activity Data*				
OGV	0	-818	468	2,147	3,472	-1,364	-1,476	-1,492	-1,887	-1,904
HC	0	118	76	168	413	134	210	351	569	505
CHE	0	-477	-153	669	1,918	514	574	947	1,446	2,113
Rail	0	-331	86	628	1,588	85	-171	-426	-682	-937
HDV	0	-2,257	-1,009	139	5,297	1,964	1,542	8,040	7,722	6,803
Total	0	-3,765	-532	3,751	12,689	1,333	679	7,420	7,169	6,579
NOx Reductions Compared to 2005	*Based on Actual Activity Data*					*Based on Forecasted Activity Data*				
OGV	0%	-6%	4%	16%	26%	-10%	-11%	-11%	-14%	-14%
HC	0%	5%	3%	7%	18%	6%	9%	16%	25%	22%
CHE	0%	-13%	-4%	18%	51%	14%	15%	25%	38%	56%
Rail	0%	-11%	3%	20%	51%	3%	-6%	-14%	-22%	-30%
HDV	0%	-19%	-8%	1%	43%	16%	13%	66%	63%	56%
Total	0%	-11%	-2%	11%	37%	4%	2%	22%	21%	19%

Figure 5.5: NOx Baseline & Forecasted Benefits

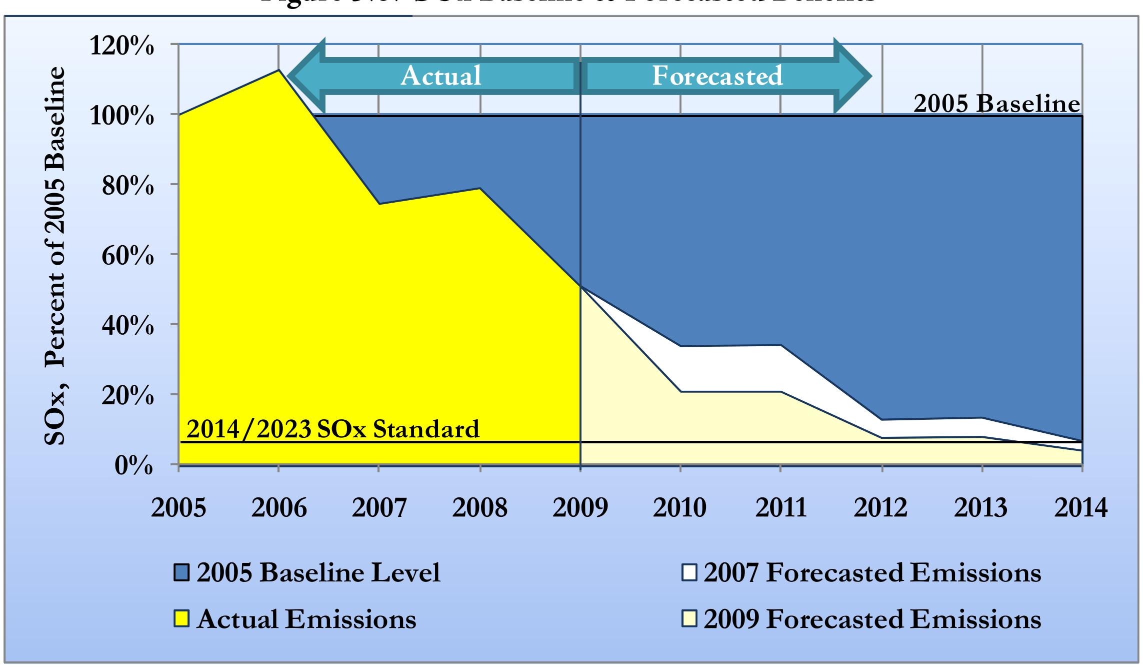


As presented above, with the implementation of the CAAP measures, including the vessel speed reduction (VSR) program, shore-power, the Clean Truck Program (CTP), and the other CAAP measures, the port's met the 2014 NOx Emission Reduction Standard in 2009. The increase in emission levels in 2010 is a manifestation of the 2007 cargo forecast compared to the actual cargo throughputs in the preceding years. The decrease in NOx emissions in 2010 is less than 2007 to 2009 because uncontrolled emissions for that year are based on the higher estimated growth from the 2007 cargo forecast, whereas controlled emissions in 2007 to 2009 reflect the actual decline in growth that occurred during those years. Increased participation in VSR out to 40 nm, increased use of shore power (or equivalent technologies) at berth, implementation of ECA in August of 2012, and introduction of new control technologies on existing and new build OGVs will significantly help in meeting the 2014 and 2023 NOx emissions reduction standard. One contributing factor to the lower NOx emissions between 2007 and 2009 has been reduced cargo volumes at both ports. If cargo volumes return to the levels projected in the 2007 cargo forecast, emissions may increase in the near-term. Therefore, diligent efforts to continue to reduce NOx emissions must be implemented to stay on track with achieving the NOx Standard in 2014 and beyond. Additionally, continued fleet turnover in other source categories will also contribute to NOx reductions. There will still continue to be significant challenges in meeting the 2023 NOx standard as the remaining emission reductions will need to come primarily from ships.

Table 5.6: Actual and Forecasted SOx Emissions & Benefits Using the 2005 EI Methodology

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
SOx, tons	*Based on Actual Activity Data*					*Based on Forecasted Activity Data*				
OGV	12,110	13,677	9,123	9,767	6,333	4,218	4,252	1,620	1,688	862
HC	12	1	1	1	1	2	2	2	2	2
CHE	31	46	42	41	4	6	6	7	7	7
Rail	173	218	101	17	12	3	3	4	4	4
HDV	94	71	11	9	8	13	13	14	14	15
Total	12,421	14,013	9,279	9,836	6,358	4,242	4,276	1,646	1,715	890
SOx Reductions Compared to 2005, tons	*Based on Actual Activity Data*					*Based on Forecasted Activity Data*				
OGV	0	-1,566	2,987	2,343	5,777	7,892	7,859	10,490	10,422	11,248
HC	0	11	11	11	11	11	11	11	11	11
CHE	0	-14	-11	-10	27	25	25	24	24	24
Rail	0	-46	71	156	161	170	169	169	169	168
HDV	0	23	84	85	86	81	81	80	80	79
Total	0	-1,592	3,142	2,585	6,063	8,179	8,145	10,775	10,706	11,531
SOx Reductions Compared to 2005	*Based on Actual Activity Data*					*Based on Forecasted Activity Data*				
OGV	0%	-13%	25%	19%	48%	65%	65%	87%	86%	93%
HC	0%	88%	88%	88%	89%	87%	87%	87%	87%	87%
CHE	0%	-47%	-36%	-31%	89%	81%	80%	79%	77%	77%
Rail	0%	-26%	41%	90%	93%	98%	98%	98%	98%	98%
HDV	0%	25%	89%	90%	91%	86%	86%	85%	85%	84%
Total	0%	-13%	25%	21%	49%	66%	66%	87%	86%	93%

Figure 5.6: SOx Baseline & Forecasted Benefits



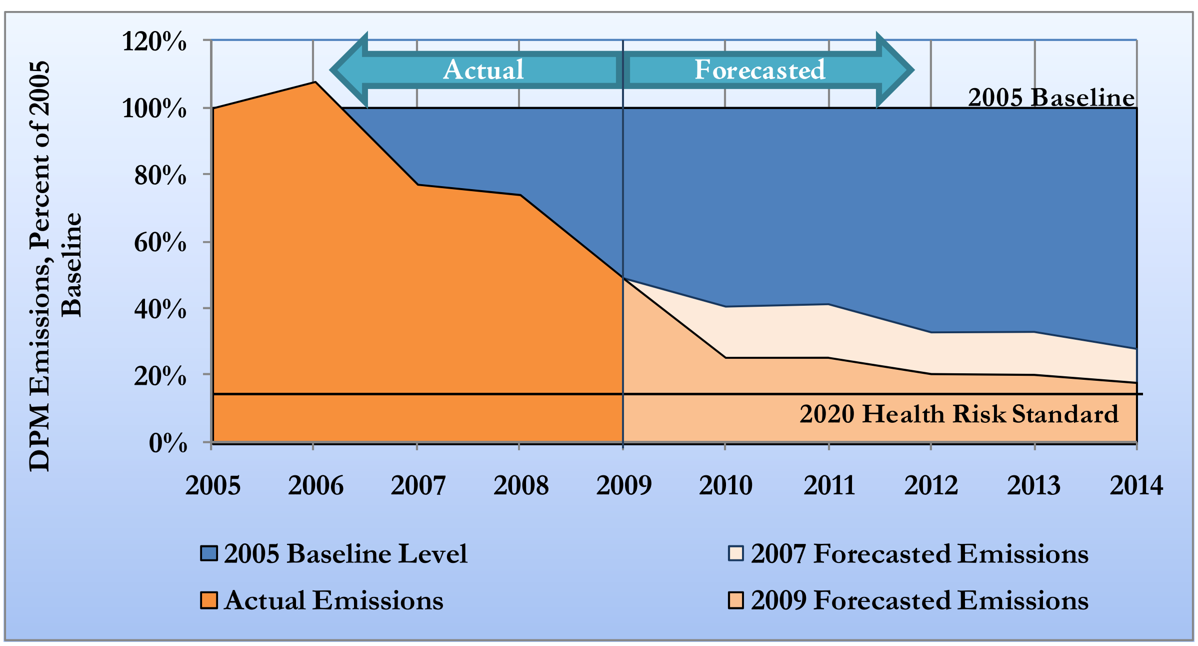
As presented above, with the implementation of additional CAAP measures, the ports' 2008/2009 OGV fuel switch incentive program, and CARB's OGV fuel regulation implemented in mid-2009, it is anticipated that the high rate of SOx reductions will continue in the coming years. The slight increase of SOx emissions from 2007 and 2008 was due to the injunction of the previous CARB OGV fuel rule in 2008. The ports are anticipated to achieve their 2014 and 2023 SOx Emissions Reduction Standards in 2014. Significant challenges however remain with closing the final gap and sustaining these reductions below the standards.

5.2 Health-Risk Reduction Standard Progress

As discussed in Section 2, the effectiveness of the CAAP's control measures and applicable regulations with respect to the population-weighted Health Risk Reduction Standard can be correlated to mass emission reductions in DPM from the 2005 baseline, as DPM emissions reductions track closely with reductions in DPM health risk. Since the Standard was based on geographically allocated forecasted DPM emissions, reductions in DPM mass emissions associated with CAAP measures and applicable regulations are therefore a representative surrogate for health risk reductions.

Progress to date and projected future benefits are determined by comparing the change in DPM mass emissions to the 2005 baseline. Figure 5.7 presents the progress to date and the projected future benefits anticipated from the CAAP and applicable regulations.

Figure 5.7: Health Risk Reduction Benefits - Progress To Date Using the 2005 EI Methodology



As presented above, with implementation of the CAAP and reduced cargo throughputs, in 2009 the ports have realized in 2009 reductions which are equivalent to over half of the 2020 Health Risk Standard. Additional DPM reducing measures like the CTP, VSR out to 40 nm, shore-power, and implementation of the ECA in August of 2012 are projected to continue and maintain the significant reductions to date. There are still significant challenges though in making the last incremental reductions to get to the 85% reduction standard and maintaining those levels.

SECTION 6: BUDGET SUMMARY

There are several funding sources associated with the implementation of the CAAP, including:

- Costs borne by the ports in developing required infrastructure improvements, funding incentives, implementation of control measures, and demonstrating new emission reduction strategies, and
- Costs borne by the industries/terminals affected by CAAP requirements, and
- Costs borne by regulatory agencies to fund grants and demonstration projects.

The CAAP is a tool developed expressly for the ports to implement comprehensive strategies that will reduce both health-risk and mass emissions associated with port operations. This budget section is a guide for the ports' financial planning. Costs that need to be borne by the ports must be identified to ensure that the programs to be funded by the ports can be properly budgeted. Potential available funding from regulatory agencies is also included for planning purposes. Health care costs and industry costs are not the focus of this section.

Port funding to date is broken down by measure and presented in Table 6.1 for POLA and Table 6.2 for POLB.

Table 6.1: POLA Funding To Date

Initiative	2006	2007	2008	2009	Total
HDV1	$0	$0	$23,317,485	$59,457,232	**$82,774,717**
HDV2	$0	$0	$0	$0	**$0**
OGV1	$0	$0	$1,400,000	$1,900,000	**$3,300,000**
OGV2	$0	$5,395,900	$17,072,800	$5,932,474	**$28,401,174**
OGV3	$0	$0	$0	$0	**$0**
OGV4	$0	$0	$354,000	$204,000	**$558,000**
OGV5	$0	$0	$0	$0	**$0**
OGV6	$0	$0	$0	$0	**$0**
CHE1	$0	$0	$0	$0	**$0**
HC1	$0	$0	$0	$0	**$0**
RL1	$0	$2,500,000	$2,500,000	$0	**$5,000,000**
RL2	$0	$0	$0	$0	**$0**
RL3	$0	$0	$0	$0	**$0**
TAP	$0	$1,737,420	$830,104	$487,668	**$3,055,192**
Recognition	$0	$5,000	$5,000	$5,000	**$15,000**
Eff. Imprv.	$0	$0	$0	$0	**$0**
TOTAL	**$0**	**$9,638,320**	**$45,479,389**	**$67,986,374**	**$123,104,083**

Table 6.2: POLB Funding To Date

Initiative	2006	2007	2008	2009	Total
HDV1	$0	$0	$15,585,307	$28,856,000	**$44,441,307**
HDV2	$0	$0	$0	$0	**$0**
OGV1	$1,615,000	$1,727,500	$1,834,600	$1,728,501	**$6,905,601**
OGV2	$5,533,900	$6,313,100	$8,078,900	$3,749,468	**$23,675,368**
OGV3	$0	$0	$0	$0	**$0**
OGV4	$0	$0	$120,800	$90,000	**$210,800**
OGV5	$0	$0	$0	$0	**$0**
OGV6	$0	$0	$0	$0	**$0**
CHE1	$0	$0	$0	$0	**$0**
HC1	$0	$0	$0	$92,180	**$92,180**
RL1	$2,500,000	$2,500,000	$0	$0	**$5,000,000**
RL2	$0	$0	$0	$0	**$0**
RL3	$0	$0	$0	$0	**$0**
TAP	$0	$1,434,000	$830,104	$107,334	**$2,371,438**
Recognition	$0	$0	$5,400	$5,000	**$10,400**
Eff. Imprv.	$0	$0	$0	$0	**$0**
TOTAL	**$9,648,900**	**$11,974,600**	**$26,455,111**	**$34,628,483**	**$82,707,094**

Significantly less port funding was needed by the CTP than originally estimated in the original CAAP since private industry funded a significant portion of the truck fleet turnover. It is estimated that private industry invested over $600 million for truck modernization.

In addition to the funding from the ports identified above, additional funding was provided by the agencies, mostly through the grant awards, or through co-funding of Technology Advancement Program projects. AQMD provided over $1,8 million in co-funding for four TAP projects and awarded a $3,2 million Carl Moyer grant for the PHL fleet replacement project. CARB provided $98 million through Prop 1B and awarded a Carl Moyer grant for a multi-district TAP project. USEPA awarded over $6 million through several DERA grants to the ports to upgrade terminal equipment and harbor craft and to support a TAP project to develop a hybrid yard hostler.

Between 2006 and 2009, the financial contribution to the CAAP progress by each partnering agency was as follows:

- SCAQMD/Carl Moyer $13,004875
- CARB/Carl Moyer/Prop 1B Funding $49,913,758
- USEPA TAP/DERA $475,000

Anticipated port funding for support of the CAAP from 2009 through 2013 is presented in Table 6.3 for POLA and Table 6.4 for POLB.

Table 6.3: 2010 - 2014 POLA Future Budget Estimates

Initative	2010	2011	2012	2013	2014	Total
HDV1	$24,683,088	$2,398,030	$5,000,000	$0	$0	**$32,081,118**
HDV2	$266,250	$0	$0	$0	$0	**$266,250**
OGV1	$3,000,000	$3,000,000	$3,000,000	$3,000,000	$3,000,000	**$15,000,000**
OGV2	$34,500,000	$16,900,000	$5,200,000	$42,000	$260,000	**$56,902,000**
OGV3	$0	$0	$0	$0	$0	**$0**
OGV4	$0	$0	$0	$0	$0	**$0**
OGV5	$0	$0	$0	$0	$0	**$0**
OGV6	$0	$0	$0	$0	$0	**$0**
CHE1	$0	$0	$0	$0	$0	**$0**
HC1	$0	$0	$0	$0	$0	**$0**
RL1	$0	$0	$0	$0	$0	**$0**
RL2	$0	$0	$0	$0	$0	**$0**
RL3	$0	$0	$0	$0	$0	**$0**
TAP	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000	**$7,500,000**
Recognition	$5,000	$5,000	$5,000	$5,000	$5,000	**$25,000**
Eff. Imprv.	$0	$0	$0	$0	$0	**$0**
TOTAL	**$63,954,338**	**$23,803,030**	**$14,705,000**	**$4,547,000**	**$4,765,000**	**$111,774,368**

Table 6.4: 2010 - 2014 POLB Future Budget Estimates

Initiative	2010	2011	2012	2013	2014	Total
HDV1	$16,279,000	$7,698,000	$3,709,000	$3,672,000	$3,672,000	**$31,358,000**
HDV2	$266,250	$0	$0	$0		**$266,250**
OGV1	$4,637,000	$2,500,000	$2,500,000	$2,500,000	$2,500,000	**$14,637,000**
OGV2	$36,495,369	$38,250,000	$56,933,477	$43,802,275	$14,749,202	**$175,481,121**
OGV3	$0	$0	$0	$0	$0	**$0**
OGV4	$0	$0	$0	$0	$0	**$0**
OGV5	$0	$0	$0	$0	$0	**$0**
OGV6	$0	$0	$0	$0	$0	**$0**
CHE1	$0	$0	$0	$0	$0	**$0**
HC1	$0	$0	$0	$0	$0	**$0**
RL1	$0	$0	$0	$0	$0	**$0**
RL2	$0	$0	$0	$0	$0	**$0**
RL3	$0	$0	$0	$0	$0	**$0**
TAP	$1,500,000	$1,500,000	$1,500,000	$1,500,000	$1,500,000	**$6,000,000**
Recognition	$5,000	$5,000	$5,000	$5,000	$5,000	**$20,000**
Eff. Imprv.	$0	$0	$0	$0	$0	**$0**
TOTAL	**$59,182,619**	**$49,953,000**	**$64,647,477**	**$51,479,275**	**$22,426,202**	**$225,262,371**

As presented in the tables above, both ports have made strong financial commitments to ensure the success of the CAAP. The budget estimates are reviewed and updated each year to ensure the proper level of funding for the CAAP.

In addition to port funding, the regulatory agencies have also made commitments to provide funding contributions for ongoing implementation of the CAAP. AQMD provided co-funding for a TAP project. CARB awarded to the SQAMD Prop 1B bond funding for the implementation of the Ports Clean Truck Program. USEPA awarded the Port of Long Beach a DERA grant awards for tenant cargo handling equipment and harbor craft projects, and awarded a DERA grant to Port of Los Angeles in the amount for port tenant cargo handling equipment projects. Details are shown in Table 6.5.

The commitments made from 2010 to 2014 are presented in Table 6.5.

Table 6.5: 2010 – 2014 Planned Contributions by Regulatory Agencies

Agency	2010	2011	2012	2013	2014	Total
SCAQMD	$832,500	ND	ND	ND	ND	**$832,500**
CARB Prop 1B Funding	$49,000,000	ND	ND	ND	ND	**$49,000,000**
USEPA	$6,299,800	$1,648,863	ND	ND	ND	**$7,948,663**
TOTAL	**$56,132,300**	**$1,648,863**	**$0**	**$0**	**$0**	**$57,781,163**

Note: ND - Not Determined at this time

The ports will continue to seek additional funding from the agencies, as well as from other sources, into the future to assist the ports and the port industry with achieving the clean air goals of the CAAP.

Appendix A: San Pedro Bay Ports Emissions Forecasting Methodology and Results

SAN PEDRO BAY PORTS
EMISSIONS FORECASTING METHODOLOGY AND RESULTS

September 2008

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EXECUTIVE SUMMARY

The Clean Air Action Plan finalized in 2006 established goals for the Ports of Los Angeles and Long Beach aimed at reducing port-related health risk through the establishment of three levels of standards. These standards include: 1) San Pedro Bay Standards, 2) Project Specific Standards, and 3) Source Specific Performance Standards.

The goals underlying the San Pedro Bay Standards include:

- The reduction of public health risk from toxic air contaminants associated with port-related mobile sources to acceptable levels.
- The reduction of criteria pollutant emission to levels that will assure that port-related sources decrease their "fair share" of regional emissions in order to facilitate the South Coast Air Basin's efforts to attain state and federal ambient air quality standards.
- The prevention of port-related violations of the state and federal ambient air quality standards at air quality monitoring stations at both ports.

Although CARB and the SCAQMD have yet to establish a "safe" level of exposure to diesel particulate matter (DPM), CARB, as part of their Goods Movement Plan established a statewide goal for reduction in DPM health risk to 85% below 2000 levels by calendar year 2020 with the near term goal of establishing measures that achieve as much reduction as possible within the first five years.

The Port's current efforts as described in this document are being undertaken in order to project what impact those regulations promulgated by the USEPA, CARB and the SCAQMD, as well as those measures enacted as part of the CAAP, will have in reducing public exposure to DPM from port-related sources in the future. The estimated reductions in mass emissions will be used to assess future risk and establish the foundation for the development of the San Pedro Bay Standard. Forecasting the levels of emissions associated with port-related sources is a complex endeavor which is heavily dependent upon anticipated changes in both activity (growth), and emissions in terms of the impact of enacted measures (control), understanding of the relationship between the two, and anticipating how these patterns might change in the future. The forecasting effort, much like the development of the underlying emissions inventories, is an ever evolving task and it is understood that the methodology utilized here will be improved upon as these complex relationships are better understood.

As with the development of the emissions inventories, a Technical Working Group (TWG) was established consisting of designated staff members from both the ports of Long Beach and Los Angeles, the US. EPA's Region 9, CARB, and the SCAQMD for the purpose of resolving those technical issues related to this effort. The TWG met several times since the inception of the project in September of 2007, and the following is the result of their combined efforts.

Table ES-1: Uncontrolled Emissions Forecast (Tons per Year)

	2005					2014					2023				
CHE	**DPM**	**NOx**	**SOx**	**CO**	**HC**	**DPM**	**NOx**	**SOx**	**CO**	**HC**	**DPM**	**NOx**	**SOx**	**CO**	**HC**
POLA	62	2,037	14	1,010	153	58	1,691	4	1,344	128	16	498	5	2,444	88
POLB	55	1,736	17	447	100	60	1,514	3	1,023	82	15	650	6	1,849	64
SPBP Total	**117**	**3,773**	**31**	**1,457**	**254**	**117**	**3,206**	**7**	**2,367**	**210**	**31**	**1,148**	**11**	**4,293**	**152**
HC															
POLA	38	1,259	7	297	26	40	1,144	1	321	29	42	1,066	1	341	31
POLB	30	1,004	5	237	20	34	881	1	266	23	37	867	1	280	25
SPBP Total	**68**	**2,263**	**12**	**535**	**46**	**74**	**2,025**	**2**	**587**	**52**	**79**	**1,933**	**2**	**621**	**55**
HDV															
POLA Container on terminal and on-port	65	1,075	7	471	151	41	1,177	1	394	132	18	1,018	2	301	104
POLB Container on terminal and on-port	68	1,305	9	553	201	53	1,579	2	519	174	25	1,519	3	437	151
POLA+POLB non Container	13	219	1	93	33	4	153	0	42	14	1	109	0	25	9
POLA+POLB Regional	404	9,580	76	3,267	572	418	10,190	12	2,668	559	86	3,310	17	1,309	259
SPBP Total	**551**	**12,179**	**94**	**4,385**	**957**	**516**	**13,099**	**15**	**3,623**	**879**	**130**	**5,956**	**22**	**2,072**	**523**
OGV															
POLA non-container	208	2,177	2,558	176	74	261	2,823	3,533	230	99	353	3,737	4,438	303	128
POLB non-container	244	2,921	2,957	245	106	322	3,774	3,987	316	137	386	4,567	4,645	382	166
POLA Container	344	4,029	3,051	365	173	703	7,651	6,695	737	381	899	9,443	8,488	945	484
POLB Container	393	4,005	3,544	358	167	695	7,817	6,693	743	347	879	9,768	8,312	940	439
SPBP Total	**1,189**	**13,132**	**12,110**	**1,143**	**520**	**1,981**	**22,065**	**20,909**	**2,025**	**965**	**2,517**	**27,516**	**25,883**	**2,570**	**1,218**
Rail															
POLA	58	1,784	97	244	100	83	2,558	6	601	145	88	2,724	6	639	154
POLB	43	1,314	76	183	74	72	2,142	3	534	121	91	2,730	4	678	154
SPBP Total	**101**	**3,097**	**173**	**427**	**174**	**155**	**4,701**	**9**	**1,135**	**266**	**180**	**5,455**	**11**	**1,317**	**309**
Grand SPBP Total (All 5 sources)	**2,025**	**34,444**	**12,421**	**7,946**	**1,951**	**2,843**	**45,096**	**20,942**	**9,736**	**2,372**	**2,937**	**42,008**	**25,928**	**10,873**	**2,256**

Table ES-2: Controlled Emissions (Tons per Year)

	2005					2014					2023				
CHE	DPM	NOx	SOx	CO	HC	DPM	NOx	SOx	CO	HC	DPM	NOx	SOx	CO	HC
POLA	62	2,037	14	1,010	153	18	893	4	1,335	90	8	234	5	2,295	40
POLB	55	1,736	17	447	100	13	767	3	1,008	49	10	401	6	1,829	34
SPBP Total	**117**	**3,773**	**31**	**1,457**	**254**	**31**	**1,660**	**7**	**2,343**	**139**	**18**	**635**	**11**	**4,124**	**74**
HC															
POLA	38	1,259	7	297	26	30	964	1	321	29	21	886	1	341	31
POLB	30	1,004	5	237	20	29	795	1	266	23	16	679	1	280	25
SPBP Total	**68**	**2,263**	**12**	**535**	**46**	**59**	**1,759**	**2**	**587**	**52**	**37**	**1,565**	**2**	**621**	**55**
HDV															
POLA Container on terminal and on-port	65	1,075	7	471	151	4	676	1	178	62	6	854	2	225	79
POLB Container on terminal and on-port	68	1,305	9	553	201	5	920	2	240	84	9	1,290	3	333	117
POLA+POLB non Container	13	219	1	93	33	0	114	0	25	9	0	100	0	21	7
POLA+POLB Regional	404	9,580	76	3,267	572	72	3,667	12	1,373	237	86	3,310	17	1,309	259
SPBP Total	**551**	**12,179**	**94**	**4,385**	**957**	**82**	**5,376**	**15**	**1,815**	**392**	**102**	**5,554**	**22**	**1,888**	**462**
OGV															
POLA non-container	208	2,177	2,558	176	74	44	2,417	207	202	86	50	2,824	253	239	102
POLB non-container	244	2,921	2,957	245	106	60	3,413	236	284	124	69	3,901	270	328	144
POLA Container	344	4,029	3,051	365	173	85	4,480	243	468	272	80	4,536	294	508	313
POLB Container	393	4,005	3,544	358	167	72	4,725	176	471	239	71	4,714	196	500	269
SPBP Total	**1,189**	**13,132**	**12,110**	**1,143**	**520**	**261**	**15,036**	**862**	**1,425**	**720**	**270**	**15,975**	**1,013**	**1,575**	**828**
Rail															
POLA	58	1,784	97	244	100	75	2,137	2	601	129	44	2,271	2	639	137
POLB	43	1,314	76	183	74	67	1,898	2	534	112	46	2,407	3	678	142
SPBP Total	**101**	**3,097**	**173**	**427**	**174**	**142**	**4,034**	**4**	**1,135**	**241**	**90**	**4,678**	**5**	**1,317**	**280**
Grand SPBP Total (All 5 sources)	**2,025**	**34,444**	**12,421**	**7,946**	**1,951**	**576**	**27,865**	**890**	**7,305**	**1,545**	**516**	**28,407**	**1,052**	**9,524**	**1,699**
Overall % reduction from 2005	**0%**	**0%**	**0%**	**0%**	**0%**	**72%**	**19%**	**93%**	**8%**	**21%**	**74%**	**18%**	**92%**	**-20%**	**13%**

Table ES-3: Reduction from 2005 by Source (%)

CHE	DPM	NOx	SOx	CO	HC	DPM	NOx	SOx	CO	HC	DPM	NOx	SOx	CO	HC
POLA	0%	0%	0%	0%	0%	70%	56%	72%	-32%	41%	87%	89%	63%	-127%	74%
POLB	0%	0%	0%	0%	0%	77%	56%	81%	-125%	51%	82%	77%	67%	-309%	66%
SPBP Total	**0%**	**0%**	**0%**	**0%**	**0%**	**73%**	**56%**	**77%**	**-61%**	**45%**	**84%**	**83%**	**65%**	**-183%**	**71%**
HC															
POLA	0%	0%	0%	0%	0%	21%	23%	87%	-8%	-9%	46%	30%	86%	-14%	-17%
POLB	0%	0%	0%	0%	0%	1%	21%	86%	-12%	-15%	47%	32%	85%	-18%	-23%
SPBP Total	**0%**	**0%**	**0%**	**0%**	**0%**	**13%**	**22%**	**87%**	**-10%**	**-12%**	**46%**	**31%**	**86%**	**-16%**	**-19%**
HDV															
POLA Container on terminal and on-port	0%	0%	0%	0%	0%	94%	37%	84%	62%	59%	90%	21%	74%	52%	48%
POLB Container 0n terminal and on-port	0%	0%	0%	0%	0%	92%	30%	83%	57%	58%	87%	1%	70%	40%	42%
POLA+POLB non Container	0%	0%	0%	0%	0%	97%	48%	89%	74%	73%	97%	54%	90%	77%	78%
POLA+POLB Regional	0%	0%	0%	0%	0%	82%	62%	84%	58%	59%	79%	65%	78%	60%	55%
SPBP Total	**0%**	**0%**	**0%**	**0%**	**0%**	**85%**	**56%**	**84%**	**59%**	**59%**	**81%**	**54%**	**77%**	**57%**	**52%**
OGV															
POLA non-container	0%	0%	0%	0%	0%	79%	-11%	92%	-15%	-16%	76%	-30%	90%	-36%	-38%
POLB non-container	0%	0%	0%	0%	0%	75%	-17%	92%	-16%	-16%	72%	-34%	91%	-34%	-35%
POLA Container	0%	0%	0%	0%	0%	75%	-11%	92%	-28%	-58%	77%	-13%	90%	-39%	-81%
POLB Container	0%	0%	0%	0%	0%	82%	-18%	95%	-32%	-43%	82%	-18%	94%	-40%	-61%
SPBP Total	**0%**	**0%**	**0%**	**0%**	**0%**	**78%**	**-14%**	**93%**	**-25%**	**-38%**	**77%**	**-22%**	**92%**	**-38%**	**-59%**
Rail															
POLA	0%	0%	0%	0%	0%	-30%	-20%	98%	-146%	-29%	24%	-27%	98%	-162%	-37%
POLB	0%	0%	0%	0%	0%	-55%	-44%	97%	-192%	-52%	-5%	-83%	97%	-271%	-93%
SPBP Total	0%	0%	0%	0%	0%	-41%	-30%	98%	-166%	-39%	11%	-51%	97%	-209%	-61%
Grand SPBP Total (All 5 sources)	**0%**	**0%**	**0%**	**0%**	**0%**	**72%**	**19%**	**93%**	**8%**	**21%**	**74%**	**18%**	**92%**	**-20%**	**13%**

SECTION 1.0 METHODOLOGY

Forecasts were made for two projected years, 2014 and 2023, for all port-related source categories: Ocean Going Vessels (OGV), Harbor Craft (HC), Cargo Handling Equipment (CHE), Heavy Duty Diesel Trucks (HDT), and Rail Locomotives (Rail). Forecasts were developed for two scenarios:

- First, 2005 emissions were grown using the growth scaling factors by source category. No further emission reductions were implemented for federal, state, and local regulations promulgated beyond October of 2005.
- Controlled scenario assuming all federal, state, local and port measures adopted as of July of 2008 are in effect in those forecasted years.

Assumptions of growth are consistent in both the controlled and uncontrolled scenarios.
In order to forecast emissions for the San Pedro Bay Ports the following elements were analyzed:

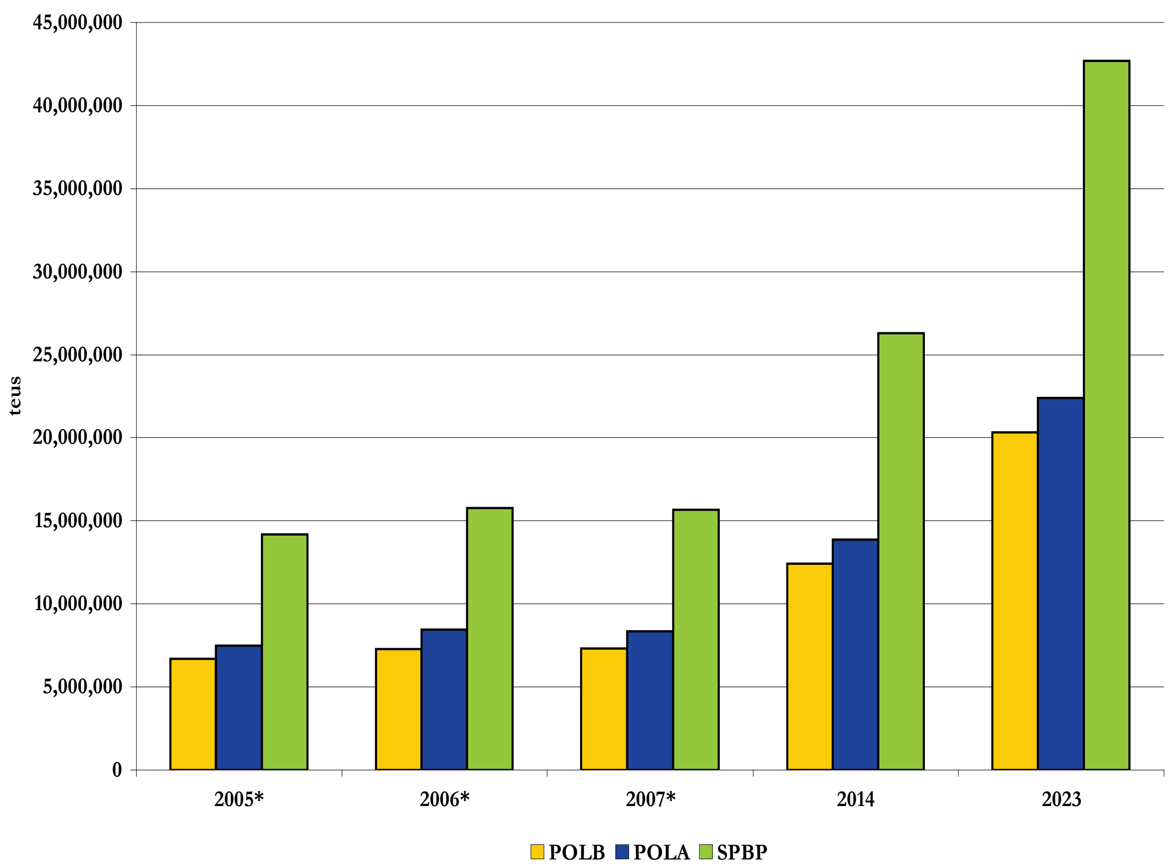
- Future activity estimates - the change or growth in cargo by type,
- Assumptions of how the activity changes affect port-related sources,
- Assumptions on future operational changes (including constraints) that would affect activity and source characteristics, and
- The potential effects of emissions reduction strategies – both through regulation and the CAAP.

Unless otherwise stated, the emission factors, models, and methods utilized in the development of these forecasts are consistent with those used in the development of the 2005 emissions inventories of both Ports.

SECTION 2.0 CARGO GROWTH ASSUMPTIONS FOR CONTAINER OGVS

Container OGV call activity for 2014 and 2023 was estimated utilizing the Mercator Report entitled, "Forecast of Container Vessel Specifications and Port Calls within San Pedro Bay" released in February of 2005. Adjustments were made to the forecasted number of calls for each Port by constraining the number of calls based on terminal capacity; something the Mercator Report neglected to take into account. The first step was to use the projected TEU throughput for both Ports from the DRAFT Global Insights 25 Year Trade Demand Forecast report which is presented below along with the actual throughput for 2005 through 2007.

Figure 2.1: Actual and Projected SPBP TEU Throughput



.* = actual not projected

Table 2.1: Port Specific and Total TEU Throughput

Year	POLB (teus)	POLA (teus)	SPBP (teus)
2005*	**6,709,725**	**7,484,615**	**14,194,340**
2006*	7,290,283	8,469,980	15,760,263
2007*	7,312,465	8,355,038	15,667,503
2014	**12,429,252**	**13,864,677**	**26,293,929**
2023	**20,314,000**	**22,384,000**	**42,698,000**

*Actual

It should be noted that container volumes from 2005 through 2007 have remained relatively flat and that the Global Insights forecasts for TEU throughput growth is currently higher than actual throughput. This is due to the rate at which goods flow in and out of the U.S., which is in turn linked to the global economy.

Based on the actual 2005 throughput and projected future TEU throughput, the Mercator scenario that best fits the forecasted growth is the "Base Case – Medium Growth and No Change to Panama Canal Dimensions" Scenario. The call distribution for the Ports was initially projected to be 108 weekly services/strings, or 5,616 annual calls in 2020, distributed by container vessel subclasses (i.e., Container 1000, Container 2000, etc.). This distribution was based on unconstrained terminal and local/regional infrastructure. This distribution was then reevaluated by Port staff and terminal constraints were taken into account on a terminal by terminal basis. The resulting annual call distribution projection for the San Pedro Bay Ports was revised from a total of 108 weekly services to 99 weekly services. The call distribution for 2005 (actual), and projections for 2014 and 2023 are provided in Table 2.2 below

Table 2.2: San Pedro Bay Ports – Container Ship Forecasting Actual and Projected Calls by Vessel Class

Container Vessel Class	Port of Long Beach			Port of Los Angeles		
	2005	**2014**	**2023**	**2005**	**2014**	**2023**
Container 1,000-1,999	203	208	52	199	0	0
Container 2,000-2,999	320	286	156	180	286	156
Container 3,000-3,999	181	182	260	285	182	260
Container 4,000-4,999	281	407	468	377	633	728
Container 5,000-5,999	170	357	416	205	267	312
Container 6,000-6,999	61	368	468	128	204	260
Container 7,000-7,999	57	166	208	49	250	312
Container 8,000-9,999	111	213	260		255	312
Container 10,000-12,000		104	260		104	260
Total	**1,384**	**2,291**	**2,548**	**1,423**	**2,181**	**2,600**

2.1 Emissions Assumptions for Container OGVs

The forecast non-controlled emissions for the container vessel fleet were developed using the 2005 EIs for each port. The average emissions per call were determined for each container class by averaging the 2005 emissions as reported in the published inventories. This analysis was performed at the vessel class and engine level to provide a ton-per-call estimate of emissions from main and auxiliary engines as well as auxiliary boilers by activity type and area (i.e., at Berth, Anchorage, Maneuvering, within the Precautionary Zone, from the Precautionary Zone to 20 nautical miles, and beyond 20 nautical miles to the overwater boundaries).

The 2005 average vessel class specific emissions by call were then multiplied by the number of calls per vessel class projected for 2014 and 2023 to derive the grown, uncontrolled emissions inventories. The by-engine and by-area distinctions were maintained within the forecast in order to facilitate the application of those control factors associated with the implementation of the CAAP and other adopted regulations.

For example:

2014 Emissions for Container 1000 vessels (main engines / PZ) =
2014 Calls for Container 1000 vessels * Average (main engine / PZ)
2005 emissions / 2005 Container 1000 calls

Table 2.3: Ton per Call 2005 Base Emission Rates (Container 1000 Vessels)

Vessel Type	Engine Type	Area / Activity	HC	CO	NOx	PM	SOx	DPM
1000	Main	PZ - 20	0.005	0.010	0.129	0.013	0.120	0.011
		Anchorage Hotelling	0.000	0.000	0.000	0.000	0.000	0.000
		Berth	0.000	0.000	0.000	0.000	0.000	0.000
		Maneuvering	0.003	0.003	0.021	0.002	0.009	0.002
		PZ	0.002	0.004	0.045	0.004	0.034	0.004
		Sea (40+)	0.012	0.028	0.349	0.034	0.288	0.030
	Aux	PZ - 20	0.000	0.001	0.010	0.001	0.008	0.001
		Anchorage Hotelling	0.001	0.002	0.022	0.002	0.017	0.002
		Berth	0.006	0.016	0.200	0.021	0.164	0.019
		Maneuvering	0.001	0.002	0.027	0.003	0.021	0.002
		PZ	0.000	0.000	0.006	0.001	0.005	0.001
		Sea (40+)	0.000	0.001	0.011	0.001	0.010	0.001
	Boiler	PZ - 20	0.000	0.000	0.000	0.000	0.000	0.000
		Anchorage Hotelling	0.000	0.000	0.004	0.002	0.032	0.000
		Berth	0.002	0.003	0.036	0.014	0.283	0.000
		Maneuvering	0.000	0.000	0.002	0.001	0.014	0.000
		PZ	0.000	0.000	0.000	0.000	0.000	0.000

Emissions data were unavailable for some of the larger capacity vessels classes given that they did not visit the San Pedro Bay Ports in 2005. In order to estimate the emissions from these vessels, regression analyses were performed assessing the power used by engine type and mode against vessel TEU capacity. It was assumed for purposes of this analysis that emissions would increase or decrease in proportion to power demand. As a result, a ***power correction factor*** was developed and applied to the emissions of the largest vessel class for which emissions data were available in order to derive an estimate of emission for those classes not included in the 2005 EI. An example of the resulting regression analysis is depicted below:

Figure 2.2: Regression Analysis Results (kWs per Vessel Capacity)

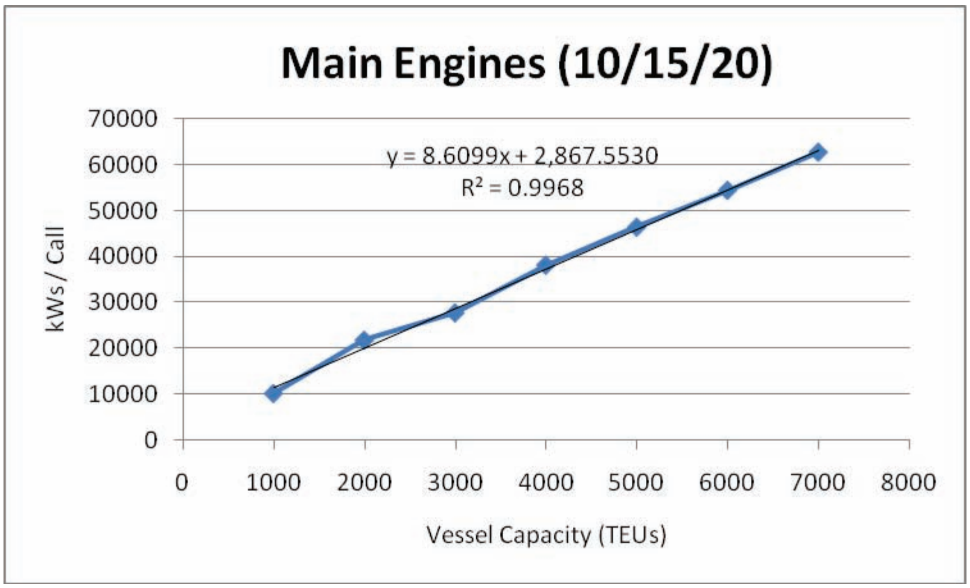


Table 2.4: Regression Analysis of Power vs. Vessel Capacity (kWs/TEU)

Engine	Activity	Equation	R^2	Engine	Activity	Equation	R^2
Main	PZ to 20	8.6099x+2867.5	0.99	Auxiliary	PZ to 20	1.938x+388.43	0.98
Main	Anchorage	N/A		Auxiliary	Anchorage	0.898x+392.47	0.95
Main	Hotelling	N/A		Auxiliary	Hotelling	1.989x+376.30	0.98
Main	Manu./PZ	8.61x+2867.55	0.99	Auxiliary	Manu./PZ	1.983x+388.43	0.98

2.2 Error Analysis

During the QA/QC process, it was discovered that emissions were being ascribed to engines during modes in which they should not be modeled as operating (i.e., emissions from main engines at berth while hotelling). Tracking down this problem led to the discovery of an error introduced into the analysis.

In order to derive the average emissions in tons per call, the basic emission rates are coupled with calls per year for each Port and vessel class. An equation was written to add the emissions from the two Ports and then divide by the combined number of calls. Although the calculation was performed correctly for the container 1,000 vessel category, the error was introduced when reproducing the equation for other vessel classes. In short, the cell references were shifted when the equation was replicated such that emissions were ascribed to the wrong activity (i.e., berth emissions per call were estimated using maneuvering emissions and maneuvering emissions were calculated using transiting emissions). This error existed for all vessel classes greater than 1,000 TEU capacity in the February 20, 2008 version of the forecasting spreadsheet yielding the overstated inventory estimates that were shared with the TWG on March 10, 2008.

The correction of the error resulted in an overall reduction in the estimate of the container OGV inventory which was in much better agreement with the initial estimates shared with the TWG in January of 2008.

2.3 Adjustment for Container Vessel Hotelling Times

As the container vessel fleet migrates toward larger capacity ships, it is anticipated that terminals will purchase additional cranes for loading and unloading cargo and make terminal densification changes that will allow the projected increased TEU throughput to be accommodated. The availability of additional cranes along with terminal operational changes should result in an overall improvement in loading and discharge rates and therefore a slight reduction in hotelling times compared to 2005 (if this does not happen, then the two Ports' forecasted TEU throughput must be reduced). Assuming a bay-wide average of approximately 1,000 moves per crane per call, the efficiency improvements in terminal operation is anticipated to result in an increase in moves per hour from an average of 28 in 2005, to 32 and 33 moves per hour in calendar years 2014 and 2023, respectively.

This increase in efficiency and the related reduction in overall hotelling times are believed to be necessary in order to accommodate the projected growth in future calls. In order to assess the impact of expected efficiencies, the Ports' projected hotelling times by vessel TEU capacity were compared to the calculated hotelling times for calendar year 2005. The actual 2005 at-berth emissions were adjusted by applying the ratio of the projected hotelling times to the calculated 2005 hotelling times. In those instances where the calculated hotelling times for 2005 exceeded actual 2005 hotelling times, no efficiency related adjustments were made.

Table 2.5: Projected Hotelling Time Efficiencies

Vessel Capacity	Average Hours POLA 2005	Average Hours POLB 2005	2014 Assumed Efficiency	2023 Assumed Efficiency
CONTAINER 1,000-1,999	36.5	23.2	0%	0%
CONTAINER 2,000-2,999	38.4	40.3	0%	0%
CONTAINER 3,000-3,999	41.6	44.7	11%	14%
CONTAINER 4,000-4,999	44.2	47.6	11%	14%
CONTAINER 5,000-5,999	73.7	72.4	11%	14%
CONTAINER 6,000-6,999	66.1	105.5	11%	14%
CONTAINER 7,000-7,999	63.5	74.0	11%	14%
CONTAINER 8,000-9,999	36.2	100.9	11%	14%
CONTAINER 10,000-12,000	N/A	N/A	0%	0%

It is important to note that it is the hotelling emissions (tons per call) rather than the times (hours per call) which are forecast. Therefore a projected hotelling efficiency of 10 percent would be reflected in the forecast by reducing the base 2005 hotelling emissions by 10 percent (2005 hotelling emissions in tons per call * 0.9). It is also important to note that the 2005 base emissions rates are calculated on average and are not Port specific.

As with vessel emissions associated with other modes of operation, the hotelling emission estimates for vessels not present in the 2005 EIs were assumed to be equivalent to those of the largest available vessel class. That is, the container 10,000-12,000 category was assumed to have the same hotelling times, and therefore emissions, as the 8,000 to 9,000 TEU capacity. As an exception, because the POLA hotelling times for this category were assumed to be uncharacteristically low (36.2 hours per call), only the POLB hotelling times (100.9 hours per call) were used for container 8,000 and larger TEU capacity vessels.

2.4 OGV Control Factor Development & Specifications

The following discussion is applicable to containerships and non-container vessels, and is common to both discussions. Emissions reductions were taken from CAAP measures, existing applicable regulatory programs, and terminal efficiencies that will have an emission reduction effect on OGVs in 2014 and 2023 are listed below:

- OGV-1: Vessel Speed Reduction
- OGV-2: Reduction of At-Berth Emissions
- OGV-3&4: Auxiliary (AUX) & Main Engine (ME) Fuel Standards
- OGV-5: ME Engine Improvements
- CARB Fuel Switch OGV Engine Low Sulfur Fuel Regulation (Main, AUX, and Boilers up to 24 nm) - July 2008
- CARB At-Berth OGV Regulation (At-Berth OGV regulation) – December 2007

2.4.1 Interaction/Hierarchy:

- OGV-1 will affect 90% of all calls in 2014 and 2023
- CARB At-Berth OGV Regulation (container, cruise, & reefer ships only) will be used in 2014 & 2023; OGV-2 will be "trumped" by the CARB rule in the out years
- CARB OGV Engine Low Sulfur Fuel Regulation applicable to main, auxiliary, and boiler engines within regulated California waters (24 nm from the coastline) will be used in 2014 & 2023. OGV3&4 will be "trumped" by the CARB rule in the out years because all of the vessels with very few exceptions are required to use either marine gas oil of marine distillate oil with sulfur limit of 0.1% by weight.
- OGV-5 will be used in 2014 & 2023 for vessels affected by a Terminal Lease Renewal (TLR)

2.4.2 CAAP Measure Implementation:

CAAP implementation methods:

OGV-1 VSR – Voluntary compliance at or >90% (Assumed 90% not lease driven)

OGV-5 is lease driven with initial implementation having fleet penetrations of 50% the 1st year, 70% 2nd year, and 90% 3rd year +. Note the year is not calendar, it's based on lease date and every 365 days after the lease has been signed. For these measures the following tables (updated from original CAAP) show the fleet penetration levels for 2014 & 2023.

Table 2.6: Port of Long Beach Fleet Penetration by Terminal

Terminal_ID	Type	OGV 2014	OGV 2023
LBA010	AUTO	90%	90%
LBB010	BREAK BULK	0%	90%
LBB030	BREAK BULK	0%	90%
LBB031	BREAK BULK	90%	90%
LBB040	BREAK BULK	0%	0%
LBB050	BREAK BULK	0%	0%
LBB060	BREAK BULK	90%	90%
LBD040	DRY BULK	0%	90%
LBC010	CONTAINER	0%	0%
LBC020	CONTAINER	90%	90%
LBC031	CONTAINER	0%	0%
LBC032	CONTAINER	0%	60%
LBC033	CONTAINER	0%	50%
LBC040	CONTAINER	90%	90%
LBC050	CONTAINER	0%	0%
LBC060	CONTAINER	90%	90%
LBB100	CRUISE	0%	0%
LBD010	DRY BULK	0%	0%
LBD020	DRY BULK	0%	0%
LBD050	DRY BULK	0%	0%
LBD070	DRY BULK	0%	0%
LBD110	DRY BULK	0%	0%
LBL020	LIQUID	90%	90%
LBL030	LIQUID	0%	0%
LBL010	LIQUID	0%	0%
LBO100	OTHER	0%	0%

Table 2.7: Port of Los Angeles Fleet Penetration by Terminal

Terminal_ID	Type	OGV 2014	OGV 2023
LAO060	AUTO	0%	0%
LAC040	BREAK BULK	90%	90%
LAO020	BREAK BULK	90%	90%
LAO120	BREAK BULK	0%	0%
LAO150	BREAK BULK	0%	90%
LAO350	BREAK BULK	90%	90%
LAC010	CONTAINER	90%	90%
LAC020	CONTAINER	90%	90%
LAC030	CONTAINER	90%	90%
LAC050	CONTAINER	90%	90%
LAC060	CONTAINER	90%	90%
LAC070	CONTAINER	0%	0%
LAC090	CONTAINER	90%	90%
LAC100	CONTAINER	90%	90%
LAO080	CRUISE	90%	90%
LAO310	DRY BULK	90%	90%
LAO130	LIQUID	57%	90%
LAO230	LIQUID	34%	67%
LAO290	LIQUID	0%	25%
LAO320	LIQUID	0%	38%
LAO330	LIQUID	90%	90%
LAO340	LIQUID	34%	67%
LAO360	LIQUID	34%	67%
LAO370	LIQUID	25%	90%
LAO400	LIQUID	90%	90%

Note: values <0.90 indicate the lease implementation is not fully engaged based on the time of year the lease is renewed and the 50%, 70, 90% implementation phase-in.

2.4.3 Control Factor Specifics:

OGV-1 Implementation:	Voluntary
Fleet penetration:	90% of all vessel classes
Applicable zones:	PZ-20, SEA (20-40)
Engine Types Affected:	Main & Auxiliary

CF Development: Ran the 2005 EI database assuming that all vessels comply with 12 knots (those vessels running <12 knots were left at their original speeds) and compared the results (which includes mains, auxiliary, and boilers) to the original 2005 EI database run on a vessel subclass to subclass basis (container 1000, container 2000, etc.) by zone (berth, anchorage, maneuvering, PZ, PZ-20, 20-EI boundary).

A Fleet Control Factor (FCF) was developed as a result of comparing the two database runs and represents the change between the two scenarios. The FCF represents the total change in ship emissions (mains/auxiliary/boilers) based on the scenario run.

Fleet Control Factor (FCF) = 100% 12 kt compliant emissions/2005 EI emissions (by subclass and zone)

Since VSR affects only PZ-20, and 20-40, all other zones have a FCF of 1.00.

Tables below show the FCF for ports of Long Beach and Los Angeles.

Table 2.8: OGV1 FCF Port of Long Beach

		PZ to 20					20 to 40 nm				
		PM	NOx	SOx	CO	HC	PM	NOx	SOx	CO	HC
LB	Auto Carrier	0.82	0.82	0.83	0.82	0.82	0.50	0.49	0.51	0.49	0.48
LB	Bulk	0.87	0.87	0.87	0.87	0.87	0.80	0.80	0.80	0.80	0.80
LB	Bulk - Heavy Load	0.94	0.93	0.94	0.93	0.93	0.89	0.86	0.91	0.86	0.87
LB	Bulk Self-Discharging	0.82	0.82	0.82	0.81	0.81	0.69	0.69	0.70	0.69	0.68
LB	Bulk Wood Chips	1.00	1.00	1.00	1.00	1.00	0.91	0.91	0.91	0.91	0.91
LB	Container1000	0.73	0.73	0.74	0.73	0.73	0.48	0.48	0.49	0.48	0.47
LB	Container2000	0.67	0.66	0.67	0.66	0.65	0.42	0.41	0.43	0.41	0.40
LB	Container3000	0.68	0.68	0.69	0.67	0.67	0.38	0.37	0.38	0.37	0.36
LB	Container4000	0.71	0.71	0.71	0.70	0.70	0.33	0.32	0.34	0.32	0.32
LB	Container5000	0.89	0.88	0.89	0.88	0.88	0.32	0.30	0.33	0.30	0.30
LB	Container6000	0.99	0.98	0.99	0.98	0.98	0.29	0.28	0.30	0.28	0.28
LB	Container7000	0.75	0.74	0.76	0.74	0.73	0.31	0.30	0.32	0.30	0.29
LB	Container8000	0.70	0.69	0.71	0.69	0.68	0.31	0.30	0.32	0.30	0.30
LB	Cruise	0.98	0.97	0.98	0.97	0.97	0.57	0.53	0.60	0.53	0.51
LB	General Cargo	0.83	0.83	0.83	0.82	0.82	0.71	0.71	0.72	0.70	0.70
LB	ITB	0.97	0.97	0.98	0.97	0.97	1.00	1.00	1.00	1.00	1.00
LB	MISC	0.78	0.81	0.76	0.82	0.82	0.74	0.81	0.71	0.83	0.82
LB	Reefer	0.78	0.77	0.79	0.77	0.76	0.52	0.51	0.53	0.51	0.50
LB	RoRo	0.77	0.77	0.77	0.75	0.75	0.49	0.50	0.44	0.49	0.48
LB	Tanker	0.84	0.83	0.83	0.83	0.83	0.80	0.79	0.80	0.79	0.79
LB	Tanker - Chemical	0.80	0.79	0.81	0.79	0.79	0.78	0.78	0.79	0.78	0.77
LB	Tanker - Crude - Aframax	0.87	0.86	0.90	0.86	0.85	0.75	0.77	0.71	0.77	0.76
LB	Tanker - Crude - Handyboat	0.92	0.92	0.92	0.92	0.92	0.75	0.75	0.76	0.75	0.74
LB	Tanker - Crude - Panamax	0.85	0.85	0.86	0.85	0.85	0.78	0.78	0.79	0.78	0.77
LB	Tanker - Crude - Suezmax	0.97	0.97	0.97	0.97	0.97	0.73	0.74	0.71	0.73	0.73
LB	Tanker - Crude - ULCC	0.94	0.94	0.94	0.94	0.94	0.72	0.72	0.73	0.72	0.71
LB	Tanker - Crude - VLCC	0.99	0.99	0.99	0.99	0.99	0.67	0.66	0.67	0.66	0.66
LB	Tanker - Oil Products	0.86	0.85	0.85	0.85	0.85	0.78	0.77	0.78	0.77	0.76

Table 2.9: OGV1 FCF Port of Los Angeles

		PZ to 20					20 to 40 nm				
		PM	NOx	SOx	CO	HC	PM	NOx	SOx	CO	HC
LA	Auto Carrier	0.71	0.70	0.71	0.70	0.70	0.51	0.50	0.52	0.50	0.50
LA	Bulk	0.86	0.86	0.86	0.86	0.86	0.79	0.79	0.79	0.79	0.79
LA	Bulk - Heavy Load	0.68	0.68	0.69	0.68	0.68	0.68	0.68	0.68	0.68	0.67
LA	Bulk Wood Chips	1.00	1.00	1.00	1.00	1.00	0.89	0.89	0.89	0.89	0.89
LA	Container1000	0.74	0.75	0.71	0.75	0.75	0.51	0.50	0.50	0.50	0.50
LA	Container2000	0.68	0.70	0.62	0.70	0.69	0.41	0.40	0.41	0.40	0.40
LA	Container3000	0.77	0.77	0.77	0.77	0.77	0.38	0.37	0.39	0.37	0.37
LA	Container4000	0.76	0.76	0.76	0.76	0.75	0.32	0.31	0.33	0.31	0.31
LA	Container5000	0.87	0.87	0.87	0.87	0.87	0.32	0.31	0.33	0.31	0.30
LA	Container6000	0.91	0.90	0.91	0.90	0.89	0.33	0.31	0.33	0.31	0.30
LA	Container7000	0.71	0.69	0.76	0.68	0.67	0.34	0.32	0.33	0.31	0.30
LA	Container8000	0.79	0.78	0.80	0.78	0.77	0.31	0.30	0.32	0.30	0.29
LA	Cruise	0.84	0.83	0.84	0.83	0.80	0.58	0.56	0.59	0.56	0.53
LA	General Cargo	0.77	0.77	0.78	0.77	0.77	0.73	0.73	0.74	0.73	0.73
LA	ITB	0.98	0.98	0.95	0.98	0.98	1.00	1.00	1.00	1.00	1.00
LA	MISC	0.92	0.93	0.93	0.93	0.92	0.68	0.65	0.60	0.66	0.66
LA	Reefer	0.78	0.76	0.78	0.76	0.76	0.53	0.52	0.54	0.52	0.51
LA	RoRo	0.79	0.79	0.79	0.79	0.78	0.43	0.42	0.43	0.42	0.42
LA	Tanker	0.83	0.83	0.83	0.83	0.83	0.76	0.76	0.76	0.76	0.76
LA	Tanker - Chemical	0.81	0.81	0.82	0.80	0.80	0.76	0.75	0.77	0.75	0.75
LA	Tanker - Crude - Aframax	0.83	0.83	0.84	0.83	0.83	0.75	0.75	0.76	0.75	0.75
LA	Tanker - Crude - Handyboat	0.91	0.91	0.91	0.91	0.90	0.80	0.79	0.80	0.79	0.79
LA	Tanker - Crude - Panamax	0.81	0.80	0.81	0.80	0.80	0.81	0.80	0.81	0.80	0.80
LA	Tanker - Oil Products	0.87	0.87	0.88	0.87	0.86	0.79	0.78	0.79	0.78	0.78

Exceptions: The Southern & Western routes have portions which lie outside of the 40 nm arc and thus a scaling factor (SF) was used to correct the emissions associated with these routes.

Applicable zone:	20-40 nm
SF all other zones:	1.00

SF Southern Route 20-40:	0.93
SF Western Route 20-40:	0.87
All other routes:	1.00

The FCF was scaled to a Scaled Fleet Control Factor (SFCF) using the following equation:

$$SFCF_{(x)} = (1 – ((1 – FCF) \text{ x } SF_{(Route)}))$$

$SF_{(Route)}$ was applied to the appropriate routes.

Because the FCF's assume compliance of the entire fleet with the measure, , the $SFCF_{(x)}$ for the 20 to 40 nm zone must be scaled to take into account the current ~90% compliance rate using a $SF_{(Compliance)}$ of 0.90.

For the PZ to 20 nm zone, an addition adjustment is needed given the fact that the voluntary VSR program was included in the 2005 EIs baseline at a 55% compliance rate (i.e., the FCF has an implicit 55% VSR compliance) for this zone. Therefore the $SF_{(Compliance)}$ must be adjusted to account for the inclusion of an additional 35% (55%+35% = 90%) of the remaining 45% of emissions (the portion of emissions that can be reduced by VSR) from the vessel fleet (35%/45%=78%) or $SF_{(Compliance)}$ of 0.78.

$SFCF_{(VSR)} = (1 - ((1 - SFCF_{(x)}) \times SF_{(Compliance)}))$

Where $SF_{(Compliance)}$ = Scaling factor (at 0.90 compliance) is 0.78 for PZ to 20 nm, 0.90 for 20 to 40 nm, and 1.00 for all other zones.

CARB OGV Engine Low Sulfur Fuel Regulation

Implementation:	Phase 1 - July 1, 2009 use of MGO with 1.5% S level or MDO with 0.5% S level (Exception is Auxiliary Engines where phase 1 is applicable as soon as the regulation is approved by California's Office of Administrative Law (OAL); Phase 2 – January 1, 2012 use of MGO or MDO with 0.1% S level
Fleet penetration:	100% with few exceptions
Applicable zones:	24 nm from the California coastline within regulated California waters
Engine Type:	Main, Auxiliary, and Boilers

Reference for the measures' details:
http://www.arb.ca.gov/regact/2008/fuelogv08/fuelogv08

CF Development: Ran the 2005 EI database assuming main, auxiliary and boiler engines are complying with 0.1% S MGO Fuel and compared the results to the original 2005 EI database run on a vessel subclass to subclass basis (container1000, container2000, bulk – self discharging, etc.) by zone (berth, anchorage, maneuvering, PZ, PZ-20, 20-EI boundary.

Emission reductions assumed from fuel switching are the same as utilized by CARB to support their Main, Auxiliary and Boiler engine Fuel Switch regulation adopted by its board on July 24, 2008. The reductions are shown in the tables below:

Popllutant	% Red: HFO to MGO @ 0.5% S	% Red: HFO to MGO @ 0.1% S
NOx	6%	6%
SOx	80%	96%
DPM/PM	75%	83%

Source: Table VII-2, Page VII-4
http://www.arb.ca.gov/regact/2008/fuelogv08/ISORfuelogv08.pdf

Fleet Control Factor (FCF) =
100% 0.1% S MGO compliant emissions/2005 EI emissions
(by subclass and zone - vessels that are already using MGO fuel were left as they were in the 2005 baseline run)

CARB's Low S Fuel FCF example for the Port of Long Beach:

		Berth-Hotelling					Manuevering				
Associated_Port	SubType	DPM	NOx	SOx	CO	HC	DPM	NOx	SOx	CO	HC
LB	Auto Carrier	0.37	0.91	0.04	1.00	1.00	0.36	0.90	0.04	1.00	1.00
LB	Bulk	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LB	Bulk - Heavy Load	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LB	Bulk Self-Discharging	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LB	Bulk Wood Chips	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LB	Container1000	0.41	0.92	0.04	1.00	1.00	0.39	0.92	0.04	1.00	1.00
LB	Container2000	0.36	0.90	0.04	1.00	1.00	0.36	0.90	0.04	1.00	1.00
LB	Container3000	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LB	Container4000	0.38	0.91	0.04	1.00	1.00	0.36	0.90	0.04	1.00	1.00
LB	Container5000	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LB	Container6000	0.38	0.91	0.04	1.00	1.00	0.37	0.91	0.04	1.00	1.00
LB	Container7000	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LB	Container8000	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LB	Cruise	0.88	0.98	0.05	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LB	General Cargo	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LB	ITB	0.82	0.99	0.20	1.00	1.00	0.79	0.98	0.18	1.00	1.00
LB	MISC	0.73	0.98	0.12	1.00	1.00	0.44	0.93	0.05	1.00	1.00
LB	Reefer	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LB	RoRo	0.61	0.98	0.09	1.00	1.00	0.39	0.94	0.04	1.00	1.00
LB	Tanker	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LB	Tanker - Chemical	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LB	Tanker - Crude - Aframax	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LB	Tanker - Crude - Handyboat	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LB	Tanker - Crude - Panamax	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LB	Tanker - Crude - Suezmax	0.39	0.95	0.04	1.00	1.00	0.38	0.94	0.04	1.00	1.00
LB	Tanker - Crude - ULCC	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LB	Tanker - Crude - VLCC	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LB	Tanker - Oil Products	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.03	1.00	1.00

CARB's Low S Fuel FCF example for the Port of Los Angeles:

		Berth-Hotelling					Manuevering				
Associated_Port	SubType	DPM	NOx	SOx	CO	HC	DPM	NOx	SOx	CO	HC
LA	Auto Carrier	0.41	0.92	0.04	1.00	1.00	0.38	0.91	0.04	1.00	1.00
LA	Bulk	0.36	0.90	0.04	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LA	Bulk - Heavy Load	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LA	Bulk Wood Chips	0.46	0.93	0.04	1.00	1.00	0.37	0.91	0.04	1.00	1.00
LA	Container1000	0.43	0.92	0.04	1.00	1.00	0.40	0.92	0.04	1.00	1.00
LA	Container2000	0.39	0.91	0.04	1.00	1.00	0.38	0.92	0.04	1.00	1.00
LA	Container3000	0.50	0.94	0.04	1.00	1.00	0.39	0.92	0.05	1.00	1.00
LA	Container4000	0.63	0.96	0.05	1.00	1.00	0.48	0.94	0.07	1.00	1.00
LA	Container5000	0.47	0.93	0.04	1.00	1.00	0.38	0.91	0.04	1.00	1.00
LA	Container6000	0.73	0.97	0.05	1.00	1.00	0.47	0.94	0.08	1.00	1.00
LA	Container7000	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LA	Container8000	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LA	Cruise	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LA	General Cargo	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LA	ITB	0.94	0.99	0.38	1.00	1.00	0.89	0.99	0.29	1.00	1.00
LA	MISC	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LA	Reefer	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LA	RoRo	0.40	0.92	0.04	1.00	1.00	0.38	0.91	0.04	1.00	1.00
LA	Tanker	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LA	Tanker - Chemical	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.04	1.00	1.00
LA	Tanker - Crude - Aframax	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LA	Tanker - Crude - Handyboat	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LA	Tanker - Crude - Panamax	0.35	0.90	0.03	1.00	1.00	0.35	0.90	0.03	1.00	1.00
LA	Tanker - Oil Products	0.35	0.90	0.04	1.00	1.00	0.35	0.90	0.04	1.00	1.00

Scaling factor for CARB's Low S Fuel FCF is to correct for the fact that the ports OGV emissions inventory covers the area up to 40 nm from the Point Fermin whereas CARB's regulation is applicable to 24 nm from the California coastline. 7% of total emissions estimates within 40 nm from the Point Fermin are outside of 24 nm area covered by the CARB regulation. Therefore, a scaling factor ($SF_{(24\ nm\ correction)}$) of 1.07 was applied as follows:

$$SFCF_{(CARB\ Fuel)} = FCF \times SF_{(24\ nm\ correction)}$$

OGV-5 OGV Technology MAN Slide Valves

Implementation:	Lease renewals
Fleet penetration:	50% (1st Year), 70% (2nd Year), and 90% (3rd +)
Applicable zones:	All except Berth and Anchorage Applies to MAN main engines only
Engine Type:	MAN Main

Reference for the measures' details: Final 2006, "San Pedro Bay Ports Clean Air Action Plan"; Technical Report (2006 CAAP document)

CF Development: The number of MAN main engines per vessel class per call was compared to the total 2005 calls by vessel class to scale to only the MAN fleet. A FCF was developed as per the 2006 CAAP document, using an emissions reduction of 30% for NO_x and 25% for PM for MAN main engines.

OGV 5 FCF example for the Port of Long Beach provided below.

		Berth-Hotelling					Manuevering				
Associated_Port	SubType	PM	NOx	SOx	CO	HC	PM	NOx	SOx	CO	HC
LB	Auto Carrier	1.00	1.00	1.00	1.00	1.00	0.86	0.84	1.00	1.00	1.00
LB	Bulk	1.00	1.00	1.00	1.00	1.00	0.84	0.82	1.00	1.00	1.00
LB	Bulk - Heavy Load	1.00	1.00	1.00	1.00	1.00	0.85	0.83	1.00	1.00	1.00
LB	Bulk Self-Discharging	1.00	1.00	1.00	1.00	1.00	0.86	0.83	1.00	1.00	1.00
LB	Bulk Wood Chips	1.00	1.00	1.00	1.00	1.00	0.84	0.82	1.00	1.00	1.00
LB	Container1000	1.00	1.00	1.00	1.00	1.00	0.85	0.85	1.00	1.00	1.00
LB	Container2000	1.00	1.00	1.00	1.00	1.00	0.86	0.85	1.00	1.00	1.00
LB	Container3000	1.00	1.00	1.00	1.00	1.00	0.84	0.82	1.00	1.00	1.00
LB	Container4000	1.00	1.00	1.00	1.00	1.00	0.84	0.83	1.00	1.00	1.00
LB	Container5000	1.00	1.00	1.00	1.00	1.00	0.85	0.83	1.00	1.00	1.00
LB	Container6000	1.00	1.00	1.00	1.00	1.00	0.84	0.82	1.00	1.00	1.00
LB	Container7000	1.00	1.00	1.00	1.00	1.00	0.85	0.83	1.00	1.00	1.00
LB	Container8000	1.00	1.00	1.00	1.00	1.00	0.84	0.82	1.00	1.00	1.00
LB	Cruise	1.00	1.00	1.00	1.00	1.00	0.90	0.89	1.00	1.00	1.00
LB	General Cargo	1.00	1.00	1.00	1.00	1.00	0.86	0.84	1.00	1.00	1.00
LB	ITB	1.00	1.00	1.00	1.00	1.00	0.81	0.77	1.00	1.00	1.00
LB	MISC	1.00	1.00	1.00	1.00	1.00	0.84	0.82	1.00	1.00	1.00
LB	Reefer	1.00	1.00	1.00	1.00	1.00	0.88	0.87	1.00	1.00	1.00
LB	RoRo	1.00	1.00	1.00	1.00	1.00	0.87	0.86	1.00	1.00	1.00
LB	Tanker	1.00	1.00	1.00	1.00	1.00	0.86	0.85	1.00	1.00	1.00
LB	Tanker - Chemical	1.00	1.00	1.00	1.00	1.00	0.86	0.84	1.00	1.00	1.00
LB	Tanker - Crude - Aframax	1.00	1.00	1.00	1.00	1.00	0.84	0.83	1.00	1.00	1.00
LB	Tanker - Crude - Handyboat	1.00	1.00	1.00	1.00	1.00	0.85	0.83	1.00	1.00	1.00
LB	Tanker - Crude - Panamax	1.00	1.00	1.00	1.00	1.00	0.83	0.81	1.00	1.00	1.00
LB	Tanker - Crude - Suezmax	1.00	1.00	1.00	1.00	1.00	0.84	0.83	1.00	1.00	1.00
LB	Tanker - Crude - ULCC	1.00	1.00	1.00	1.00	1.00	0.82	0.79	1.00	1.00	1.00
LB	Tanker - Crude - VLCC	1.00	1.00	1.00	1.00	1.00	0.82	0.79	1.00	1.00	1.00
LB	Tanker - Oil Products	1.00	1.00	1.00	1.00	1.00	0.85	0.83	1.00	1.00	1.00

OGV 5 FCF example for the Port of Los Angeles provided below

		Berth-Hotelling					Manuevering				
Associated_Port	SubType	PM	NOx	SOx	CO	HC	PM	NOx	SOx	CO	HC
LA	Auto Carrier	1.00	1.00	1.00	1.00	1.00	0.85	0.84	1.00	1.00	1.00
LA	Bulk	1.00	1.00	1.00	1.00	1.00	0.84	0.82	1.00	1.00	1.00
LA	Bulk - Heavy Load	1.00	1.00	1.00	1.00	1.00	0.85	0.84	1.00	1.00	1.00
LA	Bulk Wood Chips	1.00	1.00	1.00	1.00	1.00	0.83	0.81	1.00	1.00	1.00
LA	Container1000	1.00	1.00	1.00	1.00	1.00	0.88	0.87	1.00	1.00	1.00
LA	Container2000	1.00	1.00	1.00	1.00	1.00	0.87	0.86	1.00	1.00	1.00
LA	Container3000	1.00	1.00	1.00	1.00	1.00	0.82	0.82	1.00	1.00	1.00
LA	Container4000	1.00	1.00	1.00	1.00	1.00	0.82	0.83	1.00	1.00	1.00
LA	Container5000	1.00	1.00	1.00	1.00	1.00	0.84	0.84	1.00	1.00	1.00
LA	Container6000	1.00	1.00	1.00	1.00	1.00	0.82	0.83	1.00	1.00	1.00
LA	Container7000	1.00	1.00	1.00	1.00	1.00	0.86	0.86	1.00	1.00	1.00
LA	Container8000	1.00	1.00	1.00	1.00	1.00	0.84	0.83	1.00	1.00	1.00
LA	Cruise	1.00	1.00	1.00	1.00	1.00	0.93	0.92	1.00	1.00	1.00
LA	General Cargo	1.00	1.00	1.00	1.00	1.00	0.86	0.84	1.00	1.00	1.00
LA	ITB	1.00	1.00	1.00	1.00	1.00	0.80	0.76	1.00	1.00	1.00
LA	MISC	1.00	1.00	1.00	1.00	1.00	0.90	0.88	1.00	1.00	1.00
LA	Reefer	1.00	1.00	1.00	1.00	1.00	0.87	0.86	1.00	1.00	1.00
LA	RoRo	1.00	1.00	1.00	1.00	1.00	0.81	0.80	1.00	1.00	1.00
LA	Tanker	1.00	1.00	1.00	1.00	1.00	0.86	0.84	1.00	1.00	1.00
LA	Tanker - Chemical	1.00	1.00	1.00	1.00	1.00	0.85	0.83	1.00	1.00	1.00
LA	Tanker - Crude - Aframax	1.00	1.00	1.00	1.00	1.00	0.82	0.80	1.00	1.00	1.00
LA	Tanker - Crude - Handyboat	1.00	1.00	1.00	1.00	1.00	0.85	0.84	1.00	1.00	1.00
LA	Tanker - Crude - Panamax	1.00	1.00	1.00	1.00	1.00	0.83	0.81	1.00	1.00	1.00
LA	Tanker - Oil Products	1.00	1.00	1.00	1.00	1.00	0.86	0.84	1.00	1.00	1.00

Scaling factors for OGV5 were developed for each vessel class for the portion of total SPBP calls by ships with MAN main engines based on calls ($SF_{(MAN)}$). The implementation rates are based on when a lease renewal is triggered (50% first year, 70% second year, and 90% third year +).

Scaling factors for OGV5 are the fleet penetration rates of the leases:

SF first year:	0.50
SF second year:	0.70
SF third year +:	0.90

$$SFCF_{(Fleet\ Penetration)} = (1 - ((1 - FCF) \times SF_{(Fleet\ Penetration)}))$$

Exceptions: The Southern & Western routes have portions which lie outside of the 40 nm arc and thus a $SF_{(Route)}$ was used to correct the emissions associated with these routes.

Applicable zone:	20-40 nm
SF all other zones:	1.00
SF Southern Route 20-40:	0.93
SF Western Route 20-40:	0.87
All other routes:	1.00

$$SFCF_{(z)} = (1 - ((1 - SFCF_{(Fleet\ Penetration)}) \times SF_{(Route)}))$$

Then the $SF_{(MAN)}$ is applied to capture only the MAN portion of the fleet. The OGV-5 correction factors shown in the tables below need to be adjusted for the portion of the fleet equipped with MAN engines.

$$SFCF_{(OGV5)} = (1 - ((1 - SFCF_{(z)}) \times SF_{(MAN)}))$$

$SF_{(MAN)}$ are shown below for both ports(note calls to Anchorage only are not included):

Associated_Port	SubType	Calls05	MAN	SF(MAN)
LB	Auto Carrier	165	49	0.30
LB	Bulk	252	142	0.56
LB	Bulk - Heavy Load	4	1	0.25
LB	Bulk Self-Discharging	21	7	0.33
LB	Bulk Wood Chips	1	0	0.00
LB	Container1000	197	89	0.45
LB	Container2000	301	257	0.85
LB	Container3000	168	144	0.86
LB	Container4000	259	203	0.78
LB	Container5000	159	78	0.49
LB	Container6000	58	53	0.91
LB	Container7000	54	1	0.02
LB	Container8000	111	102	0.92
LB	Cruise	155	0	0.00
LB	General Cargo	138	95	0.69
LB	ITB	72	0	0.00
LB	MISC	20	0	0.00
LB	Reefer	18	5	0.28
LB	RoRo	109	33	0.30
LB	Tanker	47	28	0.60
LB	Tanker - Chemical	20	7	0.35
LB	Tanker - Crude - Aframax	39	17	0.44
LB	Tanker - Crude - Handyboat	11	4	0.36
LB	Tanker - Crude - Panamax	104	71	0.68
LB	Tanker - Crude - Suezmax	92	45	0.49
LB	Tanker - Crude - ULCC	28	27	0.96
LB	Tanker - Crude - VLCC	15	2	0.13
LB	Tanker - Oil Products	51	2	0.04

Associated_Port	SubType	Calls05	MAN	SF(MAN)
LA	Auto Carrier	67	20	0.30
LA	Bulk	172	103	0.60
LA	Bulk - Heavy Load	2	0	0.00
LA	Bulk Wood Chips	3	0	0.00
LA	Container1000	204	124	0.61
LA	Container2000	184	85	0.46
LA	Container3000	295	60	0.20
LA	Container4000	398	105	0.26
LA	Container5000	216	137	0.63
LA	Container6000	131	19	0.15
LA	Container7000	52	42	0.81
LA	Container8000	0	0	0.92
LA	Cruise	272	49	0.18
LA	General Cargo	74	58	0.78
LA	ITB	60	0	0.00
LA	MISC	5	0	0.00
LA	Reefer	60	30	0.50
LA	RoRo	3	0	0.00
LA	Tanker	99	51	0.52
LA	Tanker - Chemical	47	18	0.38
LA	Tanker - Crude - Aframax	4	1	0.25
LA	Tanker - Crude - Handyboat	22	14	0.64
LA	Tanker - Crude - Panamax	10	7	0.70
LA	Tanker - Oil Products	125	5	0.04

Note: POLA Container 8000 uses POLB Container 8000 $SF_{(MAN)}$.

CARB's At-Berth OGV Regulation

Implementation:	Regulation assumed to be implemented instead of OGV-2
Fleet penetration:	>50% in 2014 for 100% grid power based option; >80% in 2023 for 100% grid power based option
Applicable zones:	Hotelling at Berth
Engine Type:	Auxiliary engines of Container, Cruise, and Reefer Vessels

Reference: Staff's Suggested Modification to the Original Proposal Presented at the December 6, 2007 Board Hearing – Appendix B posted *http://www.arb.ca.gov/regact/2007/shorepwr07/shorepwr07.htm*

CF Development: CY 2014 – Grown 2014 PM, NO_x, TOG, CO and SO_x auxiliary engine emissions were reduced by 50% as suggested in CARB's regulation under "Equivalent Emissions Reduction Option." Since 100% grid power usage was assumed to achieve the required reductions, emission reductions for TOG, CO and SO_x were assumed to be same as PM and NO_x under the regulation.

CY 2023 - Grown 2023 PM and NO_x auxiliary engine emissions were reduced by 80% as suggested in CARB's regulation under "Equivalent Emissions Reduction Option." Similar to 2014, 100% grid power usage was assumed to achieve the required reductions, emission reductions for TOG, CO and SO_x were assumed to be same as required of PM and NO_x under the regulation

Although CARB's regulation reduces auxiliary engine emissions at berth by 50% in 2014 and 80% in 2023, the overall NO_x and SO_x emissions reductions at-berth are less than 50% or 80% because of the contribution of boiler emissions at berth. At this time boiler emissions are not required to be controlled either under CARB's at-berth regulation or the CAAP, therefore the resulting FCFs will be greater than 0.50 (2014) and 0.20 (2023).

FCFs for a given Calendar Year = (Baseline auxiliary engine emissions at-berth * CF) + (Baseline boiler emissions at-berth) / (Baseline auxiliary engine emissions at-berth + Baseline boiler emissions at-berth)

CARB's regulation exempts container and reefer fleets that visit California ports less than 25 times in a calendar year and passenger fleets that visit California ports (combined) less than 5 times in a calendar year. It was not possible to determine what percent of the fleet will meet the exemption criteria. Therefore, no exemption was modeled (a scaling factor of 1.00 was used).

SF Container: 1.00

$SFCF_{(CARB\ At\text{-}Berth)} = (1 - ((1 - FCF) \times SF_{(Class)}))$

The FCFs listed in the tables below have not been adjusted for any assumed future hotelling efficiencies.

CARB's At-Berth OGV Regulation FCF for the Port of Long Beach

		Berth-Hotelling - 2014					Berth-Hotelling - 2023				
Associated_I	SubType	DPM	NOx	SOx	CO	TOG	DPM	NOx	SOx	CO	TOG
LB	Auto Carrier	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Bulk	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Bulk - Heavy Load	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Bulk Self-Discharging	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Bulk Wood Chips	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Container1000	0.50	0.57	0.81	0.58	0.60	0.20	0.31	0.70	0.32	0.36
LB	Container2000	0.50	0.57	0.79	0.58	0.60	0.20	0.31	0.66	0.32	0.36
LB	Container3000	0.50	0.56	0.79	0.58	0.60	0.20	0.30	0.66	0.32	0.36
LB	Container4000	0.50	0.57	0.80	0.58	0.60	0.20	0.31	0.68	0.32	0.36
LB	Container5000	0.50	0.57	0.79	0.58	0.60	0.20	0.31	0.66	0.32	0.36
LB	Container6000	0.50	0.57	0.80	0.58	0.60	0.20	0.31	0.68	0.32	0.36
LB	Container7000	0.50	0.57	0.79	0.58	0.60	0.20	0.31	0.66	0.32	0.36
LB	Container8000	0.50	0.57	0.79	0.58	0.60	0.20	0.31	0.66	0.32	0.36
LB	Cruise	0.50	0.57	0.94	0.58	0.60	0.20	0.31	0.90	0.32	0.36
LB	General Cargo	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	ITB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	MISC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Reefer	0.50	0.56	0.79	0.58	0.60	0.20	0.30	0.66	0.32	0.36
LB	RoRo	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Tanker	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Tanker - Chemical	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Tanker - Crude - Aframax	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Tanker - Crude - Handyboat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Tanker - Crude - Panamax	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Tanker - Crude - Suezmax	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Tanker - Crude - ULCC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Tanker - Crude - VLCC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LB	Tanker - Oil Products	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

CARB's At-Berth OGV Regulation FCF for the Port of Los Angeles

		Berth-Hotelling - 2014					Berth-Hotelling - 2023				
Associated_I	SubType	DPM	NOx	SOx	CO	TOG	DPM	NOx	SOx	CO	TOG
LA	Auto Carrier	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	Bulk	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	Bulk - Heavy Load	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	Bulk Wood Chips	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	Container1000	0.50	0.57	0.82	0.58	0.60	0.20	0.31	0.72	0.32	0.36
LA	Container2000	0.50	0.57	0.80	0.58	0.60	0.20	0.30	0.68	0.32	0.36
LA	Container3000	0.50	0.57	0.84	0.58	0.60	0.20	0.31	0.75	0.32	0.36
LA	Container4000	0.50	0.57	0.89	0.58	0.60	0.20	0.31	0.82	0.32	0.36
LA	Container5000	0.50	0.58	0.86	0.58	0.60	0.20	0.33	0.77	0.32	0.36
LA	Container6000	0.50	0.57	0.91	0.58	0.60	0.20	0.32	0.85	0.32	0.36
LA	Container7000	0.50	0.57	0.98	0.58	0.60	0.20	0.31	0.98	0.32	0.36
LA	Container8000	0.50	0.57	0.79	0.58	0.60	0.20	0.31	0.66	0.32	0.36
LA	Cruise	0.50	0.57	0.79	0.58	0.60	0.20	0.30	0.66	0.32	0.36
LA	General Cargo	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	ITB	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	MISC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	Reefer	0.50	0.56	0.79	0.58	0.60	0.20	0.30	0.66	0.32	0.36
LA	RoRo	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	Tanker	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	Tanker - Chemical	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	Tanker - Crude - Aframax	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	Tanker - Crude - Handyboat	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	Tanker - Crude - Panamax	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
LA	Tanker - Oil Products	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

2.5 Sample Calculation

Container 5000 Vessels / POLB – Terminal X/ 2023 / PM

Table 2.10: 2005 Average Emissions (Tons per Call for Main, Auxiliary and Boiler)

		Area of Operation					
Vessel Type	**Pollutant**	**Berth**	**Anchorage**	**Maneuvering**	**PZ**	**PZ-20**	**20 Out**
Container 5000	PM	0.216	0.003	0.033	0.013	0.046	0.099

Grown Emissions (Tons/Year) = Calls in 2023 * 2005 Average Emissions

(Assuming 52 calls/year for container 5000 vessels @ Terminal X)

Table 2.11: Container 5000 PM Emission 2023 POLB (Tons/Year)

		Area of Operation						
Vessel Type	**Pollutant**	**Berth**	**Anchorage**	**Maneuvering**	**PZ**	**PZ-20**	**20 Out**	**Total**
Container 5000	PM	11.23	0.16	1.72	0.68	2.39	5.15	21.33

Table 2.12: Hotelling Efficiency Correction

Vessel Capacity	2005	2014	2023
CONTAINER 5000	0%	11%	14%

Emission reduction due to hotelling efficiency =
2023 PM Emissions at Berth * (1-hotelling efficiency)

Table 2.13: Container 5000 PM Emission 2023 POLB (Tons/Year) Adjusted for Hotelling

Vessel Type	Pollutant	Berth	Anchorage	Maneuvering	PZ	PZ-20	20 Out	Total
Container 5000	PM	9.66	0.16	1.72	0.68	2.39	5.15	19.76

Assuming terminal X will have a 90% Lease Implementation in 2023:

2023 Emissions=2023 emissions From Table 2.5-4 * $(SFCF_{(vsr)})$ * $(SFCF_{(CARB\ Fuel)})$ * $(SFCF_{(OGV5)})$ * $SFCF_{(CARB\ At\text{-}Berth)})$

For PM at Berth in 2023 - POLB

$(SFCF_{(vsr)})$ =	1.0
$(FCF_{(CARB\ Fuel)})$ =	0.35
$SF_{(24\ nm\ correction\ for\ fuel\ switch)}$ =	1.07
$(SFCF_{(OGV5)})$ =	1.0
$SFCF_{(CARB\ At\text{-}Berth)}$ =	0.2

PM (Berth) = 9.66 * (1.0_{vsr}) * $((0.35_{(FCF\ CARB\ Fuel)})$ * $1.07_{(24\ nm\ correction\ Factor)})$ * $(1.0_{(OGV5)})$ * $0.2_{(CARB\ at\ berth)}$ = 9.66 tons/Year * 0.075 = 0.72 tons/year

Using the equation above:

PM (Anchorage)	= 0.16 * 0.375 cf	= 0.06 tons/year
PM (Maneuvering)	= 1.72 * 0.346 cf	= 0.60 tons/year
PM (PZ)	= 0.68 * 0.334 cf	= 0.23 tons/year
PM (PZ – 20)	= 2.39 * 0.26 cf	= 0.62 tons/year
PM (20 Out)	= 5.15 * 0.14 cf	= 0.72tons/Year

Total PM for Container 5000 vessel (Terminal X 2023) = 2.95 tons/Year

Emissions Reduction = 21.33 tons/Year – 2.95 tons/year = 18.38 tons/Year
Percent Reduction = 18.38 tons/Year / 21.33 Tons/Year = 86%

2.6 Resulting Emissions

The resulting emissions estimates in tons per year are shown in the table below:

Table 2.14: Baseline and Projected Emissions in TPY for Container Vessels

	2005					2014					2023				
OGV	DPM	NOx	SOx	CO	TOG	DPM	NOx	SOx	CO	TOG	DPM	NOx	SOx	CO	TOG
POLA Container	344	4,029	3,051	365	173	85	4,480	227	468	272	80	4,536	275	508	313
POLB Container	393	4,005	3,544	358	167	72	4,725	164	471	239	71	4,714	183	500	269
SPBP Total	**1,189**	**13,132**	**12,110**	**1,143**	**520**	**261**	**15,036**	**805**	**1,425**	**720**	**270**	**15,975**	**947**	**1,575**	**828**

SECTION 3.0: CARGO GROWTH ASSUMPTIONS FOR NON-CONTAINER OGVS

SPBP cargo growth forecast numbers were provided by the Ports, based on the draft Global Insights report, with the exception of cruise passenger levels for both Ports, which were provided by the Marketing Department of the Port of Los Angeles (POLA). The projected growth of Port of Long Beach (POLB) cruise activity was assumed to mirror that of POLA cruise, and no change in average vessel size was projected.

Table 3.1: Non-Container Cargo Growth

Commodity		2005 (tonnes)	Forecasted Cargo 2014 (tonnes)	2023 (tonnes)
Dry Bulk		17,369	**26,443**	**30,141**
Liquid Bulk		23,594	**31,403**	**35,164**
General Cargo & Break Bulk		5,469	**8,597**	**11,113**
Auto		896	**1,200**	**1,560**
Reefer		476	**633**	**733**
Cruise LA	Passengers:	1,218,739	**1,406,036**	**1,727,710**

2014 and 2023 were interpolated through a straight-line method between years provided from Global Insights and the POLA 2006 Cruise Market Study. POLB cruise growth was assumed to be similar to POLA cruise growth. In addition, POLB forecast no call growth in MARAD vessel activity.

3.1 Emissions Growth Assumptions for Non-Container OGVs

Due to the large number of variables related to the possible physical and operational characteristics of future vessels and future terminal operations that could not be reasonably "locked down," it was assumed that emissions growth for non-container ships, before accounting for the effects of regulations and the CAAP, would be equal to the projected change in growth in non-container cargoes.

Uncontrolled emissions growth (estimates with no CAAP or CARB regulations applied) were based on the following scaling factors (SFs), which were calculated by dividing the projected commodity throughput in the future year by the 2005 throughput value for each category, with one exception; growth in reefer commodities are expected to shift toward containerization and away from reefer ships.

Table 3.2: Non-Container Scaling Factors

Ship Type	Scaling Factors 2014	2023
Auto	**1.34**	**1.74**
Cruise	**1.15**	**1.42**
Dry Bulk	**1.52**	**1.74**
General Cargo	**1.57**	**2.03**
Liquid Bulk	**1.33**	**1.49**
MARAD	**1.00**	**1.00**
Reefer	**1.00**	**1.00**

1) In container "string services" projected ship sizes can be scaled up or down to meet a constant cargo demand; however, since there are virtually no comparable services in non-container cargo transport and due to the nature of the business, it was assumed that the vessel sizes and class distributions would not change from 2005, with one exception (assumption #3).

2) POLA's Pacific Energy terminal will increase certain tanker subclass calls and introduce new tanker classes into POLA (although not new to San Pedro Bay because these classes already call at POLB). Characteristics of these new POLA classes are based on the average characteristics of their counterparts already calling at POLB. The forecasted call frequencies provided by POLA are:

Table 3.3: Projected Non-Container Vessel Calls

Vessel Type	2014	2023
Tanker - Panamax	**15**	**17**
Tanker - Aframax	**26**	**34**
Tanker - Suezmax	**57**	**74**
Tanker - VLCC	**46**	**65**
Total	**143**	**190**

The Ports will evaluate vessel size trends by vessel type with each new emissions inventory to determine if forecasting methods can be improved or enhanced.

3.2 OGV Control Factor Development & Specifications

The Control Factor Development & Specification discussed for container vessels are applicable to non-container OGVs. Please refer to sections 2.4, 2.4.1, 2.4.2 and 2.4.3.

Estimating Controlled Forecasted Non-Container OGV Emissions

Step 1. 2005 POLA/POLB emissions by vessel class/subclass and by zone (berth, anchorage, maneuvering, PZ, PZ-20, 20-boundary) [referred to as granular emissions].

POLB Summary (Excerpt Table 2.15, 2005 EI)

	2005 TONS						
Vessel Class	**PM10**	**PM2.5**	**DPM**	**NOx**	**SOx**	**CO**	**TOG**
Auto	15.9	12.7	15.0	164.6	125.2	14.0	6.4
Bulk	51.9	41.5	47.9	506.7	444.8	40.7	16.8
Cruise	45.5	36.4	44.9	624.4	265.5	54.7	24.8
General Cargo	16.7	13.4	14.4	160.0	153.8	13.0	5.6
Ocean Tugboat	10.4	8.3	10.4	98.6	81.4	7.6	3.3
Misc	4.2	3.4	3.4	55.4	31.6	4.6	1.9
Reefer	4.3	3.4	3.7	39.2	40.0	3.1	1.3
RoRo	18.5	14.8	16.9	248.3	133.0	21.0	8.9
Tanker	138.4	110.7	87.2	1,023.3	1,681.7	86.2	37.2
	305.8	**244.6**	**243.8**	**2,920.6**	**2,957.1**	**244.9**	**106.3**

POLA Summary (Excerpt Table 2.16, 2005 EI)

	2005 TONS						
Vessel Class	**PM10**	**PM2.5**	**DPM**	**NOx**	**SOx**	**CO**	**TOG**
Auto	7.1	5.7	6.6	72.9	56.8	6.2	2.8
Bulk	29.5	23.6	27.6	294.0	245.3	23.9	10.1
Cruise	115.5	92.4	112.2	1,065.2	968.1	84.5	34.5
General Cargo	11.9	9.5	9.7	110.0	117.4	8.8	3.7
Ocean Tugboat	4.3	3.4	4.3	40.0	32.9	3.1	1.4
Misc	0.6	0.5	0.5	5.7	6.7	0.4	0.2
Reefer	11.8	9.4	10.4	109.3	109.0	8.7	3.7
RoRo	0.5	0.4	0.4	4.5	3.3	0.4	0.2
Tanker	71.8	57.5	36.4	475.1	1,018.3	39.5	17.4
	253.0	**202.4**	**208.2**	**2,176.7**	**2,558.0**	**175.5**	**74.1**

For Pacific Energy, uncontrolled emissions were developed using the number of calls by vessel class for 2014 and 2023 and multiplying by the average emissions (by zone and pollutant) for similar vessel class from POLA and for the class, the POLB averages were used.

Illustration of the resolution of the "granular emissions"

						2005 TONS						
terminal_type_a	Mode	vessel_type_category_abbr	Type	route	Designator	PM10	PM2.5	DPM	NOx	SOx	CO	TOG
BREAK BULK	Transiting	Auto Carrier	Auto	Northern Shipping Lane Outbound from LB	PZ-20	0.06	0.05	0.06	0.66	0.43	0.05	0.02
BREAK BULK	Transiting	Auto Carrier	Auto	Southern Shipping Lane Inbound to LB	PZ-20	0.03	0.03	0.03	0.36	0.22	0.03	0.02
BREAK BULK	Transiting	Auto Carrier	Auto	Southern Shipping Lane Outbound from LB	PZ-20	0.00	0.00	0.00	0.05	0.03	0.00	0.00
AUTO	Hotelling	Auto Carrier	Auto	LB shift to anc	ANC	0.02	0.02	0.02	0.15	0.22	0.01	0.00
AUTO	Hotelling	Auto Carrier	Auto	Northern Shipping Lane Inbound to LB	ANC	0.11	0.09	0.09	0.87	1.18	0.07	0.03
BREAK BULK	Hotelling	Auto Carrier	Auto	LB shift to anc	ANC	0.01	0.01	0.01	0.07	0.11	0.01	0.00
BREAK BULK	Hotelling	Auto Carrier	Auto	LB shift to anc	ANC	0.04	0.03	0.03	0.35	0.45	0.03	0.01
BREAK BULK	Hotelling	Auto Carrier	Auto	Northern Shipping Lane Inbound to LB	ANC	0.03	0.03	0.03	0.28	0.36	0.02	0.01
BREAK BULK	Hotelling	Auto Carrier	Auto	Southern Shipping Lane Inbound to LB	ANC	0.04	0.03	0.03	0.27	0.40	0.02	0.01
AUTO	Hotelling	Auto Carrier	Auto	Anc shift to LB	BERTH	0.17	0.14	0.13	1.36	1.84	0.11	0.04
AUTO	Hotelling	Auto Carrier	Auto	LB harbor shift	BERTH	0.03	0.02	0.02	0.21	0.31	0.02	0.01
AUTO	Hotelling	Auto Carrier	Auto	Northern Shipping Lane Inbound to LB	BERTH	2.14	1.71	1.68	16.99	23.15	1.35	0.51
AUTO	Hotelling	Auto Carrier	Auto	Northern Shipping Lane Outbound from LB	BERTH	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AUTO	Hotelling	Auto Carrier	Auto	Southern Shipping Lane Outbound from LB	BERTH	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AUTO	Hotelling	Auto Carrier	Auto	Western Shipping Lane Inbound to LB	BERTH	0.02	0.02	0.02	0.16	0.21	0.01	0.00
AUTO	Hotelling	Auto Carrier	Auto	Western Shipping Lane Outbound from LB	BERTH	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BREAK BULK	Hotelling	Auto Carrier	Auto	Anc shift to LB	BERTH	0.01	0.00	0.00	0.05	0.06	0.00	0.00
BREAK BULK	Hotelling	Auto Carrier	Auto	Eastern Shipping Lane Inbound to LB	BERTH	0.01	0.01	0.01	0.08	0.10	0.01	0.00
BREAK BULK	Hotelling	Auto Carrier	Auto	Northern Shipping Lane Inbound to LB	BERTH	0.31	0.25	0.25	2.47	3.38	0.20	0.07
BREAK BULK	Hotelling	Auto Carrier	Auto	Northern Shipping Lane Outbound from LB	BERTH	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BREAK BULK	Hotelling	Auto Carrier	Auto	Southern Shipping Lane Inbound to LB	BERTH	0.54	0.43	0.43	4.30	5.85	0.34	0.13
BREAK BULK	Hotelling	Auto Carrier	Auto	Southern Shipping Lane Outbound from LB	BERTH	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BREAK BULK	Hotelling	Auto Carrier	Auto	Anc shift to LB	BERTH	0.04	0.03	0.03	0.32	0.45	0.03	0.01
BREAK BULK	Hotelling	Auto Carrier	Auto	Northern Shipping Lane Inbound to LB	BERTH	0.12	0.09	0.09	0.97	1.26	0.07	0.03
BREAK BULK	Hotelling	Auto Carrier	Auto	Northern Shipping Lane Outbound from LB	BERTH	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BREAK BULK	Hotelling	Auto Carrier	Auto	Southern Shipping Lane Inbound to LB	BERTH	0.21	0.17	0.17	1.70	2.32	0.13	0.05
BREAK BULK	Hotelling	Auto Carrier	Auto	Southern Shipping Lane Outbound from LB	BERTH	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AUTO	Maneuvering	Auto Carrier	Auto	Anc shift to LB	MANU	0.03	0.03	0.03	0.28	0.21	0.03	0.02
AUTO	Maneuvering	Auto Carrier	Auto	LB harbor shift	MANU	0.00	0.00	0.00	0.01	0.01	0.00	0.00
AUTO	Maneuvering	Auto Carrier	Auto	LB shift to anc	MANU	0.01	0.00	0.01	0.05	0.04	0.01	0.00
AUTO	Maneuvering	Auto Carrier	Auto	Northern Shipping Lane Inbound to LB	MANU	0.59	0.47	0.55	5.12	3.81	0.63	0.43
AUTO	Maneuvering	Auto Carrier	Auto	Northern Shipping Lane Outbound from LB	MANU	0.40	0.32	0.37	3.53	2.63	0.43	0.28
AUTO	Maneuvering	Auto Carrier	Auto	Southern Shipping Lane Outbound from LB	MANU	0.00	0.00	0.00	0.04	0.03	0.00	0.00

Step 2. Scale up granular emissions by scaling factors to get "uncontrolled" 2014 and 2023 emissions, using cargo growth scaling factors (emissions growth assumption #1).

	Scaling Factors	
Ship Type	**2014**	**2023**
Auto	**1.34**	**1.74**
Cruise	**1.15**	**1.42**
Dry Bulk	**1.52**	**1.74**
General Cargo	**1.57**	**2.03**
Liquid Bulk	**1.33**	**1.49**
MARAD	**1.00**	**1.00**
Reefer	**1.00**	**1.00**

2014 Uncontrolled Emissions = 2005 Emissions x 2014 Scaling Factor
2023 Uncontrolled Emissions = 2005 Emissions x 2023 Scaling Factor

Step 3. Controlled Emissions Calculations

PM10/2.5/DPM/NO_x Calc (example for 2014, same equation for 2023 using 2023 emissions & SFCFs). All four pollutants have the same calculation but each has its own unique SFCFs for each pollutant.

Controlled Emissions = Σ Uncontrolled 2014 Emissions (by vessel type by zone) x $SFCF_{(2014\ VSR)}$ x $SFCF_{(2014\ CARB\ Fuel)}$ x $SFCF_{(2014\ OGV5)}$ x $SFCF_{(2014\ CARB\ At\text{-}Berth)}$

Where (SFCFs are by vessel type and zone),

$$SFCF_{(2014\ VSR)} = (1 - ((1 - SFCF_{(x)}) \times SF_{(Compliance)}))$$
$$SFCF_{(2014\ CARB\ Fuel\ )} = FCF \times SF_{(24\ nm\ correction)})$$
$$SFCF_{(2014\ OGV5)} = (1 - ((1 - SFCF_{(Z)}) \times SF_{(MAN)}))$$
$$SFCF_{(2014\ CARB\ At\text{-}Berth)} = (1 - ((1 - FCF) \times SF_{(Class)}))$$

SO_x Calc (example for 2014, same equation for 2023 using 2023 emissions & SFCFs)

Controlled Emissions = Σ Uncontrolled 2014 Emissions (by vessel type by zone) x $SFCF_{(2014\ VSR)}$ x $SFCF_{(2014\ CARB\ Fuel\ )}$x $SFCF_{(2014\ At\text{-}Berth\ -\ CARB)}$

Where (SFCFs are by vessel type and zone),

$$SFCF_{(2014\ VSR)} = (1 - ((1 - SFCF_{(x)}) \times SF_{(Compliance)}))$$
$$SFCF_{(2014\ CARB\ Fuel} = FCF \times SF_{(24\ nm\ correction)}$$
$$SFCF_{(2014\ CARB\ At\text{-}Berth)} = (1 - ((1 - FCF) \times SF_{(Class)}))$$

CO & TOG Calc (example for 2014, same equation for 2023 using 2023 emissions & SFCFs) Both pollutants have the same calculation but each has its own unique SFCFs for each pollutant.

Controlled Emissions = Σ Uncontrolled 2014 Emissions (by vessel type by zone) x $SFCF_{(2014\ VSR)}$ x $SFCF_{(2014\ CARB\ At\text{-}Berth)}$

Where (SFCFs are by vessel type and zone),

$$SFCF_{(VSR)} = (1 - ((1 - SFCF_{(x)}) \times SF_{(Compliance)}))$$
$$SFCF_{(2014\ CARB\ At\text{-}Berth)} = (1 - ((1 - FCF) \times SF_{(Class)}))$$

Step 4. Emissions are summed up by vessel type and Port

Port of Long Beach

	2005 TPY							2014 TPY							2023 TPY						
Vessel Class	**PM10**	**PM2.5**	**DPM**	**NOx**	**SOx**	**CO**	**HC**	**PM10**	**PM2.5**	**DPM**	**NOx**	**SOx**	**CO**	**HC**	**PM10**	**PM2.5**	**DPM**	**NOx**	**SOx**	**CO**	**HC**
Auto	15.9	12.7	15.0	164.6	125.2	14.0	6.4	3.1	2.5	2.9	166.8	6.5	14.9	6.9	4.0	3.2	3.7	213.8	8.3	19.4	9.0
Bulk	51.9	41.5	47.9	506.7	444.8	40.7	16.8	13.9	11.1	12.8	727.8	31.2	58.6	24.2	16.0	12.8	14.7	834.7	36.2	69.3	28.6
Cruise	45.5	36.4	44.9	624.4	265.5	54.7	24.8	8.6	6.9	8.4	514.7	24.8	45.0	21.3	9.1	7.3	9.1	569.3	30.6	50.4	24.5
General Cargo	16.7	13.4	14.4	160.0	153.8	13.0	5.6	4.2	3.4	3.6	213.2	10.2	17.9	7.8	5.4	4.3	4.5	268.2	12.8	22.9	9.9
Ocean Tugboat	10.4	8.3	10.4	98.6	81.4	7.6	3.3	5.9	4.7	5.9	144.9	28.0	10.2	4.4	6.7	5.3	6.7	164.0	31.7	11.6	5.0
Misc	4.2	3.4	3.4	55.4	31.6	4.6	1.9	1.6	1.3	1.2	67.0	4.7	5.2	2.1	1.8	1.5	1.4	75.0	5.5	5.8	2.4
Reefer	4.3	3.4	3.7	39.2	40.0	3.1	1.3	0.5	0.4	0.4	24.8	1.4	2.0	0.9	0.3	0.2	0.3	17.8	1.2	1.5	0.7
RoRo	18.5	14.8	16.9	248.3	133.0	21.0	8.9	4.8	3.9	4.4	270.2	13.2	21.9	9.4	5.8	4.7	5.3	320.3	14.2	26.3	11.4
Tanker	138.4	110.7	87.2	1,023.3	1,681.7	86.2	37.2	33.3	26.7	20.7	1,283.7	115.9	108.0	46.6	37.3	29.9	23.2	1,438.2	129.9	120.9	52.2
	305.8	**244.6**	**243.8**	**2,920.6**	**2,957.1**	**244.9**	**106.3**	**75.9**	**60.7**	**60.3**	**3,413.1**	**235.8**	**283.7**	**123.5**	**86.4**	**69.2**	**68.8**	**3,901.3**	**270.3**	**328.1**	**143.7**

Figure 3.1: Port of Long Beach – Non Container OGV Emissions

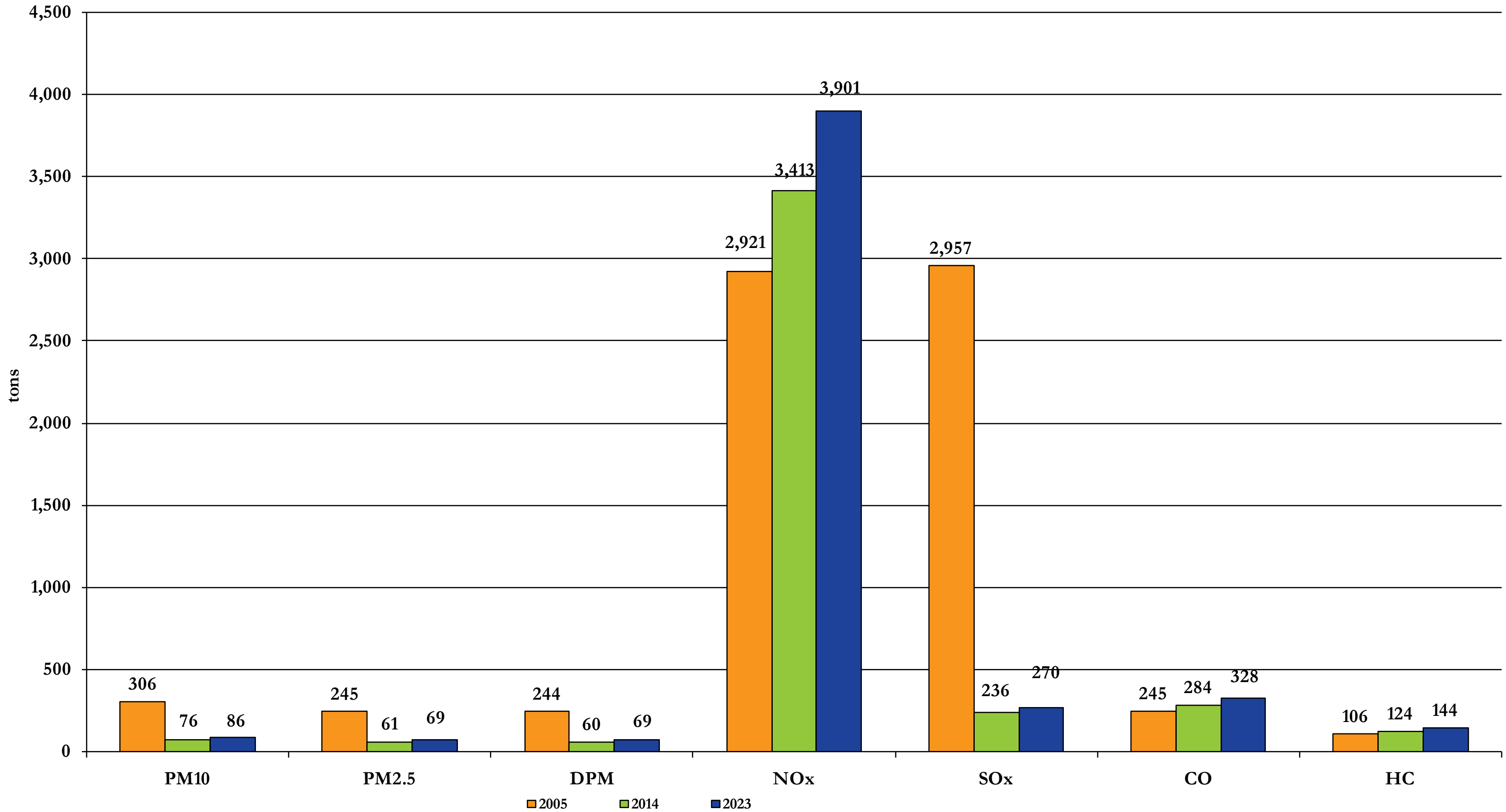
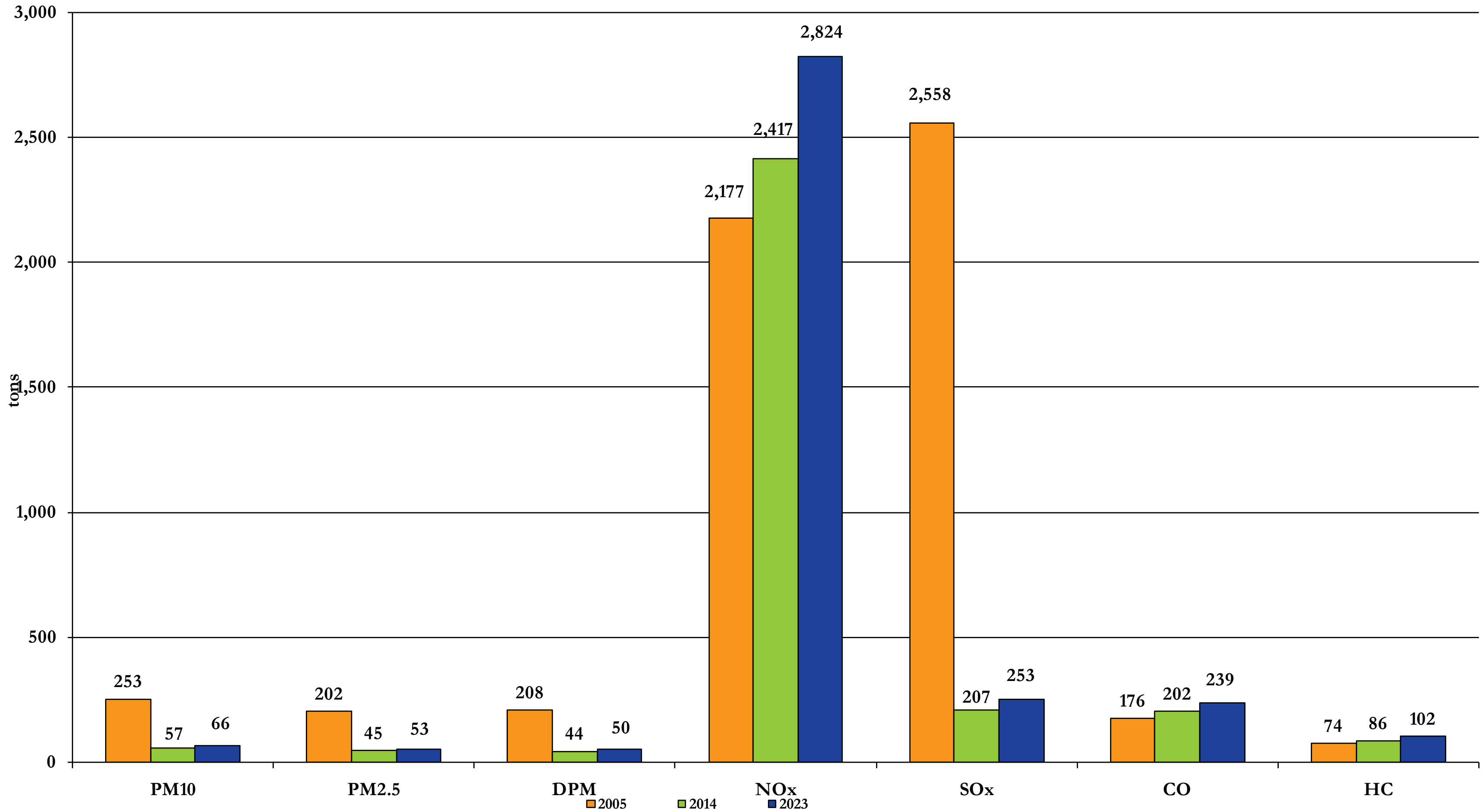


Table 3.4: Port of Los Angeles

	2005 TPY							2014 TPY							2023 TPY						
Vessel Class	**PM10**	**PM2.5**	**DPM**	**NOx**	**SOx**	**CO**	**HC**	**PM10**	**PM2.5**	**DPM**	**NOx**	**SOx**	**CO**	**HC**	**PM10**	**PM2.5**	**DPM**	**NOx**	**SOx**	**CO**	**HC**
Auto	7.1	5.7	6.6	72.9	56.8	6.2	2.8	1.5	1.2	1.4	75.7	2.8	6.5	3.0	2.0	1.6	1.8	98.3	3.7	8.4	3.9
Bulk	29.5	23.6	27.6	294.0	245.3	23.9	10.1	7.9	6.3	7.4	413.0	17.3	34.7	14.7	10.1	8.1	9.4	525.7	22.3	44.7	18.9
Cruise	115.5	92.4	112.2	1,065.2	968.1	84.5	34.5	16.8	13.5	16.4	837.5	51.7	67.9	27.6	17.7	14.2	17.5	902.5	61.1	73.8	30.6
General Cargo	11.9	9.5	9.7	110.0	117.4	8.8	3.7	3.0	2.4	2.4	141.7	6.5	12.5	5.3	3.8	3.1	3.1	183.2	8.5	16.1	6.9
Ocean Tugboat	4.3	3.4	4.3	40.0	32.9	3.1	1.4	2.7	2.2	2.7	58.8	18.2	4.1	1.8	3.1	2.4	3.1	65.8	19.9	4.6	2.0
Misc	0.6	0.5	0.5	5.7	6.7	0.4	0.2	0.2	0.1	0.1	7.2	0.4	0.6	0.2	0.2	0.1	0.2	8.5	0.4	0.7	0.3
Reefer	11.8	9.4	10.4	109.3	109.0	8.7	3.7	1.3	1.0	1.1	67.4	3.6	5.8	2.6	0.9	0.7	0.8	51.7	3.3	4.6	2.2
RoRo	0.5	0.4	0.4	4.5	3.3	0.4	0.2	0.1	0.1	0.1	4.6	0.2	0.4	0.2	0.1	0.1	0.1	5.9	0.2	0.5	0.3
Tanker	71.8	57.5	36.4	475.1	1,018.3	39.5	17.4	23.2	18.6	12.6	811.5	106.8	69.7	30.5	28.1	22.5	14.5	981.8	133.3	85.4	37.4
	253.0	**202.4**	**208.2**	**2,176.7**	**2,558.0**	**175.5**	**74.1**	**56.7**	**45.4**	**44.2**	**2,417.4**	**207.5**	**202.1**	**86.0**	**66.0**	**52.8**	**50.3**	**2,823.5**	**252.7**	**238.8**	**102.4**

Figure 3.2: Port of Los Angeles – Non Container OGV Emissions



SAMPLE CALCULATIONS NON-CONTAINER OGVS

STEP 1: 2005 BASELINE EMISSIONS

2005 Emissions by terminal, terminal type, mode, route, zone, vessel subclass and pollutant

Example: 2005 POLB Cruise, Southern Shipping Lane Inbound to LB (Note: Segment = Zone)

Port	I Mode	Class	Growth	Route	Segment	PM10 (tons)	PM2.5 (tons)	DPM (tons)	NOx (tons)	SOx (tons)	CO (tons)	TOG (tons)
LB	Hotelling	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Berth-Hotelling	7.3	5.9	6.8	163.0	8.7	14.2	5.2
LB	Hotelling	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Anchorage	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LB	Maneuvering	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Maneuvering	1.0	0.8	1.0	22.6	1.0	2.7	1.8
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	PZ	1.7	1.3	1.7	23.7	10.6	2.3	1.0
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	20 Out	2.1	1.7	2.1	20.4	13.5	2.1	1.3
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Sea (40 out)	12.1	9.7	12.1	137.7	87.2	10.9	4.6

STEP 2: SCALE UNCONTROLLED EMISSIONS TO 2014 & 2023

2014	Cruise LB	growth Scaling Factor (SF)	1.15
2023	Cruise LB	SF	1.42

2014 Grown Emissions - Uncontrolled

Port	I Mode	Class	Growth	Route	Segment	PM10 (tons)	PM2.5 (tons)	DPM (tons)	NOx (tons)	SOx (tons)	CO (tons)	TOG (tons)
LB	Hotelling	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Berth-Hotelling	8.4	6.7	7.8	187.5	10.0	16.4	6.0
LB	Hotelling	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Anchorage	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LB	Maneuvering	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Maneuvering	1.2	0.9	1.1	26.0	1.1	3.1	2.1
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	PZ	1.9	1.5	1.9	27.3	12.1	2.6	1.2
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	20 Out	2.5	2.0	2.5	23.5	15.6	2.4	1.5
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Sea (40 out)	13.9	11.1	13.9	158.4	100.3	12.5	5.3

2023 Grown Emissions - Uncontrolled

Port	I Mode	Class	Growth	Route	Segment	PM10 (tons)	PM2.5 (tons)	DPM (tons)	NOx (tons)	SOx (tons)	CO (tons)	TOG (tons)
LB	Hotelling	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Berth-Hotelling	10.4	8.3	9.6	231.5	12.4	20.2	7.4
LB	Hotelling	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Anchorage	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LB	Maneuvering	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Maneuvering	1.5	1.2	1.4	32.2	1.4	3.9	2.5
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	PZ	2.4	1.9	2.4	33.7	15.0	3.3	1.5
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	20 Out	3.0	2.4	3.0	29.0	19.2	3.0	1.9
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Sea (40 out)	17.2	13.8	17.2	195.6	123.8	15.5	6.5

STEP 3: CONTROLLED EMISSIONS CALCULATIONS

First Develop the SFCFs for each applicable control measure/regulation.

OGV-1

Applicable Compliance: $SF_{(Compliance)}$ = 90%
Zones: PZ to 20, Sea (20 to 40+); All other zones $SFCF_{(VSR)}$ = 1.00
Exceptions: $SF_{(x)}$ for Southern route (Sea zone) = 0.93

FCF:

PZ to 20					Sea (20 to 40+)				
PM	NOx	SOx	CO	TOG	PM	NOx	SOx	CO	TOG
0.98	0.97	0.98	0.97	0.97	0.57	0.53	0.60	0.53	0.51

Develop - $SFCF_{(x)}$ to take into account exception (distance of Southern Route outside the 40 nm arc) for Sea zone

$$SFCF_{(x)} = (1 – ((1 – FCF) \times SF_{(Route)}))$$

PZ to 20

PM $SFCF_{(x)}$ = (1 – ((1 – 0.98) x 1.00)) = 0.98
NOx SFCF(x) = (1 – ((1 – 0.97) x 1.00)) = 0.97
SOx SFCF(x) = (1 – ((1 – 0.98) x 1.00)) = 0.98
CO SFCF(x) = (1 – ((1 – 0.97) x 1.00)) = 0.97
TOG SFCF(x) = (1 – ((1 – 0.97) x 1.00)) = 0.97

Sea (20 – 40+)

PM $SFCF_{(x)}$ = (1 – ((1 – 0.57) x 0.93)) = 0.60
NOx SFCF(x) = (1 – ((1 – 0.53) x 0.93)) = 0.56
SOx SFCF(x) = (1 – ((1 – 0.60) x 0.93)) = 0.63
CO SFCF(x) = (1 – ((1 – 0.53) x 0.93)) = 0.56
TOG SFCF(x) = (1 – ((1 – 0.51) x 0.93)) = 0.54

Develop - $SFCF_{(VSR)}$ which is scaled to 90% compliance (Same for 2014 & 2023)

$$SFCF_{(VSR)} = (1 – ((1 – SFCF_{(x)}) \times SF_{(Compliance)}))$$

PZ to 20

PM SFCF(VSR) = (1 – ((1 – 0.98) x 0.78)) = 0.984
NOx SFCF(VSR) = (1 – ((1 – 0.97) x 0.78)) = 0.977
SOx SFCF(VSR) = (1 – ((1 – 0.98) x 0.78)) = 0.984
CO SFCF(VSR) = (1 – ((1 – 0.97) x 0.78)) = 0.977
TOG SFCF(VSR) = (1 – ((1 – 0.97) x 0.78)) = 0.977

Sea (20 – 40+)

PM SFCF(VSR) = (1 – ((1 – 0.60) x 0.90)) = 0.64
NOx SFCF(VSR) = (1 – ((1 – 0.56) x 0.90)) = 0.61
SOx SFCF(VSR) = (1 – ((1 – 0.63) x 0.90)) = 0.67
CO SFCF(VSR) = (1 – ((1 – 0.56) x 0.90)) = 0.61
TOG SFCF(VSR) = (1 – ((1 – 0.54) x 0.90)) = 0.59

CARB's Fuel Reg	Applicable
Compliance:	$SF_{(Compliance)}$ = 100%
Zones:	All
Exceptions:	$SF_{(24\ nm\ corection)}$ = 1.07

FCF for 2014 and 2023 below:

Zone	PM CARB Fuel Switch	NOx CARB Fuel Switch	SOx CARB Fuel Switch	CO CARB Fuel Switch	TOG CARB Fuel Switch
Berth-Hotelling	0.88	0.98	0.05	1.00	1.00
Maneuvering	0.35	0.9	0.03	1.00	1.00
PZ	0.35	0.9	0.04	1.00	1.00
PZ to 20	0.35	0.9	0.04	1.00	1.00
Sea (20-40 out)	0.35	0.9	0.04	1.00	1.00

Develop - $SFCF_{(CARB\ Fuel)}$ to take into account exception (24 nm correction – CARB fuel applicability) for all zones

$SFCF_{(CARB\ Fuel)} = (1 - ((1 - FCF) \times SF_{(24\ nm\ correction)}))$ where $SF_{(24\ nm\ correction)} = 1.07$

$SFCF_{(CARB\ Fuel)}$ for 2014 and 2023

Zone	PM CARB Fuel Switch	NOx CARB Fuel Switch	SOx CARB Fuel Switch	CO CARB Fuel Switch	TOG CARB Fuel Switch
Berth-Hotelling	0.94	1.00	0.05	1.00	1.00
Maneuvering	0.37	0.96	0.03	1.00	1.00
PZ	0.37	0.96	0.04	1.00	1.00
PZ to 20	0.37	0.96	0.04	1.00	1.00
Sea (20-40 out)	0.37	0.96	0.04	1.00	1.00

OGV-5 Main & Auxiliary Engine Emissions Improvements - Not Applicable because the cruise terminal doesn't lease from POLB

CARB's At-Berth OGV Reg	Applicable
Penetration:	Assumes that 100% of the calls will be applicable
Zones:	Berth-Hotelling only
Exceptions:	$SF_{(Class)}$ for = 1.00
FCFs:	

CARB At-Berth-2014

Zone	DPM CARB At-Berth	NOx CARB At-Berth	SOx CARB At-Berth	CO CARB At-Berth	TOG CARB At-Berth
Berth-Hotelling	0.5	0.57	0.94	0.58	0.6

CARB At-Berth-2023

Zone	DPM CARB At-Berth	NOx CARB At-Berth	SOx CARB At-Berth	CO CARB At-Berth	TOG CARB At-Berth
Berth-Hote	0.2	0.31	0.9	0.32	0.36

Develop for each pollutant (different in 2014 & 2023)

$SFCF_{(At\text{-}Berth\ -\ CARB)} = (1 – ((1 – FCF) \times SF_{(Class)}))$

Example: 2023 PM

$SFCF_{(At\text{-}Berth\ -\ CARB)} = (1 – ((1 – 0.2) \times 1.00 = 0.2$

SFCFs (At-Berth):

CARB At-Berth-2014

Zone	DPM CARB At-Berth	NOx CARB At-Berth	SOx CARB At-Berth	CO CARB At-Berth	TOG CARB At-Berth
Berth-Hotelling	0.5	0.57	0.94	0.58	0.6

CARB At-Berth-2023

Zone	DPM CARB At-Berth	NOx CARB At-Berth	SOx CARB At-Berth	CO CARB At-Berth	TOG CARB At-Berth
Berth-Hote	0.2	0.31	0.9	0.32	0.36

Next, string SFCFs together by zone and pollutant.

$SFCF_{(2014)} = SFCF_{(2014\ VSR)} \times SFCF_{(2014\ CARB\ Fuel)} \times SFCF_{(2014\ OGV5)} \times SFCF_{(2014\ CARB\ At\text{-}Berth)}$

$SFCF_{(2023)} = SFCF_{(2023\ VSR)} \times SFCF_{(2023\ CARB\ Fuel)} \times SFCF_{(2023\ OGV5)} \times SFCF_{(2023\ CARB\ At\text{-}Berth)}$

Example calc: PM $SFCF_{(2014)}$ Sea (20 to 40+)

$SFCF_{(2014)} = 0.64 \times 0.37 \times 1.00 \times 1.00 = 0.24$

Full list of 2014 and 2023 SFCFs:

Zone	PM SFCF (2014)	NOx SFCF (2014)	SOx SFCF (2014)	CO SFCF (2014)	TOG SFCF (2014)
Berth-Hotelling	0.47	0.57	0.05	0.58	0.6
Maneuvering	0.37	0.96	0.03	1.00	1.00
PZ	0.37	0.96	0.04	1.00	1.00
PZ to 20	0.36	0.94	0.04	0.98	0.98
Sea (20-40 out)	0.24	0.59	0.03	0.61	0.59

Zone	PM SFCF (2023)	NOx SFCF (2023)	SOx SFCF (2023)	CO SFCF (2023)	TOG SFCF (2023)
Berth-Hotelling	0.19	0.31	0.05	0.32	0.36
Maneuvering	0.37	0.96	0.03	1.00	1.00
PZ	0.37	0.96	0.04	1.00	1.00
PZ to 20	0.36	0.94	0.04	0.98	0.98
Sea (20-40 out)	0.24	0.59	0.03	0.61	0.59

Finally, multiply Grown Emissions – Uncontrolled by appropriate $SFCF_{(2014)}$ & $SFCF_{(2023)}$

Example calc: 2023 NOx Sea (20 to 40+)

2023 Grown NO_x Emissions – Controlled (Sea) = 195.6 x 0.59 = 115.4 tons

Port ID	Mode	Class	Growth	Route	Segment	2014 Grown Emissions - Controlled DPM (tons)	NOx (tons)	SOx (tons)	CO (tons)	TOG (tons)
LB	Hotelling	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Berth-Hotelling	3.7	106.9	0.5	9.5	3.6
LB	Maneuvering	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Maneuvering	0.4	25.0	0.0	3.1	2.1
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	PZ	0.7	26.2	0.5	2.6	1.2
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	PZ to 20	0.9	22.1	0.6	2.3	1.5
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Sea (20-40)	3.3	93.5	3.0	7.7	3.1

Port ID	Mode	Class	Growth	Route	Segment	2023 Grown Emissions - Controlled DPM (tons)	NOx (tons)	SOx (tons)	CO (tons)	TOG (tons)
LB	Hotelling	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Berth-Hotelling	1.8	71.8	0.6	6.5	2.7
LB	Maneuvering	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Maneuvering	0.5	30.9	0.0	3.9	2.5
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	PZ	0.9	32.3	0.6	3.3	1.5
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	PZ to 20	1.1	27.3	0.8	2.9	1.9
LB	Transiting	Cruise	Cruise LB	Southern Shipping Lane Inbound to LB	Sea (20-40)	4.1	115.4	3.7	9.4	3.8

SECTION 4.0 HARBOR CRAFT BASELINE: 2005 EMISSIONS INVENTORY

All baseline assumptions were consistent with those included in the published 2005 emissions inventories prepared for the Ports of Los Angeles and Long Beach. These assumptions include the harbor craft population, age distribution, and assumptions of activity as shown in the following tables.

Table 4.1: 2005 Port of Long Beach Harbor Craft Vessel Characteristics Summary

	Propulsion Engines			Auxiliary Engines		
Vessel Type	**Average MY**	**Average HP**	**Average Hrs/yr**	**Average MY**	**Average HP**	**Average Hrs/yr**
Assist Tug	1997	2,050	1,400	1997	130	1,390
Crew Boat	1993	400	700	1992	36	542
Excursion	na	665	1,137	na	108	2,488
Ferry	2001	1,773	1,200	na	49	857
Government	na	575	3,665	na	650	665
Tugboat, harbor	1994	1,025	824	1996	77	858
Line Haul Tug	1990	1,990	293	1990	152	293
Work Boat	na	350	125	na	18	54

Table 4.2: 2005 Port of Los Angeles Harbor Craft Vessel Characteristics Summary

	Propulsion Engines					
Vessel Type	**Average MY**	**Average HP**	**Average Hrs/yr**	**Average MY**	**Average HP**	**Average Hrs/yr**
Assist Tug	1997	2,050	1,509	1997	131	1,519
Commercial Fishing	na	239	179	na	74	55
Crew boat	1985	347	750	1991	154	713
Excursion	1995	351	2,150	1997	39	2,264
Ferry	2001	1,833	1,115	1998	56	750
Government	1996	445	450	na	212	158
Tugboat, harbor	1994	1,067	1,027	1996	84	1,064
Line Haul Tug	1988	1,530	260	1988	93	260
Work boat	na	380	309	na	30	546

Table 4.3: 2005 San Pedro Bay Ports Harbor Craft Load Factors

Harbor Vessel Type	Engine LF
Assist Tug	0.31
Commercial Fishing	0.27
Crewboat	0.45
Excursion	0.76
Ferry	0.76
Government	0.51
Tugboat, harbor	0.68
Line Haul Tug	0.68
Workboat	0.45
Auxiliary engines	0.43

Consistent with the 2005 EIs, no emissions deterioration was assumed. Tier 0, 1 and 2 emission factors are shown in the tables below.

Since the publication of 2005 EIs, CARB has revised their harbor craft emissions calculation methodology which includes a change in zero hour emission factors and load factors and addition of emission deterioration factors. In order to be consistent with 2005 EIs, these changes are not included in the emission forecasting calculations.

Emission factors for the forecast years for Tier 0, 1 and 2 engines were those used in the 2005 EIs. Emissions from Tier 3 engines were assumed to be equivalent to the Tier 3 standards (i.e., no deterioration) as shown in the table following the 2005 emission factor tables. Please note that U.S. EPA's standards are by displacement, category 1 and category 2 types and broad horsepower range. In order to match the proposed standards to horsepower ranges that were used for the ports' 2005 emissions inventories for harbor crafts, CARB staff (Mr. Todd Sterling) assistance was sought. CARB provided a cross reference table of engine displacement and various horsepower categories.

Since there are no direct Tier 2 and Tier 3 standards for hydrocarbons (the standards are "NO_x plus HC") and the pre-Tier 2 CO emission factors are lower than the Tier 2 standards, we assumed that there would be no change in the HC and CO emissions factors from the 2005 emission factors to avoid an artificial increase in forecast emissions of those pollutants.

Since no deterioration rate was assumed in the 2005 EI methodology, Tier 3 standards as shown in the summary table were treated as the emission rates.

Table 4.4: 2005 Harbor Craft Emission Factors

Lower Bound kilowatts	NOX	CO	HC	PM	SO2
			Tier 0 Engines g/kW-hr		
37	11.0	2.00	0.27	0.90	0.15
75	10.0	1.70	0.27	0.40	0.15
130	10.0	1.50	0.27	0.40	0.15
225	10.0	1.50	0.27	0.30	0.15
450	10.0	1.50	0.27	0.30	0.15
560	10.0	1.50	0.27	0.30	0.15
1,000	13.0	2.50	0.27	0.30	0.15
Category 2 engines	13.20	1.10	0.50	0.72	0.15
			Tier 1 Engines g/kW-hr		
Lower Bound kilowatts	**NOX**	**CO**	**HC**	**PM**	**SO2**
37	9.8	2.00	0.27	0.90	0.15
75	9.8	1.70	0.27	0.40	0.15
130	9.8	1.50	0.27	0.40	0.15
225	9.8	1.50	0.27	0.30	0.15
450	9.8	1.50	0.27	0.30	0.15
560	9.8	1.50	0.27	0.30	0.15
1,000	9.8	2.50	0.27	0.30	0.15
Category 2 engines	9.8	1.10	0.50	0.72	0.15
			Tier 2 Engines g/kW-hr		
Lower Bound kilowatts	**NOX**	**CO**	**HC**	**PM**	**SO2**
37	6.8	5.00	0.27	0.40	0.15
75	6.8	5.00	0.27	0.30	0.15
130	6.8	5.00	0.27	0.30	0.15
225	6.8	5.00	0.27	0.30	0.15
450	6.8	5.00	0.27	0.30	0.15
560	6.8	5.00	0.27	0.30	0.15
1,000	6.8	5.00	0.27	0.30	0.15
Category 2 engines	9.8	5.00	0.50	0.72	0.15

Table 4.5: 2005 Harbor Craft Emission Factor Sources

Engine Standard	EPA Eng. Cat.	Model Year Range	Source of Emission Factor
Tier 0	Cat 1	1999 and older	1999 EPA RIA
Tier 0	Cat 2	1999 and older	2002 Entec
Tier 1	Cat 1	2000 to 2003	1999 EPA RIA, IMO NOX
Tier 1	Cat 2	2000 to 2003	2002 Entec, IMO NOX
Tier 2	Cat 1	2004 and newer	1999 EPA RIA
Tier 2	Cat 2	2004 and newer	2002 Entec, 1999 EPA RIA

Table 4.6: EPA Tier 3 Harbor Craft Emission Standards

Engine Category	Displacement per cylinder	CARB HP Range	NOx+HC gm/hp-hr	PM gm/hp-hr	NOx* gm/hp-hr	Effective Model Year
Cat 1	disp <0.9	25-120 hp	4	0.1	3.80	2012
	0.9<=disp<1.2	120-175 hp	4	0.09	3.80	2013
	1.2<=disp<2.5	175-500 hp	4.2	0.08	4.00	2014
	1.2<=disp<2.5	175-500 hp	4.2	0.07	4.00	2018
	2.5<=disp<3.5	500-750 hp	4.2	0.08	4.00	2013
	3.5<=disp<7.0	750-1900 hp	4.3	0.08	4.10	2012
Cat 2	7<=disp<15	1900-3300 hp	4.6	0.1	4.23	2013
	15<=disp<20	3300-5000 hp	6.5	0.2	6.13	2014
	20<=disp<25	3300-5000 hp	7.3	0.2	6.93	2014
	25<=disp<30	3300-5000 hp	8.2	0.2	7.83	2014

* This estimate of NO_x emission factor is derived by subtracting Tier 1/2 HC values from the Tier 3 NO_x+HC value.
Note: All Category 2 engines operated at the Port of Los Angeles and Long Beach are <3,300 HP
Source: Tables 3 and 5 http://www.arb.ca.gov/regact/2007/chc07/appa.pdf

4.1 Activity Growth Assumptions

For future years, the activity of assist tugs and pilot boats was scaled using the projected growth in OGV calls which are consistent with OGV emissions forecast described in Section 2 of this document. Activity of all other harbor craft categories were assumed to remain constant at the 2005 EI level with the exception of fishing vessels which were assumed to decline by 6% per year between 2005 and 2009[1]. (No changes in utilization efficiency were assumed.) The table below illustrates the projected OGV calls on which the assist tug and pilot boat activity growth estimates have been made.

Table 4.7: OGV Call Growth Projections

OGV Calls	2005	2014	2023
POLA Container Calls	1,423	2,181	2,600
POLA Non-Container Calls	918	1,414	1,751
POLA Total Calls	2,341	3,595	4,351
POLA Growth Factors		**1.54**	**1.86**
POLB Container Calls	1,384	2,291	2,548
POLB Non-Container Calls	1,782	2,508	3,077
POLB Total Calls	3,166	4,799	5,625
POLB Growth Factors		**1.52**	**1.78**

4.2 Regulatory Penetration of Fleet

For purposes of this analysis, it was assumed that all tugs are home-ported and therefore subject to CARB's regulations per compliance dates as shown in the table below. Vessel types affected by CARB's regulation are assist tugs, excursion vessels, ferries, ocean tugs and tug boats.

2014 - Although the Port's Clean Air Action Plan calls for the accelerated turnover of the harbor craft vessel fleet to use lower emitting engines, at this time there is no CAAP action-forcing mechanism available. Therefore, it was assumed that the average fleet age in 2014 and 2023 will be similar to what it was in 2005 and that CARB's regulation adopted in November 2007 would dictate the implementation schedule in 2014. Refer to the table below entitled "Harbor Craft Replacement Schedule to Tier 2 or Tier 3 in 2014."

2023 – Similar to 2014, average fleet was assumed for all vessels except for those vessels where CARB's regulation was applicable. Almost 80% of the Harbor Crafts operating in San Pedro Bay Ports and subject to CARB's regulation are assumed to be Tier 3 in 2023.

[1] Reference for fishing vessel decline - page B-19; http://www.arb.ca.gov/regact/2007/chc07/appb.pdf

Table 4.8: CARB Regulation Compliance Dates for Vessels with Home Ports in the SCAQMD

Engine MY	Total Annual hours	Compliance year-End of
<=1979	>= 300	2009
1980-1985	>=300	2010
1986-1990	>= 300	2011
1991-1995	>= 300	2012
1996-2000	>= 300	2013
2001	>= 300	2014
2002	>= 300	2015
2003	>= 300	2016
2004	>= 300	2017
2005	>= 300	2018
2006	>= 300	2019
2007	>= 300	2020

Table 4.9: Harbor Craft Replacement Schedule to Tier 2 or Tier 3 in 2014

Cat 1		**Cat 2**	
Tier 2 HP Range	Tier 3 HP Range	Tier 2 HP Range	Tier 3 HP Range
All	None	All	None
All	None	All	None
All	None	All	None
>120 and <=750	<=120 and >750	All	None
175 to 500	<=175 and >500	None	All
	All	None	All
None	None	None	None
None	None	None	None
None	None	None	None
None	None	None	None
None	None	None	None
None	None	None	None

4.3 Forecast Emission Estimates

Emissions calculated as in the example for all engines in the inventory were summed for each forecast year to arrive at the emissions as presented in the following tables.

Table 4.10: Harbor Craft Emissions Forecast - Port of Long Beach

	CY 2005					CY 2014 with CARB's Regulation					CY 2023 with CARB's Regulation				
Category	HC tpy	CO tpy	NOX tpy	DPM tpy	SOx tpy	HC tpy	CO tpy	NOX tpy	DPM tpy	SOx tpy with ULSD	HC tpy	CO tpy	NOX tpy	DPM tpy	SOx tpy with ULSD
Assist Tugs															
Auxilliary	0.40	4.18	18.09	0.63	0.11	0.60	6.31	18.72	0.62	0.02	0.70	7.40	18.07	0.40	0.02
Propulsion	5.33	50.17	275.55	9.26	1.37	8.05	75.75	283.24	13.03	0.24	9.43	88.80	243.18	5.59	0.28
Commercial Fishing															
Auxilliary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Propulsion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Crew Boat															
Auxilliary	0.01	0.11	0.38	0.02	0.00	0.01	0.11	0.36	0.02	0.00	0.01	0.11	0.36	0.02	0.00
Propulsion	0.31	3.23	14.01	0.40	0.09	0.31	3.23	11.89	0.37	0.01	0.31	3.23	10.58	0.22	0.01
Excursion															
Auxilliary	0.06	0.77	3.09	0.19	0.02	0.06	0.77	1.85	0.07	0.00	0.06	0.77	1.47	0.03	0.00
Propulsion	1.01	9.52	46.72	1.17	0.28	1.01	9.52	31.77	1.12	0.03	1.01	9.52	25.78	0.49	0.03
Ferry															
Auxilliary	0.04	0.36	1.77	0.10	0.01	0.04	0.36	1.13	0.04	0.00	0.04	0.36	0.93	0.02	0.00
Propulsion	4.96	92.75	207.07	5.76	1.39	4.96	92.75	147.91	4.04	0.16	4.96	92.75	132.70	2.38	0.16
Government															
Auxilliary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Propulsion	1.58	12.20	75.62	1.82	0.05	1.58	12.20	51.42	1.76	0.05	1.58	12.20	42.09	0.76	0.05
Ocean Tug															
Auxilliary	0.07	0.63	3.46	0.13	0.02	0.07	0.63	2.02	0.05	0.00	0.07	0.63	1.93	0.05	0.00
Propulsion	1.42	12.67	87.94	2.82	0.40	1.42	12.67	46.02	1.53	0.05	1.42	12.67	45.58	1.48	0.05
Tug Boat															
Auxilliary	0.16	1.61	7.39	0.39	0.04	0.16	1.61	4.85	0.18	0.01	0.16	1.61	3.90	0.09	0.01
Propulsion	4.64	47.15	250.57	6.59	1.30	4.64	47.15	182.13	5.92	0.15	4.64	47.15	141.28	4.06	0.15
Workboat															
Auxilliary	0.00	0.01	0.04	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.01	0.02	0.00	0.00
Propulsion	0.06	0.47	2.90	0.08	0.02	0.06	0.47	1.99	0.07	0.00	0.06	0.47	1.60	0.03	0.00
Pilot Boat															
Auxilliary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Propulsion	0.20	1.56	9.56	0.22	0.06	0.30	2.35	9.91	0.34	0.01	0.36	2.76	9.34	0.16	0.01
TOTAL	**20**	**237**	**1004**	**30**	**5.2**	**23**	**266**	**795**	**29**	**0.7**	**25**	**280**	**679**	**16**	**0.8**
% Reduction from Baseline [1]						15%	12%	-21%	-1%	-86%	23%	18%	-32%	-47%	-85%
negative % indicates decrease in emissions															
TOTAL SPBP	**46**	**535**	**2263**	**68**	**12.2**	**52**	**587**	**1759**	**59**	**2.0**	**55**	**621**	**1565**	**37**	**2.1**
% Reduction from Baseline [1]						12%	10%	-22%	-12%	-84%	19%	16%	-31%	-46%	-83%

Table 4.11: Harbor Craft Emissions Forecast - Port of Los Angeles

	CY 2005 (Baseline)					CY 2014 with CARB's Regulation					CY 2023 with CARB's Regulation				
Category	**HC tpy**	**CO tpy**	**NOX tpy**	**DPM tpy**	**SOx tpy**	**HC tpy**	**CO tpy**	**NOX tpy**	**DPM tpy**	**SOx tpy with ULSD**	**HC tpy**	**CO tpy**	**NOX tpy**	**DPM tpy**	**SOx tpy with ULSD**
Assist Tugs															
Auxilliary	0.42	4.43	19.42	0.68	0.12	0.64	6.69	20.01	0.52	0.02	0.78	8.11	21.09	0.44	0.03
Propulsion	5.47	53.67	283.79	9.02	1.40	8.25	81.04	282.42	12.44	0.24	10.00	98.22	266.90	6.85	0.30
Commercial Fishing															
Auxilliary	0.53	7.40	24.05	1.35	0.15	0.41	5.77	15.99	0.72	0.01	0.41	5.77	14.09	0.62	0.01
Propulsion	2.49	22.11	116.23	3.61	0.70	1.94	17.25	83.92	0.72	0.08	1.94	17.25	60.59	0.58	0.08
Crew Boat															
Auxilliary	0.09	0.74	4.28	0.15	0.03	0.09	0.74	3.67	0.02	0.02	0.09	0.74	3.67	0.02	0.02
Propulsion	0.53	6.02	23.45	0.71	0.15	0.53	6.02	19.69	0.25	0.09	0.53	6.02	18.58	0.13	0.09
Dredge Operation															
Auxilliary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Propulsion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Excursion															
Auxilliary	0.18	1.88	8.87	0.63	0.05	0.18	1.88	4.85	0.14	0.01	0.18	1.88	4.53	0.10	0.01
Propulsion	4.48	37.66	208.76	5.42	1.24	4.48	37.66	145.80	3.62	0.36	4.48	37.66	134.57	2.37	0.36
Ferry															
Auxilliary	0.03	0.34	1.67	0.10	0.01	0.03	0.34	1.03	0.03	0.00	0.03	0.34	0.96	0.03	0.00
Propulsion	5.03	101.90	200.42	5.82	1.41	5.03	101.90	146.37	3.64	0.16	5.03	101.90	135.07	2.41	0.16
Government															
Auxilliary	0.02	0.14	0.81	0.03	0.00	0.02	0.16	0.93	0.01	0.00	0.02	0.17	0.98	0.02	0.00
Propulsion	0.63	5.41	29.60	0.72	0.04	0.72	6.24	27.75	0.64	0.02	0.78	6.76	23.26	0.55	0.02
Ocean Tug															
Auxilliary	0.03	0.25	1.33	0.06	0.01	0.03	0.25	0.81	0.03	0.00	0.03	0.25	0.79	0.02	0.00
Propulsion	0.65	6.29	39.42	1.13	0.19	0.65	6.29	20.08	0.60	0.02	0.65	6.29	19.68	0.56	0.02
Tug Boat															
Auxilliary	0.17	1.71	7.85	0.43	0.05	0.17	1.71	4.95	0.15	0.01	0.17	1.71	4.45	0.10	0.01
Propulsion	4.98	44.36	270.51	8.01	1.40	4.98	44.36	171.81	6.53	0.17	4.98	44.36	165.40	5.83	0.17
Workboat															
Auxilliary	0.03	0.31	1.41	0.10	0.01	0.03	0.31	0.75	0.02	0.00	0.03	0.31	0.76	0.02	0.00
Propulsion	0.37	2.84	17.36	0.43	0.10	0.37	2.84	12.70	0.25	0.01	0.37	2.84	10.70	0.26	0.01
TOTAL	**26**	**297**	**1,259**	**38**	**7.1**	**29**	**321**	**964**	**30**	**1.2**	**31**	**341**	**886**	**21**	**1.3**
% Reduction from Baseline [1]						9%	8%	-23%	-21%	-83%	17%	14%	-30%	-46%	-82%
negative % indicates increase in emissions															
TOTAL SPBP	**46**	**535**	**2263**	**68**	**12.2**	**52**	**587**	**1759**	**59**	**2.0**	**55**	**621**	**1565**	**37**	**2.1**
% Reduction from Baseline [1]						12%	10%	-22%	-12%	-84%	19%	16%	-31%	-46%	-83%

SECTION 5.0 CHE BASELINE: 2005 EMISSIONS INVENTORY

The cargo handling equipment forecasts for the Ports of Long Beach and Los Angeles are based upon the data underlying the published 2005 emissions inventories for each port. The population, average age, horsepower and annual hours of usage estimates are the same as those included in Tables 4.3, 4.4, 4.5 and 4.6 of 2005 Emissions Inventory reports published by both ports. The complete reports can be obtained from the following Internet sources:
http://www.portoflosangeles.org/environment_studies.htm
http://www.polb.com/environment/air_quality/documents.asp

Table 5.1: POLA 2005 Emissions in tpy by Equipment Type

Equipment Type	Count	Avg. Model Year	PM10	PM2.5	DPM	NO_x	SO_x	CO	TOG
RTG cranes, cranes	100	1994	5.2	4.8	5.2	141.9	0.8	43.3	11.5
Excavator	12	1996	1.6	1.5	1.6	55.1	0.0	12.1	4.0
Forklift	422	1995	2.9	2.7	2.5	127.0	0.3	279.4	40.5
Top Handler, Side Pick	166	1999	8.3	7.7	8.3	287.6	2.1	60.1	16.5
Other Equipment	61	1992	5.8	5.3	5.8	106.4	0.2	39.7	12.0
Sweeper	11	2000	0.1	0.1	0.1	4.6	0.0	6.9	0.6
Loader	16	1993	1.2	1.1	1.2	38.7	0.1	8.1	2.8
Yard Tractor	901	2001	37.7	34.6	36.8	1,275.2	10.5	560.5	78
Total	**1,689**	**1999**	**62.8**	**57.8**	**61.5**	**2,036.6**	**14.0**	**1,010.1**	**166.1**

Table 5.2: POLB 2005 Emissions in tpy by Equipment Type

Equipment Type	Count	Avg. Model Year	PM10	PM2.5	DPM	NO_x	SO_x	CO	TOG
RTG Crane, Crane	95	1995	10.3	9.5	10.3	356.4	3.0	84.8	27.0
Forklift	294	1993	2.1	1.9	2.0	59.8	0.3	70.3	11.9
Top Handler, Side Pick	156	2000	5.8	5.3	5.8	252.8	2.5	27.7	7.0
Aerial Lift, Truck, Other	39	1995	0.2	0.2	0.2	4.6	0.0	1.3	0.4
Sweeper	14	1996	0.2	0.2	0.2	4.7	0.0	2.9	0.6
Loader	16	1991	2.6	2.4	2.5	58.8	0.3	30.3	6.9
Yard Tractor	641	2001	34.5	31.7	34.5	999.1	10.8	229.7	46.5
Total	**1,255**	**1998**	**55.6**	**51.1**	**55.5**	**1,736.3**	**17.0**	**446.9**	**100.4**

In order to simplify the forecast, the equipment type specific averages for model year/ age, horsepower and annual hours of usage for each terminal at the ports of Long Beach and Los Angeles were utilized rather than performing a separate analysis for each individual piece of equipment.

5.1 Activity and Equipment Population Growth

The forecast was accomplished by performing separate analyses of growth and control. These analyses were performed at the terminal specific level, and separate estimates of growth were developed for containerized and non-containerized cargo.

For container terminal CHE, the Global Insight forecast growth in TEU throughput as described in the document entitled "SPBP Emissions Forecasting Methodology" (26 Oct 07) was applied to the cargo handling equipment population of each container terminal.

Estimates of growth were developed for non-container terminal CHE based upon the forecast growth in cargo tonnage provided in the Global Insight report. Separate estimate were developed for liquid-bulk, dry-bulk, break–bulk, autos, refrigerated and general cargo. Growth in cruise ship calls were provided by the Port of Los Angeles and applied to cruise ships' activity for both ports.

The population and activity of terminals that did not exist during 2005 but that are expected to come on line during the forecast period were estimated based on the average characteristics of the type of terminal (e.g., container, break bulk, liquid) in operation in 2005. The terminals that were added are:

POLA

- Berth 206-209 – Container Terminal
- Pacific Energy – Liquid-Bulk Terminal

POLB

- Pier S – Container Terminal

The various growth factors used in the forecast are depicted in the graph and table below.

Figure 5.1.: Growth Factors for CHE by Terminal Type

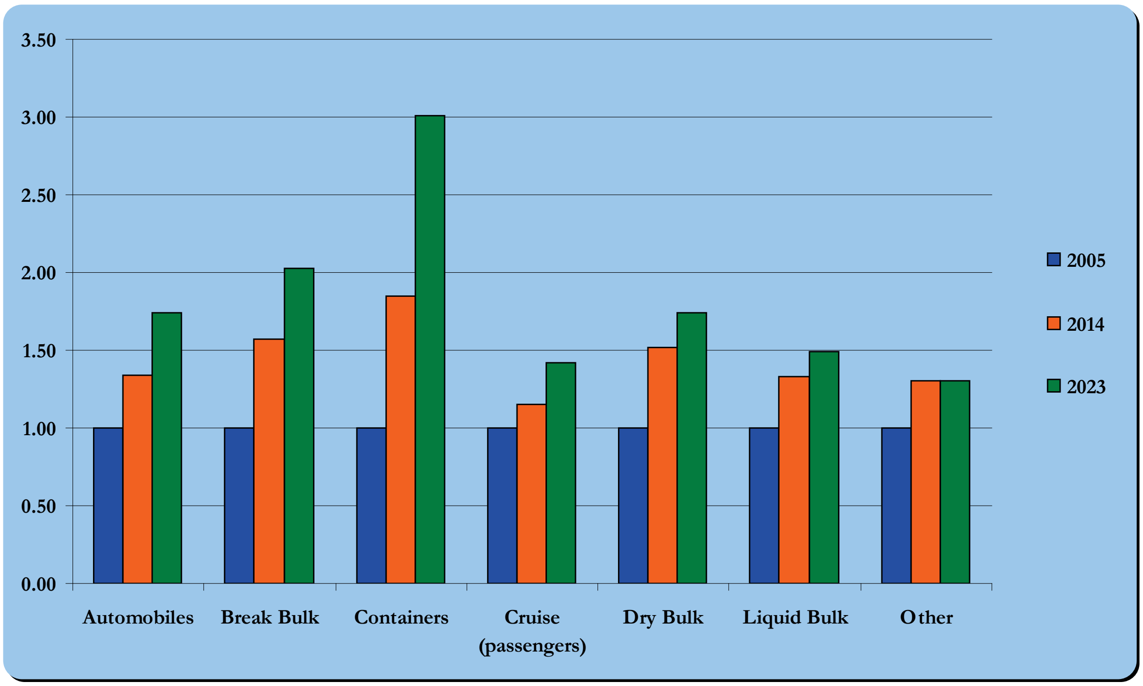


Table 5.3: Growth Factors for CHE by Terminal Type

Cargo Type	2014	2023
Automobiles	1.34	1.74
Break Bulk	1.57	2.03
Containers	1.85	3.01
Cruise (passengers)	1.15	1.42
Dry Bulk	1.52	1.74
Liquid Bulk	1.33	1.49
Other	1.30	1.30

In scaling the 2005 population according to growth in cargo, no terminal operational efficiencies were assumed regarding future CHE usage.

5.2 Emission Factors

The emission factors, assumptions of deterioration, load, useful life and fuel correction factors used in this analysis were consistent with those agreed upon by the technical working group and included in the 2005 emissions inventories. The only exception was the 2007+ model year, on-road zero hour emission factors needed to forecast yard tractor emissions. The 2007+ on-road NO_x and PM zero-hour emission rates provided by CARB for the 2005 EIs were adjusted for the more stringent USEPA 2007+ on-road diesel vehicle standards by multiplying the 2004 on-road emissions factors by the ratio of the standards applicable in 2004 versus 2007 to 2009 and 2010. An example of this adjustment is provided below:

2010+ MY (175 HP) PM in gm/hp-hr = 2004 on-road EF for 175 HP * 2010 on-road PM standard / 2004 on-road PM standard

2004+ On-Road emissions factors used for the analysis are shown in the table below:

Table 5.4: On-Road Emission Factors Utilized for Yard Tractors Equipped with On-Road Engines

Hp	Model Year	HC in gm/hp-hr	CO in gms/hp-hr	NO_x in gms/hp-hr	PM in gms/hp-hr
175	2004	0.07	2.70	2.08	0.13
175	2005	0.05	2.70	1.95	0.11
175	2006	0.05	2.70	1.95	0.11
175	2007	0.03	2.70	1.17	0.01
175	2008	0.03	2.70	1.17	0.01
175	2009	0.03	2.70	1.17	0.01
175	2010+	0.03	2.70	0.20	0.01
250	2004	0.05	0.92	2.02	0.08
250	2005	0.04	0.92	1.93	0.08
250	2006	0.04	0.92	1.93	0.08
250	2007	0.03	0.92	1.16	0.01
250	2008	0.03	0.92	1.16	0.01
250	2009	0.03	0.92	1.16	0.01
250	2010+	0.03	0.92	0.19	0.01

Emission factors for the off-road engines including Tier 4 engines are the same as provided by CARB for 2005 EIs. Emission benefits associated with the use of clean diesel fuel were assumed to lower the emissions of the CHE fleet consistent with the assumptions put forth by CARB. Reference: Table 7, "Off-Road Exhaust Emissions Inventory Fuel Correction Factors", dated July 25, 2005 posted at: http://www.arb.ca.gov/msei/supportdocs.htm#offroad

For LPG equipment, CARB provided a modified emissions factor file reflecting lower emission rates due to the "Large Spark-Ignited Off-Road Engine Regulation" adopted in 2006. More details can be found at: http://www.arb.ca.gov/regact/lore2006/lore2006.htm

5.3 Future Fleet Modeling

First the 2005 CHE population was grown to 2014 and 2023 according to the terminal specific growth factors described above. Initially, the average age of the equipment by terminal as determined by the 2005 data was retained. Second, the model year replacement or emission controls were applied to the grown CHE population according to which program requirements, those of the CAAP or those regulations adopted by the CARB, are more stringent. In making this evaluation, the CHE fleet was subdivided into the following groups:

5.3.1 2014 Equipment Groups

1) Yard Tractors regardless of the lease renewal status – The average age at both ports for off-road yard tractors in CY 2005 is five years (MY 2000) and for on-road yard tractors (15% of all yard tractors in San Pedro Bay Ports) is 0 year (MY 2005). Since CARB's regulation requires all of the pre-2003 yard tractor replacement to 2007+ on-road by end of CY 2008 and on-road yard tractors replacement by end of 2014, and since CAAP requires complete turnover to 2007+ on-road engines by CY 2010, if a terminal's lease is up for renewal before or by 2014, we used a simple rule which captures, on average, the CARB as well as CAAP's requirement. For each terminal, if the average age as determined from 2005 EI data was less than or equal to 7 years (which equates to MY 2007 + in 2014), it was retained and assumed that all yard tractors will be equipped with on-road engines. If the average age as determined from 2005 EI data was greater than 7 years (which equates to MY pre-2007 in 2017), all yard tractors were assumed to be 2007 equipped with on-road engines.
2) Non-Yard Tractors <= 750 HP in which the lease will be up for renewal regardless of fuel type – CAAP requirements were applied resulting in a Tier 4 CHE fleet
3) Non-Yard Tractors <=750 HP powered by diesel in terminals in which the lease will not be up for renewal – CARB's in-use CHE regulation was applied resulting in emissions controls applied to pre- Tier 4 equipment
4) Non-Yard Tractors >750 HP in terminals in which the lease will be up for renewal, regardless of fuel type – CAAP requirement was applied resulting in Tier 4 CHE
5) Non-Yard Tractors >750 HP powered by diesel in terminals in which the lease will not be up for renewal, regardless of fuel type – CARB's in-use CHE regulation was applied resulting in emissions controls applied to pre-Tier 4 equipment

Reference for CAAP requirement for CHE – section 5.3 of Final 2006, "San Pedro Bay Ports Clean Air Action Plan", Technical Report

Reference for CARB's in-use CHE regulation, Attachment 2 posted May 17, 2006 and Appendix D - http://www.arb.ca.gov/regact/cargo2005/cargo2005.htm

For non-yard tractors if CARB's in-use CHE regulation was applicable, all diesel powered Rubber-Tired Gantry Cranes and Forklifts were assumed to be retrofitted with level 3 VDEC systems resulting in an 85%; reduction in PM; all other diesel powered equipment were assumed to be retrofitted with level 1 VDEC system resulting in a 25% reduction in PM.

5.3.2 2023 Equipment Groups

1) All yard tractors regardless of lease status, fuel type or horsepower were assumed to be 2007+ on-road with average age same as in 2005
2) All Non-Yard Tractors regardless of lease status, fuel type or horsepower were assumed to be Tier 4 with the same average age as in 2005 if it was less than 9 years, otherwise they were assumed to be MY 2015.

Calculation Steps:
For CYs 2014 and 2023, assume the same average HP, usage and load factors by equipment by terminal as in 2005. (Also discussed above under Baseline description)

Grow the 2005 population by equipment type by terminal to 2014 and 2023 by applying terminal type appropriate growth factors (as shown in the graph and table above).

Depending upon the equipment type (Yard Tractor or non-Yard Tractor), average age of the equipment in 2005, lease schedule and CARB's in-use CHE regulation or CAAP requirement, determine the average MY of the equipment by terminal in 2014 and 2023.

Calculate emissions using 2005 EI methodology and terminal-specific equipment characteristics and based on projected average MY.

An example of one terminal scenario out of several used in developing the forecast is provided below for diesel yard tractor equipment:

2005 Baseline data
Terminal X – Container Terminal – Lease Renewal in 2010
5 diesel powered Off-Road Yard Tractors with average MY 2001 (4 years old), equipped with DOC,
Average HP 240
Average annual usage 1,600 hours
Projected growth in TEU between 2005 and 2010 is 130%

2014 Yard Tractor Data for Terminal X

The average age in 2005 was 4 years. It is assumed that turnover results in this average age continuing through 2014, which means the average model year in 2014 will be MY 2010, which complies with both the CAAP and the CARB regulation. This is a reasonable assumption because the terminal was maintaining this turnover in 2005 in the absence of any regulatory requirement, so it's reasonable to assume the terminal will continue to turn over its equipment at the same rate. This assumption means that any equipment purchased to comply with the CARB requirement to replace off-road MY 2001 and older with VDEC Yard Tractor by December 2009 will most likely have been replaced by 2014.

Other terminal fleet characteristics:

Population = 2005 population * growth factor = 5 * 1.30 = 7 (rounded)
Usage = 1,600 hours per year
Average HP = 240
PM ZH for on-road 2010 engine = 0.01 gm/hp-hr (from the table above)
DF = 0.67 for 250 hp per 2005 methodology
LF = 0.65
FCF = 0.800
Useful life = 12 years

Emissions in tons per year in 2014 =

ZH * (1+(DF*age/useful life))*annual hrs*HP*LF*FCF/(453.59*2000) =
0.015 tons per year

5.4 Forecast Emission Estimates

The resulting forecast emission estimates are listed in the tables below.

Table 5.5: POLA 2014 Emissions in tpy by Equipment Type

Equipment Type	Count	MYR	DPM	NO_x	CO	TOG	SO_x
RTG cranes, cranes	163	2008	1.1	88.9	40.2	5.2	0.2
Excavator	19	2005	1.0	47.5	11.8	1.5	0.1
Forklift	642	2006	1.6	169.8	353.5	40.6	0.1
Top Handler, Side Pick	299	2010	5.0	191.8	99.8	10.7	0.5
Other Equipment	100	2002	4.9	115.4	49.9	12.1	0.1
Sweeper	19	2011	0.1	3.6	1.9	0.2	0.0
Loader	25	2002	0.8	36.2	8.0	1.8	0.0
Yard Tractor	1588	2010	3.7	239.9	770.2	18.0	2.8
Total	**2,855**	2009	**18.2**	**893.0**	**1,335.3**	**89.9**	**3.9**
% Change from 2005	**69%**		**-70%**	**-56%**	**32%**	**-41%**	**-72%**

Negative % indicates decrease

Table 5.6: POLB 2014 Emissions in tpy by Equipment Type

Equipment Type	Count	MYR	DPM	NO_x	CO	TOG	SO_x
RTG Crane, Crane	176	2010	1.5	268.9	103.2	12.0	0.6
Forklift	457	2007	2.2	80.1	96.8	9.9	0.1
Top Handler, Side Pick	307	2011	3.9	178.0	103.4	8.4	0.5
Aerial Lift, Truck, Other	61	2008	0.4	15.0	17.1	1.1	0.0
Sweeper	26	2007	0.1	3.6	7.4	0.2	0.0
Loader	26	2001	1.8	56.2	16.5	5.2	0.0
Yard Tractor	1,130	2010	3.1	165.5	663.2	12.2	2.1
Total	**2,183**	**2009**	**12.8**	**767.3**	**1,007.5**	**49.1**	**3.3**
% Change from 2005	**74%**		**-77%**	**-56%**	**125%**	**-51%**	**-80%**

Negative % indicates decrease

Table 5.7: POLA 2023 Emissions in tpy by Equipment Type

Equipment Type	Count	MYR	DPM	NO_x	CO	TOG	SO_x
RTG cranes, cranes	242	2016	1.1	11.4	41.4	2.4	0.2
Excavator	25	2017	0.2	4.0	14.5	0.9	0.1
Forklift	830	2016	0.2	40.7	755.3	12.5	0.1
Top Handler, Side Pick	465	2016	0.8	20.8	81.2	4.6	0.4
Other Equipment	139	2017	0.3	6.8	22.5	1.1	0.1
Sweeper	30	2017	0.0	0.9	2.4	0.1	0.0
Loader	31	2015	0.1	1.4	5.5	0.3	0.0
Yard Tractor	2395	2020	5.6	147.9	1,371.9	18.2	4.1
Total	**4,157**	2018	**8.2**	**233.9**	**2,294.8**	**40.1**	**5.2**
% Change from 2005	**146%**		**-87%**	**-89%**	**127%**	**-74%**	**-63%**

Negative % indicates decrease

Table 5.8: POLB 2023 Emissions in tpy by Equipment Type

Equipment Type	Count	MYR	DPM	NO_x	CO	TOG	SO_x
RTG Crane, Crane	292	2017	2.6	222.8	176.3	10.3	1.0
Forklift	630	2016	0.3	21.6	235.8	3.1	0.2
Top Handler, Side Pick	518	2019	1.5	42.0	179.5	8.7	0.8
Aerial Lift, Truck, Other	77	2016	0.1	2.4	20.7	0.5	0.0
Sweeper	32	2017	0.0	1.3	5.0	0.1	0.0
Loader	31	2016	0.1	2.6	9.5	0.6	0.1
Yard Tractor	1,914	2019	5.6	108.1	1,202.1	10.7	3.5
Total	**3,494**	**2018**	**10.1**	**400.8**	**1,828.9**	**34.2**	**5.7**
% Change from 2005	**178%**		**-82%**	**-77%**	**309%**	**-66%**	**-67%**

Negative % indicates decrease

Table 5.9: POLA 2005 Emissions in tpy by Terminal Type – Yard Tractors

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	0	0	0.00	0.00	0.00	0.00
Break Bulk	21	1993	0.33	8.13	2.24	0.70
Container	800	2001	31.47	1,133.51	481.21	69.54
Cruise	0	0	0.00	0.00	0.00	0.00
Dry Bulk	22	1999	1.83	35.11	13.79	3.91
Liquid Bulk	0	0	0.00	0.00	0.00	0.00
Other	58	2005	3.15	98.46	63.26	3.92
Total	901	2001	36.77	1,275.20	560.51	78.07

Table 5.10: POLA 2005 Emissions in tpy by Terminal Type – Non-Yard Tractor CHE

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	7	1996	0.00	0.22	1.79	0.12
Break Bulk	241	1993	10.59	267.81	170.95	35.09
Container	311	1998	11.43	392.02	105.06	25.57
Cruise	33	1992	0.31	8.33	13.48	2.32
Dry Bulk	130	1997	0.21	38.38	119.75	17.06
Liquid Bulk	7	1995	0.04	1.91	4.16	0.63
Other	59	1996	2.12	52.73	34.68	7.14
Total	788	1996	24.70	761.40	449.86	87.91

Table 5.11: POLB 2005 Emissions in tpy by Terminal Type – Yard Tractors

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	0	0	0.00	0.00	0.00	0.00
Break Bulk	6	1998	0.04	1.26	0.80	0.05
Container	635	2001	34.47	997.83	228.85	46.43
Cruise	0	0	0.00	0.00	0.00	0.00
Dry Bulk	0	0	0.00	0.00	0.00	0.00
Liquid Bulk	0	0	0.00	0.00	0.00	0.00
Other	0	0	0.00	0.00	0.00	0.00
Total	641	2001	34.51	999.09	229.65	46.48

Table 5.12: POLB 2005 Emissions in tpy by Terminal Type – Non-Yard Tractor CHE

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	11	1995	0.04	2.41	4.29	0.63
Break Bulk	207	1992	3.89	91.86	33.62	7.70
Container	307	1997	16.36	606.02	116.77	35.14
Cruise	16	1989	0.13	8.11	19.39	3.03
Dry Bulk	63	1998	0.42	26.93	41.77	7.09
Liquid Bulk	12	1991	0.08	6.15	2.37	0.43
Other	0	0	0.00	0.00	0.00	0.00
Total	616	1995	20.93	741.49	218.21	54.02

Table 5.13: POLA 2014 Emissions in tpy by Terminal Type – Yard Tractors

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	0	0	0.00	0.00	0.00	0.00
Break Bulk	33	2008	0.01	1.87	2.40	0.06
Container	1447	2010	3.28	224.11	670.10	16.75
Cruise	0	0	0.00	0.00	0.00	0.00
Dry Bulk	33	2008	0.07	8.29	15.88	0.28
Liquid Bulk	0	0	0.00	0.00	0.00	0.00
Other	75	2014	0.30	5.61	81.86	0.94
Total	1588	2010	3.66	239.87	770.24	18.04

Table 5.14: POLA 2014 Emissions in tpy by Terminal Type – Non-Yard Tractor CHE

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	9	2005	0.01	0.38	4.23	0.13
Break Bulk	384	2004	7.61	304.59	298.42	35.11
Container	563	2010	5.54	281.55	165.47	16.53
Cruise	38	2001	0.47	14.59	33.74	5.80
Dry Bulk	199	2006	0.13	14.46	25.77	9.53
Liquid Bulk	10	2005	0.06	2.36	6.40	0.53
Other	64	2005	0.71	35.23	31.01	4.26
Total	1267	2007	14.54	653.17	565.05	71.89

Table 5.15: POLB 2014 Emissions in tpy by Terminal Type – Yard Tractors

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	0	0	0.00	0.00	0.00	0.00
Break Bulk	10	2008	0.01	0.12	1.59	0.02
Container	1120	2010	3.08	165.37	661.58	12.21
Cruise	0	0	0.00	0.00	0.00	0.00
Dry Bulk	0	0	0.00	0.00	0.00	0.00
Liquid Bulk	0	0	0.00	0.00	0.00	0.00
Other	0	0	0.00	0.00	0.00	0.00
Total	1130	2010	3.08	165.49	663.18	12.23

Table 5.16: POLB 2014 Emissions in tpy by Terminal Type – Non-Yard Tractor CHE

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	14	2012	0.00	0.35	2.02	0.03
Break Bulk	326	2007	3.35	116.93	57.10	8.43
Container	576	2010	5.98	457.71	219.52	22.28
Cruise	18	1999	0.12	8.14	24.65	2.49
Dry Bulk	104	2008	0.28	17.42	39.81	3.54
Liquid Bulk	15	2001	0.04	1.25	1.26	0.12
Other	0	0	0.00	0.00	0.00	0.00
Total	1053	2009	9.77	601.80	344.35	36.90

Table 5.17: POLA 2023 Emissions in tpy by Terminal Type – Yard Tractors

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	0	0	0.00	0.00	0.00	0.00
Break Bulk	42	2014	0.02	0.99	3.22	0.05
Container	2240	2020	5.16	139.64	1268.32	17.39
Cruise	0	0	0.00	0.00	0.00	0.00
Dry Bulk	38	2016	0.09	1.62	18.50	0.19
Liquid Bulk	0	0	0.00	0.00	0.00	0.00
Other	75	2023	0.30	5.61	81.86	0.52
Total	2395	2020	5.57	147.85	1371.91	18.17

Table 5.18: POLA 2023 Emissions in tpy by Terminal Type – Non-Yard Tractor CHE

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	12	2015	0.00	0.16	5.04	0.10
Break Bulk	502	2016	0.67	32.86	300.04	9.96
Container	899	2016	1.92	37.96	177.25	7.68
Cruise	50	2015	0.01	2.40	43.16	0.43
Dry Bulk	225	2016	0.03	9.15	360.36	3.20
Liquid Bulk	10	2015	0.00	0.47	8.08	0.08
Other	64	2017	0.04	3.02	28.95	0.50
Total	1762	2016	2.67	86.01	922.88	21.95

Table 5.19: POLB 2023 Emissions in tpy by Terminal Type – Yard Tractors

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	0	0	0.00	0.00	0.00	0.00
Break Bulk	13	2016	0.01	0.16	2.39	0.02
Container	1901	2019	5.57	107.97	1199.71	10.69
Cruise	0	0	0.00	0.00	0.00	0.00
Dry Bulk	0	0	0.00	0.00	0.00	0.00
Liquid Bulk	0	0	0.00	0.00	0.00	0.00
Other	0	0	0.00	0.00	0.00	0.00
Total	1914	2019	5.58	108.13	1202.10	10.71

Table 5.20: POLB 2023 Emissions in tpy by Terminal Type – Non-Yard Tractor CHE

Terminal Type	Count	MYR	DPM	NO_x	CO	TOG
Automobile	18	2015	0.00	0.26	7.67	0.07
Break Bulk	422	2016	0.34	19.21	61.16	2.19
Container	991	2018	4.14	267.34	385.24	19.46
Cruise	22	2015	0.00	0.71	24.82	0.23
Dry Bulk	112	2018	0.04	4.94	146.11	1.46
Liquid Bulk	15	2015	0.00	0.23	1.79	0.03
Other	0	0	0.00	0.00	0.00	0.00
Total	1580	2017	4.53	292.68	626.79	23.45

SECTION 6.0 HDV EMISSIONS FORECASTING METHODOLOGY

The basis of the forecast is the TEU throughput projection developed by the ports and summarized in Table 6.1 of the forecasting methodology document (and summarized in Table 6.1 and Figure 6.1 below).

The methodology is consistent with the previous port emissions inventories, consisting of 3 components:

- On-terminal
- On-port on-road
- Regional (off-port) on-road

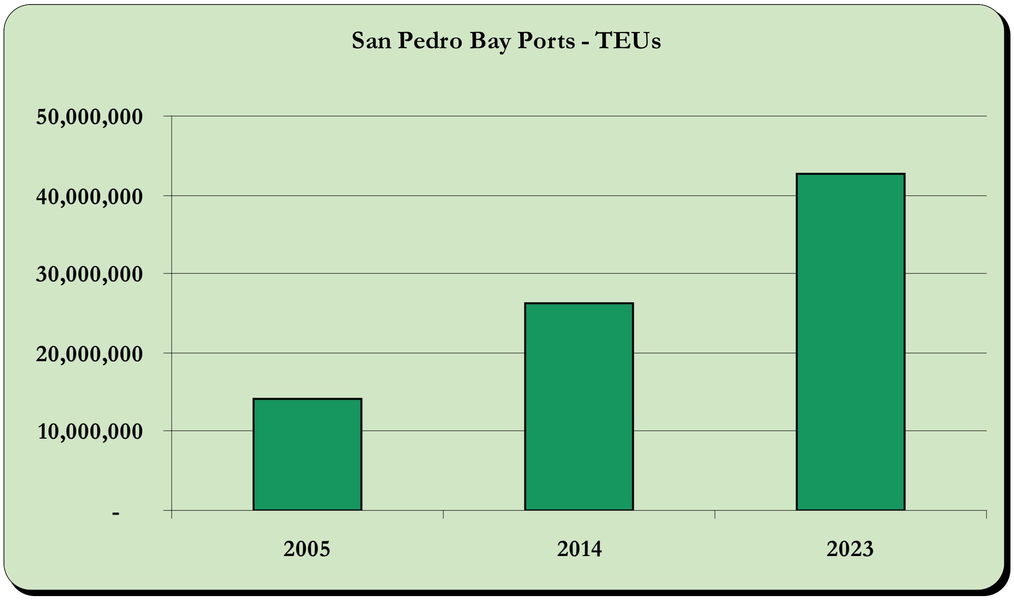
One important difference between the ports' EIs and these emission forecasts is how the on-port on-road activity and emissions are reported. Since each port's inventory stands alone, the on-port activity for each port is confined to trucks associated with that port (POLA-related truck trips on POLA roads, and POLB-related truck trips on POLB roads). The portion of a POLB-related truck trip that takes place on roads within POLA is reported in the POLB EI as a regional, off-port emission, as is the portion of a POLA-related truck trip that takes place on POLB roads. However, since these forecasts are being spatially allocated to support risk assessment modeling, the activity and emissions of trucks associated with both ports are reported for each port - that is, POLA emissions include POLB-related truck trips as well as POLA-related truck trips, and vice versa. For this reason the emissions reported as baseline (2005) emissions in this summary are not the same as those presented in the two ports' 2005 EIs.

Table 6.1: San Pedro Bay Ports Container Throughput Projection

Year	TEUs	Containers*
2005	14,194,340	7,885,745
2014	26,293,929	14,607,738
2023	42,698,000	23,721,111

*Estimated as TEU/1.8

Figure 6.1: San Pedro Bay Ports TEU Projection



6.1 Ports Truck Population Distribution by Model Year - Used to Calculate Composite Fleet Emission Factors

The baseline ports truck population distribution by model year is the same as determined by the OCR data records collected for CY 2005 and published in section 5.1.1 of San Pedro Bay Ports Clean Air Action Plan, Final 2006, as shown in the table below. Growth factors for 2014 and 2023 were based on projected on-terminal truck trips described above. Growth in CYs 2014 and 2023 with respect to CY 2005 is 43% and 125% respectively. Survival rates by age were obtained from EMFAC2007.

First, the baseline (CY 2005) population was grown to future years based on the growth factors. Second, survival rates by age were applied to calculate the remaining population. Third, the difference between the current year's and previous year's population was distributed according to the baseline distribution.

Ban and Retrofit requirements (from the Ports' Clean Truck Program tariff schedule) were applied in CYs 2008, 2010 and 2012. The trucks assumed to replace the banned population were distributed within the MYs allowed within the calendar year of concern.

Table 6.2: Model Year Distribution Assumptions

CY 2005		CY 2014		CY 2023	
Model Year	Population Fraction	Model Year	Population Fraction	Model Year	Population Fraction
2006	0.28%	2015	0.28%	2024	0.28%
2005	1.23%	2014	0.93%	2023	0.52%
2004	0.33%	2013	3.04%	2022	0.53%
2003	0.80%	2012	8.73%	2021	0.65%
2002	0.58%	2011	3.84%	2020	0.70%
2001	2.00%	2010	9.32%	2019	1.06%
2000	4.97%	2009	9.22%	2018	2.06%
1999	6.85%	2008	23.64%	2017	3.35%
1998	7.85%	2007	41.00%	2016	4.69%
1997	8.64%	2006	0.00%	2015	6.01%
1996	9.85%	2005	0.00%	2014	7.39%
1995	10.22%	2004	0.00%	2013	9.04%
1994	9.17%	2003	0.00%	2012	10.86%
1993	7.20%	2002	0.00%	2011	10.08%
1992	4.06%	2001	0.00%	2010	10.35%
1991	4.06%	2000	0.00%	2009	9.46%
1990	4.07%	1999	0.00%	2008	10.75%
1989	4.02%	1998	0.00%	2007	12.21%
1988	3.04%	1997	0.00%	2006	0.00%
1987	2.22%	1996	0.00%	2005	0.00%
1986	1.59%	1995	0.00%	2004	0.00%
1985	2.27%	1994	0.00%	2003	0.00%
1984	1.98%	1993	0.00%	2002	0.00%
1983	0.50%	1992	0.00%	2001	0.00%
1982	0.33%	1991	0.00%	2000	0.00%
1981	0.34%	1990	0.00%	1999	0.00%
1980	0.35%	1989	0.00%	1998	0.00%
1979	0.35%	1988	0.00%	1997	0.00%
1978	0.16%	1987	0.00%	1996	0.00%
1977	0.12%	1986	0.00%	1995	0.00%
1976	0.09%	1985	0.00%	1994	0.00%
1975	0.02%	1984	0.00%	1993	0.00%
1974	0.11%	1983	0.00%	1992	0.00%
1973	0.11%	1982	0.00%	1991	0.00%
1972	0.05%	1981	0.00%	1990	0.00%
1971	0.03%	1980	0.00%	1989	0.00%
1970	0.06%	1979	0.00%	1988	0.00%
1969	0.04%	1978	0.00%	1987	0.00%
1968	0.03%	1977	0.00%	1986	0.00%
1967	0.03%	1976	0.00%	1985	0.00%
1966	0.03%	1975	0.00%	1984	0.00%

6.2 Fleet Average Emission Factor Development

The EMFAC model was used to estimate fleet average emission factors based on fleet turnover rates dictated by the San Pedro Bay Ports' Clean Trucks Program tariff schedule.

Table 6.3: Speed-Corrected Fleet Average Emission Rates, g/mile

Speed, mph	5	10	15	20	25	30	35	40
NOx								
2005	54.2	44.6	30.6	23.9	22.7	22.2	21.8	21.6
2014	18.7	15.8	11.8	9.2	8.0	7.2	6.6	6.0
2023	12.3	10.3	7.6	5.9	5.1	4.6	4.3	3.9
PM								
2005	5.1	4.2	2.8	1.9	1.5	1.3	1.1	1.0
2014	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2023	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
HC								
2005	18.7	14.4	7.7	3.6	2.5	2.0	1.7	1.4
2014	4.9	3.5	1.8	0.8	0.7	0.6	0.5	0.4
2023	3.6	2.6	1.3	0.6	0.5	0.4	0.4	0.3
CO								
2005	30.2	26.9	21.2	16.5	13.6	11.4	9.5	8.0
2014	9.6	7.2	4.1	2.5	2.1	2.0	2.0	2.0
2023	7.0	5.3	3.0	1.8	1.5	1.5	1.5	1.4

(continued below)

Table 6.3: Speed-Corrected Fleet Average Emission Rates, g/mile (cont'd)

Speed, mph	45	50	55	60	65	70	Idle (g/hr)
NOx							
2005	21.6	21.7	22.0	22.5	23.2	24.2	80.6
2014	5.6	5.4	5.3	5.3	5.5	5.9	95.5
2023	3.6	3.5	3.4	3.4	3.5	3.8	95.5
PM							
2005	0.9	0.9	0.9	1.0	1.2	1.4	1.7
2014	0.1	0.1	0.1	0.1	0.2	0.2	0.1
2023	0.1	0.1	0.1	0.1	0.2	0.2	0.1
HC							
2005	1.3	1.2	1.3	1.5	1.8	2.2	11.5
2014	0.4	0.3	0.3	0.3	0.3	0.3	6.0
2023	0.3	0.3	0.2	0.2	0.2	0.2	6.0
CO							
2005	6.8	5.9	5.4	5.2	5.4	5.8	20.7
2014	2.0	2.0	2.1	2.3	2.4	2.7	16.6
2023	1.4	1.5	1.5	1.7	1.8	2.0	16.6

Figure 6.2: Speed-Corrected Fleet Average NO_x Emission Rates, g/mile

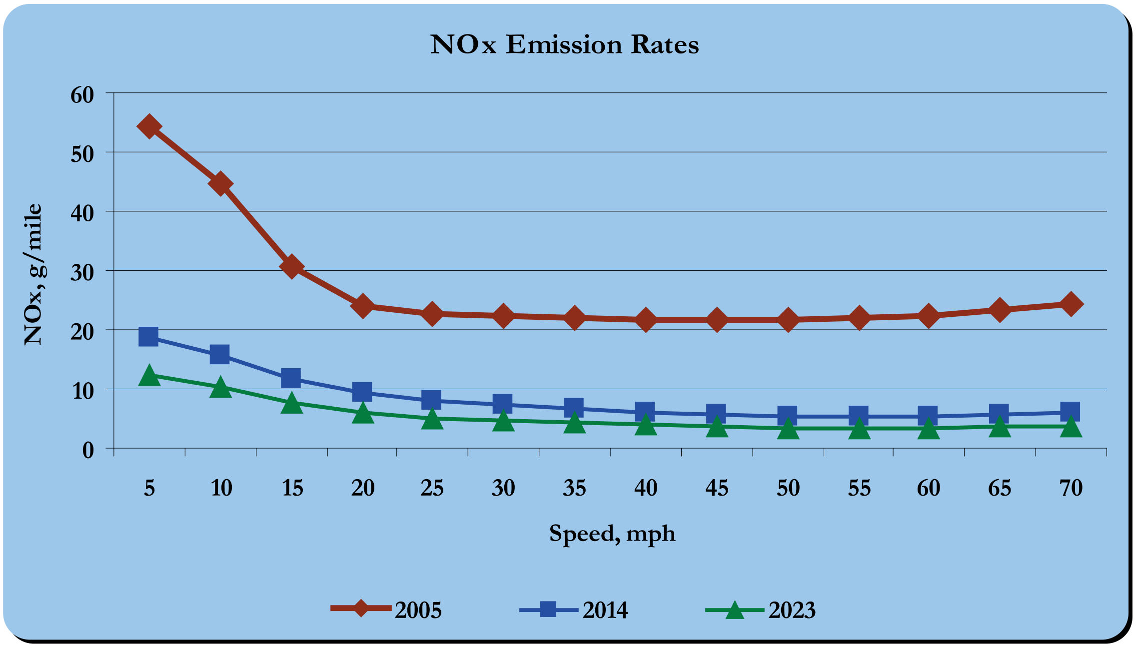
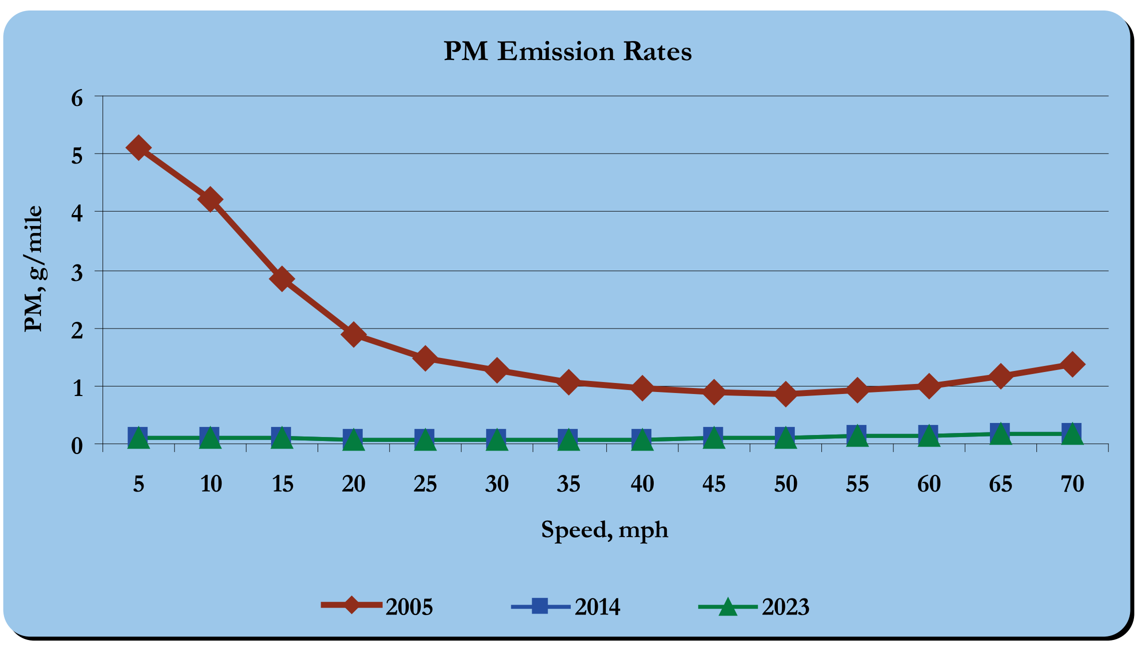


Figure 6.3: Speed-Corrected Fleet Average PM Emission Rates, g/mile



6.3 On-terminal Activity Forecasting Methodology

On-terminal activity relates to the operation of trucks as they arrive at, operate within, and depart from a terminal or other facility.

The number of truck trips for each terminal for forecast years 2014 and 2023 are from QuickTrip runs using the throughputs summarized above, and truck/rail mode split assumptions developed for each year. The terminal characteristics assumed for on-terminal speed, distance, and idling times are the 2006 characteristics which will be used to develop 2006 emission estimates - these were used in preference to the 2005 values because 2006 is believed to better reflect the effects of PierPass implementation on idling and other terminal operations. No additional information was available to adjust these values for 2014 or 2023 such as terminal efficiency improvements) so the 2006 characteristics were used unmodified for the later years.

As with the port emissions inventory methodology, the calculations are based on the number of truck trips through the terminals multiplied by either the average idling time per visit (for the idling time calculation) or the average distance traveled on-terminal during each visit. These values are terminal-specific and were obtained from the individual terminals. Total VMT and idling times were calculated for each port by summing the totals for each terminal.

Examples: 0.5 hours idling per truck visit x 1,000,000 truck visits per year = 500,000 hours idling per year
1.0 mile on-terminal per truck visit x 1,000,000 truck visits per year = 1,000,000 vehicle miles per year

The QuickTrip model provides activity numbers (number of truck visits) for container terminals. Activity related to non-container terminals has been separately projected by the Ports not to grow substantially between 2005 and 2014, with a 12% increase between 2014 and 2023.

Several facilities are located on POLA property away from the area typically considered to be within the ports. Most of these facilities are related to container transportation, such as dispatch and warehouse facilities, and one is an off-dock rail yard operated by Union Pacific - the Intermodal Container Transfer Facility (ICTF). Activity forecasting for these facilities was based on different assumptions than those used for the non-container terminals because their activity is related to container activity. Therefore, their activity growth was scaled with overall container throughput growth, with the exception that the ICTF was held at its current capacity of 1,250,000 containers per year.

The following tables and charts illustrate the forecast truck trips and VMT for the two ports' container terminals and for the other terminals (including the ICTF) for the 2005 baseline year and the forecast years 2014 and 2023.

Table 6.4: San Pedro Bay Ports On-Terminal Truck Trips

	2005	2014	2023
PoLA Container Terminals	4,179,330	6,090,289	9,565,977
PoLB Container Terminals	3,967,832	5,628,843	9,939,841
Other Terminals and ICTF	2,068,283	2,081,153	2,188,751
	10,215,445	13,800,285	21,694,569

Figure 6.4: San Pedro Bay Ports On-Terminal Truck Trips

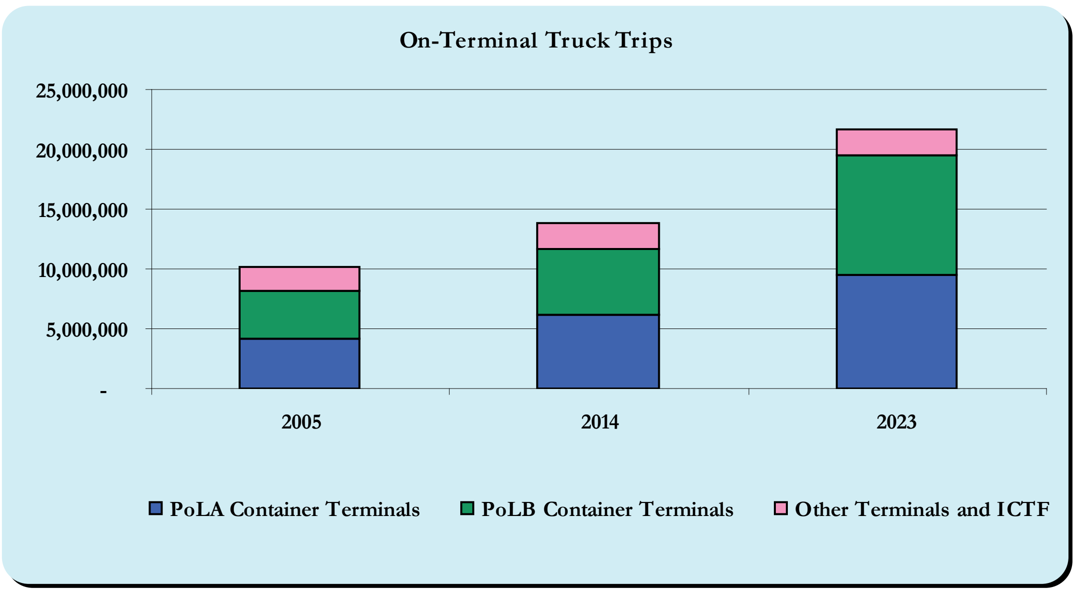
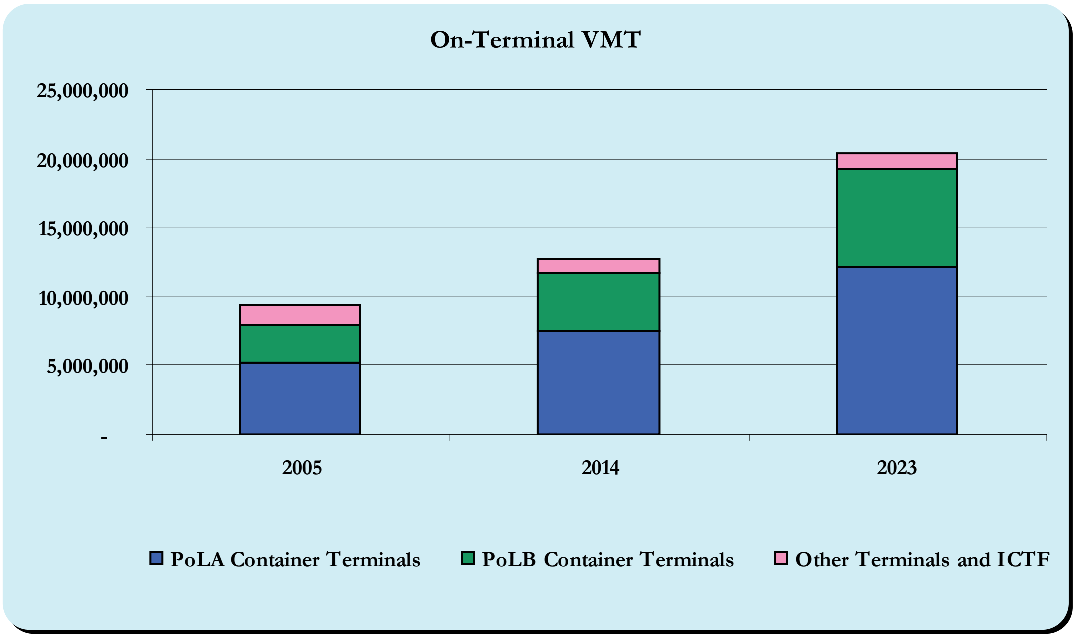


Table 6.5: San Pedro Bay Ports On-Terminal VMT

	2005	2014	2023
PoLA Container Terminals	5,188,764	7,521,509	12,105,673
PoLB Container Terminals	2,768,198	4,113,594	7,142,948
Other Terminals and ICTF	1,472,353	1,065,763	1,081,206
Total	9,429,315	12,700,866	20,329,828

Figure 6.5: San Pedro Bay Ports On-Terminal VMT



6.4 On-Port and Regional Activity Forecasting Methodology

The composite emission factors used in the heavy-duty diesel truck forecast are from the current version of CARB's EMFAC model (EMFAC 2007 Version 2.3 November 1, 2006). The model was run for calendar years 2014 and 2023 for the South Coast Air Basin under "Summer" conditions in model-year-specific five-mile-per-hour speed increments. The emissions for each speed increment and model year, in tons per day, were divided by the EMFAC model's internal VMT assumptions for that speed and year to calculate a model-year-specific gram-per-mile emission rate (with the appropriate conversion of tons to grams). The published low idle emission rates from the EMFAC 2007 documentation were used for the on-terminal estimates rather than the model output because the idle emission rates as a function of time are not readily retrievable from the output.

The model year specific emission rates were then weighted according to the calendar year specific population distribution which conforms to CARB and CAAP fleet requirements to derive a single set of composite emission rates by pollutant and speed.

The on-port and regional activity estimates were provided for the forecast years by Iteris from their travel demand model - examples of the on-port and regional modeling outputs are provided below.

Table 6.6: Example of On-Port Model Output

(this would be associated with a specific terminal's trucks over one of the four daily time periods)

Roadway Segment	From	To	Direction	Speed (MPH)	Direction	Bobtails	Chassis	Containers	Distance (Miles)	Speed (MPH)
Anaheim St	Anaheim Way	9th St	East Bound	35	Westbound	3	-	-	0.36	35
Anaheim St	9th St	Jackson	East Bound	35	Westbound	2	-	-	0.26	35
Anaheim St	Santa Fe	Canal	East Bound	35	Westbound	2	-	-	0.19	35
Anaheim St	Canal	Caspian	East Bound	35	Westbound	2	-	-	0.19	35
Anaheim St	Harbor Ave	I-710 SB ramp	East Bound	33	Westbound	2	-	-	0.05	33
New Dock St	Henry Ford	SR-47 Off Ramp	East Bound	15	Westbound	3	-	-	0.23	15
New Dock St	SR-47 Off Ramp	SR-47 On Ramp	East Bound	15	Westbound	3	-	-	0.11	15

The on-port activity files estimate the traffic volumes and speeds for approximately 350 roadway segments on the ports of Los Angeles and Long Beach for truck traffic associated with each terminal. Volumes and speeds are reported for each segment for each terminal in each direction. Separate volume estimates are made for bobtail, chassis and container trucks. The activity estimates are made for four daily periods: AM, mid-day, PM and night.

The vehicle miles traveled on each roadway segment are estimated by summing the number of trucks in each category and multiplying the total by the length of the roadway segment. The total VMT is calculated by summing all of the roadway segment VMTs.

Example:

Bobtails	Chassis	Containers	Miles
10	12	200	0.25

Segment volume = 222 trucks (bobtails + chassis + containers)
Segment VMT = 56 VMT (trucks * miles)

Although the speed traveled on each roadway segment is reported as a model output, the aggregate speed for each terminal's trucks and each time period was estimated by weighting each roadway segment's speed by the percentage of the VMT assumed to occur on that roadway. Once the average speed and overall VMT are estimated, the corresponding emission rate is used to derive the tons of emissions per time period associated with each terminal's activity. A lookup function is used to choose the speed-specific emission factor based on the next-lower speed. For example, the average speed of 33 mph in the table above would return the emission factor for 30 mph. The 35 mph speeds would return the emission factor for 35 mph.

Speed	NOx, g/mile	
25	7.98	
30	7.20	valid between 30 mph and 35 mph (less than 35)
35	6.59	valid between 35 mph and 40 mph (less than 40)
40	6.03	

Calculation:

Tons per period = Total VMT * Composite Emission Factor (at average speed) / 453.59 g/lb * 2,000 lbs/ton
Tons per period = 7,500 VMT * 7.20 g/mile / 453.59 g/lb * 2000 lbs/ton = 0.06 tons per period.

The emissions for each period and each terminal are summed to arrive at the ton-per-day total.

6.5 Regional (Off-port)

The emissions associated with regional (off-port) travel are calculated in a manner similar to that of the on-port estimate. The output of the travel demand model for regional travel consists of some 92,000 segments for each of the four daily periods (AM, Mid-day, PM and night). The distance of each segment is reported as a model output and the traveled speed is estimated using distance and time fields in the data file and the following equation:

Roadway Segment Speed = Distance (miles)/ time (mins)/60 (mins/hr) = Miles/Hour

As with the on-port emissions estimate, the roadway segment VMT was calculated by summing the number of trucks in each classification (bobtail, chassis and container) and multiplying the total by the length of the corresponding segment. The total VMT was derived by summing the VMT of all roadway segments and the average speed is estimated by weighting the individual roadway segment speeds by the fraction of the overall VMT on that roadway segment. The emissions in tons per time period were derived by applying the composite emission factor that corresponds to the VMT weighted speed to the overall VMT.

Calculation:

Regional emissions per period =
VMT per period * Composite Emission Factor (at average speed) / 453.59 g/lb*2000 lbs/ton

The emissions estimated for the four periods were added together to derive the daily emissions.

6.6 Forecast Emissions

The emissions forecast for 2014 and 2023 using the methods described above are summarized in the following two tables. After these summary tables, additional tables and charts present the information developed from the container throughput forecasts and mode split assumptions discussed above. The tables and charts show the projected numbers of containers to be moved by truck either to local destinations or to off-dock rail yards (i.e., all container throughputs other than containers to be shipped via on-dock rail).

Table 6.7: 2005 Estimated Emissions

2005	Annual Gate Moves	Total Hours Idling	Total Miles	HC tpy Running	HC tpy Idle	HC tpy Total	CO tpy Running	CO tpy Idle	CO tpy Total	NOx tpy Running	NOx tpy Idle	NOx tpy Total	PM tpy Running	PM tpy Idle	PM tpy Total	SOx tpy Running	SOx tpy Idle	SOx tpy Total
On-Terminal Emissions																		
Container																		
Port of Los Angeles	4,179,330	2,292,414	5,188,764	59	29	**88**	134	52	**186**	206	204	**410**	19.33	9.87	**29**	0.93	2.18	**3.11**
Port of Long Beach	3,967,832	3,759,192	2,768,198	53	48	**101**	89	86	**175**	158	334	**492**	14.78	5.27	**20**	0.5	3.57	**4.07**
Non-Container																		
POLA + POLB	2,068,283	819,918	1,472,353	13	10	**23**	33	19	**52**	53	73	**126**	4.57	2.80	**7**	0.26	0.78	**1.04**
Subtotal	10,215,445	6,871,524	9,429,315			**213**			**414**			**1,027**			**57**	1.69	6.53	**8.22**
On-Port On-Road Emissions																		
Container																		
Port of Los Angeles			24,270,410	62		**62**	284		**284**	665		**665**	36.05		**36**	4.36	0	**4.36**
Port of Long Beach			27,987,817	99		**99**	378		**378**	813		**813**	48.27		**48**	5.03	0	**5.03**
Non-Container																		
POLA + POLB			2,367,307	10		**10**	41		**41**	93		**93**	5.24		**5**	0.43	0	**0.43**
Subtotal			54,625,534			**172**			**704**			**1,571**			**90**	9.82	0	**9.82**
Regional Emisions																		
POLA + POLB			425,346,508	572		**572**	3,267		**3,267**	9,580		**9,580**	404.35		**404**	76.45	0	**76.45**
TOTAL	10,215,445	6,871,524	489,401,357	870	87	**957**	4,228	157	**4,385**	11,568	611	**12,179**	533	18	**551**	87.96	6.53	**94.49**

Table 6.8: 2014 Forecast Emissions

2014	Annual Gate Moves	Total Hours Idling	Total Miles	HC tpy Running	HC tpy Idle	HC tpy Total	CO tpy Running	CO tpy Idle	CO tpy Total	NOx tpy Running	NOx tpy Idle	NOx tpy Total	PM tpy Running	PM tpy Idle	PM tpy Total	SOx tpy Running	SOx tpy Idle	SOx tpy Total
On-Terminal Emissions																		
Container																		
Port of Los Angeles	6,090,289	2,830,365	7,521,509	21	19	**40**	46	52	**98**	113	298	**411**	0.78	0.22	**1**	0.15	0.31	**0.46**
Port of Long Beach	5,628,843	4,001,841	4,113,594	20	26	**47**	41	73	**114**	81	421	**502**	0.47	0.32	**1**	0.08	0.44	**0.52**
Non-Container																		
POLA + POLB	2,081,153	786,739	1,065,763	2	5	**7**	5	14	**20**	14	83	**97**	0.10	0.06	**0**	0.02	0.09	**0.11**
Subtotal	13,800,285	7,618,944	12,700,866			**94**			**231**			**1,010**			**2**	0.25	0.84	**1.09**
On-Port On-Road Emissions																		
Container																		
Port of Los Angeles			34,357,077	22		**22**	80		**80**	265		**265**	3.11		**3**	0.71	0	**0.71**
Port of Long Beach			51,399,096	37		**37**	126		**126**	417		**417**	4.60		**5**	1.06	0	**1.06**
Non-Container																		
POLA + POLB			2,367,307	1		**2**	5		**5**	17		**17**	0.21		**0**	0.05	0	**0.05**
Subtotal			88,123,480			**61**			**211**			**699**			**8**	1.82	0	**1.82**
Regional Emisions																		
POLA + POLB			601,170,480	237		**237**	1,373		**1,373**	3,667		**3,667**	71.97		**72**	12.37	0	**12.37**
TOTAL	13,800,285	7,618,944	701,994,826	342	50	**392**	1,676	139	**1,815**	4,574	802	**5,376**	81	1	**82**	14.44	0.84	**15.28**

Table 6.9: 2023 Forecast Emissions

2023	Annual	Total	Total	HC tpy			CO tpy			NOx tpy			PM tpy			SOx tpy		
	Gate Moves	Hours Idling	Miles	Running	Idle	Total	Running	Idle	Total	Running	Idle	Total	Running	Idle	Total	Running	Idle	Total
On-Terminal Emissions																		
Container																		
Port of Los Angeles	9,565,977	4,566,527	12,105,673	25	30	**55**	53	84	**137**	117	481	**597**	1.27	0.36	**2**	0.25	0.5	**0.75**
Port of Long Beach	9,939,841	7,229,621	7,142,948	27	48	**74**	53	132	**185**	94	761	**855**	0.86	0.57	**1**	0.15	0.79	**0.94**
Non-Container																		
POLA + POLB	2,188,751	753,735	1,081,206	1	5	**6**	3	14	**17**	9	79	**88**	0.10	0.06	**0**	0.02	0.08	**0.1**
Subtotal	21,694,569	12,549,883	20,329,828			**135**			**339**			**1,540**			**3**	0.42	1.37	**1.79**
On-Port On-Road Emissions																		
Container																		
Port of Los Angeles			55,981,788	24		**24**	88		**88**	256		**256**	4.69		**5**	1.17	0	**1.17**
Port of Long Beach			87,117,614	43		**43**	147		**147**	436		**436**	7.54		**8**	1.83	0	**1.83**
Non-Container																		
POLA + POLB			2,579,817	1		**1**	4		**4**	12		**12**	0.23		**0**	0.05	0	**0.05**
Subtotal			145,679,219			**68**			**239**			**704**			**12**	3.05	0	**3.05**
Regional Emisions																		
POLA + POLB			806,350,493	259		**259**	1,309		**1,309**	3,310		**3,310**	86.45		**86**	16.91	0	**16.91**
TOTAL	21,694,569	12,549,883	972,359,539	379	83	**462**	1,658	230	**1,888**	4,233	1,321	**5,554**	101	1	**102**	20.38	1.37	**21.75**

Table 6.10: Port of Long Beach Container Moves by Truck

Container Moves by Truck	2005	2014	2023
Local destinations	2,516,539	4,434,220	7,247,157
Off-dock rail yards	726,376	819,606	1,803,912
Total	**3,242,914**	**5,253,825**	**9,051,069**

Table 6.11: Port of Los Angeles Container Moves by Truck

Container Moves by Truck	2005	2014	2023
Local destinations	2,600,931	4,946,317	7,985,643
Off-dock rail yards	645,659	699,969	2,135,021
Total	**3,246,590**	**5,646,286**	**10,120,664**

Table 6.12: San Pedro Bay Ports Container Moves by Truck

Container Moves by Truck	2005	2014	2023
Local destinations	5,117,470	9,380,537	15,232,800
Off-dock rail yards	1,372,035	1,519,574	3,938,933
Total	**6,489,505**	**10,900,111**	**19,171,733**

Figure 6.6: Port of Long Beach Container Moves by Truck

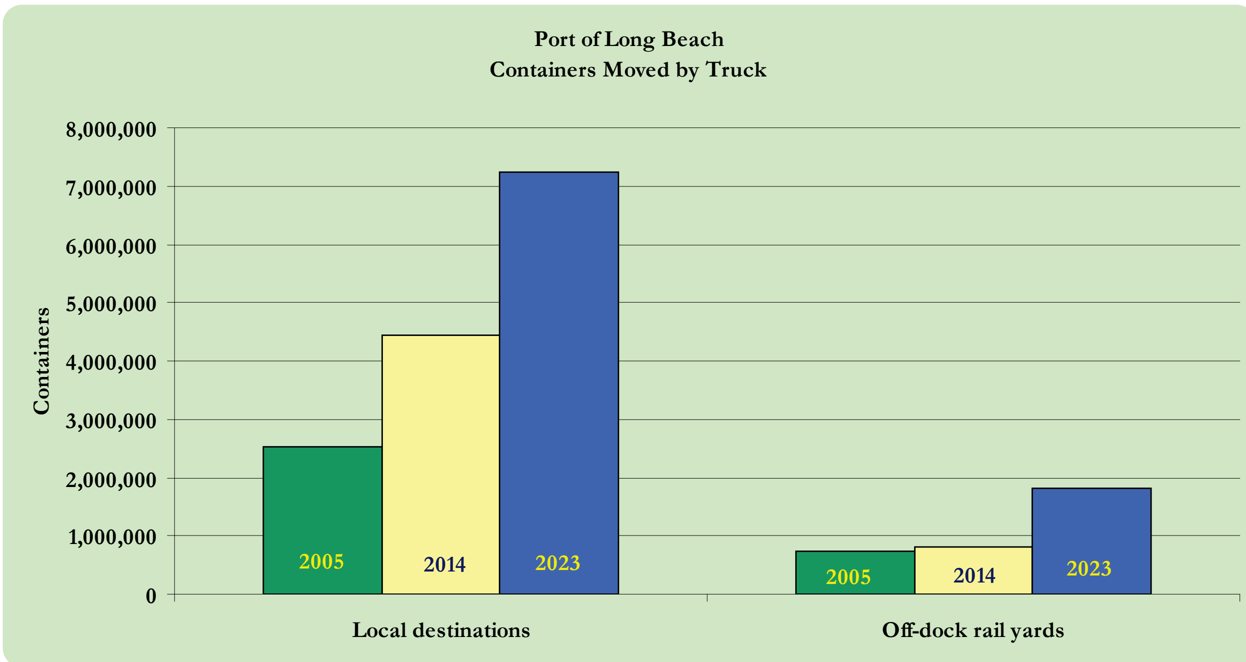


Figure 6.7: Port of Los Angeles Container Moves by Truck

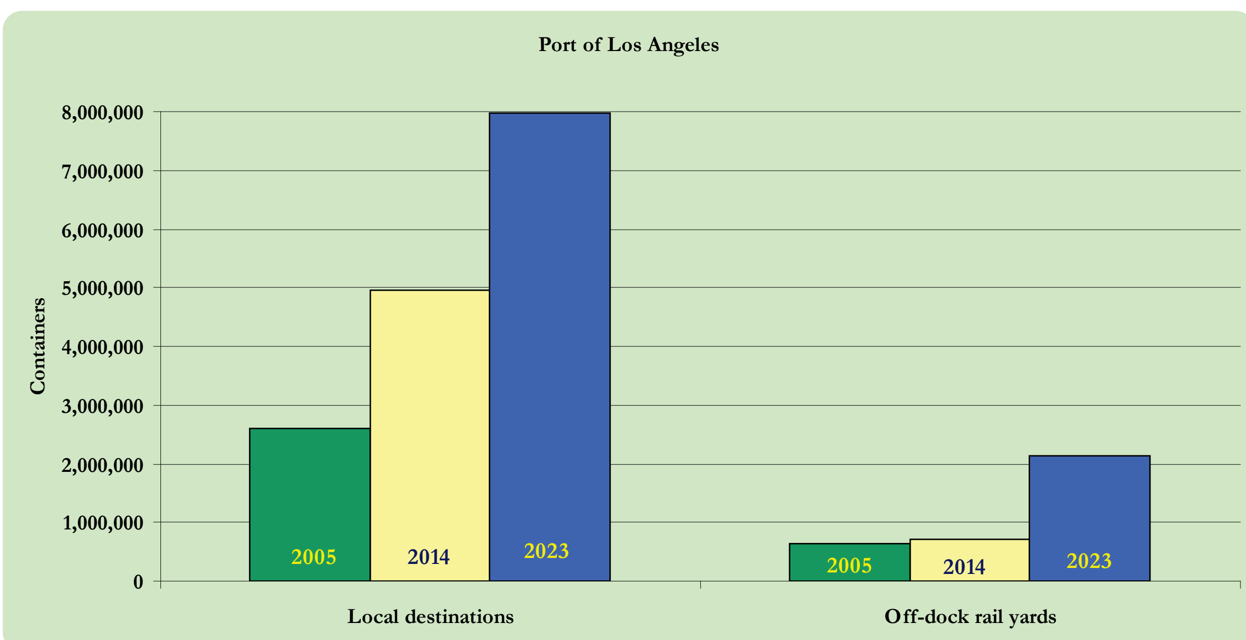
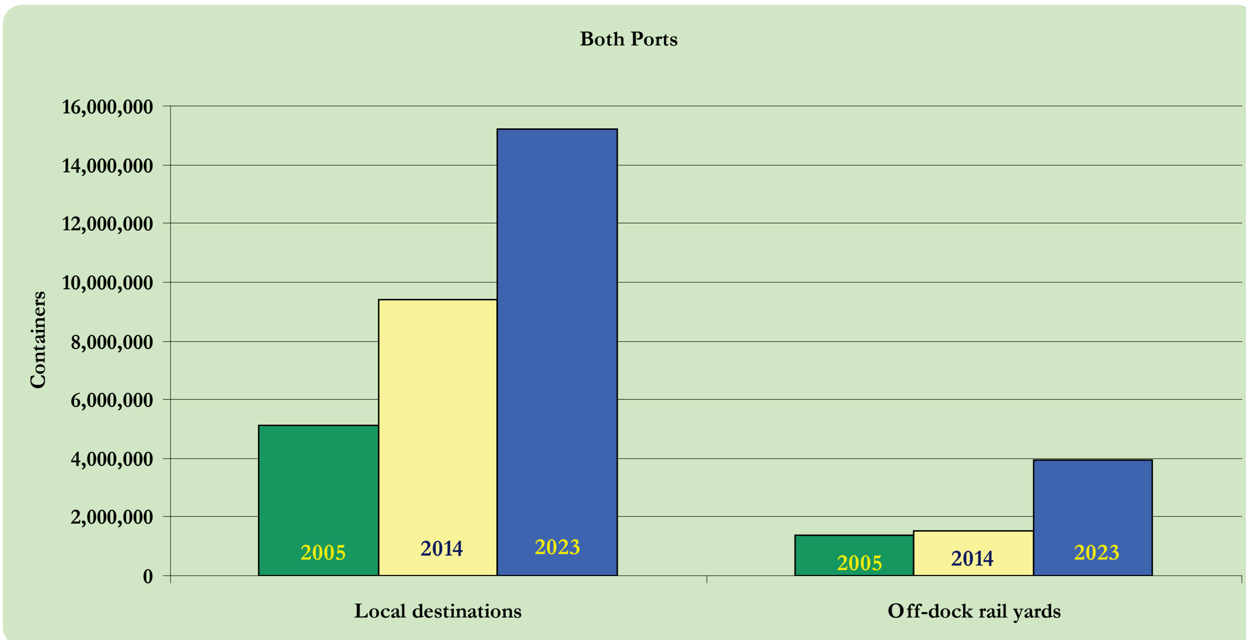


Figure 6.8: San Pedro Bay Ports Container Moves by Truck



SECTION 7.0 RAIL EMISSIONS FORECASTING METHODOLOGY

The rail emission forecasts for the Ports of Long Beach and Los Angeles are based upon the emission estimates developed for the published 2005 emissions inventories for each port and on cargo throughput increases forecast for the ports. The increases were used to develop growth factors that were multiplied by the 2005 emission estimates to develop "uncontrolled" emission estimates for 2014 and 2023. These uncontrolled estimates were adjusted to account for the effect of a cleaner locomotive fleet in the forecast years than in 2005.

Table 7.1: POLA 2005 Emissions in tpy

	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	TOG
On-port switching	6.3	5.8	6.3	296.1	1.6	30.8	16.7
On-port line haul	16.2	14.9	16.2	464.6	31.1	67.4	25.9
Off-port switching	1.8	1.7	1.8	71.1	0.4	7.5	4.4
Off-port line haul	33.1	30.5	33.1	951.6	63.7	138.2	53.1
Total	57.5	52.9	57.5	1,783.5	96.8	243.9	100.2

Table 7.2: POLB 2005 Emissions in tpy

	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	TOG
On-port switching	2.9	2.6	2.9	134.4	0.5	13.9	7.6
On-port line haul	11.5	10.6	11.5	331.4	22.2	48.1	18.5
Off-port switching	1.5	1.4	1.5	58.2	0.3	6.1	3.6
Off-port line haul	27.5	25.3	27.5	789.7	52.8	114.6	44.1
Total	43.4	39.9	43.4	1,313.6	75.9	182.8	73.8

7.1 Activity Growth Assumptions

Assumptions about the growth in rail activity were drawn from port-wide TEU throughput growth assumptions (previously distributed) and from truck/rail mode splits developed by the ports and used in the QuickTrip terminal throughput model.

Total annual containers x on-dock mode split (%) = on-dock rail containers.

Example:

7,494,420 containers multiplied by 25% on-dock rail = 1,848,134 containers by on-dock rail

The estimated numbers of containers moved by rail from on-dock rail yards and from the near-port rail yard on POLA property (ICTF) are presented in the following tables. Because the splits between each port to the ICTF versus the other off-port rail yards is not known, the ICTF throughput was divided equally between each port for each year. The summary information for both ports is depicted graphically in the figure following the tables.

Table 7.3: Port of Long Beach Container Moves by Rail

Container Moves by Rail	2005	2014	2023
On-dock rail	493,013	1,464,689	1,929,472
Off-dock rail (ICTF)	300,375	389,000	389,000
Total	**793,388**	**1,853,689**	**2,318,472**

Table 7.4: Port of Los Angeles Container Moves by Rail

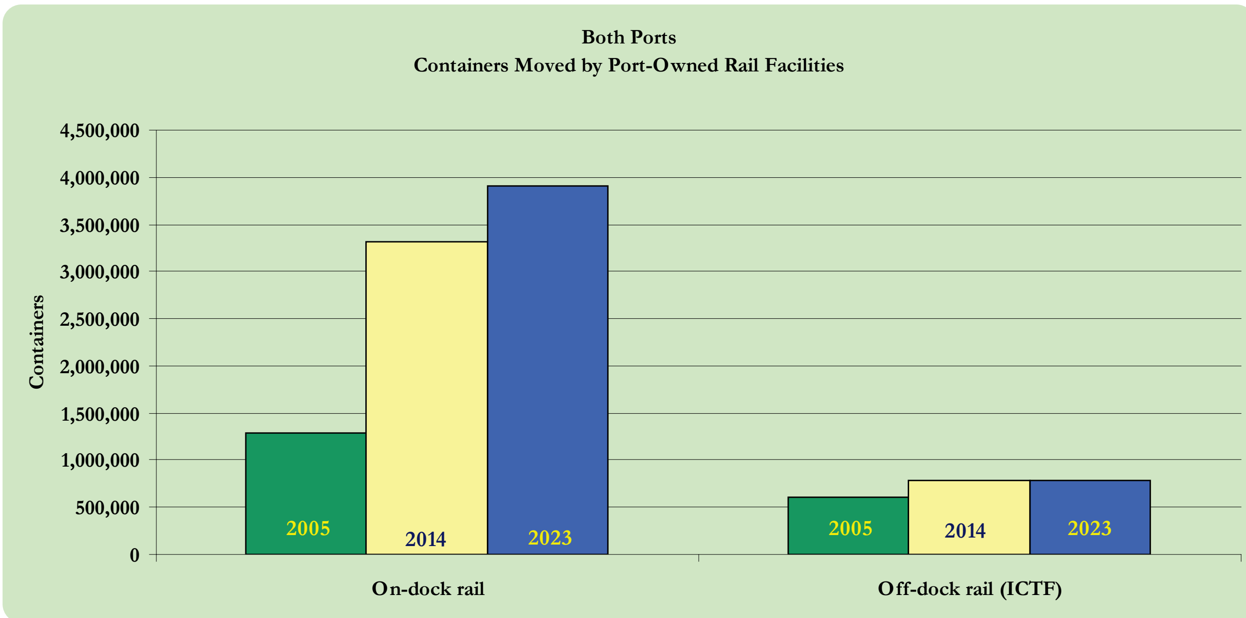
Container Moves by Rail	2005	2014	2023
On-dock rail	792,123	1,848,134	1,978,795
Off-dock rail (ICTF)	300,375	389,000	389,000
Total	**1,092,498**	**2,237,134**	**2,367,795**

Table 7.5: San Pedro Bay Ports Container Moves by Rail

Container Moves by Rail	2005	2014	2023
On-dock rail	1,285,136	3,312,823	3,908,267
Off-dock rail (ICTF)	600,750	778,000	778,000
Total	**1,885,886**	**4,090,823**	**4,686,267**

It has been noted that the total ICTF throughput ascribed to 2005 in Table 7.5 is lower than the value used in developing the 2005 emission estimates. This is because the number used for the 2005 estimates inadvertently included containers moved by the same railroad but at other (non-port) locations.

Figure 7.1: San Pedro Bay Ports Container Moves by Rail



The projected changes in rail activity between 2005 and 2014 and between 2005 and 2023 were used to develop growth factors applied to 2005 emission estimates.

2014 # of containers / 2005 # of containers = 2005 to 2014 growth factor

Example:

3,312,823 containers in 2014 / 1,285,136 containers in 2005 = 2.58 growth factor for 2005 to 2014

Growth factors were developed for two categories of rail activity – on-dock rail and off-dock rail (limited to the off-dock rail yard located on POLA property). The on-dock rail growth will affect the activity growth of on-port line haul and switching, and will be a component of off-port line haul activity, because the trains that originate or terminate on-port travel off-port through the air basin;. The off-dock rail growth will affect off-port (ICTF) switching and will also be a component of off-port line haul activity growth. The off-port switching growth was estimated by comparing the actual 2005 ICTF throughput with its current capacity, which it is expected to reach before the 2014 forecast year. This assumes that increases in off-dock rail beyond the current capacity of the ICTF will be allocated to existing or future off-port rail yards, and the transportation between the ports and these off-port locations is reflected in the on-road truck activity projections.

Table 7.6: Container Related Growth Factors Relative to 2005

Port / Rail Component	2005	'05 - '14	'05 - '23
POLA On-Port Line Haul & Switching	1.00	2.33	2.50
POLB On-Port Line Haul & Switching	1.00	2.97	3.91
Off-Port Switching	1.00	1.30	1.30
POLA On-Dock & ICTF	1.00	2.05	2.17
POLB On-Dock & ICTF	1.00	2.34	2.92

Most of the growth associated with port rail activity will be related to container throughput, and the growth discussed above is based on anticipated container traffic. However, non-container freight is also a component of Port rail operations, so the container-related growth factors were adjusted to account for the non-container component. This was done according to the ratio of container to non-container trains in 2005 and the projected changes in non-container freight tonnages that were used to forecast changes in non-container OGV traffic. Specifically, the forecasts for liquid and dry bulk, general cargo, break bulk, and automobiles were used to develop non-container rail growth projections.

The 2005 line haul railroad emission estimates were based on a rail volume equivalent to approximately 32 trains per day. The port switching railroad PHL has reported that they assembled on average one non-container train per day. If one outbound and one inbound non-container train per day are assumed, then the non-container traffic was equal to approximately 6% of the container traffic in 2005 (2 / 32 = 0.06). This relationship will not continue into the future, however, because container throughput is anticipated to increase at a greater rate than non-container throughput. To take this into account, the differences between container growth and non-container growth in 2014 and 2023 were applied to the 6% difference in 2005 to produce an estimate of the fraction that non-container traffic will be of container traffic in 2014 and 2023. The table below illustrates the results of this process for the periods 2005 to 2014 and 2005 to 2023. For example, the '05-to-'14 non-container growth divided by the '05-to-'14 container growth is 0.55, meaning the non-container growth will be approximately half that of container growth. Multiplying this fraction by the 6% non-container/container ratio in 2005 projects that non-container traffic will be approximately 3% of container traffic in 2014. The same ratio is obtained for 2023.

Table 7.7: Adjustment for Non-Container Fraction of Container Activity Increases

Growth Measure	05 - '14	05 - '23
Non-container growth	1.43	1.65
On-dock rail growth	2.58	3.04
Non-container growth relative to containers	0.55	0.54
Percentage relative to 6% in '05	3%	3%

The 3% result was used to adjust the projected container-based growth factors to take into account the different projected growth rates of container and non-container activity. This was done in three ways for different components of Port rail activity. For on-port line haul activity, the 3% was added to the growth factor to account for the additional activity represented by the non-container activity over the projected container activity, because the 2005 activity data was based on containers and did not include the non-container component. For on-port switching, however, because the activity estimates underlying the 2005 emission estimates included non-container as well as container activity (i.e., were based on all of PHL's switching activity), the 3% was subtracted from the growth factors since the growth in combined container and non-container activity will not be as great as container activity alone. The third growth factor to be adjusted was the off-port rail activity factor. The off-port rail activity includes both on-dock rail (once it leaves the port) and off-dock (ICTF) container traffic. The ICTF portion of off-port rail will not be affected by the differential growth rates between container and non-container activity because only containers are handled at that facility, so the 3% non-container adjustment was reduced to account for the on-port/off-port split to approximately 2%. The final growth factors representing container and non-container growth are presented in the following table.

Table 7.8: Container and Non-Container Related Growth Factors Relative to 2005

Port / Rail Component	2005	'05 - '14	'05 - '23
POLA On-Port Switching	1.00	2.30	2.47
POLB On-Port Switching	1.00	2.94	3.88
POLA On-Port Line Haul	1.00	2.36	2.53
POLB On-Port-Line Haul	1.00	3.00	3.94
Off-Port Switching	1.00	1.30	1.30
POLA Off-port line haul	1.00	2.08	2.20
POLB Off-port line haul	1.00	2.37	2.95

The growth factors listed above were multiplied by the 2005 emission estimates to develop "uncontrolled" emission estimates for 2014 and 2023, as listed below. These estimates include only the effects of growth and do not include the effects of any emission reduction programs."

Table 7.9: 2014 Emission Estimates Adjusted for Activity Changes

		PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	TOG
On-port switching	POLA	14.6	13.4	14.6	680.3	3.6	70.7	38.3
	POLB	8.4	7.8	8.4	394.6	1.5	41.0	22.2
	Total	23.0	21.2	23.0	1,074.8	5.1	111.6	60.5
On-port line haul	POLA	38.2	35.2	38.2	1,097.8	73.5	159.4	61.3
	POLB	34.7	31.9	34.7	995.2	66.6	144.5	55.6
	Total	72.9	67.1	72.9	2,093.0	140.1	303.9	116.9
Off-port switching	POLA	2.3	2.2	2.3	92.4	0.5	9.7	5.7
	POLB	1.9	1.8	1.9	75.6	0.4	8.0	4.7
	Total	4.3	3.9	4.3	168.1	1.0	17.7	10.4
Off-port line haul	POLA	68.9	63.3	68.9	1,976.8	132.3	287.0	110.4
	POLB	65.1	59.9	65.1	1,868.4	125.0	271.2	104.3
	Total	133.9	123.2	133.9	3,845.2	257.3	558.2	214.7

Table 7.10: 2023 Emission Estimates Adjusted for Activity Changes

		PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	TOG
On-port switching	POLA	15.7	14.4	15.7	730.9	3.9	76.0	41.2
	POLB	11.1	10.3	11.1	521.0	1.9	54.1	29.3
	Total	26.8	24.7	26.8	1,251.9	5.9	130.0	70.5
On-port line haul	POLA	41.0	37.7	41.0	1,176.3	78.7	170.8	65.7
	POLB	45.5	41.9	45.5	1,306.4	87.4	189.7	73.0
	Total	86.5	79.6	86.5	2,482.7	166.1	360.4	138.6
Off-port switching	POLA	2.3	2.2	2.3	92.4	0.5	9.7	5.7
	POLB	1.9	1.8	1.9	75.6	0.4	8.0	4.7
	Total	4.3	3.9	4.3	168.1	1.0	17.7	10.4
Off-port line haul	POLA	72.8	67.0	72.8	2,090.5	139.9	303.5	116.7
	POLB	81.0	74.6	81.0	2,326.8	155.7	337.8	129.9
	Total	153.9	141.5	153.9	4,417.4	295.6	641.3	246.7

7.2 Emission Factors

The growth adjusted uncontrolled emissions were adjusted to account for the effect of a cleaner locomotive fleet in the forecast years than in 2005. This was done by developing control factors based on the difference between the emission factors used for the 2005 emission estimates and the anticipated emissions from the fleets in operation in the forecast years. The following section addresses the 2005 and future emission factors.

7.2.1 Line Haul Locomotives (2005)

Emission factors in g/hp-hr from EPA's Regulatory Support Document, 2005 line haul fleet average emission factors from http://www.epa.gov/oms/locomotv.htm, spreadsheet: locorsd.wk3, tab H (this file has been converted to Microsoft® Excel® format and will be distributed with this write-up).

NO_x, g/hp-hr	PM, g/hp-hr		NO_x, g/hp-hr	PM, g/hp-hr
8.817	0.307	shown in 2005 EI reports as:	8.82	0.31

Converted to grams/gallon using BSFC of 20.8 hp-hr/gal from EPA420-F-97-051 Locomotive Rule Technical Highlights, Dec. 1997, page 2 (copy attached).

NO_x, g/gal	PM, g/gal
183.7	6.4

For the 2005 EI emission estimates, these g/gal factors were multiplied by fuel use estimates to derive emission estimates.

7.2.2 Switching Locomotives (2005)

Off-Port (ICTF)

Emission factors in g/gal from EPA420-F-97-051 Locomotive Rule Technical Highlights, Dec. 1997, Table 3 – representing baseline in-use emission rates – chosen because the railroad did not provide fleet-specific information.

NO_x, g/gal	PM, g/gal
362	9.2

For the 2005 EI emission estimates, these g/gal factors were multiplied by fuel use estimates to derive emission estimates.

On-Port (PHL)
Developed lb/hr emission rates from EPA's notch-specific g/hp-hr switch engine emission rates (from locorsd.wk3 cited above, tab E) and PHL throttle notch frequency data. The process is documented in 2005 EIs, pages 163 – 169 in Port of Long Beach EI and pages 174 – 180 in Port of LA EI, and also in the 2002 Port of Long Beach EI and 2001 Port of LA EI summary is provided below:

Started with average g/hp-hr by notch from EPA switching locomotive rates (from locorsd.wk3, tab E):

Table 7.11: Horsepower-Based Emission Factors from RSD, g/hp-hr

Notch	PM g/bhp-hr	NO_x g/bhp-hr
DB	1.05	40.20
Idle	2.26	77.70
1	0.29	16.63
2	0.37	12.26
3	0.34	13.09
4	0.26	14.27
5	0.24	15.10
6	0.29	15.88
7	0.25	16.37
8	0.29	16.15

Converted these to hourly notch-specific rates using estimate of the average in-use notch-specific horsepower of PHL fleet.(The notch-specific horsepower was estimated by comparing the average rated horsepower of PHL locomotives with the average rated power of the switching locomotives EPA included in their data, and the average power-in-notch reported by EPA – see below.)

Equation: lb/hr = g/hp-hr * hp /453.6 g/lb

Table 7.12: Hourly Notch-Specific Emission Rates, lb/hr

Notch	Power in Notch, bhp	PM g/bhp-hr	PM lb/hr	NO_x g/bhp-hr	NO_x lb/hr
DB	81	1.05	0.19	40.20	7.18
Idle	17	2.26	0.08	77.70	2.91
1	101	0.29	0.06	16.63	3.70
2	304	0.37	0.25	12.26	8.22
3	596	0.34	0.44	13.09	17.20
4	900	0.26	0.51	14.27	28.32
5	1,229	0.24	0.64	15.10	40.92
6	1,554	0.29	0.98	15.88	54.40
7	1,923	0.25	1.08	16.37	69.41
8	2,258	0.29	1.42	16.15	80.38

Then the notch-specific emission rates were combined with the PHL-specific throttle notch data to estimate the weighted average lb/hr emission rates.
Equation: lb/hr = ∑ wt'd avg % time in mode * lb/hr

Table 7.13: Weighted Average Emission Rates, lb/hr

Notch	wt'd avg % time in mode	PM lb/hr	PM % x lb/hr	NO_x lb/hr	NO_x % x lb/hr
DB	0.0%	0.19	0.00	7.18	0.00
Idle	67.4%	0.08	0.05	2.91	1.96
1	5.9%	0.06	0.004	3.70	0.22
2	7.7%	0.25	0.02	8.22	0.63
3	6.7%	0.44	0.03	17.20	1.16
4	5.3%	0.51	0.03	28.32	1.49
5	3.0%	0.64	0.02	40.92	1.24
6	2.0%	0.98	0.02	54.40	1.11
7	0.9%	1.08	0.01	69.41	0.64
8	1.1%	1.42	0.02	80.38	0.88
Sum			**0.20**		**9.33**

These lb/hr factors were multiplied by annual PHL activity estimates (based on their switching schedule history) to derive emission estimates.

The average in-use notch-specific horsepower of the PHL fleet was estimated by comparing the average percent of full power in each notch of the locomotives in EPA's switch locomotive dataset with the average power rating of the PHL fleet.

EPA/RSD average rated hp: 1,750; PHL average rated hp: 2,144

Equations: % of avg. rated hp = RSD power in notch / RSD avg rated hp
Avg in-use power = % of average rated hp * PHL avg. rated hp

Table 7.14: Average In-Use Horsepower

Notch	RSD Power in Notch, bhp	% of Avg. Rated bhp	Avg. in-use Power, bhp
DB	67	3.8%	81
Idle	14	0.8%	17
1	83	4.7%	101
2	249	14.2%	304
3	487	27.8%	596
4	735	42.0%	900
5	1,002	57.3%	1,229
6	1,268	72.5%	1,554
7	1,570	89.7%	1,923
8	1,843	105.3%	2,258

7.3 Tier 2 Emission Factors (for forecast years)

7.3.1 Line Haul Locomotives

Tier 2 emission standards of 5.5 g/hp-hr for NO_x, 0.20 g/hp-hr for PM from Table 4-9 of EPA's Regulatory Support Document (April 1998) were used as future case emission factors based on the 1998 MOU between the Class 1 railroads and the California air Resources Board which requires Tier 2 average emission rates by 2010. However, since not all locomotives will necessarily be Tier 2 locomotives, the use of the lower in-use emission rates (also listed in Table 4-9 of the document) is not appropriate.

7.3.2 Switching Locomotives

Off-Port

The same Tier 2 emission standards have been used for off-port switching locomotives as for line haul because they are also covered under the MOU and will be part of the Tier 2 (5.5 g NO_x/hp-hr) averaging process.

On-Port

Tier 2 in-use emission rates for the switching duty cycle from Table 4-9 of EPA's Regulatory Support Document April 1998: NO_x – 7.3 g/hp-hr, PM – 0.19 g/hp-hr. These are the appropriate factors because the ports' MOU with the on-port switching railroad requires Tier 2 or better switching locomotives.

An additional measure that was factored into the emission control factors is the implementation of idling shut-down devices on switching and on-port line haul operations. The amount of reduction, 9% reduction of PM and 8% reduction of NO_x, was estimated as part of the work of the No Net Increase Task Force. The reduction was not applied to off-port line haul emissions since once the trains leave the port they will be less likely to spend as much time idling.

The following example illustrates the control factor calculation for PM emissions from line haul locomotives with 2005 emissions of 0.31 g/hp-hr and 2014 (Tier 2 standard) emissions of 0.20 g/hp-hr.

% rdx = (0.31 – 0.20) / 0.31 = 0.35 or 35% reduction without idle limiters (off-port)
Corresponding control factor is 1 – 0.35 = 0.65

% rdx = (0.31 – (0.20 * (1 - 0.9))) / 0.31 = 0.41, or 41% reduction with idle limiters (on-port)
Corresponding control factor is 1 – 0.41 = 0.59

The following tables detail the percent reductions and control factors for on- and off-port line haul and on-and off-port switching emissions.

Table 7.15: Line Haul Emission Reductions, 2005 to 2014

Line Haul	PM_{10}	NO_x	SO_x	CO	TOG
2005 EF, g/bhp-hr	0.31	8.82	0.59	1.28	0.49
Tier 2 standard, g/hp-hr	0.20	5.50	0.0046	1.50	0.30
% Rdx (off-port)	35%	38%	99%	-17%	39%
% Rdx with idle rdx (on-port)	41%	43%	99%	-17%	39%
Control factors (off-port)	0.65	0.62	0.01	1.17	0.61
Control factors (on-port)	0.59	0.57	0.01	1.17	0.61

Table 7.16: On-Port Switching Emission Reductions, 2005 to Tier 2

On-Port Switching	PM_{10}	NO_x	SO_x	CO	TOG
2005 EF, g/bhp-hr	0.38	17.63	0.09	1.83	0.87
Tier 2 in-use, g/hp-hr	0.19	7.30	0.0046	1.83	0.51
% Rdx	50%	59%	95%	0%	41%
% Rdx with idle rdx	54%	62%	95%	0%	41%
Control factors	0.46	0.38	0.05	1.00	0.59

Table 7.17: Off-Port Switching Emission Reductions, 2005 to Tier 2

Off-Port Switching	PM_{10}	NO_x	SO_x	CO	TOG
2005 EF, g/bhp-hr	0.44	17.40	0.09	1.83	1.01
Tier 2 line haul standard, g/hp-hr	0.20	5.50	0.0046	1.50	0.30
% Rdx	55%	68%	95%	18%	70%
% Rdx with idle rdx	59%	71%	95%	18%	70%
Control factors	0.41	0.29	0.05	0.82	0.30

7.3.3 Tier 3, Tier 4, and Rebuilds

Recently promulgated regulations will require that locomotive engines undergoing rebuild will be retrofit to meet lower emission standards than when they were new. The net effect of the requirements will be that, after rebuild, the locomotives will emit 50% less particulate matter than before. New Tier 3 locomotives manufactured in 2012 and later will also achieve 50% reduction in particulate matter. It is anticipated that, by 2023, all locomotives will have been either rebuilt to emit 50% of what they emitted before the rebuild or will have been replaced by Tier 3 locomotives, which will have half the particulate matter emissions of Tier 2 engines. As a result, the line haul emission forecast for 2023 has been reduced by an additional 50% to account for the effect of the new regulation. Although new Tier 4 locomotives (2015 and later) will provide additional reductions by 2023, if deployed, these reductions are not quantified at this time because of uncertainties in terms of the potential penetration level of Tier 4 locomotives serving the ports by 2023, the upcoming Tier 2 MOU requirements, and the long useful life of locomotives.

7.4 Forecast Emission Estimates

The 2005 emission estimates adjusted for activity changes presented above were further adjusted for locomotive emission reductions using the control factors immediately above. The ton-per-year value for each pollutant and activity category was multiplied by the corresponding control factor to arrive at the forecast emission estimate for the year and pollutant, as presented in the following tables.

Table 7.18: 2014 Port of Los Angeles Emission Estimates Adjusted For Activity and Controls

Activity Category	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	TOG
On-port switching	6.7	6.2	6.7	258.5	0.2	70.7	22.6
On-port line haul	22.6	20.8	22.6	625.7	0.7	186.5	37.4
Off-port switching	1.0	0.9	1.0	26.8	0.0	8.0	1.7
Off-port line haul	44.8	41.2	44.8	1,225.6	1.3	335.8	67.3
Total	75.0	69.0	75.0	2,136.7	2.3	600.9	129.1

Table 7.19: 2014 Port of Long Beach Emission Estimates Adjusted For Activity and Controls

Activity Category	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	TOG
On-port switching	3.9	3.6	3.9	149.9	0.1	41.0	13.1
On-port line haul	20.5	18.8	20.5	567.3	0.7	169.0	33.9
Off-port switching	0.8	0.7	0.8	21.9	0.0	6.5	1.4
Off-port line haul	42.3	38.9	42.3	1,158.4	1.3	317.4	63.6
Total	67.4	62.0	67.4	1,897.6	2.0	533.9	112.1

Table 7.20: 2023 Port of Los Angeles Emission Estimates Adjusted For Activity and Controls

Activity Category	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	TOG
On-port switching	7.2	6.6	7.2	277.7	0.2	76.0	24.3
On-port line haul	12.1	11.1	12.1	670.5	0.8	199.8	40.1
Off-port switching	1.0	0.9	1.0	26.8	0.0	8.0	1.7
Off-port line haul	23.7	21.8	23.7	1,296.1	1.4	355.1	71.2
Total	43.9	40.4	43.9	2,271.1	2.4	638.8	137.3

Table 7.21: 2023 Port of Long Beach Emission Estimates Adjusted For Activity and Controls

Activity Category	PM_{10}	$PM_{2.5}$	DPM	NO_x	SO_x	CO	TOG
On-port switching	5.1	4.7	5.1	198.0	0.1	54.1	17.3
On-port line haul	13.4	12.3	13.4	744.7	0.9	221.9	44.5
Off-port switching	0.8	0.7	0.8	21.9	0.0	6.5	1.4
Off-port line haul	26.3	24.2	26.3	1,442.6	1.6	395.2	79.3
Total	45.7	42.0	45.7	2,407.2	2.6	677.7	142.5

8.0 ADDENDUM - 2020 FORECAST EMISSION ESTIMATES (UPDATE AS OF AUGUST 2009)

The 2014 and 2023 controlled emissions discussed above became basis for San Pedro Bay Emissions Reduction Standards as outlined in "2009 Update San Pedro Bay Ports Clean Air Action Plan Technical Report". To compliment the CARB's Emission Reduction Plan, the ports of Long Beach and Los Angeles conducted further analysis for calendar year 2020. This analysis was done to assess both ports emissions reduction progress against CARB's Health Risk Reduction goal of 85% reduction in DPM emissions reduction relative to 2005 conditions.

Using the same methodology and emissions control regulation and CAAP control measures the following table shows 2020 controlled DPM emissions for the ports of Long Beach and Los Angeles.

As stated above, the growth factors and emissions control factors for 2020 are same as used for 2014 and 2023 with the following exceptions:

OGV5
Actual terminal lease renewal schedule for CY 2020 was used which is slightly different than for CY 2023.

HDV
The actual age distribution with Clean Truck Program implemented in 2020 was developed to estimate 2020 emissions estimates.

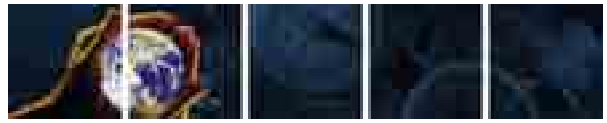
Locomotives
In 2020, it was assumed that line haul locomotives operating at the ports will be consisted of engines meeting 10% Tier 2 and 90% Tier 3 standards. For the 2023 emissions modeling, all line haul locomotives operating at the ports were assumed to be meeting on average Tier 3 standards.

Following table presents the DPM results of 2020 analysis:

Table 8.1: Controlled DPM Emissions Forecast (Tons Per Year)

	2005	2020
CHE	**DPM**	**DPM**
POLA	62	7
POLB	55	9
SPBP Total	**117**	**16**
HC		
POLA	38	20
POLB	30	15
SPBP Total	**68**	**36**
HDV		
POLA Container on terminal and on-port	65	8
POLB Container on terminal and on-port	68	10
POLA+POLB non Container	13	0
POLA+POLB Regional	404	102
SPBP Total	**551**	**120**
OGV		
POLA	552	120
POLB	637	136
SPBP Total	**1,189**	**256**
Rail		
POLA	58	46
POLB	43	46
SPBP Total	**101**	**92**
Grand SPBP Total (All 5 sources)	**2,025**	**520**
Overall % reduction from 2005	0%	74%

Appendix B: Final Bay-Wide Regional Human Health Risk Assessment Tool for Diesel Exhaust Particulate Matter (DPM)



BAY-WIDE REGIONAL HUMAN HEALTH RISK ASSESSMENT TOOL FOR DIESEL EXHAUST PARTICULATE MATTER (DPM)

Prepared for:
Port of Los Angeles and
the Port of Long Beach
Los Angeles, California
and Long Beach, California

Prepared by:
ENVIRON International Corporation
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Date:
December 14, 2009

Project Number:
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ENVIRON

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ACRONYMS and ABBREVIATIONS

AERMAP	AERMOD's Terrain Preprocessor
AERMET	AERMOD Meteorological Preprocessor
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
ARB	Air Resources Board
Basin	South Coast Air Basin
BWHRA	Bay-Wide Health Risk Assessment
CAAP	Clean Air Action Plan
Cal/EPA	California Environmental Protection Agency
CEQA	California Environmental Quality Act
CHE	Cargo Handling Equipment
COPC	Chemicals of Potential Concern
CSF	Cancer Slope Factor
DEM	Digital Elevation Maps
DPM	Diesel Exhaust Particulate Matter
HDV	Heavy-duty Vehicle
HRA	Health Risk Assessment
IARC	International Agency for Research on Cancer
ISCST3	Industrial Source Complex Short Term (Version 3) Air Dispersion Model
kg	Kilogram
km	Kilometer
L	Liter
m^3	Cubic Meter
mg	Milligram
µg	Microgram
NEPA	National Environmental Policy Act
NLCD	National Land Cover Dataset
NRC	National Research Council
NWS	National Weather Service
OEHHA	Office of Environmental Health Hazard Assessment
OGV	Ocean-going Vessels
POLA	Port of Los Angeles
POLB	Port of Long Beach
Ports	Port of Los Angeles and Port of Long Beach
PM	Particulate Matter
REL	Reference Exposure Level
SCAQMD	South Coast Air Quality Management District
SPPS	St. Peter and Paul School
Starcrest	Starcrest Consulting, LLC
TAC	Toxic Air Contaminants

TITP	Terminal Island Treatment Plant
TWG	Technical Working Group
USEPA	US Environmental Protection Agency
USGS	United States Geological Survey
WHO	World Health Organization

Executive Summary

In the San Pedro Bay Ports Clean Air Action Plan (CAAP 2006), the Port of Los Angeles and the Port of Long Beach (Ports) committed to develop goals and implement strategies that would substantially and constantly reduce emissions and public health risks from Ports-related mobile sources. These commitments were made in recognition of the Air Resources Board (ARB) statewide goal to reduce diesel-related health risks 85% by 2020 (ARB 2006a). As a means of characterizing reductions in public health impacts that could be achieved by implementation of CAAP commitments, and to understand the Ports progress towards meeting the CAAP Health Risk Reduction Standard, the Ports developed the Bay-Wide Health Risk Assessment (BWHRA) Tool. A key component in the development of the BWHRA Tool was preparation of a Bay-wide health risk assessment protocol (Protocol, Appendix A), developed in collaboration with the Technical Working Group (TWG) comprised of representatives from the Ports, United States Environmental Protection Agency (USEPA), ARB, and South Coast Air Quality Management District (SCAQMD). The Protocol identified cancer risk from diesel exhaust particulate matter (DPM) as the metric for characterizing cancer risk reductions achieved by implementation of Ports emission control strategies and current regulations, recognizing that cancer risk reductions are also a surrogate for reductions in other health effects. The ARB's exposure assessment of the Ports (ARB 2006b) served as the basis for the air dispersion modeling components of the Protocol. The Protocol also identified the methodologies to be followed in calculating exposure concentrations and cancer risk which are consistent with the guidance of the SCAQMD and California's Office of Environmental Health Hazard Assessment (OEHHA).

The selection of DPM-attributable cancer risk as the BWHRA Tool metric reflects the fact that DPM has been identified as the dominant contributor to state-wide cancer risks from airborne pollutants (ARB 2000). The ARB's exposure assessment of the Ports (ARB 2006b) also focused solely on DPM because of its potential to cause cancer and other health effects, and because cancer risks from DPM tend to be highest in areas with concentrated emissions, such as in areas impacted by the Ports. Notwithstanding the emphasis of the BWHRA Tool on DPM cancer risk, it is important to note that DPM emission control strategies that achieve cancer risk reductions will provide benefits towards reducing non-cancer health effects of DPM as well. Because diesel exhaust contributes particulate matter and other components to ambient air, DPM emission reduction strategies are also expected to reduce health impacts associated with small particulates (particulate matter with a diameter of 2.5 microns or less or $PM_{2.5}$) and to further attainment of the federal $PM_{2.5}$ standard in the South Coast Air Basin (Basin).

Methods

The BWHRA Tool consists of three major components: (1) the DPM emission inventory of the mobile equipment operating at the Ports, (2) air dispersion modeling, and (3) an assessment of cancer risks from exposure to airborne DPM. The DPM emission inventory provides an estimate of how much DPM is generated from different emission sources, while air dispersion modeling incorporates the emission inventory and meteorological data inputs into a computer model to predict concentrations of DPM in ambient air. Potential health risks from DPM were estimated for residential populations based on these modeled concentrations of DPM.

The BWHRA Tool utilized the Ports' DPM emission inventories for the baseline year of 2005 (Starcrest Consulting, LLC [Starcrest] 2007a,b) and forecast DPM emissions for 2020 (Starcrest 2008). The 2020 forecast emissions account for pre-recession Ports growth estimates, implementation of CAAP emission reduction strategies, and adopted regulations. DPM emission rates were developed for each of five source categories; heavy duty vehicles (HDV); railroad locomotives; harbor craft; ocean going vessels (OGV); and cargo handling equipment (CHE). The BWHRA Tool addressed emissions from these mobile sources within the Ports boundaries as well as over-water emissions from activities that occurred approximately 40 nautical miles from the coast. DPM emissions from HDVs on Interstates 110 and 710 and Highways 47 and 103 north to Interstate 405, as well as locomotives on the Alameda Corridor north to Interstate 405 were also included.

Air dispersion modeling was performed to estimate exposure concentrations from the environmental transport and distribution of DPM emissions from mobile sources at the Ports into the atmosphere. This modeling was performed in a manner consistent with ARB (2006b) with a few key modifications. First, AERMOD, the current USEPA approved state-of-the-art regulatory model was used instead of the older model used in ARB's study, ISCST3. Second, Port-specific meteorological data were used. Third, off-Port sources such as trucks and locomotives were modeled on major transportation corridors to I-405, which is farther than considered in the ARB assessment. The air dispersion modeling provided estimated ambient air concentrations of DPM within the same 20 by 20 mile modeling domain used by ARB. These concentrations were used along with standard exposure parameters and California's DPM cancer slope factor (CSF) to develop estimates of individual lifetime cancer risks above background, and population-weighted average lifetime cancer risks attributable to inhalation of DPM for residential populations in 2005 and 2020.

Results

Implementation of the CAAP and existing regulations are predicted to achieve widespread and significant reductions in individual cancer risk by 2020 throughout the BWHRA Tool modeling domain.

Between 2005 and 2020, residential cancer risks above 500 x 10^{-6} (500 in a million) are virtually eliminated from the zone around the Ports, with only small areas near Interstate 710 that still exceed this level. In 2005, estimated cancer risks between 251 and 500 x 10^{-6} (two hundred fifty one and five hundred in a million) impacted an extensive area around the Ports and major transportation corridors; by 2020, the zone that is affected by this level of risk is predicted to shrink dramatically, and is largely restricted to areas directly adjacent to transportation corridors and the Ports boundaries.

By 2020, these risk reductions exceed 75% in many areas, with risk reductions between 70 and 75% expected for the majority of the domain. For residents in communities within 2 kilometer (km) of the Ports boundaries, most individuals are expected to experience risk reductions of 70% or more by the year 2020. Approximately 10% of individuals are predicted to have risk reductions between 60 to 70%, and a small area is expected to have risk reductions between 50 and 60%. The areas with the lowest predicted cancer risk reductions, less than 50%, occur in commercially or industrially-zoned areas between the Ports that are not currently occupied by residents.

As a means of characterizing the population-based reduction in risk within both the BWHRA Tool modeling domain and highly impacted communities, population-weighted average cancer risks attributable to Ports DPM sources were also calculated. For the modeling domain overall, population-weighted average cancer risks for 2005 of 249×10^{-6} (249 in a million) are predicted to be reduced significantly by 2020 to 66×10^{-6} (66 in a million). This 74% decrease in risk is consistent with the domain-wide risk reductions calculated for individuals. For communities within 2 km of the Port boundaries, population-weighted average cancer risks for 2005 of 519×10^{-6} (519 in a million) are predicted to be reduced by 2020 to 143×10^{-6} (143 in a million), a 72% decrease in risk.

These predicted risk reductions for 2020 are directly attributable to the Ports' CAAP (2006) emission reduction strategies, implemented in combination with USEPA's and ARB's adopted regulations. Further, the Ports are committed to reviewing the CAAP on a regular basis, and to examine progress towards achieving the CAAP goals during these reviews. The CAAP reviews will focus on the need to adjust implementation strategies by incorporating newly-developed technologies or other available measures to ensure that the CAAP goals and Health Risk Standard[1] are achieved. By following this framework, the Ports expect to achieve significant reductions in risk, and to attain more than their 'fair share' of DPM emission reductions on a statewide basis (CAAP 2009).

[1] The Health Risk Reduction Standard for reducing overall port-related health risk impacts, relative to 2005 conditions is: By 2020, reduce the population-weighted cancer risk of ports-related DPM emissions by 85% in highly-impacted communities located proximate to port sources and throughout the residential areas in the port region (CAAP 2009).

1 Introduction

In the San Pedro Bay Ports Clean Air Action Plan (CAAP 2006), the Ports articulated diesel exhaust particulate matter (DPM) emissions and health risk reduction goals whose specific targets would be incorporated into the San Pedro Bay-wide Standards. The focus of the Health Risk Reduction Standard (Standard) was to identify a criterion to use for understanding and monitoring progress towards achieving the Ports commitment to expeditiously and constantly reduce public health risk associated with Ports-related mobile sources. To inform development of that Standard, the Ports developed the Bay-wide health risk assessment (BWHRA) Tool, whose methodologies and results are described in this report and supporting appendices. A key component in the development of the BWHRA Tool was preparation of a BWHRA protocol (Protocol, Appendix A). The Protocol was developed in collaboration with the Technical Working Group (TWG), comprised of representatives from the Ports, the California Air Resources Board (ARB), the United States Environmental Protection Agency (USEPA) and the South Coast Air Quality Management District (SCAQMD). The Protocol identified cancer risk from DPM as the metric for characterizing cancer risk reductions achieved by implementation of Ports emission control strategies and current regulations, recognizing that cancer risk reductions are a surrogate for reductions in DPM non-cancer health effects as well. The ARB's exposure assessment of the Ports (ARB 2006b) provided the basis for the air dispersion modeling components of the Protocol. The Protocol also identified methodologies to be followed in calculating exposure concentrations and cancer risk which are consistent with the guidance of the SCAQMD and California's Office of Environmental Health Hazard Assessment (OEHHA).

The focus of the BWHRA Tool on DPM reflects the fact that long-term exposure to air pollution in the South Coast Air Basin (Basin) has been linked to a number of serious health effects including impaired lung function and an increased incidence of asthma (ARB 2004a) and impaired lung development in children (Gauderman et al. 2007). Diesel exhaust contributes particulate matter (PM) and other components to air pollution, and ARB determined that DPM accounts for approximately 70% of California's estimated potential cancer risk from toxic air contaminants (TACs) based on its monitoring data (ARB 2000). The ARB's Exposure Assessment for the Ports focused solely on DPM because of its potential to cause cancer and other health effects, and because cancer risks from diesel exhaust tend to be highest in areas with concentrated emissions (ARB 2006a). Consistent with those facts, ARB's analysis identified elevated regional cancer risks associated with ports-related DPM emissions (ARB 2006a). These results, supplemented by recently-completed project analyses at the Ports (*e.g.,* Port of Los Angeles [POLA] 2007, 2008; and Port of Long Beach [POLB], 2009) indicate that DPM sources at the ports may be the most significant single contributor of any TAC to regional health effects. The ambient DPM concentrations in the vicinity of the Ports are below the State of California's current non-cancer reference exposure level (REL) (OEHHA & ARB 2009), and thus are lower than the level at which significant adverse non-cancer health effects would be anticipated. Therefore, the BWHRA Tool focuses solely on cancer risk estimation.

1.1 Objective

The objective of the BWHRA Tool was to prepare an exposure and risk assessment for Ports-related DPM sources in the baseline year 2005 relative to those estimated for forecasted DPM emissions from the Ports in 2020. These analyses were conducted to characterize the effectiveness of implementing current CAAP measures and adopted regulations, while providing an understanding of the overall progress of the Ports towards achieving the Standard. The year 2020 assessment includes assumptions of a 7.1% annual increase in growth of the Ports (*i.e.,* pre-recession rates of growth) in the years between 2005 and 2020 (Starcrest 2008), implementation of adopted regulations, and implementation of additional select control measures (CAAP 2006; Starcrest 2007a,b, 2008). These scenarios, the underlying assumptions, and emissions estimation methodologies were developed by Starcrest (2008) with the participation of staff of the Ports, the ARB, and the SCAQMD.

For diesel exhaust from goods movement in particular, the ARB has prepared a series of risk assessments, including human health risk assessments (HRAs) for a number of railyards (*e.g.,* ARB 2004b, 2007a,b), a human HRA for diesel emissions associated with the statewide goods movement system (ARB 2006b), and an evaluation of regional health risks posed by diesel emissions from the Ports (ARB 2006a). While the risk assessments prepared for the individual rail yards focused on local impacts, the risk assessments prepared as part of the Emission Reduction Plan for Ports and Goods Movement (ARB 2006b) and for the Ports (ARB 2006a) focused on sub-regional impacts. This BWHRA Tool also focuses on sub-regional, rather than local, impacts. Local impacts are addressed in the facility-specific risk assessments prepared with project-specific protocols by the Ports under the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) as part of the Ports' environmental programs. Since the BWHRA Tool is a sub-regional assessment that was specifically developed to support the CAAP health risk standard development, the methodologies of the BWHRA Tool have certain differences from specific guidance of state and local programs whose focus is on regulating single emission sources. In addition, due to the nature of the assessment, the BWHRA Tool utilized several technical approaches *e.g.,* analysis only of ports-related emission sources, use of fleet-average parameters to represent emission sources, and the generalization (grouping) of emission sources, that prevent the use of this tool to quantitatively assess project-specific cumulative risk under CEQA and NEPA.

Consistent with the Ports emissions inventories, and for comparability to ARB (2006a), the BWHRA Tool addresses mobile sources within the Ports' boundaries as well as over-water emissions. In addition, DPM emissions from trucks on major roadways (*i.e.,* Interstates 110 and 710 and Highways 47 and 103) and locomotives on the major rail line (*i.e.,* the Alameda Corridor) associated with Port operations - but outside the Ports' boundaries – were included. Based on an evaluation of meteorological data collected from stations in the vicinity of the Ports, the BWHRA Tool included out-of-port truck and locomotive DPM emissions over an area extending approximately to Interstate 405 (see Appendix A).[2]

1.2 Project Scope

The Port of Los Angeles and the Port of Long Beach are owned by the cities of Los Angeles and Long Beach, respectively, and are operated and managed under a State Tidelands Trust that grants local municipalities jurisdiction over ports. Collectively, the two Ports encompass approximately 10,700 acres and more than 50 miles of waterfront. The Ports build and lease the terminals, but do not operate the ships, CHE, trucks, harbor craft, and locomotives that support activities of the Ports tenants. The BWHRA Tool evaluates on-port mobile source emissions from the Port of Los Angeles and the Port of Long Beach, and their respective cargo terminals, passenger terminals, inter-modal rail facilities, and maritime support services. Port-related truck emissions on major freeways (*i.e.,* Interstates 110 and 710 and Highways 47 and 103) and locomotive emissions on the major rail line (*i.e.,* the Alameda Corridor) in the vicinity of the Ports and north to Interstate 405 were also considered in the BWHRA Tool. Over-water emissions from OGVs are also included for activities within 40 nautical miles off the coast of Los Angeles and Orange counties. The mobile source categories evaluated in this assessment include OGVs, harbor craft (*e.g.,* tugboats, ferries, commercial fishing vessels, etc.), off-road CHE, railroad locomotives, and on-road HDVs (see Section 3).

To facilitate comparisons with ARB's Exposure Assessment of the Ports (ARB 2006a), the BWHRA Tool assesses sub-regional impacts of DPM, and uses the same geographic area (domain) of air dispersion modeling for estimation of DPM exposure point concentrations as that used by ARB.

1.3 Methodology

This report provides the background to the analysis, and also describes the methodologies followed for the air dispersion modeling and human health risk assessment elements of the BWHRA Tool. These approaches were established in a health risk assessment Protocol reviewed by the TWG (Appendix A). Emissions estimation methodologies are described in separate documents prepared by Starcrest (2007 a,b, 2008) and reviewed by the TWG.

Like any risk assessment for chemicals emitted to air, the BWHRA includes estimation of air emissions, dispersion modeling to estimate exposure concentrations, and calculation of potential health risks associated with modeled exposure concentrations. The risk assessment methods used in the BWHRA Tool are based on the fundamental principles of human health risk assessment described by the National Research Council ([NRC] 1983, 1994). The risk assessment methods of the BWHRA Tool are also consistent with guidance of the California

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[2] The section of Interstate 110 between 223rd Street and Interstate 405 in northern Long Beach is not included in the analysis, as discussed in Appendix A.

Environmental Protection Agency (Cal/EPA), OEHHA (2003), the USEPA (2005a) and the SCAQMD (2003, 2005). These regulatory guidelines were developed to conform to the fundamental human HRA principles of the NRC (1983, 1994).

To foster comparability of the cancer risk estimates developed in this assessment with risk estimates from other analyses prepared for goods movement in California, the methods used in this BWHRA Tool are generally consistent with the risk assessment guidelines cited above - in particular with the ARB Hot Spots Guidance (OEHHA 2003). However, because those guidance documents were developed as part of specific regulatory programs that are not addressed by the BWHRA Tool, the detailed guidance in those documents is not necessarily consistent with the methodology and objectives of the BWHRA Tool sub-regional assessment.

For air dispersion modeling, the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) was used to estimate DPM exposure concentrations at off-site receptor locations. Air dispersion modeling with AERMOD follows a similar approach to that used by the ARB (2006b). Additional details of how the air modeling was performed are provided in Section 3 and in Appendices A and B.

The BWHRA Tool utilizes default exposure assumptions that are consistent with those recommended by OEHHA for screening-level (*i.e.,* Tier 1) assessments under the AB2588 Hot Spots program (OEHHA 2003). Cancer risk was calculated using a CSF for DPM that was derived by OEHHA to represent the toxicity of the diesel exhaust mixture (OEHHA 1998, 2000). The BWHRA Tool evaluates risks to residential receptor populations, with exposure quantified for the inhalation exposure pathway. Details of the exposure and risk calculations are given in Section 4 and Appendix C, and the results are presented in Section 5.

1.4 Report Organization

This report is divided into six sections as follows:

Section 1.0 – Introduction: describes the purpose and scope of this report and outlines the report organization.

Section 2.0 – Emission Inventory Summary: summarizes the DPM emission inventory results prepared by Starcrest.

Section 3.0 – Air Dispersion Modeling: describes the air dispersion modeling methods used to estimate DPM concentrations.

Section 4.0 – Risk Characterization: describes the methods used to estimate cancer risk from DPM exposure.

Section 5.0 – Results: provides the results of applying the BWHRA Tool, and discusses uncertainties in risk assessment.

Section 6.0 – References: provides citations for all references given in this report.

The appendices include supporting information as follows:

Appendix A: provides the Protocol developed for the BWHRA Tool.

Appendix B: provides additional details of the air dispersion modeling.

Appendix C: provides additional details of the risk characterization.

2 Air Emission Inventory Methodology

Starcrest was commissioned by each of the Ports to conduct a comprehensive, activity-based baseline emissions inventory of off-road CHE, railroad locomotives, on-road HDVs, OGVs, and harbor craft associated with the Ports activities in 2005 (Starcrest 2007a,b).

The Starcrest inventory addresses emissions that occur within the Ports boundaries from the five mobile sources categories noted above (OGVs, harbor craft [*e.g.,* tugboats, ferries, commercial fishing vessels, etc.], CHE, railroad locomotives, and HDVs). In addition, out-of-port Port-related truck emissions on major freeways (*i.e.,* Interstates 110 and 710 and Highways 47 and 103) and locomotive emissions on the major rail line (*i.e.,* the Alameda Corridor) in the vicinity of the Ports are also included in the BWHRA Tool. For consistency with ARB (2006a), Port-related over-water emissions from OGVs have also been included. The Starcrest inventories do not include mobile emissions from activities or facilities within the Ports' boundaries that are either on private land or that are unrelated to Ports operations. As noted in the Introduction, only those emission sources under Ports control are evaluated in the BWHRA Tool.

The baseline inventory encompasses emissions from a single calendar year (2005), and relies on methodologies described in Starcrest (2007a,b). Although Starcrest developed emissions data for a number of compounds, the BWHRA Tool only utilizes data for DPM emissions (see discussion in Introduction). Starcrest also developed an emission forecast for 2020 (Starcrest, 2008). That emission forecast incorporated growth projections for mobile sources at the Ports and reflects adopted regulations as well as implementation of the CAAP (2006). Table 2-1 summarizes the 2005 and 2020 DPM emissions by source category, and also provides the total mass and percentage reductions in DPM emissions for each Port.

3 Air Dispersion Modeling Methodology

Air dispersion modeling is performed to estimate exposure concentrations from the environmental transport and distribution of DPM emissions into the atmosphere from mobile sources at the Ports and from over-water Port-related vessel and harbor craft emissions and out-of-port Port-related truck emissions on major freeways as well as locomotive emissions on the major rail line in the vicinity of the Ports. Air dispersion modeling requires the selection of an appropriate dispersion model and input data based on regulatory guidance, common industry standards/practice, and/or professional judgment. In general, ENVIRON performed the air dispersion modeling in a manner consistent with the BWHRA Tool Protocol reviewed by the TWG (Appendix A). Air dispersion methodologies from other studies are used, where appropriate. These included ARB's Exposure Assessment study of the Ports (ARB 2006a) and/or guidance documents related to intermodal and railyard facilities prepared by ARB (2004b, 2005a, 2005b, 2006c) and SCAQMD (2003).

Air dispersion modeling is performed to estimate DPM exposure concentrations at off-Port locations within the modeling domain ("receptor locations") for two emissions scenarios:

- Baseline (year 2005) emissions inventory and
- Year 2020 emissions forecast inventory including projected growth of the Ports, emissions reductions due to adopted regulations, and implementation of the CAAP measures.

These scenarios, the underlying assumptions, and emissions estimation methodologies were developed by Starcrest (2007a,b, 2008) with the participation of staff of the Ports, the ARB, and the SCAQMD. The type of air dispersion model and modeling inputs that were used (i.e., pollutants modeled, pollutant averaging times, source characterization and parameters, meteorological data, terrain, land use, and receptor locations) are summarized below with further details in Appendix B.

3.1 Model Selection and Option

The air dispersion modeling conducted for the BWHRA tool uses the USEPA's state-of-the-art regulatory model AERMOD (version 07026) to estimate DPM exposure concentrations at off-Port receptor locations (USEPA 2005b). AERMOD is a near-field, steady-state Gaussian plume model, and uses site-representative hourly surface and twice-daily upper air meteorological data to simulate the effects of dispersion of emissions from industrial-type releases (e.g., point, area, and volume sources) for distances of up to 50 kilometers. The use of AERMOD represents an update to the approach taken in ARB's Exposure Assessment of the Ports (ARB 2006a) in which an older USEPA model, Industrial Source Complex Short Term version 3 (ISCST3), was used to estimate exposure concentrations of DPM.

Because the BWHRA tool focuses solely on DPM-associated cancer risk, ENVIRON calculated the annual average DPM concentration for both the 2005 and 2020 emission scenarios consistent with regulatory guidance for the averaging time used for cancer risk assessments.

3.2 Source Characterizations and Parameters

Source characterization, location, and model-specific parameter information is necessary to model the dispersion of air emissions. As the BWHRA tool is developed to evaluate sub-regional impacts, ENVIRON performed the air dispersion modeling analyses using a simplified source treatment similar to the methods applied by ARB in their assessment of the Ports (ARB 2006a), which includes the identification of major source categories (e.g., OGVs, harbor craft, locomotives, CHEs, on-terminal and on-road HDVs), the approximation of locations for major source categories, and the use of fleet-average source parameter.

Details of emission source model parameters and locations are described further in Appendix B. Sources are assumed to have identical spatial allocation for both the 2005 and 2020 scenarios except for a few specific changes associated with approved or anticipated projects at the Ports. See Appendix B for a list of projects and spatial allocation changes that are either approved or anticipated to occur by 2020. ENVIRON used temporal data to represent the daily time variation of emissions for the major source types consistent with ARB's study (ARB 2006a).

3.3 Meteorological Data

AERMOD requires meteorological data from both near the surface and higher up in the atmosphere ('upper air data") to characterize the transport and dispersion of pollutants in the atmosphere. Details of the meteorological selection and processing are provided in Appendices A (which includes the BWHRA Tool Protocol prepared for this project) and B.

Given the large extent of the modeling domain for this assessment and the influence of geographic features on prevailing wind patterns, several surface meteorological stations were needed to fully characterize the varying conditions found in different areas of the Ports' operations. In order to determine the area(s) over which individual surface meteorological stations would be applicable, ENVIRON divided the Ports' operational areas into four zones: Inner Harbor, Middle Harbor, Outer Harbor and Beyond the Breakwater. The geographical areas comprising the operational zones are shown in Figure 3-1 and are defined in Appendix B. In the BWHRA tool Protocol and Sphere of Influence Report (Appendix A), the following stations, located on or near Port operational areas and operated by the Port of Los Angeles, were identified as the most representative of meteorological conditions within or near the Ports:

- St. Peter and Paul School (SPPS): Inner Harbor and Land-side Out of Port Emissions
- Terminal Island Treatment Plant (TITP): Middle Harbor
- Berth 47: Outer Harbor and Beyond Breakwater

As recommended by the National Climatic Data Center, Upper air data from the San Diego Miramar Naval Air Station is used in AERMET (USEPA's meteorological data processor for AERMOD) processing for the Ports. The cloud cover data from Long Beach Daugherty Field, as recommended by ARB, is also used in AERMET processing for the Ports.

Prior to running AERMET, surface characteristics for the meteorological monitoring site and/or the selected Port facilities must be specified. The surface parameters include surface roughness, albedo, and Bowen ratio, which are used to compute fluxes and stability of the atmosphere (USEPA 2004). The evaluation and selection of surface parameters, including the selection of surface parameter values and land use sectors is described in the BWHRA Tool Protocol found in Appendix A and utilizes USEPA methods applicable at the time that the BWHRA tool was developed.[3]

3.4 Land Use and Terrain

AERMOD can evaluate the effects of urban heat island effects on atmospheric transport and dispersion using an urban boundary layer option. ENVIRON selected the urban boundary layer option for this study based on the highly urbanized areas present in the modeling domain Appendix B provides additional details on the model inputs used for this option.

To ensure the modeling reflected the geographic features found in the modeling domain, ENVIRON used United States Geological Survey (USGS) 7.5 minute digital elevation maps (DEMs) for the entire modeling domain, similar to ARB's Ports study (ARB 2006a). Appendix B lists the specific terrain files used and any exceptions to the incorporation of elevation data into AERMOD.

3.5 Receptor Locations and Estimation of Exposure Concentrations

As described in the Protocol (Appendix A), two Cartesian grids representing off-site receptor locations around the Ports were included in the dispersion modeling to estimate DPM exposure concentrations for use in the estimation of DPM cancer risks. ENVIRON uses a receptor grid with 200-meter spacing, similar to ARB's Ports study (ARB 2006a), out to a distance of two kilometers (km) from the Ports' boundaries. A second Cartesian receptor grid with 500-meter spacing covering a total area of approximately 20 miles by 20 miles is also included. The extent of this grid is similar to the Cartesian receptor grid in ARB's Ports study (ARB 2006a) and extends south of the Ports over the San Pedro Bay, north to approximately Lynwood, west to approximately Torrance, and east to approximately Buena Park, as shown in Figure 3-1.

[3] In January 2008, USEPA released updated guidance for surface parameters analysis with the release of AERSURFACE, a model preprocessor to assist in determining surface parameters consistent with the new guidance (USEPA 2008a,b). The guidance recommends different methods than those used in the BWHRA tool for calculating the surface parameters. However, the impact of using these different methods relative to the methods used in the BWHRA Tool is insignificant, as discussed in more detail in Appendix B.

DPM exposure concentrations from all modeled sources were summed to estimate the total DPM exposure concentration at each receptor location for both the 2005 baseline and 2020 future forecast scenarios.

4 Health Risk Assessment Methodology

This section describes the methodology used in evaluating potential human health risk from exposure to DPM emitted during operations of the Ports, and Section 5 presents the principal results of that assessment. Supplemental material is provided in Appendix C, including a discussion of the derivation of the DPM CSF. Quantification of potential health effects from DPM exposure incorporates the four elements of risk assessment identified by the NRC (1983): (1) hazard identification (including identification of chemicals of potential concern); (2) exposure assessment; (3) dose-response assessment; and (4) risk characterization. Each of these components is addressed in the following sections.

The risk assessment regulations and guidance documents that were considered in developing the methodology used in this assessment include:

- Air Toxics Hot Spots Program Risk Assessment Guidelines (OEHHA 2003),
- Air Resources Board Recommended Interim Risk Management Policy for Inhalation-Based Residential Cancer Risk (ARB 2003b)
- Supplemental Guidelines for Preparing Risk Assessments for the Air Toxics “Hot Spots” Information and Assessment Act (SCAQMD 2005)

The BWHRA Tool utilized screening-level (Tier 1) assumptions and parameters in accordance with the guidance cited above. The focus of the BWHRA Tool on sub-regional effects distinguishes it from project-specific CEQA or NEPA evaluations at the Ports, which are designed to address questions of local impacts and health effects associated with a project or facility. Using air dispersion modeling of contaminants to near-source receptors, project-specific analyses examine impacts at maximum impact points, sensitive receptors locations, and other receptor populations that are not consistent with the source characterization methods and air dispersion modeling of the BWHRA Tool. In contrast, the BWHRA Tool estimates overall sub-regional cancer risks attributable to DPM emissions from the Ports consistent with the ARB (2006a) Exposure Assessment of the Ports. The BWHRA Tool methodology is further distinguished from that used in project analyses by the manner in which emission rates are averaged. The BWHRA Tool uses discrete DPM emission rates estimated for 2005 and 2020 and held constant over the subsequent respective 70-year averaging periods, whereas project analyses utilize emission rates calculated for each year of the project life. Because of these significant technical differences, the BWHRA Tool results are appropriate for informing development of the Standard as well as emission reduction strategies in general, but are not applicable for evaluating the impacts of an individual project or facility on the bay-wide scale.

4.1 Hazard Identification (Identification of Chemicals of Potential Concern)

Hazard identification is defined by the NRC (1983) as the determination of whether a particular chemical is or is not causally linked to particular health effects. In practice, this component of a risk assessment identifies chemicals associated with a site or activity that are also linked to adverse health effects, and determines whether they should be carried through the risk assessment as chemicals of potential concern (COPCs).

As discussed in the Introduction, this BWHRA Tool focuses on DPM as the sole COPC. Under California regulatory guidelines (OEHHA 1998, 2007), DPM is used as a surrogate for the chemical mixture that is diesel exhaust, and the unit risk factor (URF) that OEHHA developed for DPM reflects that approach (OEHHA 1998). Diesel exhaust is a complex mixture of hydrocarbons, particulates, gases, water, and other compounds. The precise composition of the mixture depends on several factors including the fuel source, engine type, engine age, and operating condition. Diesel exhaust is classified by OEHHA and the USEPA as a carcinogen, and both agencies also recognize that diesel exhaust causes non-cancer effects as well (OEHHA 1998, 2007; USEPA 2007). DPM is a component of PM, and recent scientific data have linked prolonged exposure to PM to premature mortality, respiratory effects, and cardiovascular disease (see discussion in the Introduction and in Section 5.3).

4.2 Exposure Assessment

This component of a human health risk assessment is used to determine the extent of human exposure before or after application of regulatory controls (NRC 1983). As implemented here, the exposure assessment identifies the scenarios and receptor populations, and selects exposure pathways and exposure parameters appropriate to quantification of intake and potential cancer health effects associated with DPM emissions from the Ports. Theoretical chemical intakes for each potentially exposed human population and exposure pathway are estimated using equations consistent with or recommended by OEHHA (2003) and ARB (2003b).

4.2.1 Potentially Exposed Populations

The BWHRA Tool quantifies health effects to residential populations. In accordance with the sub-regional focus of the BWHRA Tool, impacts on sensitive receptors are not addressed in this assessment, but are considered in project HRAs that address local impacts.

Exposure of residential receptors was estimated based on DPM concentrations in all areas outside of the Ports boundaries, excluding over water areas, within the modeling domain. Actual land use zoning was not considered in the evaluation of residential receptor exposure.

4.2.2 Exposure Pathways

At the Ports, DPM is released to ambient air as exhaust from internal combustion engines. Because air is the principal environmental medium affected by DPM emissions, inhalation is the dominant route of exposure, and is the only exposure pathway evaluated by the BWHRA Tool.

4.2.3 Exposure Parameters

The parameters used to calculate exposure are based on a series of reported and assumed factors regarding human activity in the vicinity of the Ports *e.g.,* exposure time, exposure frequency, and exposure duration. The exposure parameters listed below for residential populations are consistent with a screening level, Tier 1 risk assessment when applied pursuant to OEHHA guidelines (OEHHA 2003).

Exposure estimates for residential receptors were based on the assumption that exposure to DPM occurs outdoors 24 hours per day, 350 days per year for 70 years (*i.e.,* that residents are present in their home seven days a week for 50 weeks a year [or about 96 percent of the time] with approximately two weeks [15 days] spent away from home) (OEHHA 2003). Uptake of DPM by inhalation was calculated using the 80th percentile breathing rate of 302 liters per kilogram of body weight per day (L/kg BW-day) (ARB 2003a). A default value for averaging time of 70 years, or 25,550 days was used.

The equation used to calculate exposure to a modeled concentration of DPM is provided in Appendix C.

4.3 Dose-Response Assessment

Because of the decision to focus on DPM-attributable cancer risk as the sole assessment metric (see Introduction), cancer risk was the only health effect end point evaluated in this BWHRA Tool. Both OEHHA (2008) and the USEPA have classified diesel exhaust as a carcinogen (USEPA 2008c). Consistent with OEHHA and the USEPA, other health agencies, including the International Agency for Research on Cancer ([IARC] 1998), and the World Health Organization ([WHO] 1996) have also concluded that diesel exhaust is a probable human carcinogen.

For DPM, the value used to estimate cancer risk from exposure is the CSF. The CSF is defined by OEHHA (2003) as the “theoretical upper bound probability of excess cancer cases occurring in an exposed population assuming a lifetime exposure to the chemical when the chemical dose is expressed in exposure units of milligrams/kilogram-day (mg/kg-d).” OEHHA’s CSF for DPM is 1.1 $(mg/kg\text{-}d)^{-1}$; derivation of the CSF for diesel exhaust is discussed in Appendix C.

5 Results

This section presents the results of the risk calculations for Ports-related DPM emissions in 2005 and 2020. Details of how cancer risks were calculated are provided in Appendix C.

5.1 Individual Cancer Risks

Implementation of CAAP emission reduction measures and adopted regulations are predicted to achieve widespread and significant reductions in individual cancer risk.

Between 2005 and 2020, residential cancer risks above 500 x 10^{-6} (500 in a million) are virtually eliminated from the zone around the Ports, with only small areas near Interstate 710 that still exceed this level (Figures 5-1 and 5-2). In 2005, estimated residential cancer risks between 251 and 500 x 10^{-6} (two hundred fifty one and five hundred in a million) impacted an extensive area around the Ports and major transportation corridors; by 2020, the zone that is affected by this level of risk is predicted to shrink dramatically, and is largely limited to areas directly adjacent to transportation corridors and the Ports boundaries.

Figure 5-3 shows the percentage reduction in individual cancer risk between 2005 and 2020 across the BWHRA Tool modeling domain. This method of presenting cancer risk provides important perspective on the scale of the risk reductions; by the year 2020, risk reductions exceed 75% in many areas of the domain, with risk reductions between 70 and 75% expected for the majority of the domain.

The Ports recognize that individuals who reside in communities within 2 km of the Ports boundaries and nearby transportation corridors may be more highly impacted by Ports-related emissions than for individuals in the domain as a whole. Evaluation of this near-Port area (Figure 5-4), showed that while significant risk reductions of 70% or more are predicted for the majority of this 2 km zone by 2020, approximately 10 % of individuals are predicted to have risk reductions between 60 to 70% and a small area is expected to have risk reductions between 50 and 60%.The areas with the lowest predicted cancer risk reductions, less than 50%, occur in commercially or industrially-zoned areas between the Ports that are not currently occupied by residents.

DPM emissions and risks from all sources decrease by the year 2020, with the relative importance to cancer risk of different source categories such as HDVs, locomotives, or OGVs varying throughout the domain (Figure 5-5). For the communities closest to the Ports and transportation corridors, ports-related truck and locomotive emissions are important contributors to risk in both 2005 and 2020. Although risks attributable to HDV remain for these communities in 2020, overall HDV emissions are expected to have decreased 84%, resulting in substantial decreases in risk from this source by 2020 relative to 2005 levels. CHE-associated risks are also important contributors to 2005 risks near intermodal operations, but by 2020 the importance of this source decreases markedly due to significant reductions in emissions from this source. For the year 2020, the planned increased reliance on on-port rail as a means of decreasing HDV emissions results in only modest reductions in rail-related emissions and risk for locations near the Ports. OGV emissions, while reduced significantly by 2020, continue to be a major contributor to risk levels throughout the domain. OGV emissions are the focus of ARB and international regulatory efforts targeting reductions in fuel sulfur content. When implemented, along with ARB's regulation for the use of shorepower, these regulations should yield public health benefits throughout the Basin.

5.2 Population-Weighted Average Cancer Risks

Population-weighted average cancer risks attributable to Ports DPM sources were calculated to characterize the population-based reduction in risk within the BWHRA Tool domain between 2005 and 2020. For the modeling domain overall, population-weighted average cancer risks for 2005 of 249×10^{-6} (249 in a million) are predicted to be reduced significantly by 2020 to 66×10^{-6} (66 in a million), a decrease of 74% (Table 5-1). For highly impacted communities, population-weighted average cancer risks for 2005 of 519×10^{-6} (519 in a million) are predicted to be reduced by 2020 to 143×10^{-6} (143 in a million), a 72% decrease in risk (Table 5-2). These decreases in risk are consistent with the risk reductions calculated for individual residential receptors (see preceding discussion), and confirm the magnitude of the risk reductions expected from the Ports current DPM emission reduction strategies.

5.3 Discussion and Conclusions

The BWHRA Tool was used to predict reductions in both individual and population-weighted average cancer risk in 2020 from implementing CAAP (2006) DPM emission reduction strategies in combination with regulations adopted by the USEPA and ARB. The cancer risks calculated for 2005 and 2020 represent the predicted risks, above background levels, attributable to Ports-related DPM sources. These analyses indicate that widespread public health benefits will result from the reduction in DPM emissions from Ports-related mobile sources, yielding risk reductions of 70% or more for the majority of the modeling domain in 2020.

For the entire Basin in the year 2000, individual cancer risk from all TACs combined has been estimated at 1000×10^{-6} (1000 in a million); risks of approximately 720×10^{-6} (720 in a million) have been attributed to DPM alone (ARB 2006d). These values represent risk to individuals from all sources, and they indicate that Ports DPM sources represent only a portion of the air quality and public health risk concerns facing the Basin.

As discussed in the CAAP (2009) update, the Ports cannot singlehandedly resolve the Basin's air quality issues, the results from application of the BWHRA Tool demonstrate that the Ports' CAAP commitments, actions, and policies to reduce DPM levels can have significant beneficial effects on public health. The reduction in DPM emissions will also reduce $PM_{2.5}$, producing additional health benefits while supporting Basin-wide efforts to attain the federal $PM_{2.5}$ standard. The Ports have committed to reviewing the CAAP on a regular basis, and during these reviews, to examine progress towards achieving the CAAP goals. The CAAP reviews will focus on the need to adjust implementation strategies by incorporating newly-developed technologies or other available measures to ensure that the CAAP goals and Health Risk Standard are achieved. By following this framework, the Ports expect to attain the significant reductions in cancer risk noted above, and to identify and apply technologies not yet available to ultimately reach the Health Risk Reduction Standard (CAAP 2009).

5.4 Uncertainties Associated with Health Risk Analysis

There is inherent uncertainty in all risk assessments, with the source(s) of that uncertainty dependent on the specific assumptions and models used to estimate risk (Council on Environmental Quality 1989). Understanding the degree of uncertainty associated with each component of a risk assessment is critical to interpreting the results of that assessment. As recommended by the NRC (1994), [a risk assessment should include] "a full and open discussion of uncertainties in the body of each … risk assessment, including prominent display of critical uncertainties in the risk characterization." In accordance with these recommendations, the key uncertainties and critical assumptions associated with the air dispersion modeling and health risk estimation are provided in Appendices B and C. The uncertainties associated with the emission estimations used in this BWHRA Tool are provided in Starcrest (2007a,b and 2008).

The risks calculated by application of the BWHRA Tool were estimated using a series of conservative assumptions regarding exposure concentrations, the magnitude and duration of exposure, and carcinogenic potency of DPM. These assumptions, applied in a manner consistent with current guidance (OEHHA 2003; ARB 2003b), tend to produce upper-bound estimates of risk, ensuring that these values do not underestimate the actual risks posed by DPM emissions from the ports. It is important to note that the risks calculated in the BWHRA Tool do not necessarily represent the actual risks experienced by populations in the modeling domain. By using standardized conservative assumptions in a risk assessment, the USEPA (1989) has noted that:

> *"These values [risk estimates] are upper-bound estimates of excess cancer risk potentially arising from lifetime exposure to the chemical in question. A number of assumptions have been made in the derivation of these values, many of which are likely to overestimate exposure and toxicity. The actual incidence of cancer is likely to be lower than these estimates and may be zero."*

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Tables

Table 2-1: Forecasted 2020 Compared to 2005 Emissions Bay-Wide Health Risk Assessment Tool

Emissions Source		2005 Emissions (tpy)	2020 Emissions (tpy)	Percent Reduction (2020/2005)
OGV	**Total**	**1189**	**255**	**79%**
	POLA Hoteling (At Berth)	196	27	86%
	POLA Transit	301	69	77%
	POLA Maneuvering	44	16	63%
	POLA Maneuvering	44	16	63%
	POLA Anchorage	11	7	38%
	POLB Hoteling (At Berth)	236	28	88%
	POLB Transit	318	82	74%
	POLB Maneuvering	41	15	63%
	POLB Anchorage	41	11	74%
HC	**Total**	**68**	**36**	**47%**
	POLA	38	20	46%
	POLB	30	15	48%
CHE	**Total**	**117**	**16**	**86%**
	POLA	62	7	88%
	POLB	56	9	84%
HDV	**Total**	**198**	**32**	**84%**
	Total On-Port	*141*	*18*	*87%*
	POLA On-Port On-Road	36	6	83%
	POLA On-Port On-Terminal	36	2	94%
	POLB On-Port On-Road	48	8	83%
	POLB On-Port On-Terminal	21	1	93%
	Total Off-Port	*57*	*14*	*75%*
Rail	**Total**	**41**	**40**	**2%**
	Total On-Port	*37*	*38*	*-4%*

Table 2-1: Forecasted 2020 Compared to 2005 Emissions Bay-Wide Health Risk Assessment Tool

	POLA On-Port	23	20	11%
	POLB On-Port	14	18	-27%
	Total Off-Port	*4*	*1*	*63%*
TOTAL (with Off-Port HDV and Rail)		**1612**	**379**	**77%**
TOTAL (without Off-Port HDV and Rail)		**1551**	**363**	**77%**

Key:

OGV = Ocean-Going Vessels
HC = Harbor Craft

CHE = Cargo Handling Equipment
HDV = Heavy Duty Vehicles

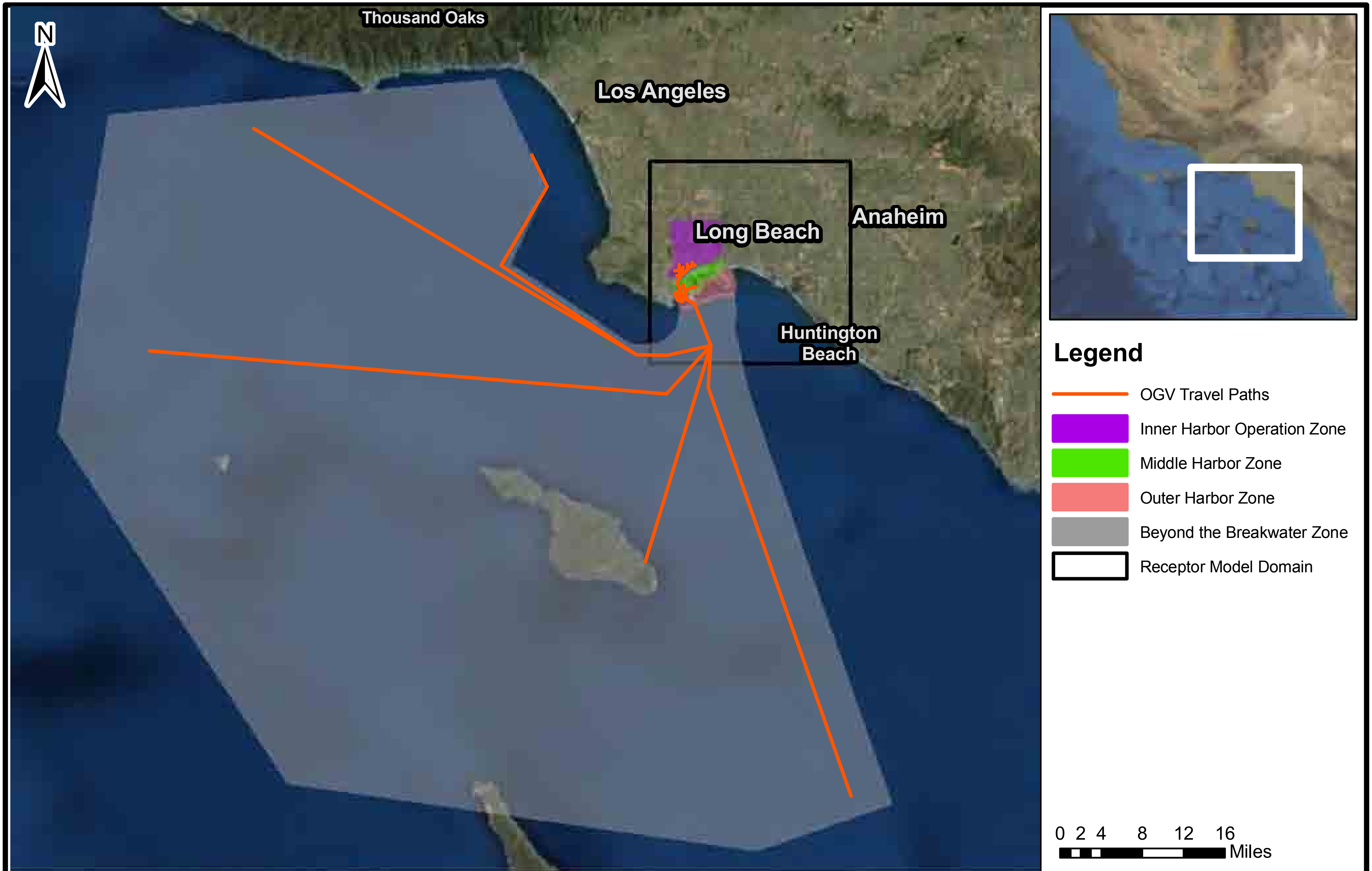
Table 5-1: Population-weighted Average Risk to Residential Populations from DPM Emissions, 2005 and 2020

Year	Population-weighted Averaged Risk (per million)	Percent Reduction in Risk from 2005
2005	249	-----
2020	66	74

Table 5-2: Population-weighted Average Risk from DPM Emissions to Residential Populations in Nearby Communities, 2005 and 2020

Year	Population-weighted Averaged Risk (per million)	Percent Reduction in Risk from 2005
2005	519	-----
2020	143	72

Figures



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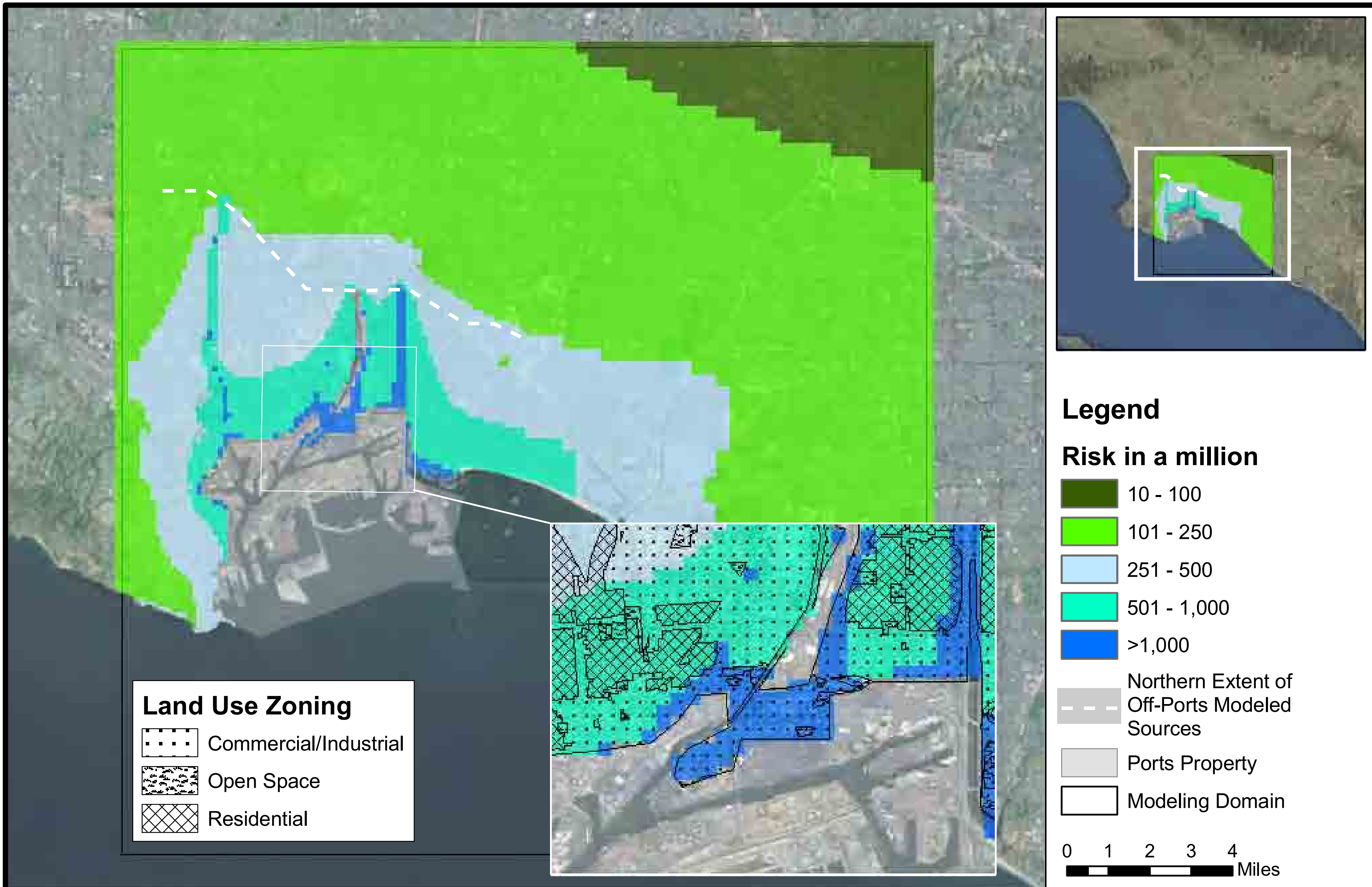
Source and Receptor Modeling Domains
San Pedro Bay Ports, California

Figure

3-1



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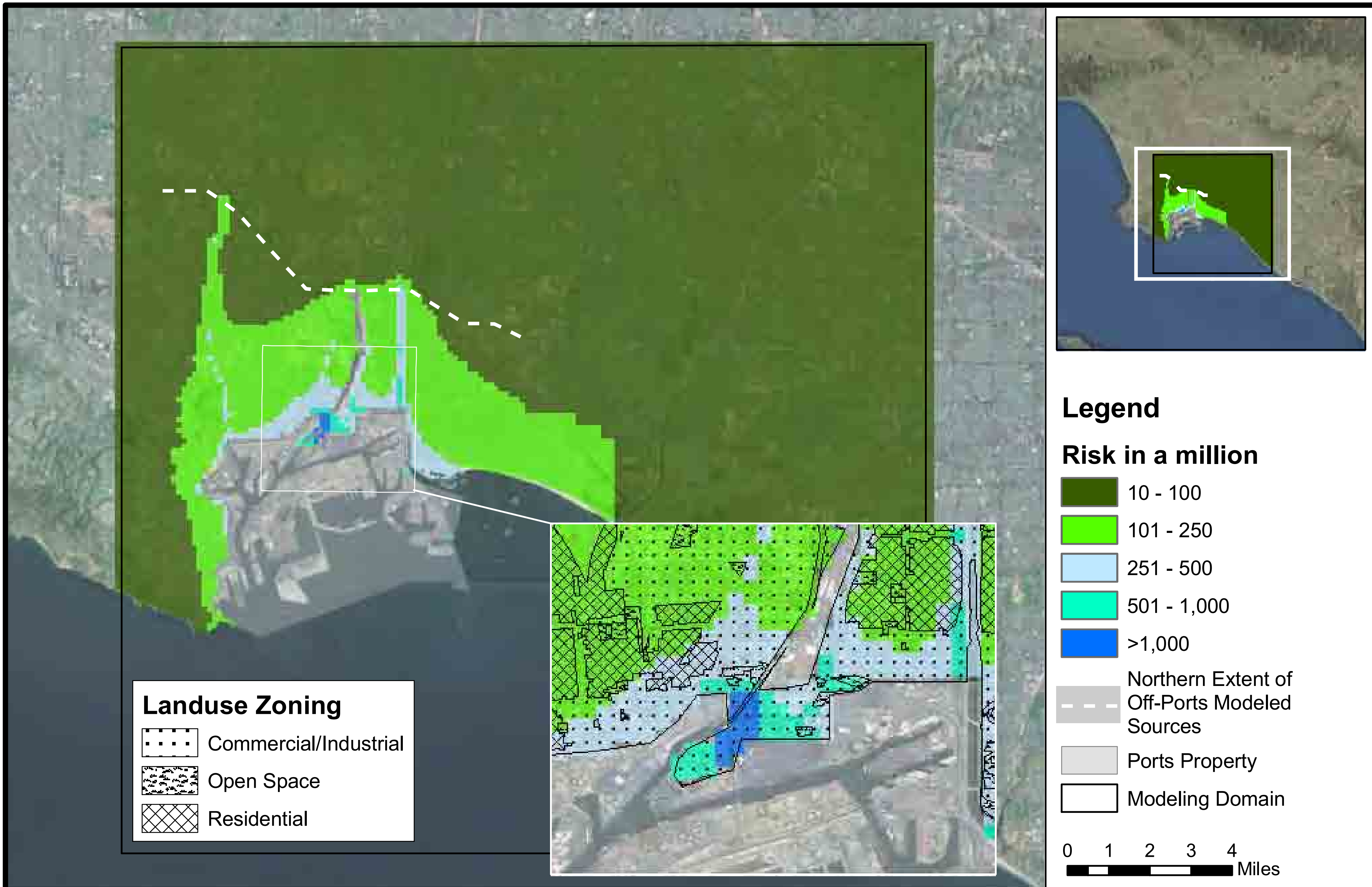
Health Risk Results - DPM from All Sources, 2005
Residential Exposure Assumptions
San Pedro Bay Ports, California

Figure

5-1



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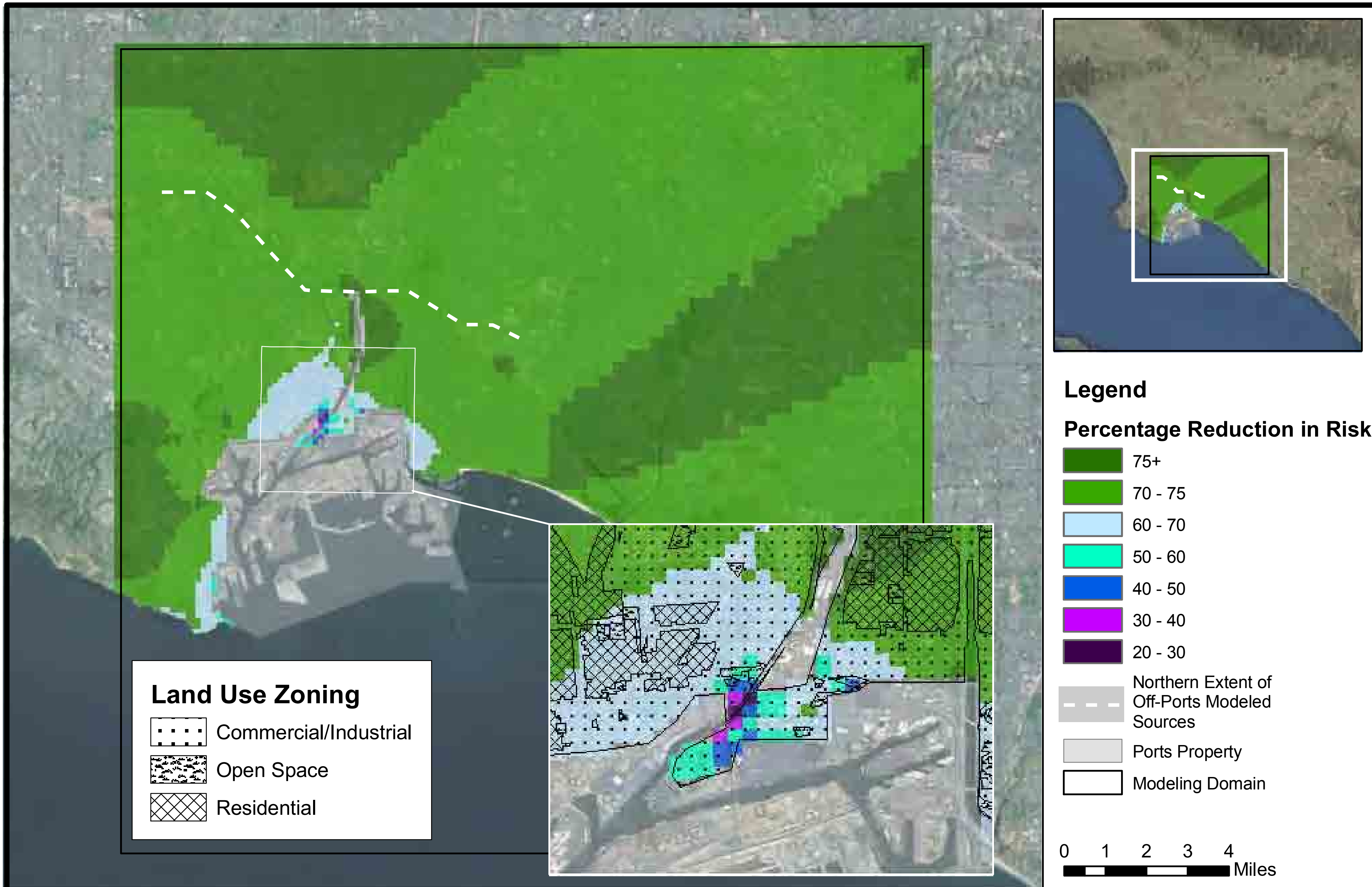
Health Risk Results - DPM from All Sources, 2020
Residential Exposure Assumptions
San Pedro Bay Ports, California

Figure

5-2



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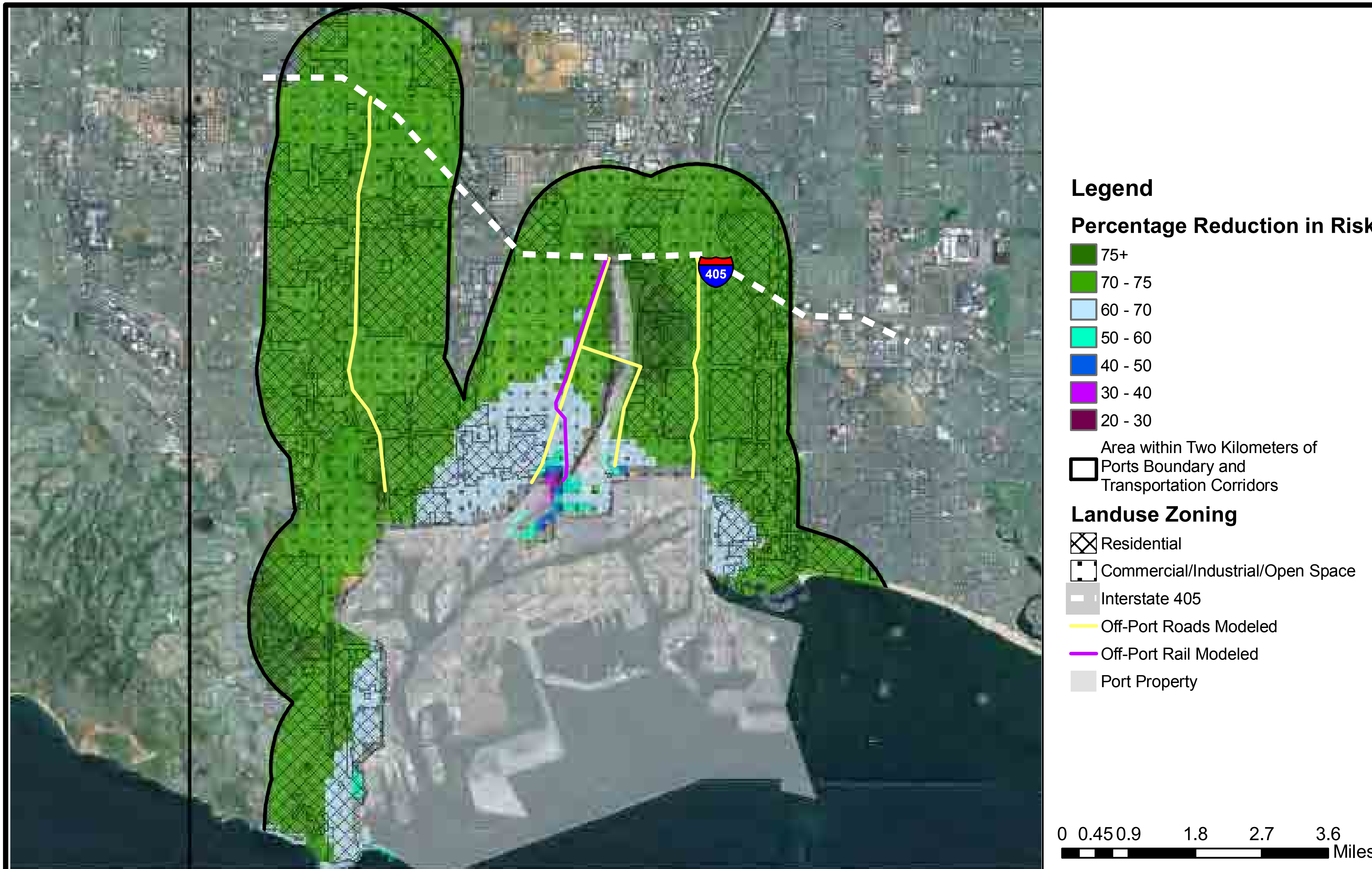
Health Risk Results - DPM from All Sources
Percent Difference between 2005 and 2020 Emissions,
Residential Exposure Assumptions
San Pedro Bay Ports, California

Figure
5-3



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Health Risk Results – DPM from All Sources. Localized Impacts Analysis.
Percent Reduction in Risks Between 2005 and 2020 Emissions.
Residential Exposure Assumptions
San Pedro Bay Ports, California

Figure

5-4

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Health Risk Results - DPM from All Sources: Source Breakdown
2005 and 2020 Emissions,
Residential Exposure Assumptions

Figure

5-5

Figures

Figure 1: ARB Modeling Domain and Approximate Extent of Port Emissions Activities

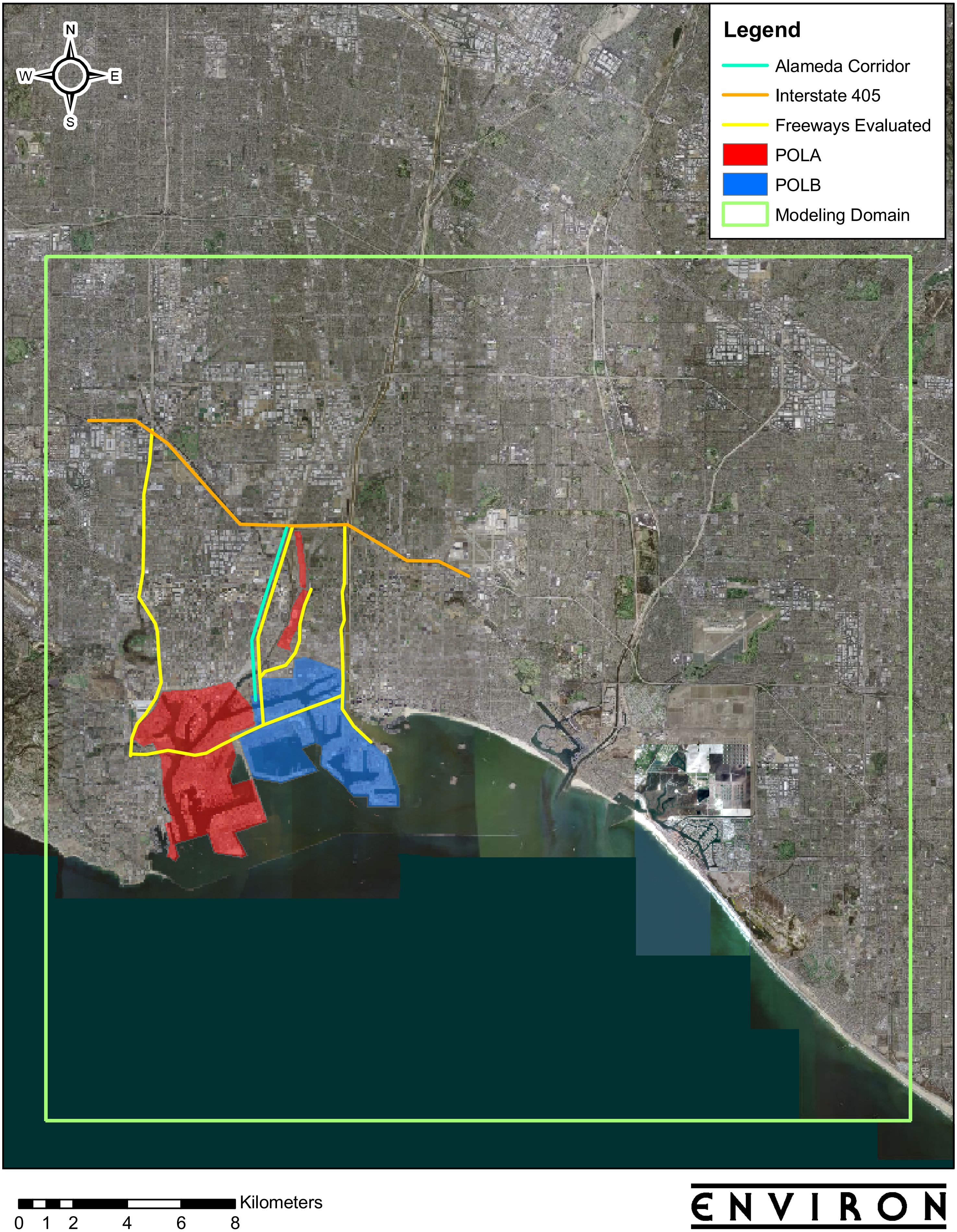

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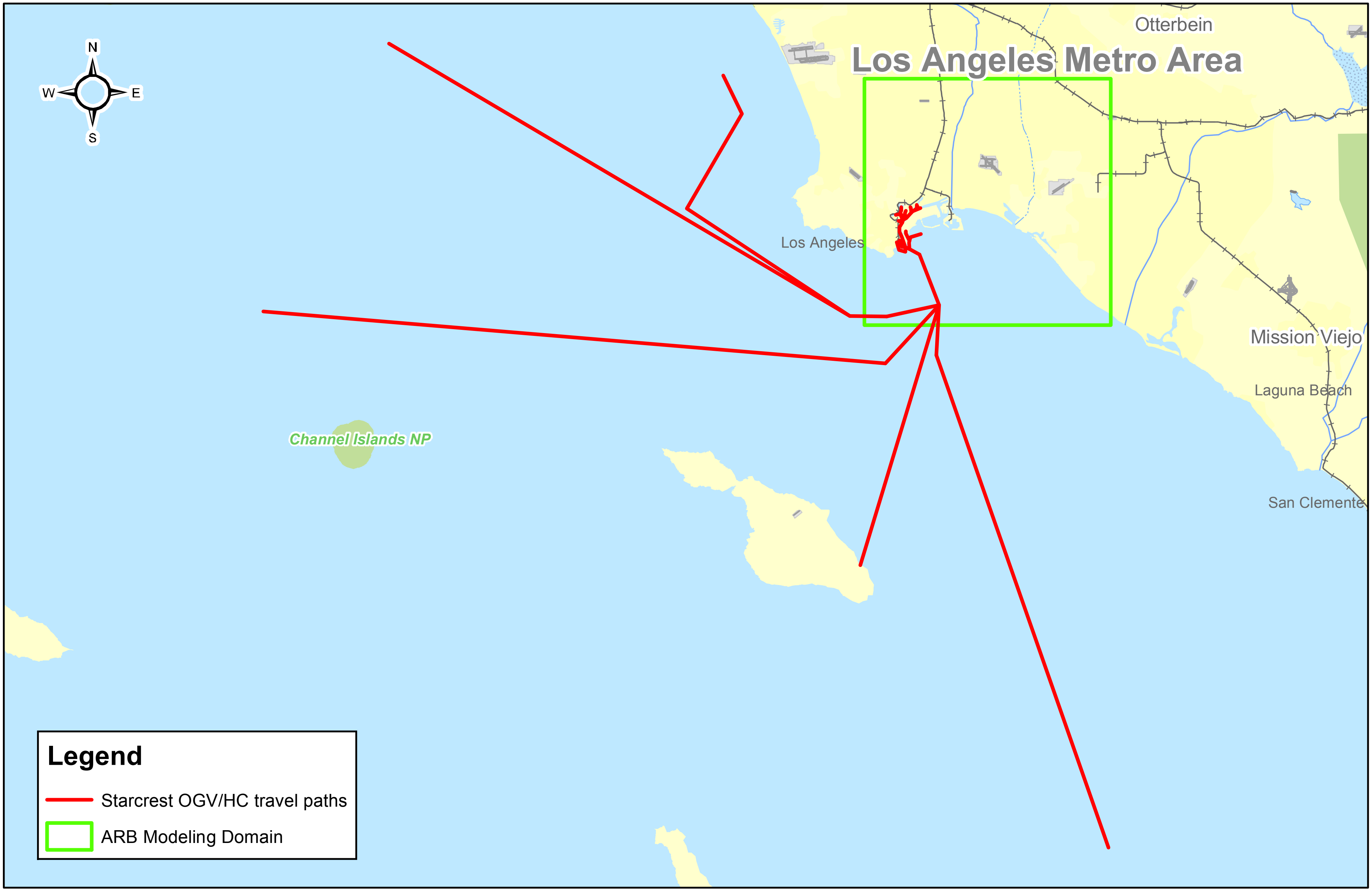
Figure 2. Extent of Emission Source Operating Areas - Ocean Going Vessels and Commercial Harbor Craft



0 5 10 20 30 40 Kilometers

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Figure 3: Inner, Middle, and Outer Harbor Zones for Meteorological Applicability POLA/POLB

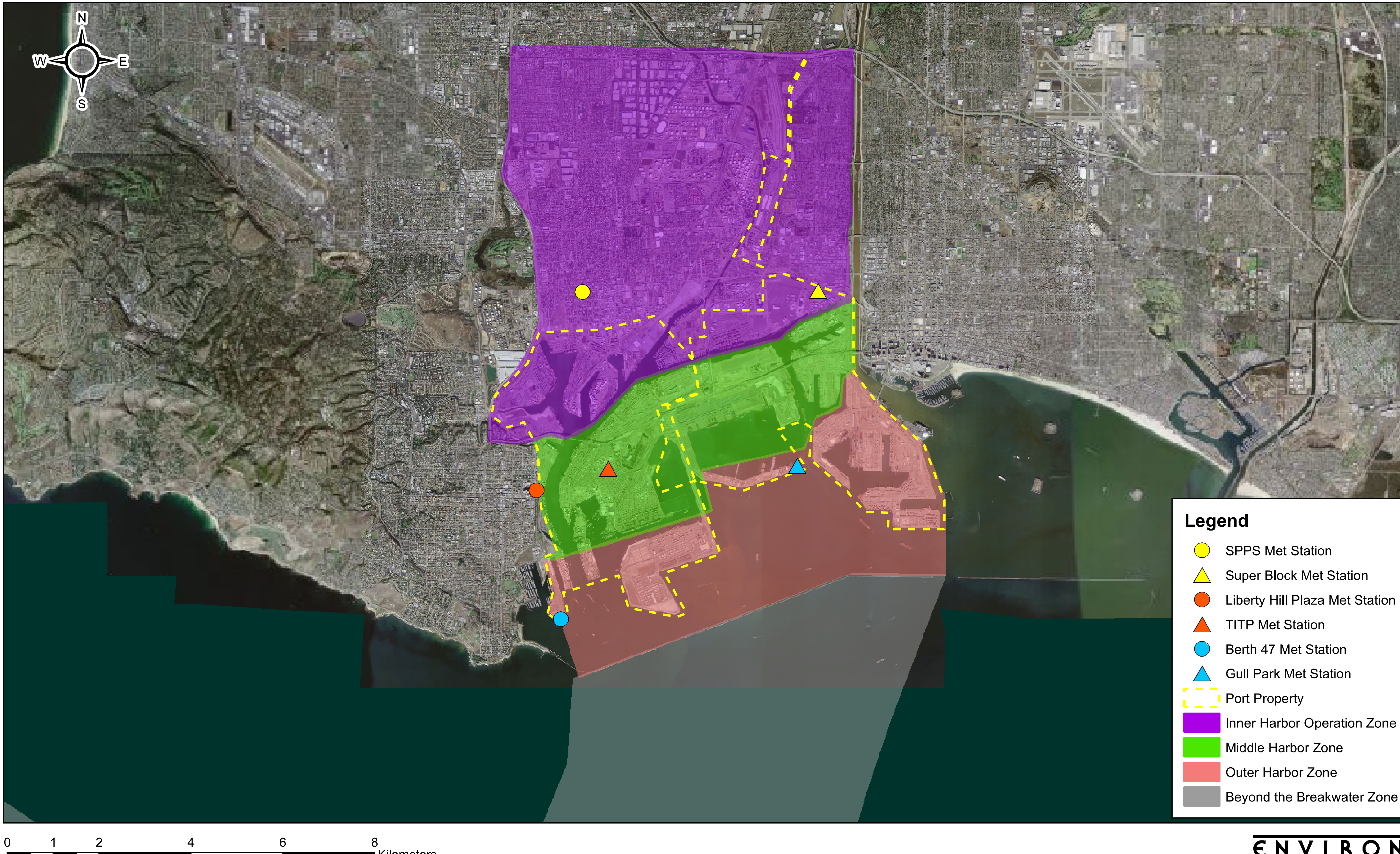

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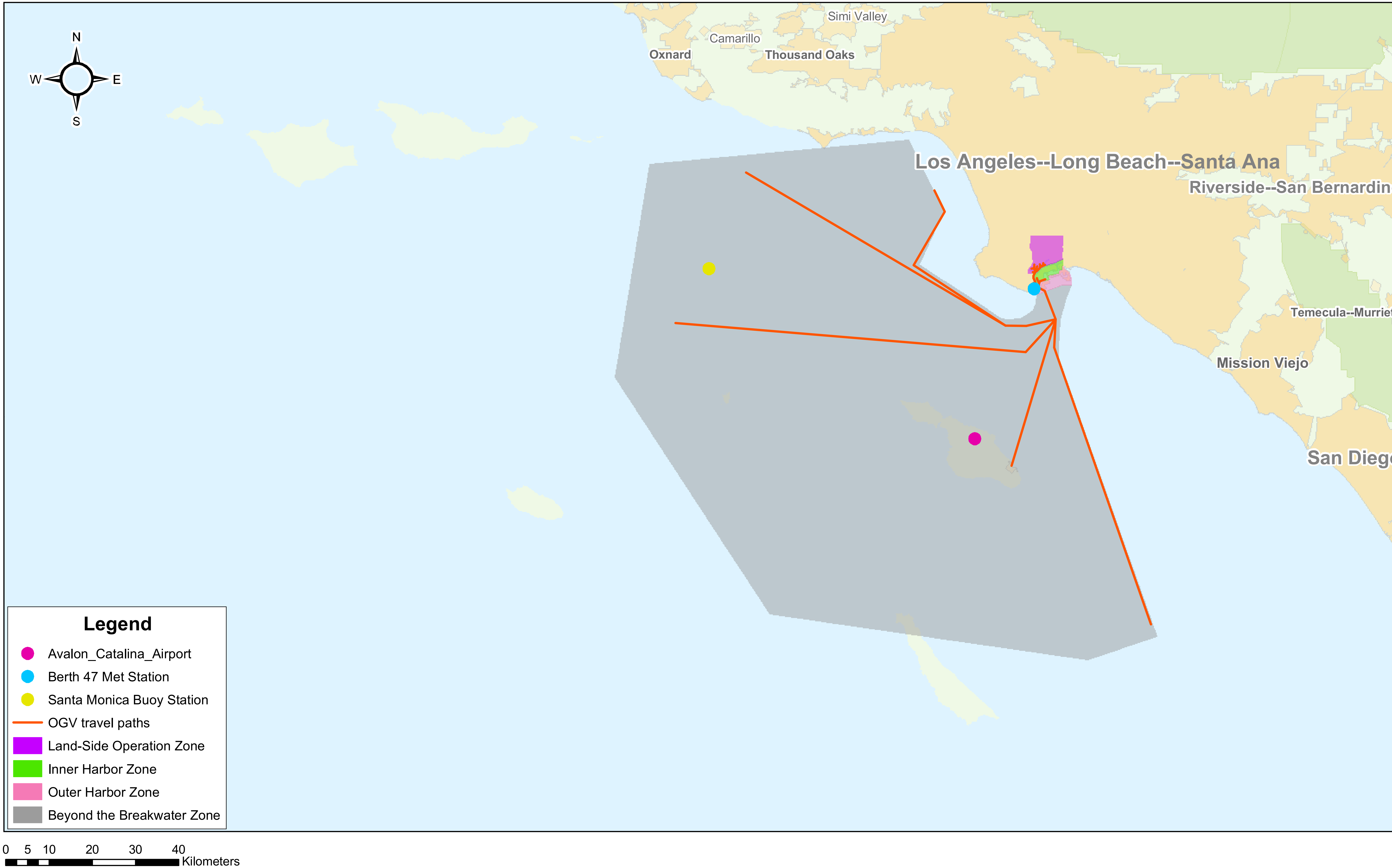
Figure 4: Beyond the Breakwater Zone for Meteorological Applicability
POLA and POLB



Attachment I:

Bay-Wide Sphere of Influence Analysis for Surface Meteorological Stations Near the Ports

Attachment I:

Bay-Wide Sphere of Influence Analysis of Surface Meteorological Station Near the Ports
Baseline Bay-Wide Regional Human Health Risk Assessment for Diesel Exhaust Particulate Matter (DPM)

Contents

ACRONYMS and ABBREVIATIONS

AERMET	AERMOD Meteorological Preprocessor
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
BWHRA	Bay-Wide Health Risk Assessment
CEQA	California Environmental Quality Act
EIR	Environment Impacts Report
HRA	Health Risk Assessment
km	Kilometer
NWS	National Weather Service
Ports	Port of Los Angeles and Port of Long Beach
SPPS	St. Peter and Paul School
TITP	Terminal Island Treatment Plant
USEPA	US Environmental Protection Agency

1 Introduction

The Port of Los Angeles and the Port of Long Beach, referred to collectively as the San Pedro Bay Ports (the Ports), has requested that ENVIRON prepare a report on a “Sphere of Influence Analysis” for surface meteorological stations near the Ports. Its purpose is to provide additional guidance on the approach, methodology, and assumptions on selection of meteorological data for air dispersion modeling of individual health risk assessments (HRAs) or for environmental impact reports (EIRs) at the Ports, prepared to meet the requirements of the California Environmental Quality Act (CEQA). In addition, this memorandum is to provide consistency for the Ports in selecting meteorological data for CEQA projects and for the Bay-Wide Health Risk Assessment (BWHRA).

This document summarizes the selection of available, representative meteorological data near the Ports. It also describes the approach used to divide the Ports’ operational areas into four zones over which individual meteorological stations would be applicable. A general description of the methodology used to select appropriate station(s) within each zone for the project under consideration is also provided.

Please note that although this document aims to provide consistency for the Ports in selecting meteorological data for CEQA projects and for the BWHRA, it allows flexibility and encourages professional judgment to be used when selecting meteorological station(s) for individual CEQA projects. This document is subject to the review of other consultants and parties who are currently conducting EIR or HRA projects for the Ports.

2 Selection of Surface Meteorological Data

When characterizing near-field air pollutant dispersion using models such as AERMOD, representative hourly surface meteorological data inputs are required to characterize the atmospheric transport and dispersion in the area to be studied. AERMET, the meteorological preprocessor to AERMOD, requires certain surface meteorological parameters in order to prepare an AERMOD meteorological data input file. The minimum surface meteorological parameters required include wind speed, wind direction, temperature, and cloud cover (United States Environmental Protection Agency [USEPA] 2004b). Station pressure is also recommended, but not required for AERMET (USEPA 2004a).

A comprehensive search was conducted to identify surface meteorological stations in the vicinity of the Ports. Fourteen meteorological stations located within a 20-Kilometer (km) radius of the Ports with at least one year of meteorological data[1] were evaluated to select surface meteorological data that are representative of conditions at the Ports. Two additional off-shore meteorological stations were evaluated to select surface meteorological data that are representative of conditions of ocean-going vessels and harbor craft traveling near the Ports. The relative location of each station to the Ports, the data quality, and the wind patterns at each station as compared to the general wind patterns in the vicinity of the Ports were investigated. The detailed evaluation of each station can be found in Appendix A. As the result of the evaluation, seven meteorological stations were selected as candidates to represent meteorological conditions for individual CEQA projects of the Ports and for the BWHRA:

- St. Peter and Paul School (SPPS)
- Liberty Hill Plaza
- Terminal Island Treatment Plant (TITP)
- Berth 47
- Gull Park
- Super Block
- Santa Monica Buoy Station (Santa Monica)

Note that the stations above only collect wind speed, wind direction, temperature, and pressure data in some cases. Because cloud cover data (a required data input for AERMET) is only available from National Weather Service (NWS) stations, the evaluation and treatment of cloud cover data is discussed separately in Section A.5 in Appendix A.

[1] The two meteorological stations operated by the Port of Long Beach – Gull Park and Super Block-east began collecting data since September 1, 2006. Current evaluation of these two stations was based on data collected between September 1, 2006 and June 30, 2007. An updated evaluation will be performed once the a complete year of data has been collected for these two stations.

3 Definition of Zones

In order to determine over which area individual meteorological stations would be applicable, ENVIRON divided the Ports' operational area into four zones:

- Inner harbor – north of the East Basin Channel, Cerritos Channel, and Vincent Thomas Bridge, and bounded by Interstate 110 on west, Interstate 710 on the east, and an approximate east-west line created by Interstate 405 and 223rd Street in the northern part of Long Beach on the north
- Middle harbor – the majority of Terminal Island and San Pedro
- Outer harbor – the terminals on the southern end of Terminal Island and inside the breakwater
- Beyond the breakwater – San Pedro Bay and Pacific Ocean outside of the breakwater

Figure I-1 and Figure I-2 show the boundaries of the four zones. Terrain features in the vicinity of the Ports, shipping channels and water bodies in and near the Ports were evaluated to determine the boundaries of the zones.

Under current definition of the zones, two meteorological stations fall within each zone except for the "beyond the breakwater" zone for which Berth 47 appears representative of conditions in this zone as discussed in Section A.4 of Appendix A:

- Inner harbor – SPPS; Super Block
- Middle harbor – Liberty Hill Plaza; TITP
- Outer harbor – Berth 47; Gull Park
- Beyond the breakwater – Berth 47 (Primary); Santa Monica (project-specific considerations)

Figure I-3 and Figure I-4 present the relative location of each meteorological station within each zone. Wind flow patterns at each station are also shown in these figures. Please note that the wind roses of the Gull Park station and the Super Block-east station were currently based on data collected between September 1, 2006 and June 30, 2007. There may be differences once a full year of data has been collected due to potential seasonal and annual variations.

4 Sphere of Influence Analysis

The applicable zone(s) for each project under consideration will be selected based on the location of the project. Once the zone of the project has been determined, a more in-depth analysis will be necessary in order to select appropriate meteorological station(s) within the zone(s) for the air dispersion modeling of the project. This document discusses general methodology used to select appropriate station(s) within each zone for the project under consideration in the following paragraphs. It should be noted that this methodology is somewhat flexible and allows professional judgment to be used when selecting meteorological station(s) for individual CEQA projects.

- If the project location is very close to a particular meteorological station within the zone, select this station
- If there are obvious terrain features between the project location and a particular meteorological station within the zone, consider not selecting this station
- If there are significant water bodies and shipping channels between the project location and a particular meteorological station within the zone, consider not selecting this station
- In many cases, the project location will fall between two meteorological stations within one or more zones or cover more than one zone. Under such conditions, a comparison of wind roses may be performed to investigate the similarities and differences of wind flow patterns at these stations. A meteorological station can be selected which, when used, will yield more conservative results from the air dispersion modeling
- Multiple meteorological stations can be used for air dispersion modeling when appropriate. Sensitivity analyses are recommended to balance the use of multiple stations with the level of precision and to evaluate the uncertainties

Figure I-3 and Figure I-4[2] identify the available surface meteorological data sets for the various zones for conducting the analysis described above. The area over which each meteorological station is representative can be determined using the general methodology discussed above, which allows for flexibility and the application of professional judgment to select surface meteorological data for individual CEQA projects.

[2] Note that Figure 4 also shows a windrose for the Avalon Catalina Airport station to support the selection of Berth 47 for the operational area outside the breakwater. Although five years of meteorological data were available from the Avalon station, the data do not meet the minimum completeness criteria for air dispersion modeling.

5 Summary

ENVIRON prepared this report to provide consistency for the Ports in selecting meteorological data for CEQA projects and for the BWHRA. Hourly surface data from seven meteorological stations near the Ports are available for air dispersion modeling. The Ports' operational area is divided into four zones over which a "sphere of influence" of each meteorological station is analyzed. At least two meteorological data sets per zone are identified for use in air dispersion modeling conducted for Port-related sources. Selection methodology is proposed that is flexible and encourages professional judgment to be applied when selecting meteorological station(s) for individual CEQA projects.

6 References

United States Environmental Protection Agency (USEPA). 2004a. User's Guide for the AERMOD Meteorological Preprocessor (AERMET). Office of Air Quality Planning and Standards. Emissions Monitoring and Analysis Division. Research Triangle Park, North Carolina. EPA-454/B-03-002. 5-9, 4-49. November

USEPA. 2004b. User's Guide for the AMS/EPA Regulatory Model - AERMOD. Office of Air Quality Planning and Standards. Emissions Monitoring and Analysis Division. Research Triangle Park, North Carolina. EPA-454/B-03-001. September

Figures

Figure I-1: Inner, Middle, and Outer Harbor Zones for Meteorological Applicability
POLA/POLB

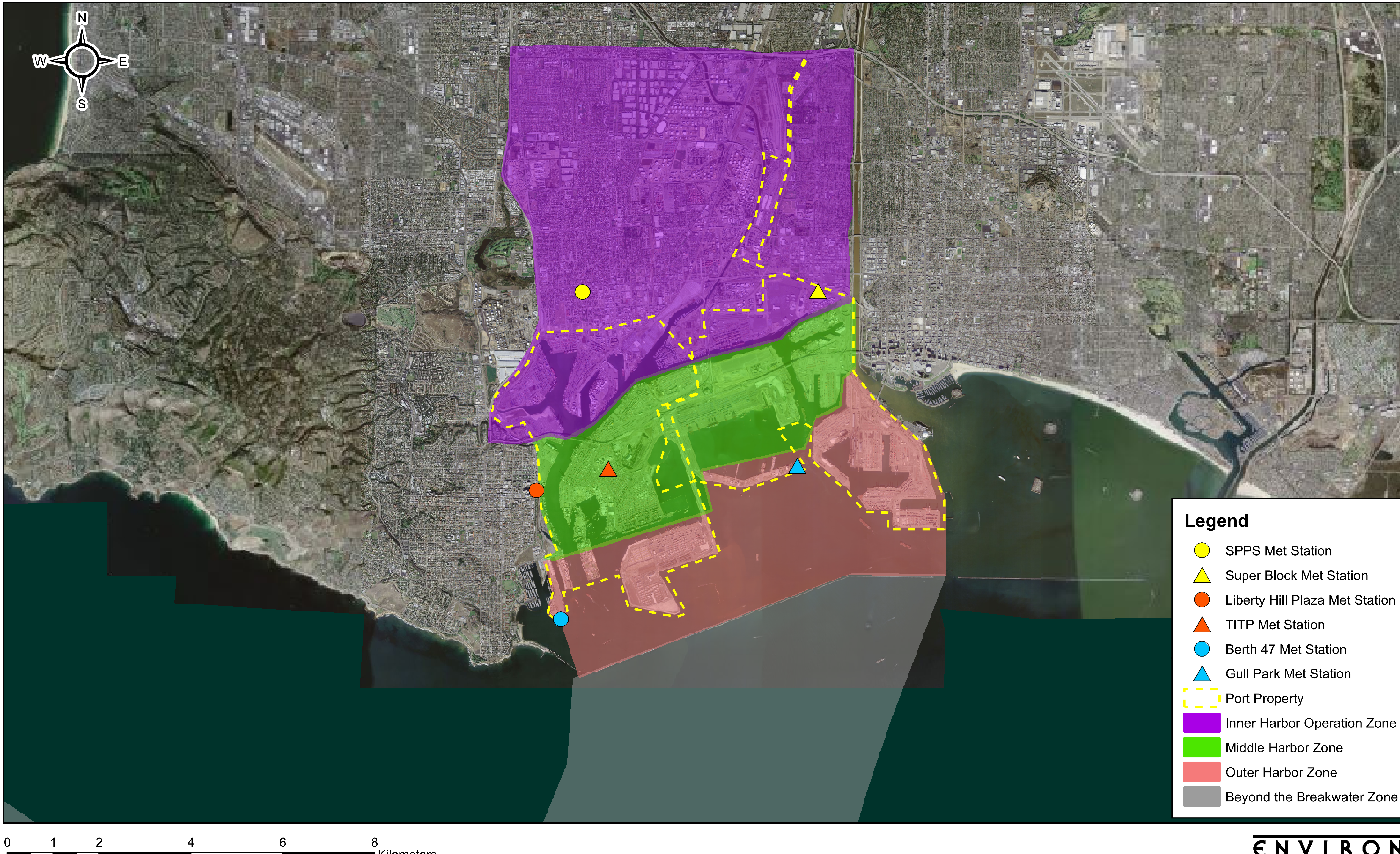


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**Figure I-2: Beyond the Breakwater Zone for Meteorological Applicability
POLA and POLB**

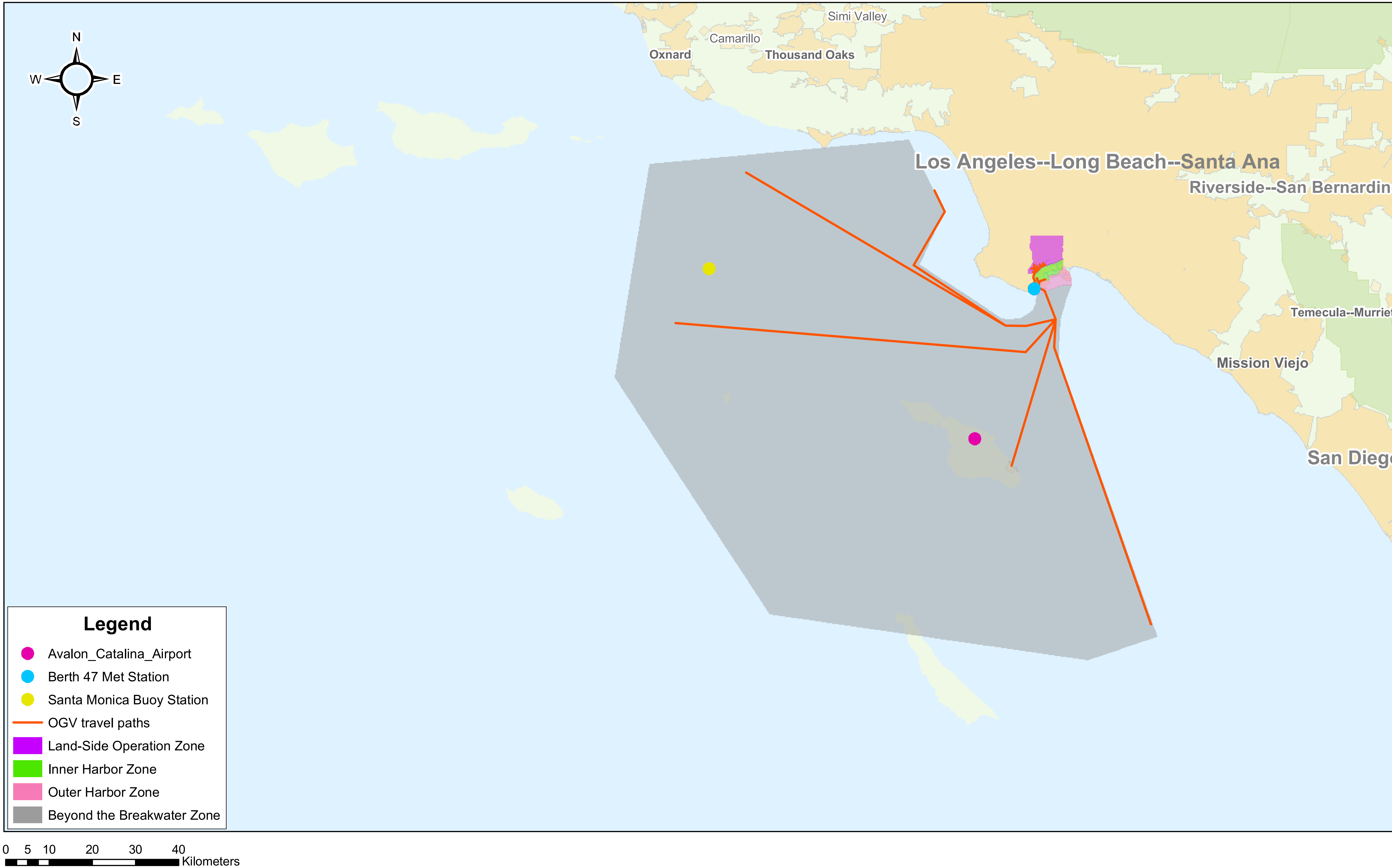

Figure I-3: Wind Patterns for Surface Meteorological Stations POLA and POLB

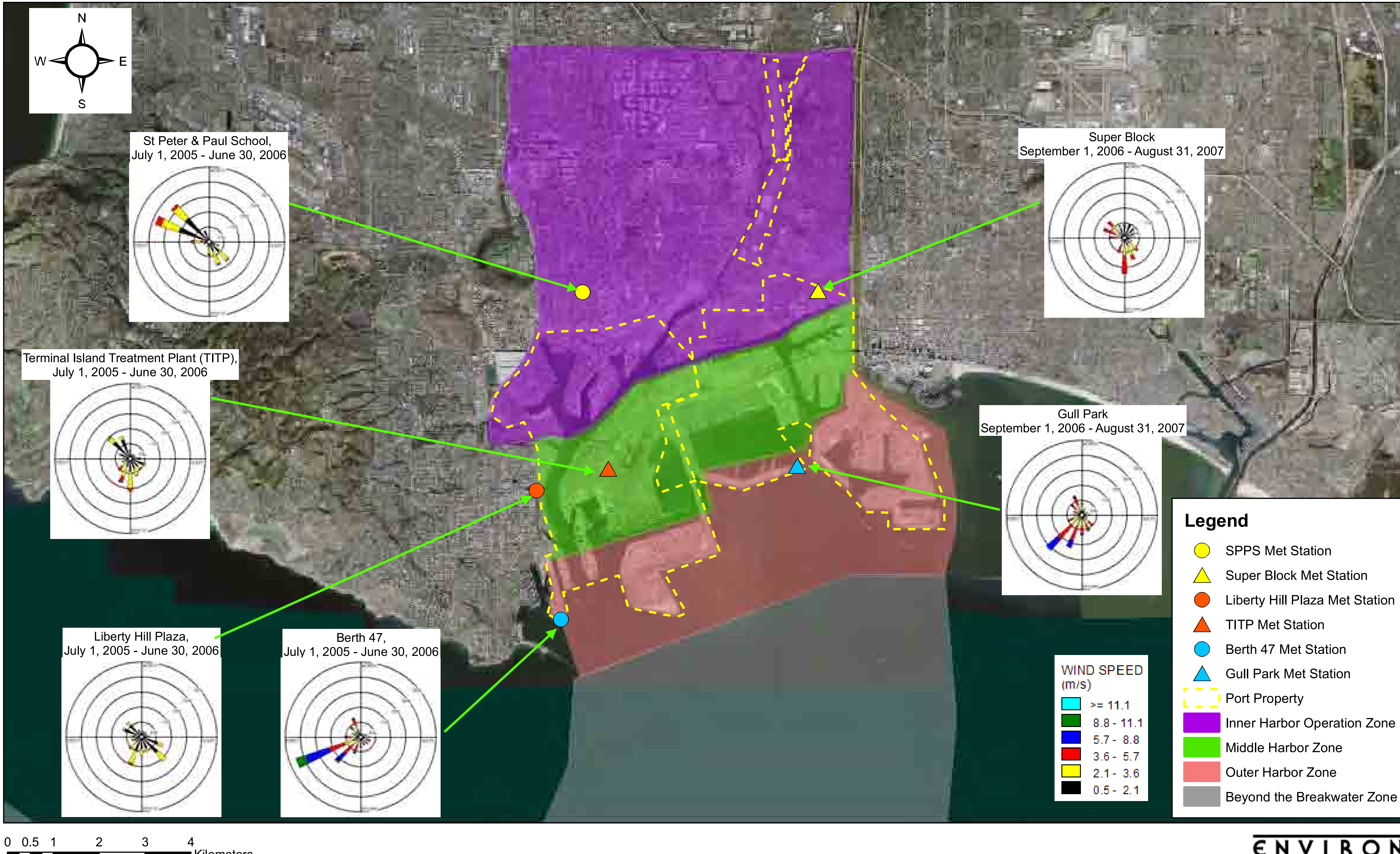

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Figure I-4: Wind Patterns for Beyond the Meteorological Stations POLA and POLB

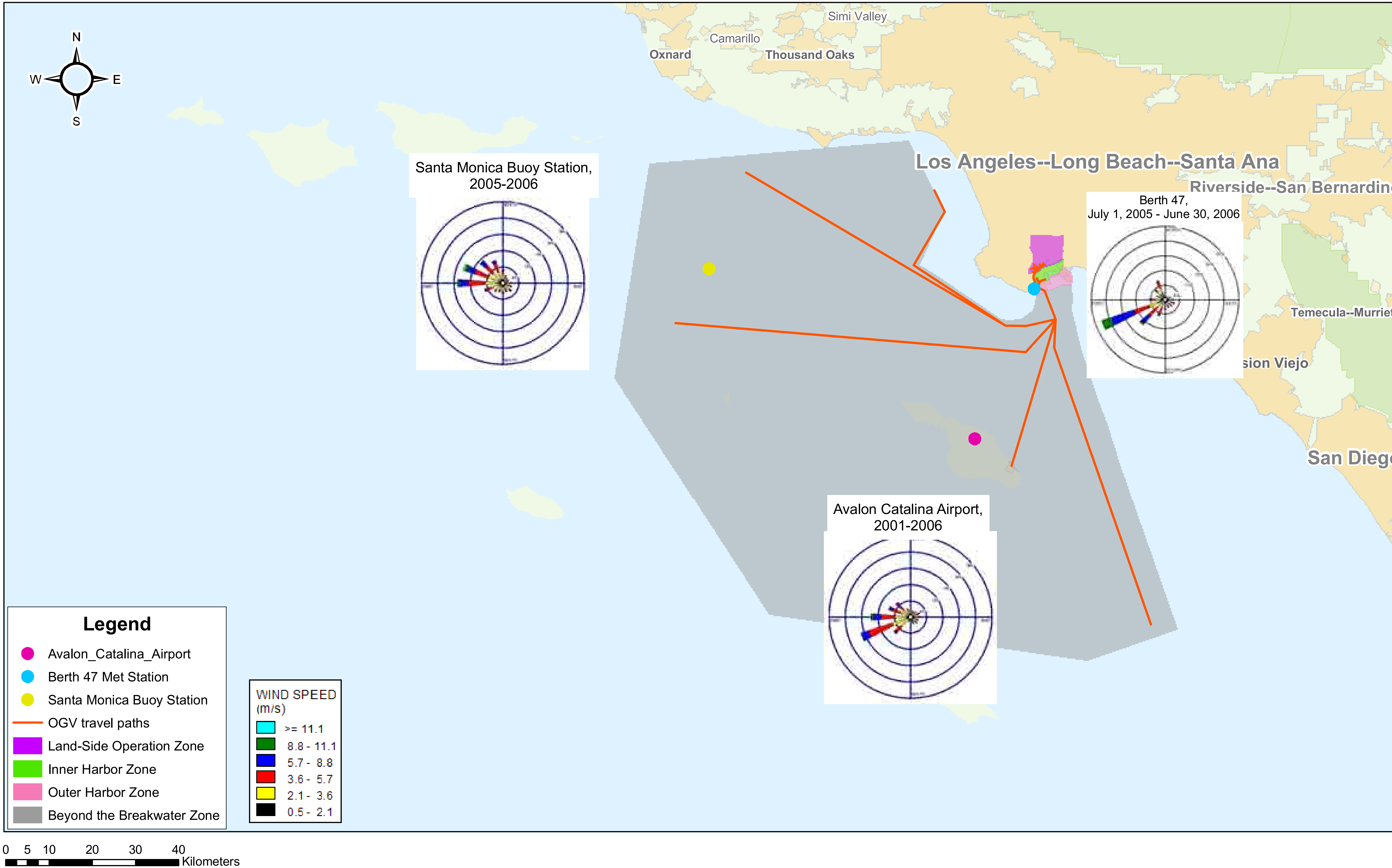

Figure I-A-1: Surface Meteorological Stations near POLA and POLB

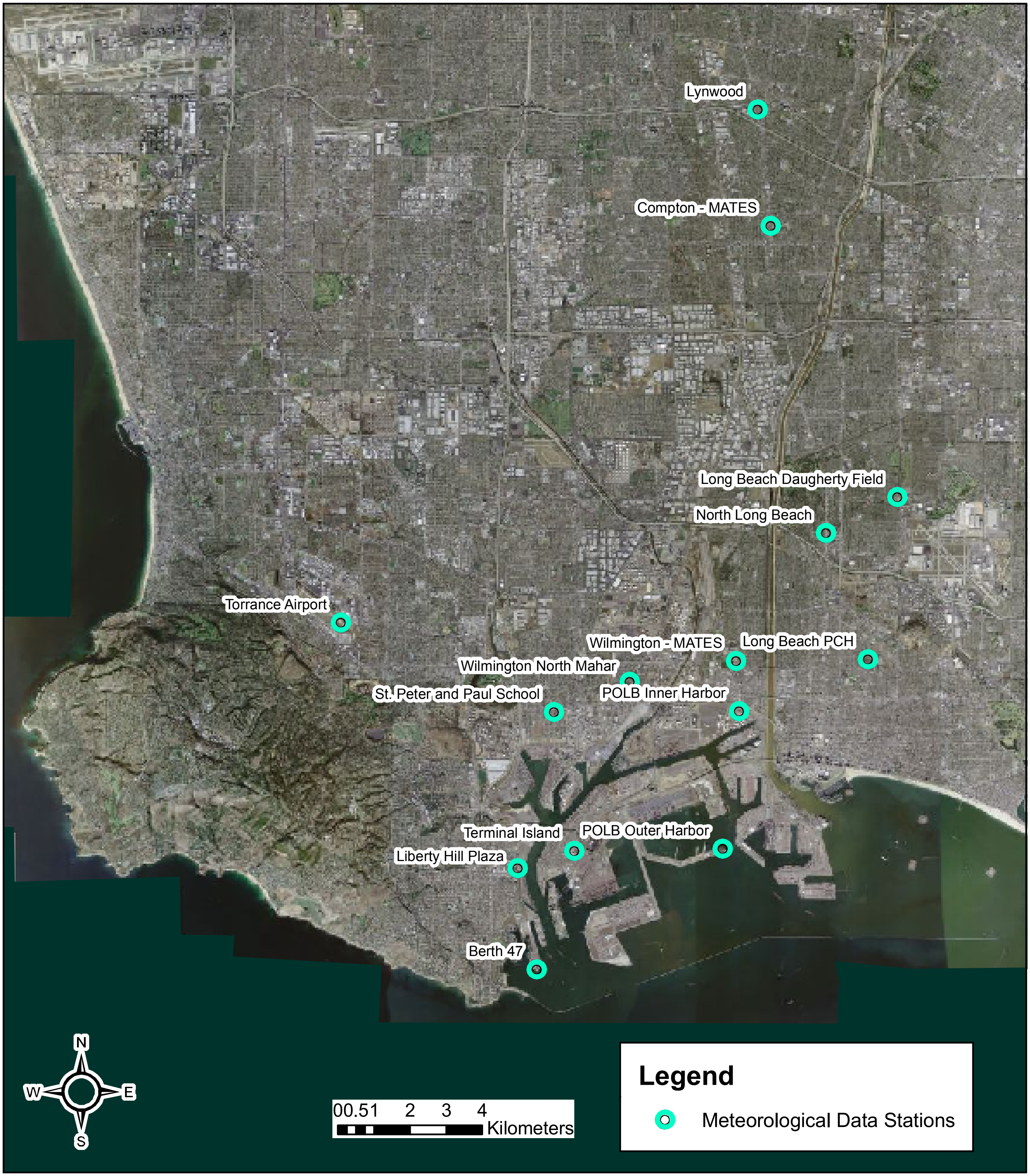

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Figure I-A-2: Wind Patterns for Surface Meteorological Stations near the POLA and POLB

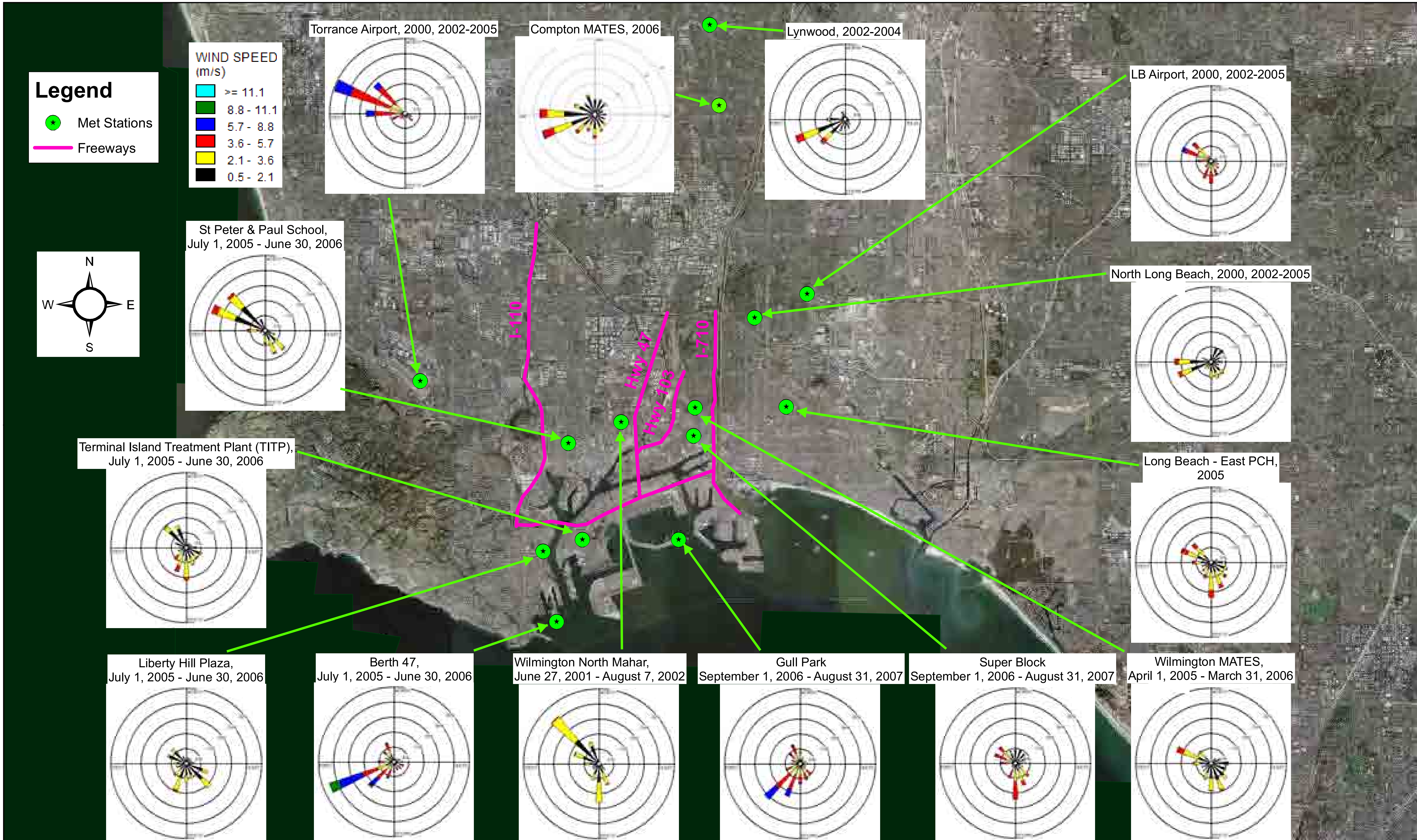

Figure I-A-3: North Long Beach Surface Meteorological Station and Nearby Buildings

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Figure I-A-4: POLA and POLB Surface Meteorological Stations

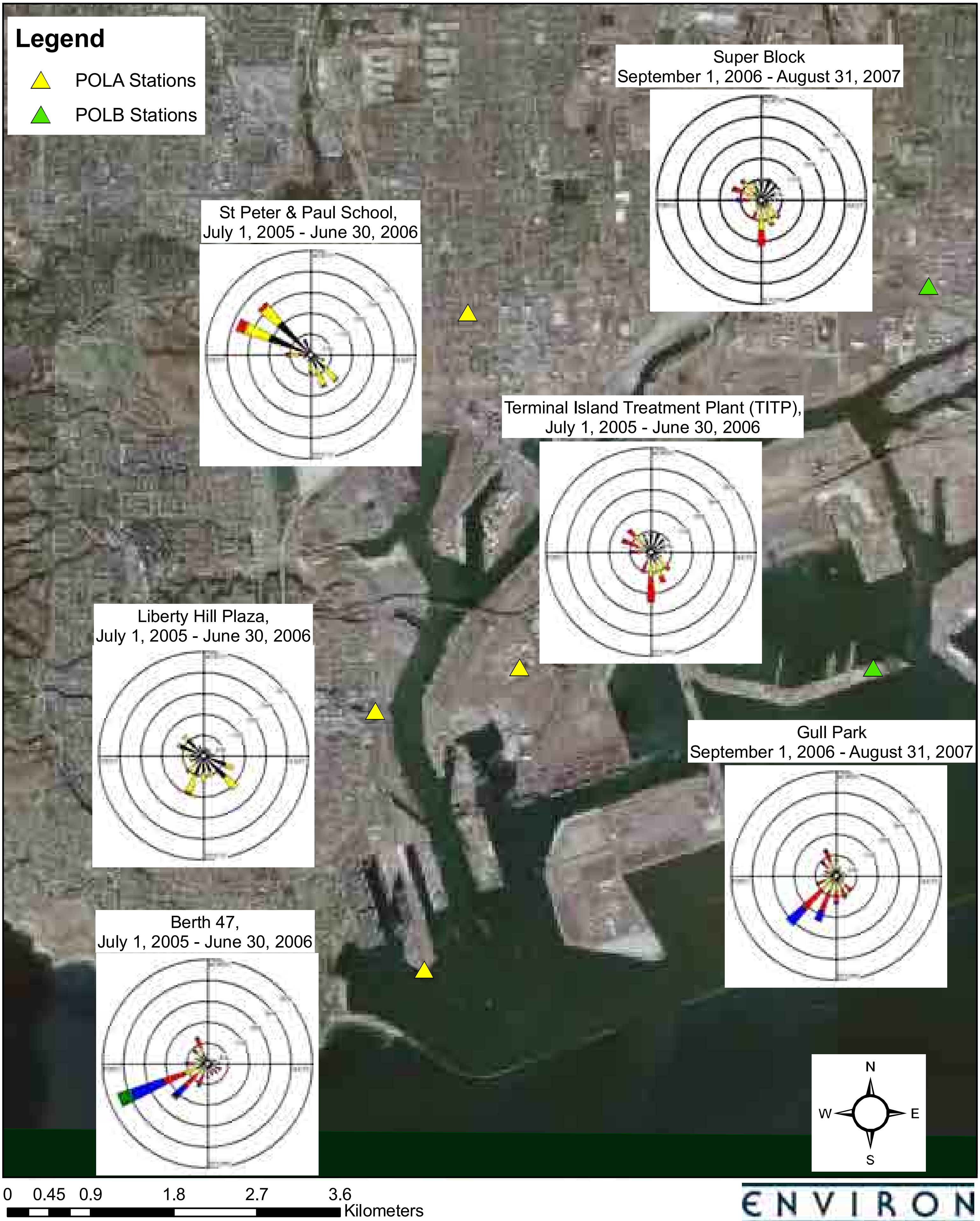

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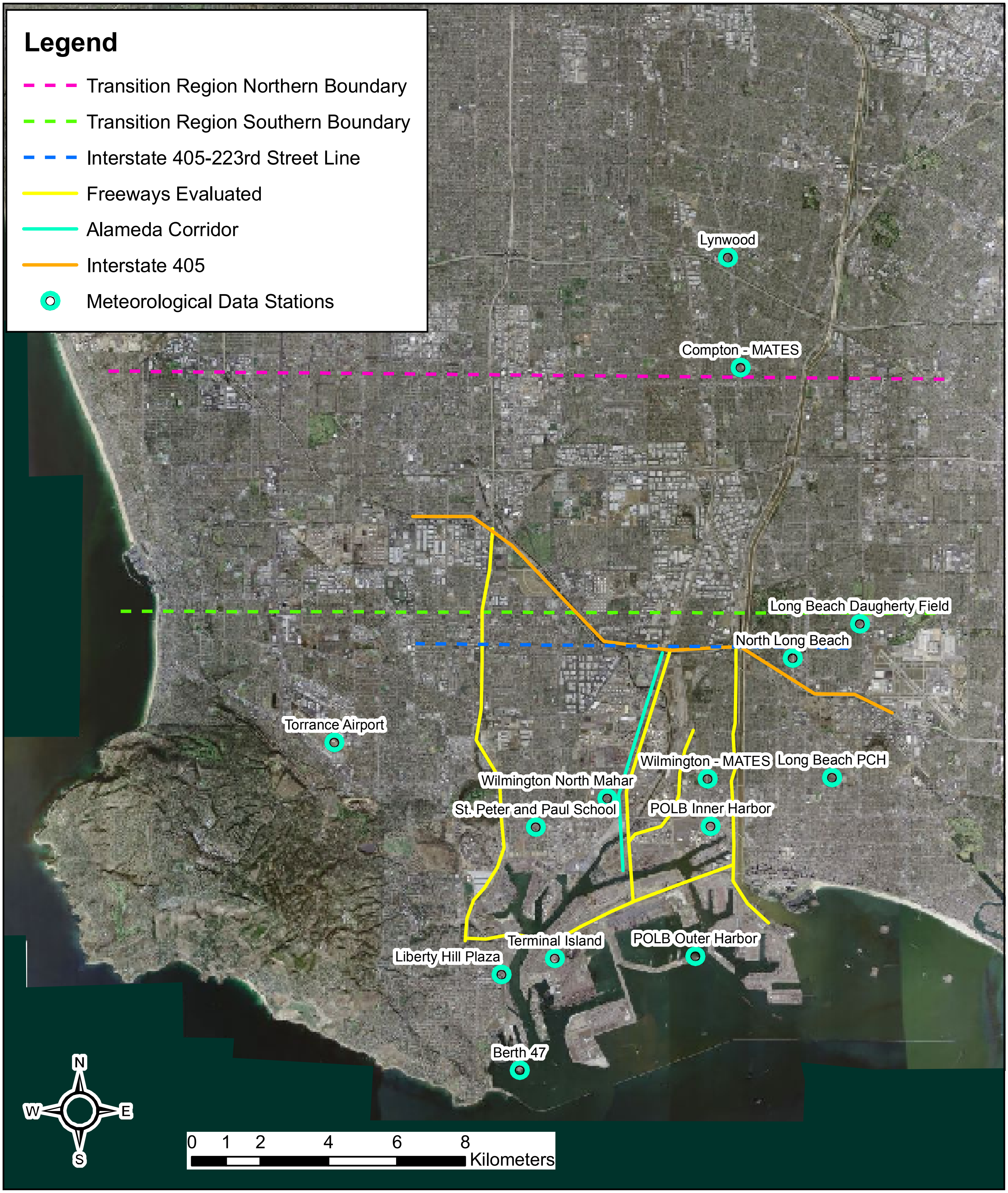
Figure I-A-5: Surface Meteorological Data Transition Region



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Appendix A:
Meteorological Data

APPENDIX A

A.1 Hourly Surface Meteorological Data Stations

When characterizing near-field air dispersion using models such as AERMOD, representative hourly surface meteorological data inputs are required in order to characterize the atmospheric transport and dispersion in the area to be studied. AERMET, the meteorological preprocessor to AERMOD, requires certain surface meteorological parameters in order to prepare an AERMOD meteorological data input file. The minimum surface meteorological parameters required include wind speed, wind direction, temperature, and cloud cover (United Staes Environmental Protection Agency [USEPA] 2004b). Station pressure is also recommended, but not required, for AERMET (USEPA 2004a). This appendix discusses the availability of such surface meteorological data, the selection criteria used to choose representative surface meteorological data for the Ports and the major freeways and rail line near the Ports, and the results of this selection methodology. The methodologies employed in this selection process were previously approved by the California Air Resources Board (ARB) for air dispersion modeling purposes at the BNSF Watson/Wilmington Rail Yard (ENVIRON 2006), located within one mile of the Ports.[1] Because cloud cover data is only available from national weather service (NWS) stations, the evaluation and treatment of cloud cover data is discussed separately in Section A.5 below.

The dominant terrain features/water bodies that may influence wind patterns in this part of the Los Angeles Basin include the Pacific Ocean to the west, the hills of the Palos Verdes Peninsula to the west/southwest and the San Pedro Bay and shipping channels to the south of the study area. Although the area in the immediate vicinity of the Ports is generally flat, these terrain features/water bodies may result in significant variations in wind patterns over relatively short distances. In order to identify meteorological data stations that may be representative of operations at the Ports and out-of-port emissions on major freeways and the major rail line extending north from the Ports, a comprehensive search was conducted to identify surface meteorological data stations in the vicinity of the Ports. Databases of meteorological stations referenced by the USEPA's Support Center for Atmospheric Modeling (SCRAM) website and available from the National Climatic Data Center (NCDC 2006a,b,c) were searched. The database of stations operated by ARB or managed by local agencies and reporting to ARB was also used (ARB 2006a). Meteorological stations that contain wind speed, wind direction, temperature, and pressure data that may be appropriate for air dispersion modeling located within a 20-km radius of the studied area include four ARB stations, two NCDC/NWS stations, two South Coast Air Quality Management District (SCAQMD) stations, four stations at the Port of Los Angeles, and two stations at the Port of Long beach. Figure I-A-1 shows the locations of the fourteen meteorological stations in the vicinity of the Ports and the freeways near the Ports. Meteorological data from the most recent five years were obtained, where available, from each

[1] Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.

of the stations identified above. For stations that had less than five years of data available, the longest possible time period for which complete data were available was used in the evaluation. Wind flow patterns at each of the stations are shown in Figure I-A-2.

A.2 Hourly Surface Meteorological Data Selection for On-Port Emission Sources

ENVIRON evaluated the fourteen meteorological stations located within a 20-km radius of the Ports with at least one year of quality-checked meteorological data to select surface meteorological data that are representative of conditions at the Ports.[2,3] ENVIRON evaluated the relative location of each station to the Ports, the data quality, and the wind patterns at each station as compared to the general wind patterns in the vicinity of the Ports when evaluating each station. ENVIRON also evaluated the data quality (e.g., completeness and quality assurance reports) and monitor siting against USEPA guidelines (USEPA 2000) based on available information. ENVIRON previously evaluated each of these stations based on criteria significant to dispersion modeling (e.g. representativeness, proximity to emissions sources, and proximity to terrain features) during the meteorological data selection process for the BNSF Watson/Wilmington Rail Yard (ENVIRON 2006), which was previously approved by ARB.[4] The remainder of this section describes the results of ENVIRON's evaluation.

From May 2001 through July 2002, ARB operated a Wilmington station (Wilmington North Mahar) as part of a Special Community Air Quality Monitoring Study (ARB 2003a). ARB used the meteorological data from this station in their diesel exhaust particulate matter (DPM) Exposure Assessment for the port area (ARB 2006a). [Note that data from the Port of Los Angeles sites were not available at the time for use in the ARB (2006a) study.] This report states that the Wilmington North Mahar station was chosen rather than the North Long Beach station because it is closer to the combined ports area and the data is more recent. It should be noted that the ENVIRON analyses described above (ENVIRON 2006) chose not to recommend the Wilmington North Mahar station because requested wind speed data for this station was provided in vector-averaged format and this format is discouraged by USEPA and ARB Memorandum of Understanding (MOU) modeling guidelines (USEPA 2000; ARB 2006b).

The Torrance Municipal Airport station, located approximately eight kilometers west of the Ports is situated at the eastern edge of the Palos Verdes Hills. The wind flow patterns at the Torrance Municipal Airport station appear to reflect channeling of the winds parallel to these hills. Therefore, the Torrance Municipal Airport station was eliminated from further consideration.

[2] The SCAQMD Lynwood and Compton-MATES stations were not evaluated as part of the meteorological data evaluation for the on-port emission sources as these stations are located more than 10 km from the Ports.
[3] The two meteorological stations operated by the Port of Long Beach – Gull Park and Super Block-east began collecting data since September 1, 2006. Current evaluation of these two stations was based on data collected between September 1, 2006 and June 30, 2007. An updated evaluation will be performed once a complete year of data has arrived for these two stations.
[4] Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.

Of the four remaining NCDC/NWS stations and ARB stations, all of the stations except the North Long Beach station exhibited a significant component of the winds (20% to 35%) blowing from the northwest. The North Long Beach Station wind rose shows only a small component of winds blowing from the northwest (approximately 3%), with predominant winds from the west and southwest. According to USEPA meteorological monitoring guidance (USEPA 2000), sensors for wind speed and wind direction should be located at a distance at least ten times the height of nearby obstructions. An inspection of photographs[5,6] of this meteorological station indicated that buildings located approximately 100 meters to the northwest of the station and 90 meters to the south/southwest of the building may be obstructing winds from the northwest and south/southwest, respectively. Figure I-A-3 shows the location of the North Long Beach station and the outline of these two buildings in the vicinity of the station. Based on this evaluation, the North Long Beach station was eliminated from further consideration.

NCDC recommended the Long Beach Daugherty Field station as the most complete NCDC station in the vicinity of the Wilmington Yard[7], located within one mile of the Ports. However, the Long Beach Daugherty Field wind rose exhibited almost twice as many hours with calm winds (approximately 28% of all hours for the five year period 2000 plus 2002 to 2005) when compared to the other stations under consideration (approximately 2% for Wilmington-North Mahar, 3% for Wilmington-Multiple Air Toxics Exposure Assessment (MATES), 4% for Long Beach-East Pacific Coast Highway, and 3% for SPPS stations). In addition, the wind speed distribution for the Long Beach Daugherty Field station appeared to show a higher frequency of high-speed winds than the other stations under consideration. Most importantly, the Long Beach Daugherty Field station is much farther from the Ports than the other stations considered in this evaluation. Therefore, wind patterns and speeds at the Long Beach Daugherty Field station are likely to be the least representative of the conditions at the Ports. Based on the station's relative distance from the Ports, the relatively high percentage of calms and higher frequency of high-speed winds at the Long Beach Daugherty Field, this station was eliminated from further consideration for all surface measurements except cloud cover.

According to SCAQMD, meteorological data collected at the Wilmington-MATES and Long Beach-East Pacific Coast Highway stations have not been quality-assured/quality-checked by ARB or SCAQMD. In addition, wind speed data for the Wilmington-MATES station were provided in vector-averaged format, which is discouraged by USEPA modeling guidelines (USEPA 2000). Because the meteorological data at these two stations have not been quality-assured, and vector-averaged format is not recommended by USEPA or ARB, the Wilmington-MATES and Long Beach-East Pacific Coast Highway stations were eliminated from further consideration.

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[5] http://www.arb.ca.gov/qaweb/photo_view.php?file=0570072-tationw.jpg&site_no=70072&date=05&caption=Looking%20West%20from%20the%20probe.

[6] http://www.arb.ca.gov/qaweb/photo_view.php?file=0470072-stations.jpg&site_no=70072&date=04&caption=Looking%20South%20from%20the%20probe.

[7] Personal Communication. William Brown of NCDC by telephone to C. Mukai of ENVIRON on May 5, 2006.

Four air quality monitoring stations operated by the Port of Los Angeles collect meteorological data in the vicinity of the Port of Los Angeles (POLA) as part of the POLA Terminal Improvement Project monitoring program.[8] The Port of Long Beach also operates two meteorological stations.[9] The wind flow patterns at each of these six meteorological monitoring stations are displayed as period-average wind roses in Figure I-A-4. The period-average wind roses for the four POLA stations are based on the most complete one year of data since the stations began operating in 2005. The period-average wind roses for the two Port of Long Beach (POLB) stations are based on data collected between September 1, 2006 and June 30, 2007. There may be differences once a full year of data have been collected due to potential seasonal differences. As shown in Figure I-A-4, the “SPPS”, “TITP”, “Liberty Hill Plaza”, “Super Block” stations are all located in the central or northern area of the harbor. The SPPS, TITP, and Super Block stations are located on flat terrain, and wind patterns at these stations may be representative of winds at Port leaseholders inland or in the mid-harbor. The “Liberty Hill Plaza” station, located on the eastern edge of the Palos Verdes Hills, may be representative of winds at Port leaseholders very close to this station.

Two other potentially important stations are the Port of Los Angeles “Berth 47” station, and the Port of Long Beach “Gull Park” station, which are both situated in the outer harbor and may be representative of meteorology affecting plumes of ships entering and leaving the port. Outer harbor wind patterns are very different than wind patterns closer to the port-area and port-area receptors. As seen in Figure I-A-4, the wind rose for Berth 47 indicates different wind patterns than those at the other four Port of Los Angeles and Port of Long Beach stations but similar to the Port of Long Beach Gull Park Station. Specifically, the wind rose indicates that patterns characterized by higher wind speeds and less variation in direction than patterns further inland. Further discussion of these two stations is provided in Section A.4

Based on the ENVIRON’s review of available meteorological data near the Ports, discussed above and in ENVIRON’s meteorological analysis for the BNSF Wilmington Yard (ENVIRON 2006), six meteorological stations were selected as candidates to represent meteorological conditions for on-Port sources:

- Port of Los Angeles- SPPS
- Port of Los Angeles-Liberty Hill Plaza
- Port of Los Angeles- TITP
- Port of Los Angeles-Berth 47
- Port of Long Beach-Gull Park
- Port of Long Beach-Super Block

[8] Los Angeles Harbor Department. http://www.portoflosangeles.org/AQ_Monitoring/Workplan.pdf
[9] Port of Long Beach. http://www.polb.com/environment/air_quality/air_monitoring.asp

A.3 Hourly Surface Meteorological Data Selection for Land-Side Out-of-Port Emission Sources

Due to the increase in air dispersion modeling uncertainty associated with the use of multiple meteorological stations with different predominant wind directions, ENVIRON evaluated the geographical area over which Port-representative meteorological data (e.g., data from SPPS and TITP) were also representative of out-of-port emissions from trucks on major freeways (i.e., Interstates 110 and 710 and Highways 47 and 103) and the major rail line (i.e., the Alameda Corridor) extending north from the Ports. As part of this evaluation, two additional stations north of the Ports, Compton-MATES and Lynwood, operated by SCAQMD, were identified and evaluated in addition to the twelve meteorological stations described above. The period-average wind roses for Lynwood and Compton-MATES stations are displayed in Figure I-A-2.

As discussed above, the dominant terrain features/water bodies that may influence wind patterns in this part of the Los Angeles Basin include the Pacific Ocean to the west, the hills of the Palos Verdes Peninsula to the west/southwest, and the San Pedro Bay and shipping channels to the south. As indicated in Figure I-A-2, the meteorological data stations to the west of the Palos Verdes Hills and within approximately 5 kilometers of the San Pedro Bay (i.e., SPPS, TITP, Wilmington-North Mahar, Wilmington-MATES, Long Beach-East Pacific Coast Highway, and Long Beach Airport) generally exhibit predominant winds from the northwest and from the south or southeast. The consistency of the predominant winds among these stations indicate that the Palos Verdes Hills are channeling the winds from the northwest and that the San Pedro Bay and shipping channels influence the winds from the south and southeast. As discussed above, other nearby stations that do not show these patterns may be influenced by additional factors. For instance, the Torrance Airport station is located within one kilometer (km) of the Palos Verdes Hills and on the north side of the hills (i.e., the influence of the San Pedro Bay is blocked by the hills), thus the predominant winds are only from the northwest. The Berth 47 station is located at the southern tip of the POLA, where the winds appear to be heavily influenced by the San Pedro Bay and predominant winds are from the southwest. At the North Long Beach station, two buildings located to the northwest and south/southwest of the buildings may be obstructing winds from these directions, as described in Section A.2.

As indicated in Figure I-A-2, the Lynwood and Compton-MATES stations, located further to the north and out of the region of influence of the both the Palos Verdes Hills and the San Pedro Bay, exhibit different wind patterns than those stations that are within approximately 10 kilometers of these terrain features/water bodies. The predominant wind directions at these two stations are from the west and southwest, indicating that on-shore flow is the dominant influence on the wind patterns in the area around these stations.

As indicated in Figure I-A-2, there is a large geographical area between the Long Beach area meteorological stations, which exhibit predominant winds from the northwest and south/southeast, and the Lynwood and Compton-MATES meteorological stations which exhibit predominant winds from the west and southwest, where there are no meteorological data stations. Thus, the transition region where wind patterns shift from the northwest and south/southeast (i.e., in the Long Beach area) to the west/southwest (i.e., the Compton/Lynwood area) is currently not well defined. However, the locations of the meteorological data stations, aerial photographs, and topographical maps may be used to approximate the northern and southern extents of this transition region. As shown in Figure I-A-5, the southern boundary of this transition region may be approximated by the Long Beach Airport meteorological data station (i.e., just to the north of the north edge of the Palos Verdes Hills), and the northern boundary of the transition region may be approximated by the location of the Compton-MATES meteorological station. The boundaries of this transition region are likely conservative (i.e., the transition region is likely not as wide as indicated in Figure I-A-5).

As discussed above, due to the absence of surface meteorological data stations between the northern edge of the Palos Verdes Hills and the City of Compton, a more precise determination of the area over which the predominant wind directions change cannot be made. Therefore, ENVIRON has assumed that a shift in wind patterns likely occurs in a transition area north of the approximate east-west line created by Interstate 405 and 223rd Street in the northern part of Long Beach (see Figure I-A-5). Because all of the Long Beach area stations indicate the same general wind patterns (i.e., predominant winds from the northwest and south/southeast), and due to the data quality issues identified for most of the other stations identified in Section A.2, ENVIRON has assumed that the Port of Los Angeles-SPPS meteorological station or Port of Long Beach-Super Block may be used as a representative meteorological data set for the out-of-Port truck emissions on major freeways and locomotive emissions on the Alameda Corridor to the south of the east-west line approximated by Interstate 405 and 223rd Street in the northern part of Long Beach.

A.4 Hourly Surface Meteorological Data Selection for Ocean-Side Emission Sources

ENVIRON also evaluated off-shore meteorological stations which might be representative of ocean-side emission sources. The stations considered in this evaluation were the Berth 47 Station, located at the southern tip of the Port of Los Angeles in the outer harbor, the Santa Monica Station, located in open ocean approximately 70 kilometers west of the Ports, and the Avalon Catalina Airport, located on Catalina Island as shown in Figure I-2. Figure I-4 shows wind flow patterns for these three stations. As discussed in section A.3, the Berth 47 station appears to be strongly influenced by the San Pedro Bay. The wind patterns observed there differ in both characteristic direction and wind speed from the nearby stations further inland and are characterized by higher wind speeds and directional consistency. The wind rose for the Avalon Catalina station also indicates high wind speeds generally blowing from west-south-west. Although five years of meteorological data were available from the Avalon Catalina Airport Station, the data do not meet the minimum completeness criteria for air dispersion modeling purposes. However, the wind-rose for the Avalon Catalina Station confirms that the Berth 47 wind patterns are representative of those seen by ocean-side sources between Catalina Island and the Ports. An examination of the wind-rose for the Santa Monica Station indicates that the wind is more variable in direction than the pattern at the Berth 47 Station with a higher frequency of winds blowing parallel to or away the shoreline. Since the Santa Monica Station has a higher frequency of winds that are parallel or away from the shoreline, air dispersion modeling using meteorological data from the Santa Monica Station may result in lower concentrations at over-land receptors. In addition, the Santa Monica station is far from the Ports. However, the higher wind speeds at this buoy confirms the expectation of higher wind speeds in the area outside of the Ports breakwater. In cases in which the modeling domain extends into the area near to this buoy, further project-specific consideration could be given to this station. Based on the above evaluation, ENVIRON selected the Port of Los Angeles Berth 47 station as representative of the wind patterns at off-shore locations outside of the Ports breakwater.

A.5 Cloud Cover Data Selection

In general, most non-NWS stations do not collect cloud cover, but AERMET, the meteorological preprocessor to AERMOD, requires cloud cover data. Therefore, since cloud cover data was not available for the station identified as the most representative for the Ports area in the other required surface parameters, the nearest available cloud cover data from an NWS station was selected for use. The substitution of data from a nearby NWS station into an incomplete set of otherwise more representative data is an option in the AERMET preprocessor algorithm (USEPA 2004a). In addition, substitution of nearby cloud cover data was approved by ARB.[10]

The nearest NCDC/NWS stations with available cloud cover data are located at Torrance Airport and Long Beach Daugherty Field. Figure I-A-1 shows the locations of these two stations with respect to the Ports area. The Long Beach Daugherty Field station is located approximately twelve kilometers to the northeast of the Ports, and the Torrance Municipal Airport station is located approximately ten kilometers to the northwest of the Ports at the eastern edge of the Palos Verdes Hills. Due to the potential for coastal fog conditions and the effects of the Palos Verdes Hills at the Torrance Airport, measurements of cloud cover at Long Beach Daugherty Field are likely more representative of cloud cover conditions in the vicinity of the Ports. NCDC also recommended the use of surface meteorological data from Long Beach Daugherty Field over Torrance Municipal airport due to the completeness and quality of the Long Beach Daugherty Field data.[11] Based on NCDC's recommendation and the potential for coastal fog conditions at the Torrance Municipal Airport, cloud cover data from the Long Beach Daugherty Field station should be merged with the surface data from the surface meteorological data stations identified above.

[10] Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.
[11] Personal communication. William Brown of NCDC by telephone to Catherine Mukai of ENVIRON. 2006.

A.6 References

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Attachment II:

Surface Parameter Analysis for Berth 47 Surface Meteorological Station

Attachment II:

Surface Parameter Analysis for Berth 47 Baseline Bay-Wide Regional Human Health Risk Assessment for Diesel Exhaust Particulate Matter (DPM)

Contents

ACRONYMS and ABBREVIATIONS

AERMET	AERMOD Meteorological Preprocessor
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
ARB	Air Resources Board
BWHRA	Bay-Wide Health Risk Assessment
Ports	Port of Los Angeles and Port of Long Beach
USEPA	US Environmental Protection Agency
USGS	United States Geological Survey

1 Introduction

AERMOD requires a meteorological input file to characterize the transport and dispersion of pollutants in the atmosphere. Surface and upper air meteorological data inputs as well as surface parameter data describing the land use and surface characteristics near the site are first processed using AERMET, the meteorological preprocessor to AERMOD. The output file generated by AERMET is the meteorological input file required by AERMOD. Details of AERMET and AERMOD meteorological data needs are described in USEPA guidance documents (United States Environmental Protection Agency [USEPA] 2004a,b). This attachment describes one key aspect of the AERMET analysis for Berth 47: the surface parameter evaluation. ENVIRON proposes to modify standard USEPA guidance (USEPA 2004a) to account for a several orders-of-magnitude change in surface roughness for shoreline meteorological stations as described in "Wind Flow and Vapor Cloud Dispersion at Industrial and Urban Sites" (Hanna and Britter 2002). This proposed modification would be applied only to Berth 47 (and Gull Park when sufficient data are available) as other Port of Los Angeles and Port of Long Beach (collectively referred to as the Ports) stations are sufficiently inland from a clear water/land interface.

Due to the large difference in surface parameters between water and land, the use of meteorological data from stations located near the shoreline may require a more detailed land use analysis than for a station in a more homogenous area, as described in Hanna and Britter (2002). The division of the surface parameter analysis area into radial sectors does not account for transitions in surface parameters that occur normal to the sector boundaries. In such cases, applying a distance weighted average based on zones defined in the radial direction from the meteorological station can result in surface roughness estimates which, when used for dispersion modeling applications, produce more representative results. In practice, changes of several orders of magnitude in surface roughness most frequently occur in transitions between water and land. In the AERMOD model, land-use analysis is also performed such that concentrations estimated in a sector downwind of a source are based on surface characteristics upwind from the source. However, for shoreline sources, the assignment of surface parameters to such a mixed-use sector containing significant amounts of both land and water based on upwind surface characteristics can significantly over or under predict concentrations depending on the configuration of the land-use, sources, and receptors. The approach adopted in by Hanna and Britter (2002) only includes the effects of roughness downwind of the source, because the distance to achieve a new equilibrium boundary layer is typically much less than distances of interest.

2 Surface Parameter Evaluation Methodology

Prior to running AERMET, it is necessary to specify the surface characteristics for the meteorological monitoring site and/or the project area. The surface parameters include surface roughness, Albedo, and Bowen ratio, and are used to compute fluxes and stability of the atmosphere (USEPA 2004a) and require the evaluation of nearby land use and temporal impacts on these surface parameters. USEPA (2005) and Air Resources Board (ARB) recommend use surface parameters specified for the area surrounding the meteorological monitoring site, rather than the project area, for AERMET. However, an analysis may be necessary to determine whether the area surrounding the meteorological monitoring site is representative of the area surrounding the project area. Because the Berth 47 meteorological station is within the boundary of the Outer Harbor Zone of the Ports, where its surface meteorological data are determined to be representative, the area surrounding the meteorological station overlaps with the area surrounding project area. In addition, the land use pattern surrounding the Berth 47 station is very similar to the land use pattern in the Outer Harbor Zone. Therefore, surface parameters calculated for the Berth 47 meteorological station should be representative of many areas in the Outer Harbor Zone.

In general, ENVIRON determined radial land-use sectors around the meteorological monitoring site using United States Geological Survey (USGS) land cover maps in conjunction with recent aerial photographs. ENVIRON then specified surface parameters for each sector using default seasonal values adjusted for the local climate as allowed under USEPA guidance (USEPA 2004a). When a radial land-use sector consisted of multiple land-use types, ENVIRON, in general, used an area-weighted average of each surface parameter as recommended by USEPA (2004a) with a few exceptions as noted below. Because of the meteorological monitoring station's proximity to the shoreline, ENVIRON made additional considerations of the appropriateness of using default methods in assigning surface roughness to radial sectors surrounding the facility. The locale-specific surface parameters used in this evaluation were described in an ENVIRON report to ARB (ENVIRON 2006).

Table 1 gives land use type breakdown surrounding the Berth 47 Met Station. Urban and water land uses contribute to over 99% of the land use in the surrounding area (3-kilometer [km] buffer):

Table 1: Land Use Surrounding Berth 47 Met Station

US EPA Class (Grid Code)	Land Use	AREA (m2)	% of Total
4	Desert Shrubland	63,095	0.22%
5	Grassland	69,490	0.25%

Table 1: Land Use Surrounding Berth 47 Met Station			
US EPA Class (Grid Code)	**Land Use**	**AREA (m2)**	**% of Total**
7	Swamp	125,365	0.44%
8	Urban	11,337,630	40.08%
9	Water	16,690,399	59.01%
Sources: USGS 2007, USEPA 2004a			

Table 2 displays the surface roughness characteristics by land use type. Urban and water are most predominant around the Outer Harbor Zone of the Ports, and do not vary by season:

Table 2: Surface Roughness Characteristics by Land Use Type				
Land Use	**Surface Roughness**			
	Spring	**Summer**	**Summer/Autumn**	**Autumn**
Coniferous Forest	1.3	1.3	1.3	1.3
Cultivated Land	0.03	0.2	0.13	0.05
Deciduous Forest	1	1.3	1.05	0.8
Desert Shrubland	0.30	0.30	0.30	0.30
Grassland	0.05	0.1	0.06	0.01
Mixed Forest	1.150	1.300	1.175	1.050
Swamp	0.2	0.2	0.2	0.2
Urban	1	1	1	1
Water	0.0001	0.0001	0.0001	0.0001
Sources: USEPA 2004a				

In general, USEPA-default land-use analysis is performed such that concentrations estimated in a sector downwind of a source are based on surface characteristics upwind from the source. However, for shoreline sources, sectors can be comprised of both land and water, where land-use types can vary by as much as three orders of magnitude in surface roughness as evidenced by Table 1 above. The assignment of surface parameters to such a mixed-use sector containing significant amounts of both land and water based on upwind surface characteristics can significantly over- or under-predict concentrations depending on the configuration of the land-use, source, and receptors (ENVIRON 2007). The approach adopted in Hanna and Britter (2002) only includes the effects of roughness downwind of the source, because the distance to achieve a new equilibrium boundary layer is typically much less than distances of interest, as is the case for the Bay-Wide Health Risk Assessment (BWHRA) where the modeling domain is 20 km by 20 km. Thus, for the Berth 47 Met Station, ENVIRON modified USEPA guidance and performed an evaluation of the assignment of upwind or downwind land-use patterns for each sector as recommended by Hanna and Britter (2002) to account for this physical factor.

Figure 1 shows the sectors ENVIRON defined around the Berth 47 Station for use in the AERMET processing and the USEPA land-use types within each sector. Before assigning surface parameters for each sector, ENVIRON evaluated the appropriateness of using land-use characteristics upwind of the source for estimating concentrations downwind of the source:

- **Sector 5:** Concentrations estimated in Sector 5 are based on winds flowing from Sector 2. Sector 2 is almost all water while Sector 5 is almost entirely urban in land use. Since the surface roughness differences between the upwind and downwind sectors are potentially more than two orders of magnitude in difference, concentrations in Sector 5 could be significantly overestimated if concentrations in these sectors were estimated using land-use upwind of the source. Thus, land-use characteristics for concentrations estimated for Sector 5 are based on land-use downwind of the source using the methodology of Hanna and Britter (2002).
- **Sectors 2 and 3:** Concentrations estimated in Sectors 2 and 3 are based on winds flowing from the Sectors 5 and 6, respectively. Sector 5 is almost entirely urban in land use while Sector 2 is almost all water. Sector 6 also has significant portion of land while Sector 3 is almost all water. Using land-use parameters upwind of the source to calculate concentrations at receptors downwind of the source could inappropriately take into account the amount of land in Sectors 5 and 6 and thus under-predict concentrations at potentially water-based receptors. Hence, land-use parameters downwind of the source are used to calculate concentrations at receptors in Sectors 2 and 3 using the methodology of Hanna and Britter (2002).
- **Sector comprised of Sub-sectors 6a through 6o [Assuming Hanna and Britter Distance-Weighted Analysis]:** Concentrations estimated in Sector 6 are based on winds flowing from Sector 3. Sub-sectors 6a through 6o have significant portions of land while Sector 3 is almost entirely water. Since the surface roughness differences between the upwind and downwind sectors are significant, concentrations in Sector 6 could be overestimated if concentrations in these sectors were estimated using land-use upwind of

the source. Thus, land-use characteristics for concentrations estimated for Sector 6 are based on land-use downwind of the source using the methodology of Hanna and Britter (2002). In addition, receptors representing populations being evaluated in the BWHRA are likely to be located beyond the outer parts of Sector 6. Winds going to this portion will have traveled over a significant stretch of land before reaching these receptors. Thus using downwind surface parameters for these receptors would take into account the land characteristics that the wind would travel across before reaching the receptors, as per the Hanna and Britter method (2002) discussed above.

- **Sectors comprised of Sub-sectors 1a through 1o, and Sub-sectors 4a through 4o [Assuming Hanna and Britter Distance-Weighted Analysis]:** Concentrations estimated in Sectors 1 and 4 are based on winds flowing from the Sectors 4 and 1, respectively. Land-use in Sector 1 and 4 are somewhat similar, with a stretch of water close to the center of the 3-km radius, a significant portion of in the middle of the sector, and area of water at the outer part of the sector. However a closer investigation revealed that the stretch of water close to the center of the 3-km radius in Sector 1 extends much further than that in Sector 4. Thus winds going to Sector 1 will have traveled over longer distance of water before reaching the receptors compared to Sector 4. Therefore using land-use characteristics downwind for these receptors would take into account the land-use characteristics that the wind would travel across before reaching the receptors, as per the Hanna and Britter method (2002) discussed above.

Another consideration made for the Berth 47 Met Station is that the division of the project area into radial sectors does not account for transitions in surface parameters that occur normal to the sector boundaries. Specifically, analyses of the effect of cross-wind transitions in surface roughness [the surface parameter that can influence AERMOD predicted airborne concentrations most significantly (ENVIRON 2005; Long et al. 2004)], indicate that changes more than two orders of magnitude (e.g., transitions between water and land) can result in significant over-estimates or under-estimates of concentrations (Hanna and Britter 2002). As discussed above, applying a distance-weighted average based on zones defined in the radial direction from the project area can result in surface roughness estimates which, when used for dispersion modeling applications, produce more representative results. The sectors comprised of sub-sectors 1a – 1o, 4a – 4o, and 5a – 5o are the three sectors in this analysis that have a significant transition in surface parameters that occurs normal to the sector boundaries and contains receptors such that concentrations predicted would be significantly impacted by this arrangement (i.e. downwind receptors). Thus, ENVIRON employed a distance-weighted average for the calculation of the surface roughness for these sectors using the methodology suggested by Hanna and Britter (2002) for sectors with surface roughness that varies a few orders of magnitude in the radial direction. Distance-weighting is not required for sectors that are relatively homogeneous or do not have surface roughness varying by a few orders of magnitude, as is the case for Sectors 2, 3, and 5 shown in Figure II-1.

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Appendix B:

Air Dispersion Modeling Supplemental Information

Appendix B:
Air Dispersion Modeling Supplemental Information

Contents

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ACRONYMS and ABBREVIATIONS

AERMET	AERMOD Meteorological Preprocessor
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
ARB	Air Resources Board
BWHRA	Bay-Wide Health Risk Assessment
CEQA	California Environmental Quality Act
CHE	Cargo Handling Equipment
DEM	Digital Elevation Maps
DPM	Diesel Particulate Matter
HDV	Heavy-duty Vehicle
HRA	Health Risk Assessment
MSA	Metropolitan Statistical Area
NAS	Naval Air Station
NED	National Elevation Dataset
NRC	National Research Council
NWS	National Weather Service
OGV	Ocean-going Vessels
POLA	Port of Los Angeles
POLB	Port of Long Beach
PMI	Point of Maximum Impact
Ports	Port of Los Angeles and Port of Long Beach
SCAQMD	South Coast Air Quality Management District
SPPS	St. Peter and Paul School
Starcrest	Starcrest Consulting, LLC
TITP	Terminal Island Treatment Plant
TWG	Technical Working Group
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

1 Air Dispersion Modeling Supplemental Information

The Bay-Wide Health Risk Assessment (BWHRA) Tool is based on a Protocol developed specifically for this assessment (Appendix A), which describes the methodology that is used in the BWHRA Tool. Some details that were not available at the time the Protocol was developed, but which are necessary for the air dispersion modeling are discussed in this Appendix. In addition, deviations from the Protocol document are discussed briefly in Section 3 of the main report with further details provided in this Appendix. Finally, key uncertainties and crucial assumptions associated with the air dispersion modeling are discussed in this Appendix.

This Appendix includes details not included in the main report or the Protocol on source characterization and parameters, source placement (including variations between 2005 and 2020), temporal emission factors, terrain, and meteorological data requirements. This Appendix also includes a brief discussion of recent changes in AERMOD guidance and their potential impact on the BWHRA Tool results.

1.1 Source Characterization and Parameters

1.1.1 Description of Source Allocation

ENVIRON used information provided by Starcrest Consulting, LLC (Starcrest) and the Port of Los Angeles and Port of Long Beach (collectively referred to as the Ports) in order to spatially allocate the different emissions sources into configurations that are appropriate for the air dispersion modeling. The following is a summary of the spatial allocations and parameters used for each source group. The allocation for each source group is based on spatial information provided by Starcrest, which ENVIRON evaluated and confirmed with aerial photos. Table B-1 shows the specific source parameters (depending on the modeled source type these can include the following: stack heights, release heights, initial vertical dimension, initial lateral dimension, temperature, exit velocity, and diameter) used for each source category. Figures B-1 through B-23 present locations of the points/volumes/areas representing each source category in the air dispersion model for both the 2005 and 2020 scenarios.

1.1.1.1 Ocean-Going Vessel

OGV – At Berth (Figure B-1)

The coordinates of the ocean-going vessel (OGV) berth locations were provided by Starcrest. The berth locations are all located within the Ports' harbors adjacent to land. ENVIRON used point sources to represent this stationary emissions source group. Source parameters are based on the California Air Resources Board (ARB) exposure assessment of the Ports (ARB 2006a).

OGV – Anchorage (Figures B-2)

ENVIRON used area sources to represent the OGV anchorage areas provided by Starcrest. These areas are located south and slightly east of the central Ports area. Source parameters are based on typical parameters for ships based on the ARB exposure assessment of the Ports (ARB 2006a)[1]. Initial vertical dimensions were calculated based on the release heights following AERMOD guidance for an elevated source not on or adjacent to a building.

OGV – Maneuvering (Figures B-3, B-4)

ENVIRON used consecutive volume sources to represent the OGV maneuvering emissions from the Starcrest-provided maneuvering paths within the Ports. The volume sources serve the function of line sources in AERMOD. Following ARB guidance (2006a), ENVIRON spaced volume sources 160 meters apart throughout the in-Port maneuvering paths. For narrow maneuvering paths, volume sources are reduced in size to fit the channel widths and 160-meter spacing was retained. Other source parameters are also based on the ARB exposure assessment of the Ports (ARB 2006a).

OGV – Transit (Figures B-5, B-6)

As with maneuvering sources, ENVIRON used consecutive volume sources to represent the OGV transit emissions from the Starcrest-provided shipping lanes outside of the Ports. Following ARB guidance, ENVIRON spaced volume sources 800 meters apart throughout the shipping lanes. Other source parameters are also based on the ARB exposure assessment of the Ports (ARB 2006a).

1.1.1.2 Harborcraft

Harborcraft – Maneuvering (Figures B-7, B-8)

ENVIRON used consecutive volume sources to represent the harborcraft maneuvering emissions from the Starcrest-provided maneuvering paths within the Ports. Following ARB guidance, ENVIRON spaced volume sources 160 meters apart throughout the in-Port maneuvering paths. For narrow maneuvering paths, volume sources are reduced in size to fit the channel widths and 160-meter spacing was retained. Other source parameters are also based on the ARB exposure assessment of the Ports (ARB 2006a).

Harborcraft – Transit (Figures B-9, B-10)

As with maneuvering sources, ENVIRON used consecutive volume sources to represent the harborcraft transit emissions from the Starcrest-provided shipping lanes outside of the Ports. Following ARB guidance, ENVIRON spaced volume sources 800 meters apart throughout the shipping lanes. Other source parameters are also based on the ARB exposure assessment of the Ports (ARB 2006a).

[1] OGV anchorage was not modeled for the ARB exposure assessment of the Ports. ENVIRON instead used source height for OGV maneuvering sources modeled in the ARB assessment.

Harborcraft – Area (Figures B-11 through B-13)

Certain types of harborcraft vessels do not travel in defined shipping lanes, rather these vessels can travel in a broad areas surrounding the ports. Starcrest-provided ENVIRON with specific areas over which these harborcraft vessels can operate. ENVIRON conservatively modeled these sources as area sources due to the undefined nature of their travel. The release height for the vessels is also provided by ARB (2006a). Initial vertical dimensions are calculated based on the release heights following AERMOD guidance for an elevated source not on or adjacent to a building.

1.1.1.3 Rail

Rail – Off-Port, Port of Los Angeles (POLA) On-Port, Port of Long Beach (POLB) On-Port (Figures B-14 through B-16)

ENVIRON used consecutive volume sources to represent the off-port and on-port rail emissions from the Starcrest-provided rail segments. When the given rail segments pass over an area with multiple separated rail tracks, volumes are placed over the individual tracks so as not to include the non-rail activity spaces between tracks. However, when the given rail segments pass over an area with multiple adjacent rail tracks with only small separation between tracks, a single set of larger volumes is used to cover the entire activity area.

The sizing and spacing of volume sources varied between rail segments. ENVIRON used volume sources sized to visually fit the width of the tracks and determined the spacing based on the volume sizes. Volumes are spaced a minimum of 50 meters apart, with spacing increasing in 25-meter increments above 50 meters. Each rail segment had constant spacing between volume sources although spacing varied between different segments. Thus, the spacing for each segment is determined by the largest volume source in that segment so that no sources overlapped.

ENVIRON based the release height on the ARB exposure assessment of the Ports (ARB 2006a). The initial vertical dimension is calculated based on the release height following AERMOD guidance for an elevated source not on or adjacent to a building. Following previous ENVIRON reports submitted to ARB, ENVIRON used a conversion factor of 4.3 to calculate the initial vertical dimension. Initial lateral dimensions are also calculated based on volume size divided by 4.3 following AERMOD guidance for a single volume source.

1.1.1.4 On-Road Heavy-Duty Vehicles

Off-Port and On-Port Road (Figures B-17 through B-19)

ENVIRON used consecutive volume sources to represent the off-port and on-port on-road Heavy-duty Vehicle (HDV) emissions from the Starcrest-provided road segments. When the given road segments pass over an area with multiple separated roads, volumes are placed over the individual roads so as not to include the non-activity spaces between roads. However, when the given road segments included multiple vehicle lanes, a single set of larger volumes is used to cover the entire activity area.

The sizing of volume sources varies between road segments such that volume sources visually fit the widths of the roads. All volumes were spaced 50 meters apart. Release heights were provided by Starcrest. The initial vertical dimensions are calculated based on the release height following AERMOD guidance for an elevated source not on or adjacent to a building. Initial lateral dimensions are also calculated based on volume size divided by 4.3 following AERMOD guidance for a single volume source.

1.1.1.5 Cargo Handling Equipment and On-Terminal Heavy-Duty Vehicles

CHE and On-Terminal HDV (Figures B-20 through B-23)

ENVIRON used area sources to represent the Cargo Handling Equipment (CHE) and HDV on-terminal activities. Terminal areas and specific CHE types and release heights were provided by Starcrest. The release height for the on-terminal HDV was also provided by Starcrest. Initial vertical dimensions are calculated based on the release heights following AERMOD guidance for an elevated source not on or adjacent to a building.

2 Source Placement

As described in Section 3 of the report, ENVIRON defined four geographic areas over which the emissions sources operate – Inner Harbor Zone, Middle Harbor Zone, Outer Harbor Zone, and Beyond Breakwater Zone. ENVIRON conducted an in-depth analysis to select specific meteorological dataset for each of the four zones. A detailed description of the approach used to divide the Ports' operational areas into four zones over which individual meteorological stations are applicable is provided in the Sphere of Influence Report included as Attachment I of Appendix A of this report. Sources are then assigned to the areas representing the inner, middle, outer, and beyond breakwater meteorological zones. Sources that fall completely within one zone are assigned to that zone for modeling. If a source falls within multiple zones, ENVIRON uses a "90/10 percent" rule to determine how to assign the source to meteorological zones. The "90/10 percent rule" states that if the length/area of a source within a meteorological zone is less than 10 percent of the length/area of the entire source, this source is assigned to the same meteorological zone as the other 90%; otherwise the source is split at the border of the multiple zones and sub-segments of the source is modeled separately using different meteorological data.

3 Variation of Source Allocation between 2020 And 2005

3.1 Description of Spatial Changes from 2005 to 2020

Sources are assumed to have identical spatial allocation for both the 2005 and 2023 scenarios except for a few specific land changes associated with the following anticipated projects:

- Cruise Terminal upon entering the Port of Los Angeles (POLA)
- Pacific Energy marine Oil Terminal (POLA)
- China Shipping Addition (POLA)
- Vopak (Port of Long Beach, POLB)
- Pier S (POLB)
- Middle Harbor (Pier D, E, F) (POLB)
- Pier G (POLB)
- Pier J (POLB)
- Pier A (POLB)

In 2020, there are no significant spatial changes for rail (POLA, POLB, and off-port), on-road heavy-duty vehicles (on- and off-port), harborcraft transiting, ocean-going vessels transiting, and ocean-going vessels anchorage. For the sources that did change, this document describes the source spatial changes that result from expected additions, removals, expansions, and reductions of 2005 emissions sources in 2020. ENVIRON received all 2020 spatial allocations from Starcrest; this document describes the changes assumed based on ENVIRON's comparison of the 2020 and 2005 spatial allocations.

3.1.1 Ocean-Going Vessels

OGV – At Berth

The OGV berth locations are expected to change between 2005 and 2020, in part due to physical changes in the Port configurations. Figure B-1 shows these changes.

OGV – Maneuvering

The in-port OGV maneuvering paths are expected to change substantially between 2005 and 2020, in part due to physical changes in the Port configurations. For POLB, a maneuvering path travels through the POLA terminals to reach some POLB terminals. Figures B-3 and B-4 show these changes.

3.1.2 Harborcraft

Harborcraft – Maneuvering

The in-port harborcraft maneuvering paths are expected to change substantially between 2005 and 2020, in part due to physical changes in the Port configurations. For POLB, a maneuvering path travels through the POLA terminals to reach some POLB terminals. Figures B-7 and B-8 show these changes.

Harborcraft – Operating Areas

The harborcraft operating area beyond 50 miles from the port did not change between 2005 and 2020. The operating areas up to 50 miles from the port changed minimally, with a slight reduction in area within the port property. This is due to reconfigurations at POLB. Figures B-11 through B-13 show these changes.

3.1.3 Cargo-Handling Equipment and On-Terminal Heavy-Duty Vehicles

CHE and On-Terminal HDV

The cargo handling operating areas and on-terminal HDV areas changed due to reconfigurations. Figures B-20 through B-23 show these changes.

4 Temporal Emission Factors

Temporal emission factors are used to represent differences in the amount of emissions that occur at different hours or days for a given activity. This allows one to allocate the total emissions according to different times of the day. This is important since meteorological parameters can vary significantly depending on the time of day. ENVIRON observed that for all three stations used in the BWHRA Tool, wind speeds are significantly higher during the daytime hours between 6am and 6pm. The lower wind speeds at night means that there is less dispersion of pollutants and thus higher concentrations close to the emissions sources. During the day, however, higher wind speeds disperse pollutants farther from the sources.

Predominant wind directions also affect the spatial characteristics of concentration profiles. Main wind directions do not vary much at Berth 47, but are significantly different between day and night at the Saint Peter Paul School (SPPS) and Terminal Island Treatment Plant (TITP) stations. Pollutant concentrations will typically move in different patterns during the day and the night because of these wind direction differences. The temporal emission factors allow for more accurate concentration estimates by matching emissions weighting with the different day and night wind speed and direction patterns.

Original temporal emission factors for each source group were provided by ARB (2006a). ENVIRON scaled these proportionally so that the factors summed to 24 hours each day and averaged to 1. The resulting temporal emission factors used in the models are shown in Table B-2.

5 Meteorological

AERMOD requires a meteorological input file to characterize the transport and dispersion of pollutants in the atmosphere. Surface and upper air meteorological data inputs as well as surface parameter data describing the land use and surface characteristics near the site are first processed using AERMOD Meteorological Preprocessor (AERMET), the meteorological preprocessor to AERMOD. The output file generated by AERMET is the meteorological input file required by AERMOD. Details of AERMET and AERMOD meteorological data needs are described in United States Environmental Protection Agency (USEPA) guidance documents (USEPA 2004a,b). Since the meteorological data selection and processing methods described in the BWHRA Protocol and the Sphere of Influence Report included as Appendix A of this report, the remainder of this section only briefly describes the following two key aspects of the AERMET analysis: the surface and upper air meteorological data selected and the surface parameter evaluation for BWHRA Tool.

5.1 Surface and Upper Air Meteorological Data

The focus of the Health Risk Assessment (HRA) is the characterization of risk in the areas immediately surrounding the Ports and major freeways (i.e., Interstates 110 and 710 and Highways 47 and 103) and rail line (i.e., the Alameda Corridor) extending from the Ports north to approximately Interstate 405. As such, ENVIRON selected meteorological data for air dispersion modeling based upon their spatial and temporal representativeness of conditions in the immediate vicinity of the Ports and the freeways near the Ports. As described in BWHRA Protocol on meteorological data selection and processing methods, ENVIRON defined four geographic area over which the emissions sources operate – Inner Harbor Zone, Middle Harbor Zone, Outer Harbor Zone, and Beyond Breakwater Zone. A detailed description of the approach used to divide the Ports' operational areas into four zones over which individual meteorological stations is applicable is provided in the Sphere of Influence Report included as Attachment I of Appendix A of this report. Meteorological dataset from the following stations are used for modeling sources within each of the four zones:

- Inner harbor – SPPS;
- Middle harbor – TITP;
- Outer harbor – Berth 47; and
- Beyond the breakwater – Berth 47

The most representative available wind speed, wind direction, temperature, and pressure data from each station during the twelve-month period from July 2005 through June 2006 is used in the air dispersion analysis of the BWHRA Tool. ENVIRON used cloud cover data (as the three stations did not record cloud cover data) from the National Weather Service's (NWS's) Long Beach Daugherty Field station for the twelve-month period from July 2005 through June 2006. Upper air data from the San Diego Miramar Naval Air Station (NAS) is used in AERMET processing for the BWHRA Tool.

According to the USEPA, meteorological data used for air quality modeling purposes should be at least 90 percent complete before substitution and contain no data gaps greater than two weeks (USEPA 2000). Since the meteorological datasets meet these criteria and are not 100% complete, substitution of missing meteorological data to obtain a meteorological data file with 100 percent complete data was performed using procedures outlined in Atkinson and Lee (1992). Table B-3 presents the completeness summary of the selected meteorological datasets before substitution and all of the parameters met the completeness criteria. Figure B-24 shows overall wind directions and speeds for the three selected meteorological datasets after substitution.

5.1.1 Surface Parameters

Prior to running AERMET, it is necessary to specify the surface characteristics for the meteorological monitoring site and/or the project area. The surface parameters include surface roughness, Albedo, and Bowen ratio, and are used to compute fluxes and stability of the atmosphere (USEPA 2004a) and require the evaluation of nearby land use and temporal impacts on these surface parameters. Surface parameters supplied to the model are specified for the area surrounding the surface meteorological monitoring sites (i.e., SPPS, TITP, and Berth 47 stations), rather than the project area (the Ports and vicinity area) as recommended by USEPA (2005) and ARB[2]. Because the selected meteorological stations are either on or in very close proximity to the Ports operations and the land use surrounding the meteorological stations is very similar to the land use in each operational zone the individual station is applicable to, surface parameters calculated for the meteorological stations are representative of the operational zone over which the meteorological station is used for modeling.

Detailed information on the process of surface parameter analysis used in this evaluation are described in ENVIRON's BWHRA Protocol (Appendix A of this report). Table B-4 summarizes the sector-specific surface parameters (surface roughness, Albedo, and Bowen ratio) determined for each of the three stations which wasn't available at the time the Protocol was developed.

[2] Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.

6 Terrain and Land Use

Another important consideration in an air dispersion modeling analysis is whether the terrain in the modeling area is simple or complex (i.e., terrain above the effective height of the emission point). ENVIRON used the following United States Geological Survey (USGS) 7.5 Minute digital elevation model (DEMs) information to identify terrain heights within the modeling domain:

- Long Beach (digital)
- Long Beach OES
- San Pedro
- Torrance
- Anaheim
- Inglewood
- La Habra
- Los Alamitos
- Newport
- Seal beach
- Southgate
- Whittier

ENVIRON provided terrain elevation data to the AERMOD model using version 06341 of AERMAP, AERMOD's terrain preprocessor. Due to discontinuities at the boundaries between some of the DEMs, AERMAP is not able to estimate the terrain elevations for 201 receptor locations. Using the known terrain elevation at adjacent receptors, ENVIRON estimated the terrain elevations at these 201 receptors using a linear interpolation methodology.

AERMOD can evaluate the effects of urban heat islands on atmospheric transport and dispersion using an urban boundary layer option. Due to the industrial, commercial, and dense residential land use at the impacted receptors, and consistent with ARB's Ports study (ARB 2006b) and South Coast Air Quality Management District (SCAQMD)'s past practices, the area in the vicinity of the Ports is considered urban. Accordingly, ENVIRON selected the urban boundary layer option. Use of the urban boundary layer option requires both population data and a surface roughness length. Published census data are used that correspond to the Metropolitan Division of the Los Angeles-Long Beach-Glendale area, as recommended by USEPA (2005). ENVIRON used the area-averaged roughness length calculated for a 3-kilometer fetch around each station to capture the influence of the water areas which have a significantly lower surface roughness.

7 Uncertainties in Air Dispersion Modeling

There is inherent uncertainty in all risk assessments, with the source(s) of that uncertainty dependent on the specific assumptions and models used to estimate risk (Council on Environmental Quality 1989). Understanding the degree of uncertainty associated with each component of a risk assessment is critical to interpreting the results of that assessment. As recommended by the National Research Council (NRC 1994), [a risk assessment should include] “a full and open discussion of uncertainties in the body of each … risk assessment, including prominent display of critical uncertainties in the risk characterization.” The NRC (1994) further states that “when … [reporting] estimates of risk to decision-makers and the public, it should present not only point estimates of risk, but also the sources and magnitude of uncertainty associated with these estimates.” Thus, to ensure an objective and balanced characterization of risk and to place the risk assessment results in the proper perspective, the results of a risk assessment should always be accompanied by a description of the uncertainties and critical assumptions that influence the key findings of the risk assessment.

In accordance with the recommendations described above, the key uncertainties and critical assumptions associated with the air dispersion modeling are described below. The uncertainties associated with the health risk estimation are described in Appendix C. The uncertainties associated with the emission estimations used in this BWHRA Tool are provided in Starcrest (2007a,b).

This section discusses the uncertainties associated with the air dispersion modeling performed as part of the BWHRA Tool. This includes uncertainties associated with estimates from air dispersion models, source placement and representation, meteorological data selection, and building downwash. Work on the BWHRA Tool was initiated prior to the release of new AERMOD guidance from USEPA (January 9, 2008 and March, 19, 2009). These guidance changes are not incorporated in the BWHRA Tool and the likely effect of these changes to the BWHRA Tool results are discussed above.

As discussed in Section 3, the USEPA-recommended dispersion model AERMOD was used to estimate diesel particulate matter (DPM) exposure concentrations at off-site receptor locations. This model uses the Gaussian plume equation to calculate ambient air concentrations from emission sources. For this model, the magnitude of error for the maximum concentration is estimated to range from 10 to 40% (USEPA 2005). Therefore, off-site exposure concentrations used in this assessment only represent approximate concentrations. As mentioned above, since the purpose of the BWHRA Tool is to characterize the difference between baseline and future forecast emissions, this does not introduce a large degree of uncertainty for the BWHRA Tool results.

As indicated in the BWHRA Protocol (Appendix A), the purpose of this assessment is to evaluate regional health risks from DPM sources related to Ports activities in order to inform development of the Standard. Therefore, unlike health risk assessments conducted for compliance with California Environmental Quality Act (CEQA), detailed spatial and temporal characteristics of the emissions sources are not used in the BWHRA Tool. Besides these uncertainties associated with source placement and representation, other uncertainties discussed in the following sections result in approximate predictions of DPM concentrations at receptors. Since neither the point of maximum impact (PMI) is needed for the BWHRA Tool nor can it be precisely located, the location of the PMI is not provided.

7.1 Source Placement and Representation

The sources in this HRA are generalized both in location and by restricting the analysis to a few major source categories with fleet average characteristics. Consequently, the representation of sources does not reflect the level of specific source category information that would be present in a project-specific HRA. The uncertainty introduced by the generalization of the sources is due to both the uncertainty in the placement of sources and the representation of the source parameters.

Because the BWHRA Tool evaluates only mobile sources, the distribution of emissions during movement in the operational areas is an important source of uncertainty. Unlike fixed stationary sources, emissions from moving sources would occur over a continuum rather than as discrete points. However, regulatory-approved models were originally developed for the evaluation of fixed stationary sources, and the use of a continuum of source locations to model source emissions during movement results in an unacceptably large number (in the tens of thousands) of sources and correspondingly long modeling run times (on the order of months rather than hours or days).

The source placement may introduce uncertainties to the modeled exposure concentrations. First, closer spacing between volume sources may impact the predicted concentrations at receptor locations near the Ports operational areas. Previous sensitivity analyses ENVIRON performed (see Appendix C of ENVIRON's BNSF Commerce/Mechanical Report [ENVIRON 2006]) indicated that concentrations at receptors nearest to the specific emission sources could be over-predicted by at least 10 percent. In addition, distributing on-terminal CHEs and HDVs emission over the entire area of each facility instead of the actual operational area of each facility may potentially increase or decrease the modeled exposure concentrations.

The source parameters (i.e., release velocity and release temperature) used to model OGV hotelling activities are sources of uncertainty. Due to a lack of information on source parameter configurations, ENVIRON followed the methodology of ARB's exposure assessment of the Ports (ARB 2006b) and used the fleet-average source parameters. The use of fleet-average source parameters for activities results in approximate predictions for these sources.

The release heights and vertical dimensions used for movement sources are also sources of uncertainty. ENVIRON followed ARB's exposure assessment of the Ports (ARB 2006b) for release heights of OGVs, HCs, and locomotives. ENVIRON also used typical equipment class-specific release heights of CHEs and HDVs provided by Starcrest. These equipment class-specific release heights can vary among individual pieces of equipment also. It was not clear to ENVIRON whether the adopted release heights had been adjusted to include nominal plume rise. Thus, the use of these release heights and associated vertical dimensions results in approximate predictions of receptor-specific DPM concentrations for these sources.

7.2 Meteorological Data Set

Uncertainty also exists in the meteorological data used in the AERMOD air dispersion model. These uncertainties are related to the use of multiple meteorological stations for the modeling, the combination of surface data from two meteorological stations, substitution of missing meteorological data, calculation of surface parameters for the meteorological station as opposed to the Ports operational areas, and use of a single year of meteorological data to calculate long-term average concentrations. Recent USEPA AERMOD guidance changes affect meteorological processing methodologies which were not included in this BWHRA Tool, in that the BWHRA Tool was partially completed at the time of the release of that guidance (January 9, 2008). The likely impact of these changes to guidance is discussed below.

AERMOD is not designed to use multiple meteorological datasets. However, due to the scale of this health risk assessment, the meteorological dataset from one station does not represent spatial and temporal conditions of all the emission sources. The geographical zones using different meteorological datasets are represented as having a fixed border. Two sources close to each other on different sides of a border would be modeled using different meteorological datasets. However in reality, a transition region likely exists in which either meteorological dataset is appropriate to use. The model can not account for the transition region, a fact which likely results in uncertainties in the modeled concentrations for this region.

AERMOD is designed to model near-field short-term dispersion for distances up to 50 kilometers. However, in this assessment, ENVIRON used AERMOD to simulate dispersion from emissions as far as 80 kilometers from the modeling domain. This may introduce inaccuracies into the modeled results. Since the emissions located beyond 50 kilometers are located far from the shore, they represent a small portion of the total risk calculated for the BWHRA Tool.

A complete set of surface meteorological data is not available at the SPPS, TITP, and Berth 47 stations. Therefore, wind speed, wind direction, temperature, and pressure data from the three stations are combined with cloud cover data from Long Beach Daugherty Field. In addition, meteorological surface measurements from the three stations and Long Beach Daugherty Field stations are not 100% complete for all modeled years, so missing data are substituted using procedures outlined in Atkinson and Lee (1992).

Surface parameters supplied to the model are specified for the area surrounding the surface meteorological monitoring sites, rather than the project area as recommended by USEPA (2005) and ARB[3]. Note that the new AERMOD Implementation Guide (USEPA 2008, 2009) requires the representativeness of the meteorological data as a prerequisite. Because of both

[3] Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.

the proximity of the selected meteorological stations to the modeled operations and the similarities of the land use surrounding the meteorological stations to that in each operational zone, surface parameters calculated for the meteorological stations are representative of the operational zone over which the meteorological station is used for modeling.

In accordance with the recommendation of guidance (see discussion and references in Section 3.4), ENVIRON used a full year of meteorological data from the selected meteorological stations to model long-term average DPM concentrations. Since the one-year dataset could potentially include short-term fluctuations of certain meteorological parameters, using one year's worth of data rather than five years' represents a source of uncertainty in the estimated exposure concentrations.

7.3 Building Downwash

ENVIRON did not account for building-induced aerodynamic downwash effects in this assessment. As most emission sources included in this assessment are mobile sources that were modeled as volume or area sources, the exclusion of building downwash effects is not likely to significantly impact air dispersion modeling results. However since the spacing and placement of point sources relative to buildings or structures results in impacts to building downwash parameters and resulting modeling concentrations, not including OGV structures when modeling OGV hotelling operations as point sources could potentially result in approximate predictions of concentrations near the source locations.

7.4 Recent Changes to AERMOD Guidance

ENVIRON performed the surface parameter analysis and meteorological data processing based on USEPA's AERMET User's guide (USEPA 2004a) and AERMOD Implementation Guide (USEPA 2005). However a new version (January 9, 2008) of the AERMOD Implementation Guide was released after the BWHRA Tool modeling analysis was already mainly completed. Later another version of the AERMOD Implementation Guide was released on Mach 19, 2009 after the BWHRA Tool was completed. Revisions from the original Implementation Guide (USEPA 2005) include the following:

Meteorological Data Processing Change

- Determining surface characteristics
- Processing site-specific meteorological data for urban applications
- Meteorological data selections for urban applications
- Selecting upper air sounding levels
- Optional urban roughness length

Modeling Change

- Modeling sources with terrain-following plumes in sloping terrain
- Urban/rural determination

- Selecting population data for AERMOD's urban mode
- Terrain elevation data source

ENVIRON performed a review of these changes and determined that either the modeling practice for BWHRA Tool is consistent with the guidance, or some of the revisions will not likely have a noticeable effect on the modeling results, as discussed below.

The processing of site-specific meteorological data for urban applications has been clarified in the newer Implementation Guides (USEPA 2008, 2009). Site-specific turbulence measurements are not used and the urban option is employed in the BWHRA Tool modeling, consistent with the newer Implementation Guides. Recommendations for meteorological data selections for urban applications have also been clarified. Meteorological processing for data on this project is consistent with the recommendations. The recommendations on the selection of upper air sounding levels in the newer Implementation Guides explicitly describes which levels of upper air data to extract are acceptable. As the upper air data are extracted at "all levels" for this project, the BWHRA Tool modeling is consistent with the Guide.

The current Implementation Guide recommends that for the urban/rural determination, in general, all sources within an urban complex have the "urban" option selected, even if some individual sources may be considered rural using a land use procedure. The "urban" option is selected for all sources, consistent with the Guide. Recommendations for terrain-following plumes are not applicable for the BWHRA Tool modeling.

The recommendation for selecting population data for AERMOD's urban mode is slightly different from the approach used in the BWHRA Tool modeling. As recommended, published census data are used to determine population density. However since the Metropolitan Statistical Area (MSA) for the Ports contains two Metropolitan Divisions, ENVIRON conservatively uses population data for the Metropolitan Division that covers the Ports' area to avoid overestimating of urban heat island effect. Therefore, the methodology used in BWHRA Tool modeling results in more conservative results.

For the optional urban roughness length, the current guidance (USEPA 2008, 2009) recommends a surface roughness of one meter when using the urban option. ENVIRON used a different surface roughness for each meteorological zone based on an area-averaged roughness length calculated within a 3-km buffer of each meteorological station. Naturally, some of the meteorological zones cover a higher percentage of water than other meteorological zones and have a lower surface roughness. Use of this lower surface roughness results in a more conservative result.

Recent changes to AERMAP have allowed for the use of the National Elevation Dataset (NED) and therefore it is recommended that this dataset be used rather than the USGS, DEM data. DEM files are used in the BWHRA Tool modeling since modeling had begun before the release of the new AERMAP. This change in dataset will not likely have a noticeable effect on the modeling results.

The most significant change is with the determination of surface characteristics in the processing of meteorological data. According to the latest Implementation Guide (USEPA 2008, 2009), the surface roughness is generally the most important consideration. The Guide specifies that the surface roughness length should be based on an inverse-distance weighted geometric mean for the default upwind distance of 1 kilometer relative to the meteorological station. The surface roughness parameter may be varied by sector, but the sector widths should be no smaller than 30 degrees.

In ENVIRON's meteorological data processing of Port data using USEPA guidance in effect at the time, the surface roughness length was based on an upwind fetch of 3 kilometers and surface roughness values were taken as the arithmetic mean, rather than the inverse-distance weighted geometric mean, within each sector as per the original USEPA guidance, except for Berth 47. Surface roughness length at Berth 47 was taken as the inverse-distance weighting using either up-wind or down-wind land use patterns determined on a sector-by-sector basis. A qualitative review of the three selected Port stations indicates that the potential impact of this guidance revision could be as follows:

- It is likely that a greater surface roughness would result for Saint Peter and Paul School and Terminal Island Treatment Plant meteorological sites for most sectors as this will capture less water. Greater surface roughness will result in greater dispersion of pollutants (i.e., lower concentrations).
- It is likely that a lower surface roughness for four sectors would result for the Berth 47 meteorological site overall due to the higher percentage of water captured in the 1-kilometer fetch. Lower surface roughness will result in less dispersion of pollutants (i.e., higher concentrations).

Methodologies used to determine Bowen ratio and albedo in the processing of meteorological data are also changed. However, the changes in Bowen ratio and albedo do not have a significant impact on the modeling results (Laffoon et al. 2005; Long et al. 2004).

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Appendix B:

Air Dispersion Modeling Supplemental Information

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Air Dispersion Modeling Supplemental Information

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ACRONYMS and ABBREVIATIONS

AERMET	AERMOD Meteorological Preprocessor
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
ARB	Air Resources Board
BWHRA	Bay-Wide Health Risk Assessment
CEQA	California Environmental Quality Act
CHE	Cargo Handling Equipment
DEM	Digital Elevation Maps
DPM	Diesel Particulate Matter
HDV	Heavy-duty Vehicle
HRA	Health Risk Assessment
MSA	Metropolitan Statistical Area
NAS	Naval Air Station
NED	National Elevation Dataset
NRC	National Research Council
NWS	National Weather Service
OGV	Ocean-going Vessels
POLA	Port of Los Angeles
POLB	Port of Long Beach
PMI	Point of Maximum Impact
Ports	Port of Los Angeles and Port of Long Beach
SCAQMD	South Coast Air Quality Management District
SPPS	St. Peter and Paul School
Starcrest	Starcrest Consulting, LLC
TITP	Terminal Island Treatment Plant
TWG	Technical Working Group
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

1 Air Dispersion Modeling Supplemental Information

The Bay-Wide Health Risk Assessment (BWHRA) Tool is based on a Protocol developed specifically for this assessment (Appendix A), which describes the methodology that is used in the BWHRA Tool. Some details that were not available at the time the Protocol was developed, but which are necessary for the air dispersion modeling are discussed in this Appendix. In addition, deviations from the Protocol document are discussed briefly in Section 3 of the main report with further details provided in this Appendix. Finally, key uncertainties and crucial assumptions associated with the air dispersion modeling are discussed in this Appendix.

This Appendix includes details not included in the main report or the Protocol on source characterization and parameters, source placement (including variations between 2005 and 2020), temporal emission factors, terrain, and meteorological data requirements. This Appendix also includes a brief discussion of recent changes in AERMOD guidance and their potential impact on the BWHRA Tool results.

1.1 Source Characterization and Parameters

1.1.1 Description of Source Allocation

ENVIRON used information provided by Starcrest Consulting, LLC (Starcrest) and the Port of Los Angeles and Port of Long Beach (collectively referred to as the Ports) in order to spatially allocate the different emissions sources into configurations that are appropriate for the air dispersion modeling. The following is a summary of the spatial allocations and parameters used for each source group. The allocation for each source group is based on spatial information provided by Starcrest, which ENVIRON evaluated and confirmed with aerial photos. Table B-1 shows the specific source parameters (depending on the modeled source type these can include the following: stack heights, release heights, initial vertical dimension, initial lateral dimension, temperature, exit velocity, and diameter) used for each source category. Figures B-1 through B-23 present locations of the points/volumes/areas representing each source category in the air dispersion model for both the 2005 and 2020 scenarios.

1.1.1.1 Ocean-Going Vessel

OGV – At Berth (Figure B-1)

The coordinates of the ocean-going vessel (OGV) berth locations were provided by Starcrest. The berth locations are all located within the Ports' harbors adjacent to land. ENVIRON used point sources to represent this stationary emissions source group. Source parameters are based on the California Air Resources Board (ARB) exposure assessment of the Ports (ARB 2006a).

OGV – Anchorage (Figures B-2)

ENVIRON used area sources to represent the OGV anchorage areas provided by Starcrest. These areas are located south and slightly east of the central Ports area. Source parameters are based on typical parameters for ships based on the ARB exposure assessment of the Ports (ARB 2006a)[1]. Initial vertical dimensions were calculated based on the release heights following AERMOD guidance for an elevated source not on or adjacent to a building.

OGV – Maneuvering (Figures B-3, B-4)

ENVIRON used consecutive volume sources to represent the OGV maneuvering emissions from the Starcrest-provided maneuvering paths within the Ports. The volume sources serve the function of line sources in AERMOD. Following ARB guidance (2006a), ENVIRON spaced volume sources 160 meters apart throughout the in-Port maneuvering paths. For narrow maneuvering paths, volume sources are reduced in size to fit the channel widths and 160-meter spacing was retained. Other source parameters are also based on the ARB exposure assessment of the Ports (ARB 2006a).

OGV – Transit (Figures B-5, B-6)

As with maneuvering sources, ENVIRON used consecutive volume sources to represent the OGV transit emissions from the Starcrest-provided shipping lanes outside of the Ports. Following ARB guidance, ENVIRON spaced volume sources 800 meters apart throughout the shipping lanes. Other source parameters are also based on the ARB exposure assessment of the Ports (ARB 2006a).

1.1.1.2 Harborcraft

Harborcraft – Maneuvering (Figures B-7, B-8)

ENVIRON used consecutive volume sources to represent the harborcraft maneuvering emissions from the Starcrest-provided maneuvering paths within the Ports. Following ARB guidance, ENVIRON spaced volume sources 160 meters apart throughout the in-Port maneuvering paths. For narrow maneuvering paths, volume sources are reduced in size to fit the channel widths and 160-meter spacing was retained. Other source parameters are also based on the ARB exposure assessment of the Ports (ARB 2006a).

Harborcraft – Transit (Figures B-9, B-10)

As with maneuvering sources, ENVIRON used consecutive volume sources to represent the harborcraft transit emissions from the Starcrest-provided shipping lanes outside of the Ports. Following ARB guidance, ENVIRON spaced volume sources 800 meters apart throughout the shipping lanes. Other source parameters are also based on the ARB exposure assessment of the Ports (ARB 2006a).

[1] OGV anchorage was not modeled for the ARB exposure assessment of the Ports. ENVIRON instead used source height for OGV maneuvering sources modeled in the ARB assessment.

Harborcraft – Area (Figures B-11 through B-13)

Certain types of harborcraft vessels do not travel in defined shipping lanes, rather these vessels can travel in a broad areas surrounding the ports. Starcrest-provided ENVIRON with specific areas over which these harborcraft vessels can operate. ENVIRON conservatively modeled these sources as area sources due to the undefined nature of their travel. The release height for the vessels is also provided by ARB (2006a). Initial vertical dimensions are calculated based on the release heights following AERMOD guidance for an elevated source not on or adjacent to a building.

1.1.1.3 Rail

Rail – Off-Port, Port of Los Angeles (POLA) On-Port, Port of Long Beach (POLB) On-Port (Figures B-14 through B-16)

ENVIRON used consecutive volume sources to represent the off-port and on-port rail emissions from the Starcrest-provided rail segments. When the given rail segments pass over an area with multiple separated rail tracks, volumes are placed over the individual tracks so as not to include the non-rail activity spaces between tracks. However, when the given rail segments pass over an area with multiple adjacent rail tracks with only small separation between tracks, a single set of larger volumes is used to cover the entire activity area.

The sizing and spacing of volume sources varied between rail segments. ENVIRON used volume sources sized to visually fit the width of the tracks and determined the spacing based on the volume sizes. Volumes are spaced a minimum of 50 meters apart, with spacing increasing in 25-meter increments above 50 meters. Each rail segment had constant spacing between volume sources although spacing varied between different segments. Thus, the spacing for each segment is determined by the largest volume source in that segment so that no sources overlapped.

ENVIRON based the release height on the ARB exposure assessment of the Ports (ARB 2006a). The initial vertical dimension is calculated based on the release height following AERMOD guidance for an elevated source not on or adjacent to a building. Following previous ENVIRON reports submitted to ARB, ENVIRON used a conversion factor of 4.3 to calculate the initial vertical dimension. Initial lateral dimensions are also calculated based on volume size divided by 4.3 following AERMOD guidance for a single volume source.

1.1.1.4 On-Road Heavy-Duty Vehicles

Off-Port and On-Port Road (Figures B-17 through B-19)

ENVIRON used consecutive volume sources to represent the off-port and on-port on-road Heavy-duty Vehicle (HDV) emissions from the Starcrest-provided road segments. When the given road segments pass over an area with multiple separated roads, volumes are placed over the individual roads so as not to include the non-activity spaces between roads. However, when the given road segments included multiple vehicle lanes, a single set of larger volumes is used to cover the entire activity area.

The sizing of volume sources varies between road segments such that volume sources visually fit the widths of the roads. All volumes were spaced 50 meters apart. Release heights were provided by Starcrest. The initial vertical dimensions are calculated based on the release height following AERMOD guidance for an elevated source not on or adjacent to a building. Initial lateral dimensions are also calculated based on volume size divided by 4.3 following AERMOD guidance for a single volume source.

1.1.1.5 Cargo Handling Equipment and On-Terminal Heavy-Duty Vehicles

CHE and On-Terminal HDV (Figures B-20 through B-23)

ENVIRON used area sources to represent the Cargo Handling Equipment (CHE) and HDV on-terminal activities. Terminal areas and specific CHE types and release heights were provided by Starcrest. The release height for the on-terminal HDV was also provided by Starcrest. Initial vertical dimensions are calculated based on the release heights following AERMOD guidance for an elevated source not on or adjacent to a building.

2 Source Placement

As described in Section 3 of the report, ENVIRON defined four geographic areas over which the emissions sources operate – Inner Harbor Zone, Middle Harbor Zone, Outer Harbor Zone, and Beyond Breakwater Zone. ENVIRON conducted an in-depth analysis to select specific meteorological dataset for each of the four zones. A detailed description of the approach used to divide the Ports' operational areas into four zones over which individual meteorological stations are applicable is provided in the Sphere of Influence Report included as Attachment I of Appendix A of this report. Sources are then assigned to the areas representing the inner, middle, outer, and beyond breakwater meteorological zones. Sources that fall completely within one zone are assigned to that zone for modeling. If a source falls within multiple zones, ENVIRON uses a "90/10 percent" rule to determine how to assign the source to meteorological zones. The "90/10 percent rule" states that if the length/area of a source within a meteorological zone is less than 10 percent of the length/area of the entire source, this source is assigned to the same meteorological zone as the other 90%; otherwise the source is split at the border of the multiple zones and sub-segments of the source is modeled separately using different meteorological data.

3 Variation of Source Allocation between 2020 And 2005

3.1 Description of Spatial Changes from 2005 to 2020

Sources are assumed to have identical spatial allocation for both the 2005 and 2023 scenarios except for a few specific land changes associated with the following anticipated projects:

- Cruise Terminal upon entering the Port of Los Angeles (POLA)
- Pacific Energy marine Oil Terminal (POLA)
- China Shipping Addition (POLA)
- Vopak (Port of Long Beach, POLB)
- Pier S (POLB)
- Middle Harbor (Pier D, E, F) (POLB)
- Pier G (POLB)
- Pier J (POLB)
- Pier A (POLB)

In 2020, there are no significant spatial changes for rail (POLA, POLB, and off-port), on-road heavy-duty vehicles (on- and off-port), harborcraft transiting, ocean-going vessels transiting, and ocean-going vessels anchorage. For the sources that did change, this document describes the source spatial changes that result from expected additions, removals, expansions, and reductions of 2005 emissions sources in 2020. ENVIRON received all 2020 spatial allocations from Starcrest; this document describes the changes assumed based on ENVIRON's comparison of the 2020 and 2005 spatial allocations.

3.1.1 Ocean-Going Vessels

OGV – At Berth

The OGV berth locations are expected to change between 2005 and 2020, in part due to physical changes in the Port configurations. Figure B-1 shows these changes.

OGV – Maneuvering

The in-port OGV maneuvering paths are expected to change substantially between 2005 and 2020, in part due to physical changes in the Port configurations. For POLB, a maneuvering path travels through the POLA terminals to reach some POLB terminals. Figures B-3 and B-4 show these changes.

3.1.2 Harborcraft

Harborcraft – Maneuvering

The in-port harborcraft maneuvering paths are expected to change substantially between 2005 and 2020, in part due to physical changes in the Port configurations. For POLB, a maneuvering path travels through the POLA terminals to reach some POLB terminals. Figures B-7 and B-8 show these changes.

Harborcraft – Operating Areas

The harborcraft operating area beyond 50 miles from the port did not change between 2005 and 2020. The operating areas up to 50 miles from the port changed minimally, with a slight reduction in area within the port property. This is due to reconfigurations at POLB. Figures B-11 through B-13 show these changes.

3.1.3 Cargo-Handling Equipment and On-Terminal Heavy-Duty Vehicles

CHE and On-Terminal HDV

The cargo handling operating areas and on-terminal HDV areas changed due to reconfigurations. Figures B-20 through B-23 show these changes.

4 Temporal Emission Factors

Temporal emission factors are used to represent differences in the amount of emissions that occur at different hours or days for a given activity. This allows one to allocate the total emissions according to different times of the day. This is important since meteorological parameters can vary significantly depending on the time of day. ENVIRON observed that for all three stations used in the BWHRA Tool, wind speeds are significantly higher during the daytime hours between 6am and 6pm. The lower wind speeds at night means that there is less dispersion of pollutants and thus higher concentrations close to the emissions sources. During the day, however, higher wind speeds disperse pollutants farther from the sources.

Predominant wind directions also affect the spatial characteristics of concentration profiles. Main wind directions do not vary much at Berth 47, but are significantly different between day and night at the Saint Peter Paul School (SPPS) and Terminal Island Treatment Plant (TITP) stations. Pollutant concentrations will typically move in different patterns during the day and the night because of these wind direction differences. The temporal emission factors allow for more accurate concentration estimates by matching emissions weighting with the different day and night wind speed and direction patterns.

Original temporal emission factors for each source group were provided by ARB (2006a). ENVIRON scaled these proportionally so that the factors summed to 24 hours each day and averaged to 1. The resulting temporal emission factors used in the models are shown in Table B-2.

5 Meteorological

AERMOD requires a meteorological input file to characterize the transport and dispersion of pollutants in the atmosphere. Surface and upper air meteorological data inputs as well as surface parameter data describing the land use and surface characteristics near the site are first processed using AERMOD Meteorological Preprocessor (AERMET), the meteorological preprocessor to AERMOD. The output file generated by AERMET is the meteorological input file required by AERMOD. Details of AERMET and AERMOD meteorological data needs are described in United States Environmental Protection Agency (USEPA) guidance documents (USEPA 2004a,b). Since the meteorological data selection and processing methods described in the BWHRA Protocol and the Sphere of Influence Report included as Appendix A of this report, the remainder of this section only briefly describes the following two key aspects of the AERMET analysis: the surface and upper air meteorological data selected and the surface parameter evaluation for BWHRA Tool.

5.1 Surface and Upper Air Meteorological Data

The focus of the Health Risk Assessment (HRA) is the characterization of risk in the areas immediately surrounding the Ports and major freeways (i.e., Interstates 110 and 710 and Highways 47 and 103) and rail line (i.e., the Alameda Corridor) extending from the Ports north to approximately Interstate 405. As such, ENVIRON selected meteorological data for air dispersion modeling based upon their spatial and temporal representativeness of conditions in the immediate vicinity of the Ports and the freeways near the Ports. As described in BWHRA Protocol on meteorological data selection and processing methods, ENVIRON defined four geographic area over which the emissions sources operate – Inner Harbor Zone, Middle Harbor Zone, Outer Harbor Zone, and Beyond Breakwater Zone. A detailed description of the approach used to divide the Ports' operational areas into four zones over which individual meteorological stations is applicable is provided in the Sphere of Influence Report included as Attachment I of Appendix A of this report. Meteorological dataset from the following stations are used for modeling sources within each of the four zones:

- Inner harbor – SPPS;
- Middle harbor – TITP;
- Outer harbor – Berth 47; and
- Beyond the breakwater – Berth 47

The most representative available wind speed, wind direction, temperature, and pressure data from each station during the twelve-month period from July 2005 through June 2006 is used in the air dispersion analysis of the BWHRA Tool. ENVIRON used cloud cover data (as the three stations did not record cloud cover data) from the National Weather Service's (NWS's) Long Beach Daugherty Field station for the twelve-month period from July 2005 through June 2006. Upper air data from the San Diego Miramar Naval Air Station (NAS) is used in AERMET processing for the BWHRA Tool.

According to the USEPA, meteorological data used for air quality modeling purposes should be at least 90 percent complete before substitution and contain no data gaps greater than two weeks (USEPA 2000). Since the meteorological datasets meet these criteria and are not 100% complete, substitution of missing meteorological data to obtain a meteorological data file with 100 percent complete data was performed using procedures outlined in Atkinson and Lee (1992). Table B-3 presents the completeness summary of the selected meteorological datasets before substitution and all of the parameters met the completeness criteria. Figure B-24 shows overall wind directions and speeds for the three selected meteorological datasets after substitution.

5.1.1 Surface Parameters

Prior to running AERMET, it is necessary to specify the surface characteristics for the meteorological monitoring site and/or the project area. The surface parameters include surface roughness, Albedo, and Bowen ratio, and are used to compute fluxes and stability of the atmosphere (USEPA 2004a) and require the evaluation of nearby land use and temporal impacts on these surface parameters. Surface parameters supplied to the model are specified for the area surrounding the surface meteorological monitoring sites (i.e., SPPS, TITP, and Berth 47 stations), rather than the project area (the Ports and vicinity area) as recommended by USEPA (2005) and ARB[2]. Because the selected meteorological stations are either on or in very close proximity to the Ports operations and the land use surrounding the meteorological stations is very similar to the land use in each operational zone the individual station is applicable to, surface parameters calculated for the meteorological stations are representative of the operational zone over which the meteorological station is used for modeling.

Detailed information on the process of surface parameter analysis used in this evaluation are described in ENVIRON's BWHRA Protocol (Appendix A of this report). Table B-4 summarizes the sector-specific surface parameters (surface roughness, Albedo, and Bowen ratio) determined for each of the three stations which wasn't available at the time the Protocol was developed.

[2] Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.

6 Terrain and Land Use

Another important consideration in an air dispersion modeling analysis is whether the terrain in the modeling area is simple or complex (i.e., terrain above the effective height of the emission point). ENVIRON used the following United States Geological Survey (USGS) 7.5 Minute digital elevation model (DEMs) information to identify terrain heights within the modeling domain:

- Long Beach (digital)
- Long Beach OES
- San Pedro
- Torrance
- Anaheim
- Inglewood
- La Habra
- Los Alamitos
- Newport
- Seal beach
- Southgate
- Whittier

ENVIRON provided terrain elevation data to the AERMOD model using version 06341 of AERMAP, AERMOD's terrain preprocessor. Due to discontinuities at the boundaries between some of the DEMs, AERMAP is not able to estimate the terrain elevations for 201 receptor locations. Using the known terrain elevation at adjacent receptors, ENVIRON estimated the terrain elevations at these 201 receptors using a linear interpolation methodology.

AERMOD can evaluate the effects of urban heat islands on atmospheric transport and dispersion using an urban boundary layer option. Due to the industrial, commercial, and dense residential land use at the impacted receptors, and consistent with ARB's Ports study (ARB 2006b) and South Coast Air Quality Management District (SCAQMD)'s past practices, the area in the vicinity of the Ports is considered urban. Accordingly, ENVIRON selected the urban boundary layer option. Use of the urban boundary layer option requires both population data and a surface roughness length. Published census data are used that correspond to the Metropolitan Division of the Los Angeles-Long Beach-Glendale area, as recommended by USEPA (2005). ENVIRON used the area-averaged roughness length calculated for a 3-kilometer fetch around each station to capture the influence of the water areas which have a significantly lower surface roughness.

7 Uncertainties in Air Dispersion Modeling

There is inherent uncertainty in all risk assessments, with the source(s) of that uncertainty dependent on the specific assumptions and models used to estimate risk (Council on Environmental Quality 1989). Understanding the degree of uncertainty associated with each component of a risk assessment is critical to interpreting the results of that assessment. As recommended by the National Research Council (NRC 1994), [a risk assessment should include] "a full and open discussion of uncertainties in the body of each … risk assessment, including prominent display of critical uncertainties in the risk characterization." The NRC (1994) further states that "when … [reporting] estimates of risk to decision-makers and the public, it should present not only point estimates of risk, but also the sources and magnitude of uncertainty associated with these estimates." Thus, to ensure an objective and balanced characterization of risk and to place the risk assessment results in the proper perspective, the results of a risk assessment should always be accompanied by a description of the uncertainties and critical assumptions that influence the key findings of the risk assessment.

In accordance with the recommendations described above, the key uncertainties and critical assumptions associated with the air dispersion modeling are described below. The uncertainties associated with the health risk estimation are described in Appendix C. The uncertainties associated with the emission estimations used in this BWHRA Tool are provided in Starcrest (2007a,b).

This section discusses the uncertainties associated with the air dispersion modeling performed as part of the BWHRA Tool. This includes uncertainties associated with estimates from air dispersion models, source placement and representation, meteorological data selection, and building downwash. Work on the BWHRA Tool was initiated prior to the release of new AERMOD guidance from USEPA (January 9, 2008 and March, 19, 2009). These guidance changes are not incorporated in the BWHRA Tool and the likely effect of these changes to the BWHRA Tool results are discussed above.

As discussed in Section 3, the USEPA-recommended dispersion model AERMOD was used to estimate diesel particulate matter (DPM) exposure concentrations at off-site receptor locations. This model uses the Gaussian plume equation to calculate ambient air concentrations from emission sources. For this model, the magnitude of error for the maximum concentration is estimated to range from 10 to 40% (USEPA 2005). Therefore, off-site exposure concentrations used in this assessment only represent approximate concentrations. As mentioned above, since the purpose of the BWHRA Tool is to characterize the difference between baseline and future forecast emissions, this does not introduce a large degree of uncertainty for the BWHRA Tool results.

As indicated in the BWHRA Protocol (Appendix A), the purpose of this assessment is to evaluate regional health risks from DPM sources related to Ports activities in order to inform development of the Standard. Therefore, unlike health risk assessments conducted for compliance with California Environmental Quality Act (CEQA), detailed spatial and temporal characteristics of the emissions sources are not used in the BWHRA Tool. Besides these uncertainties associated with source placement and representation, other uncertainties discussed in the following sections result in approximate predictions of DPM concentrations at receptors. Since neither the point of maximum impact (PMI) is needed for the BWHRA Tool nor can it be precisely located, the location of the PMI is not provided.

7.1 Source Placement and Representation

The sources in this HRA are generalized both in location and by restricting the analysis to a few major source categories with fleet average characteristics. Consequently, the representation of sources does not reflect the level of specific source category information that would be present in a project-specific HRA. The uncertainty introduced by the generalization of the sources is due to both the uncertainty in the placement of sources and the representation of the source parameters.

Because the BWHRA Tool evaluates only mobile sources, the distribution of emissions during movement in the operational areas is an important source of uncertainty. Unlike fixed stationary sources, emissions from moving sources would occur over a continuum rather than as discrete points. However, regulatory-approved models were originally developed for the evaluation of fixed stationary sources, and the use of a continuum of source locations to model source emissions during movement results in an unacceptably large number (in the tens of thousands) of sources and correspondingly long modeling run times (on the order of months rather than hours or days).

The source placement may introduce uncertainties to the modeled exposure concentrations. First, closer spacing between volume sources may impact the predicted concentrations at receptor locations near the Ports operational areas. Previous sensitivity analyses ENVIRON performed (see Appendix C of ENVIRON's BNSF Commerce/Mechanical Report [ENVIRON 2006]) indicated that concentrations at receptors nearest to the specific emission sources could be over-predicted by at least 10 percent. In addition, distributing on-terminal CHEs and HDVs emission over the entire area of each facility instead of the actual operational area of each facility may potentially increase or decrease the modeled exposure concentrations.

The source parameters (i.e., release velocity and release temperature) used to model OGV hotelling activities are sources of uncertainty. Due to a lack of information on source parameter configurations, ENVIRON followed the methodology of ARB's exposure assessment of the Ports (ARB 2006b) and used the fleet-average source parameters. The use of fleet-average source parameters for activities results in approximate predictions for these sources.

The release heights and vertical dimensions used for movement sources are also sources of uncertainty. ENVIRON followed ARB's exposure assessment of the Ports (ARB 2006b) for release heights of OGVs, HCs, and locomotives. ENVIRON also used typical equipment class-specific release heights of CHEs and HDVs provided by Starcrest. These equipment class-specific release heights can vary among individual pieces of equipment also. It was not clear to ENVIRON whether the adopted release heights had been adjusted to include nominal plume rise. Thus, the use of these release heights and associated vertical dimensions results in approximate predictions of receptor-specific DPM concentrations for these sources.

7.2 Meteorological Data Set

Uncertainty also exists in the meteorological data used in the AERMOD air dispersion model. These uncertainties are related to the use of multiple meteorological stations for the modeling, the combination of surface data from two meteorological stations, substitution of missing meteorological data, calculation of surface parameters for the meteorological station as opposed to the Ports operational areas, and use of a single year of meteorological data to calculate long-term average concentrations. Recent USEPA AERMOD guidance changes affect meteorological processing methodologies which were not included in this BWHRA Tool, in that the BWHRA Tool was partially completed at the time of the release of that guidance (January 9, 2008). The likely impact of these changes to guidance is discussed below.

AERMOD is not designed to use multiple meteorological datasets. However, due to the scale of this health risk assessment, the meteorological dataset from one station does not represent spatial and temporal conditions of all the emission sources. The geographical zones using different meteorological datasets are represented as having a fixed border. Two sources close to each other on different sides of a border would be modeled using different meteorological datasets. However in reality, a transition region likely exists in which either meteorological dataset is appropriate to use. The model can not account for the transition region, a fact which likely results in uncertainties in the modeled concentrations for this region.

AERMOD is designed to model near-field short-term dispersion for distances up to 50 kilometers. However, in this assessment, ENVIRON used AERMOD to simulate dispersion from emissions as far as 80 kilometers from the modeling domain. This may introduce inaccuracies into the modeled results. Since the emissions located beyond 50 kilometers are located far from the shore, they represent a small portion of the total risk calculated for the BWHRA Tool.

A complete set of surface meteorological data is not available at the SPPS, TITP, and Berth 47 stations. Therefore, wind speed, wind direction, temperature, and pressure data from the three stations are combined with cloud cover data from Long Beach Daugherty Field. In addition, meteorological surface measurements from the three stations and Long Beach Daugherty Field stations are not 100% complete for all modeled years, so missing data are substituted using procedures outlined in Atkinson and Lee (1992).

Surface parameters supplied to the model are specified for the area surrounding the surface meteorological monitoring sites, rather than the project area as recommended by USEPA (2005) and ARB[3]. Note that the new AERMOD Implementation Guide (USEPA 2008, 2009) requires the representativeness of the meteorological data as a prerequisite. Because of both

3 Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.

the proximity of the selected meteorological stations to the modeled operations and the similarities of the land use surrounding the meteorological stations to that in each operational zone, surface parameters calculated for the meteorological stations are representative of the operational zone over which the meteorological station is used for modeling.

In accordance with the recommendation of guidance (see discussion and references in Section 3.4), ENVIRON used a full year of meteorological data from the selected meteorological stations to model long-term average DPM concentrations. Since the one-year dataset could potentially include short-term fluctuations of certain meteorological parameters, using one year's worth of data rather than five years' represents a source of uncertainty in the estimated exposure concentrations.

7.3 Building Downwash

ENVIRON did not account for building-induced aerodynamic downwash effects in this assessment. As most emission sources included in this assessment are mobile sources that were modeled as volume or area sources, the exclusion of building downwash effects is not likely to significantly impact air dispersion modeling results. However since the spacing and placement of point sources relative to buildings or structures results in impacts to building downwash parameters and resulting modeling concentrations, not including OGV structures when modeling OGV hotelling operations as point sources could potentially result in approximate predictions of concentrations near the source locations.

7.4 Recent Changes to AERMOD Guidance

ENVIRON performed the surface parameter analysis and meteorological data processing based on USEPA's AERMET User's guide (USEPA 2004a) and AERMOD Implementation Guide (USEPA 2005). However a new version (January 9, 2008) of the AERMOD Implementation Guide was released after the BWHRA Tool modeling analysis was already mainly completed. Later another version of the AERMOD Implementation Guide was released on Mach 19, 2009 after the BWHRA Tool was completed. Revisions from the original Implementation Guide (USEPA 2005) include the following:

Meteorological Data Processing Change

- Determining surface characteristics
- Processing site-specific meteorological data for urban applications
- Meteorological data selections for urban applications
- Selecting upper air sounding levels
- Optional urban roughness length

Modeling Change

- Modeling sources with terrain-following plumes in sloping terrain
- Urban/rural determination

- Selecting population data for AERMOD's urban mode
- Terrain elevation data source

ENVIRON performed a review of these changes and determined that either the modeling practice for BWHRA Tool is consistent with the guidance, or some of the revisions will not likely have a noticeable effect on the modeling results, as discussed below.

The processing of site-specific meteorological data for urban applications has been clarified in the newer Implementation Guides (USEPA 2008, 2009). Site-specific turbulence measurements are not used and the urban option is employed in the BWHRA Tool modeling, consistent with the newer Implementation Guides. Recommendations for meteorological data selections for urban applications have also been clarified. Meteorological processing for data on this project is consistent with the recommendations. The recommendations on the selection of upper air sounding levels in the newer Implementation Guides explicitly describes which levels of upper air data to extract are acceptable. As the upper air data are extracted at "all levels" for this project, the BWHRA Tool modeling is consistent with the Guide.

The current Implementation Guide recommends that for the urban/rural determination, in general, all sources within an urban complex have the "urban" option selected, even if some individual sources may be considered rural using a land use procedure. The "urban" option is selected for all sources, consistent with the Guide. Recommendations for terrain-following plumes are not applicable for the BWHRA Tool modeling.

The recommendation for selecting population data for AERMOD's urban mode is slightly different from the approach used in the BWHRA Tool modeling. As recommended, published census data are used to determine population density. However since the Metropolitan Statistical Area (MSA) for the Ports contains two Metropolitan Divisions, ENVIRON conservatively uses population data for the Metropolitan Division that covers the Ports' area to avoid overestimating of urban heat island effect. Therefore, the methodology used in BWHRA Tool modeling results in more conservative results.

For the optional urban roughness length, the current guidance (USEPA 2008, 2009) recommends a surface roughness of one meter when using the urban option. ENVIRON used a different surface roughness for each meteorological zone based on an area-averaged roughness length calculated within a 3-km buffer of each meteorological station. Naturally, some of the meteorological zones cover a higher percentage of water than other meteorological zones and have a lower surface roughness. Use of this lower surface roughness results in a more conservative result.

Recent changes to AERMAP have allowed for the use of the National Elevation Dataset (NED) and therefore it is recommended that this dataset be used rather than the USGS, DEM data. DEM files are used in the BWHRA Tool modeling since modeling had begun before the release of the new AERMAP. This change in dataset will not likely have a noticeable effect on the modeling results.

The most significant change is with the determination of surface characteristics in the processing of meteorological data. According to the latest Implementation Guide (USEPA 2008, 2009), the surface roughness is generally the most important consideration. The Guide specifies that the surface roughness length should be based on an inverse-distance weighted geometric mean for the default upwind distance of 1 kilometer relative to the meteorological station. The surface roughness parameter may be varied by sector, but the sector widths should be no smaller than 30 degrees.

In ENVIRON's meteorological data processing of Port data using USEPA guidance in effect at the time, the surface roughness length was based on an upwind fetch of 3 kilometers and surface roughness values were taken as the arithmetic mean, rather than the inverse-distance weighted geometric mean, within each sector as per the original USEPA guidance, except for Berth 47. Surface roughness length at Berth 47 was taken as the inverse-distance weighting using either up-wind or down-wind land use patterns determined on a sector-by-sector basis. A qualitative review of the three selected Port stations indicates that the potential impact of this guidance revision could be as follows:

- It is likely that a greater surface roughness would result for Saint Peter and Paul School and Terminal Island Treatment Plant meteorological sites for most sectors as this will capture less water. Greater surface roughness will result in greater dispersion of pollutants (i.e., lower concentrations).
- It is likely that a lower surface roughness for four sectors would result for the Berth 47 meteorological site overall due to the higher percentage of water captured in the 1-kilometer fetch. Lower surface roughness will result in less dispersion of pollutants (i.e., higher concentrations).

Methodologies used to determine Bowen ratio and albedo in the processing of meteorological data are also changed. However, the changes in Bowen ratio and albedo do not have a significant impact on the modeling results (Laffoon et al. 2005; Long et al. 2004).

8 References

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USEPA. 2009. AERMOD Implementation Guide. Research Triangle Park, North Carolina. March 19.

Tables

Table B-1
Modeled Source Parameters
Baywide HRA

Source		Modeled Source Type	Source Parameters[7]					
			Release Height or Stack Height (m)	Initial Vertical Dimesion[6] (m)	Initial Lateral Dimension (m)	Temperature (K)	Exit Velocty (m/s)	Diameter (m)
Ocean-Going Vessels[1]	Anchorage	Area	50	11.6	---	---	---	---
	At Berth	Point	43	---	---	618	16	0.5
	Maneuvering	Volume	50	11.6	74.4	---	---	---
	Transit		50	11.6	372.1	---	---	---
Harborcraft[2]	Maneuvering	Volume	6	1.4	32.6 - 74.4	---	---	---
	Transit		6	1.4	372.1	---	---	---
Rail[3]	On-Port	Volume	5	1.2	0.7 - 18.6	---	---	---
	Off-Port		5	1.2	1.9 - 13.0	---	---	---
Heavy-Duty Vehicles[4]	On-Port Road	Volume	3.7	0.9	2.3 - 9.3	---	---	---
	Off-Port Road		5	1.2	4.7 - 9.3	---	---	---
	On-Terminal	Area	3.7	0.9	---	---	---	---
Cargo Handling Equipment[5]	Bulldozer	Area	3.7 - 4.9	0.9 - 1.1	---	---	---	---
	Crane		4.9	1.1	---	---	---	---
	Dump Truck		3.7	0.9	---	---	---	---
	Electric Pallet Jack		2.4	0.6	---	---	---	---
	Excavator		3.7	0.9	---	---	---	---
	Forklift		2.4 - 3	0.6 - 0.7	---	---	---	---
	Fuel Truck		3 - 3.7	0.7 - 0.9	---	---	---	---
	Loader		3.7	0.9	---	---	---	---
	Man Lift		3	0.7	---	---	---	---
	Propane Truck		3	0.7	---	---	---	---
	Rail Pusher		4.9	1.1	---	---	---	---
	Reach Stacker		3.7	0.9	---	---	---	---
	Roller		3.7	0.9	---	---	---	---
	Rubber-tired gantry crane		18.3	4.3	---	---	---	---
	Side pick		3	0.7	---	---	---	---
	Skid Steer Loader		3	0.7	---	---	---	---
	Sweeper		3	0.7	---	---	---	---
	Top handler		3 - 3.7	0.7 - 0.9	---	---	---	---
	Tractor		3.7	0.9	---	---	---	---
	Truck		2.4 - 3.7	0.6 - 0.9	---	---	---	---
	Utility		3	0.7	---	---	---	---
	Vacuum Truck		3	0.7	---	---	---	---
	Water Truck		3	0.7	---	---	---	---
	Yard tractor		3.7	0.9	---	---	---	---

Notes:
1. Source parameters for ocean-going vessels are based on ARB values.
2. Release height for harborcraft is based on ARB values. Initial lateral dimensions are also based on ARB values and adjusted based on channel widths.
3. Release height for rail is based on ARB values. Initial lateral dimensions are based on visual inspection of aerial photos; dimensions are selected to ensure that volume sources fit over rail tracks.
4. Release heights for heavy-duty vehicles are provided by Starcrest. Initial lateral dimensions are based on visual inspection of aerial photos; dimensions are selected to ensure that volume sources fit over roads.
5. Release heights for cargo handling equipment are provided by Starcrest for specific equipment types.
6. Initial vertical dimensions are calculated following AERMOD guidance for an elevated source not on or adjacent to a building.
7. The "---" in the table signifies the parameter is not applicable to this source.

References:

Air Resources Board (ARB). Diesel Particulate Matter Exposure Assessment Study for the Ports of Los Angeles and Long Beach. Final Report. April 2006.
USEPA. User's Guide for the AMS/EPA Regulatory Model - AERMOD. EPA-454/B-03-001. September 2004.

Table B-2
POLA and POLB Temporal Emission Factors
Baywide HRA

Source		Temporal Emission Factor[1]	Hours[2]
Cargo-Handling Equipment		0.36	5pm - 3am
		0.23	3am - 8am
		2.13	8am - 5pm
Harborcraft		0.40	6pm - 6am
		1.60	6am - 6pm
Ocean-Going Vessels	Anchorage	1.00	24 hrs/day
	At Berth	1.00	24 hrs/day
	Maneuvering	0.60	8pm - 4am
		1.20	4am - 8pm
	Transit	0.60	8pm - 4am
		1.20	4am - 8pm
Rail		1.00	24 hrs/day
Heavy-Duty Vehicles		0.40	6pm - 6am
		1.60	6am - 6pm

Notes:

1. Original emission factors were provided by ARB. ENVIRON scaled these emission factors so that each category sums to 24 hours.
2. Day is designated as 6am - 6pm; night is designated as 6pm - 6am.

References:

Air Resources Board (ARB). Diesel Particulate Matter Exposure Assessment Study for the Ports of Los Angeles and Long Beach. Final Report. April 2006.

Table B-3
Data Completeness Statistics
Bay-wide HRA

Station	Date Range			Wind Speed		Wind Direction		Temperature		Cloud Cover	
	Start Date	End Date	Actual Hours	# Missing Hours	% Complete[1]	# Missing Hours	% Complete[1]	# Missing Hours	% Complete[1]	# Missing Hours	% Complete[1]
TITP	7/1/2005	6/30/2006	8760	12	99.16%	12	99.16%	12	99.16%	---	---
Berth47	7/1/2005	6/30/2006	8760	509	94.19%	492	94.38%	518	94.09%	---	---
SPPS	7/1/2005	6/30/2006	8760	332	94.95%	331	94.97%	366	94.57%	---	---
Long Beach Daugherty Field	7/1/2005	6/30/2006	8760	---	---	---	---	---	---	7	99.92%

Notes:
1. Includes skipped records as well as invalid data. For wind speed invalid data includes < 0 mph and > 100 mph;
For Temperature invalid data includes < -20 F and > 150 F

Table B-4
Sector-Specific Surface Roughness, Bowen Ratio, and Albedo
Bay-wide HRA

SPPS

Month	SEASON	Sector No.	July 2005- June 2006 Albedo	Bowen Ratio	Surface Roughness
January	Autumn	1	0.180	2.000	1.000
February	Spring		0.140	1.000	1.000
March	Spring		0.140	1.000	1.000
April	Summer		0.160	2.000	1.000
May	Summer		0.160	2.000	1.000
June	Summer		0.160	2.000	1.000
July	Summer/Autumn		0.170	1.000	1.000
August	Summer/Autumn		0.170	1.000	1.000
September	Summer/Autumn		0.170	1.000	1.000
October	Summer/Autumn		0.170	1.000	1.000
November	Autumn		0.180	2.000	1.000
December	Autumn		0.180	2.000	1.000
January	Autumn	2	0.174	1.698	0.841
February	Spring		0.137	0.857	0.841
March	Spring		0.137	0.857	0.841
April	Summer		0.151	1.698	0.841
May	Summer		0.151	1.698	0.841
June	Summer		0.151	1.698	0.841
July	Summer/Autumn		0.162	0.857	0.841
August	Summer/Autumn		0.162	0.857	0.841
September	Summer/Autumn		0.162	0.857	0.841
October	Summer/Autumn		0.162	0.857	0.841
November	Autumn		0.174	1.698	0.841
December	Autumn		0.174	1.698	0.841
January	Autumn	3	0.169	1.477	0.722
February	Spring		0.135	0.752	0.722
March	Spring		0.135	0.752	0.722
April	Summer		0.143	1.475	0.722
May	Summer		0.143	1.475	0.722
June	Summer		0.143	1.475	0.722
July	Summer/Autumn		0.156	0.751	0.722
August	Summer/Autumn		0.156	0.751	0.722
September	Summer/Autumn		0.156	0.751	0.722
October	Summer/Autumn		0.156	0.751	0.722
November	Autumn		0.169	1.477	0.722
December	Autumn		0.169	1.477	0.722
January	Autumn	4	0.182	1.954	0.936
February	Spring		0.143	0.971	0.938
March	Spring		0.143	0.971	0.938
April	Summer		0.162	1.934	0.941
May	Summer		0.162	1.934	0.941
June	Summer		0.162	1.934	0.941
July	Summer/Autumn		0.172	0.969	0.938
August	Summer/Autumn		0.172	0.969	0.938
September	Summer/Autumn		0.172	0.969	0.938
October	Summer/Autumn		0.172	0.969	0.938
November	Autumn		0.182	1.954	0.936
December	Autumn		0.182	1.954	0.936
January	Autumn	5	0.178	1.859	0.927
February	Spring		0.139	0.931	0.928
March	Spring		0.139	0.931	0.928
April	Summer		0.158	1.856	0.929
May	Summer		0.158	1.856	0.929
June	Summer		0.158	1.856	0.929
July	Summer/Autumn		0.168	0.932	0.928
August	Summer/Autumn		0.168	0.932	0.928
September	Summer/Autumn		0.168	0.932	0.928
October	Summer/Autumn		0.168	0.932	0.928
November	Autumn		0.178	1.859	0.927
December	Autumn		0.178	1.859	0.927
January	Autumn	6	0.180	2.003	0.996
February	Spring		0.140	1.001	0.996
March	Spring		0.140	1.001	0.996
April	Summer		0.160	1.999	0.996
May	Summer		0.160	1.999	0.996
June	Summer		0.160	1.999	0.996
July	Summer/Autumn		0.170	0.999	0.996
August	Summer/Autumn		0.170	0.999	0.996
September	Summer/Autumn		0.170	0.999	0.996
October	Summer/Autumn		0.170	0.999	0.996
November	Autumn		0.180	2.003	0.996
December	Autumn		0.180	2.003	0.996

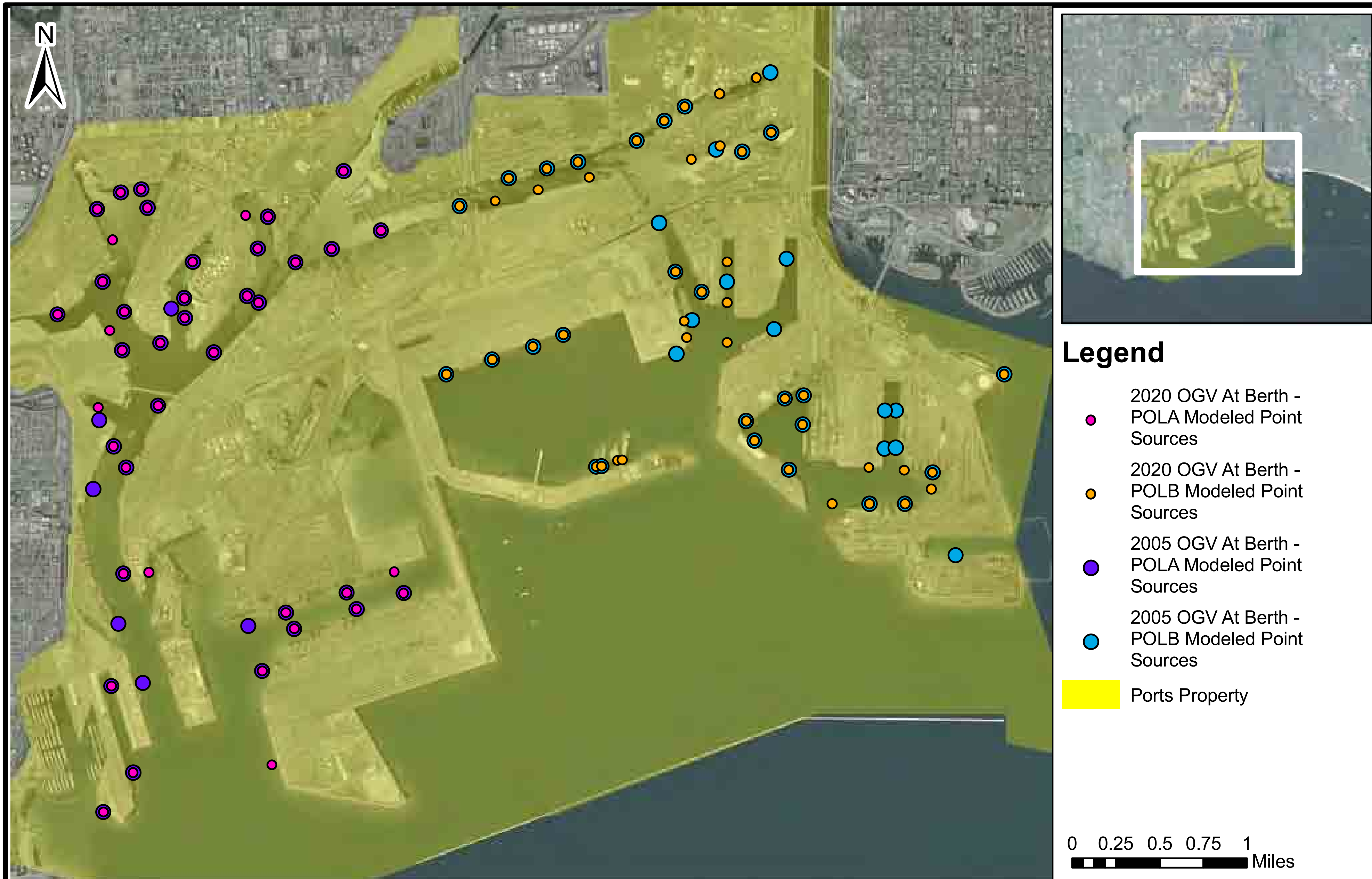
TITP

Month	SEASON	Sector No.	July 2005- June 2006 Albedo	Bowen Ratio	Surface Roughness
January	Autumn	1	0.176	1.811	0.896
February	Spring		0.138	0.911	0.896
March	Spring		0.138	0.911	0.896
April	Summer		0.154	1.808	0.896
May	Summer		0.154	1.808	0.896
June	Summer		0.154	1.808	0.896
July	Summer/Autumn		0.165	0.909	0.896
August	Summer/Autumn		0.165	0.909	0.896
September	Summer/Autumn		0.165	0.909	0.896
October	Summer/Autumn		0.165	0.909	0.896
November	Autumn		0.176	1.811	0.896
December	Autumn		0.176	1.811	0.896
January	Autumn	2	0.151	0.640	0.284
February	Spring		0.126	0.356	0.284
March	Spring		0.126	0.356	0.284
April	Summer		0.117	0.640	0.284
May	Summer		0.117	0.640	0.284
June	Summer		0.117	0.640	0.284
July	Summer/Autumn		0.134	0.356	0.284
August	Summer/Autumn		0.134	0.356	0.284
September	Summer/Autumn		0.134	0.356	0.284
October	Summer/Autumn		0.134	0.356	0.284
November	Autumn		0.151	0.640	0.284
December	Autumn		0.151	0.640	0.284
January	Autumn	3	0.170	1.504	0.736
February	Spring		0.135	0.764	0.736
March	Spring		0.135	0.764	0.736
April	Summer		0.145	1.502	0.736
May	Summer		0.145	1.502	0.736
June	Summer		0.145	1.502	0.736
July	Summer/Autumn		0.157	0.764	0.736
August	Summer/Autumn		0.157	0.764	0.736
September	Summer/Autumn		0.157	0.764	0.736
October	Summer/Autumn		0.157	0.764	0.736
November	Autumn		0.170	1.504	0.736
December	Autumn		0.170	1.504	0.736
January	Autumn	4	0.156	0.846	0.394
February	Spring		0.128	0.454	0.394
March	Spring		0.128	0.454	0.394
April	Summer		0.124	0.846	0.394
May	Summer		0.124	0.846	0.394
June	Summer		0.124	0.846	0.394
July	Summer/Autumn		0.140	0.454	0.394
August	Summer/Autumn		0.140	0.454	0.394
September	Summer/Autumn		0.140	0.454	0.394
October	Summer/Autumn		0.140	0.454	0.394
November	Autumn		0.156	0.846	0.394
December	Autumn		0.156	0.846	0.394
January	Autumn	5	0.174	1.736	0.861
February	Spring		0.137	0.875	0.861
March	Spring		0.137	0.875	0.861
April	Summer		0.152	1.736	0.861
May	Summer		0.152	1.736	0.861
June	Summer		0.152	1.736	0.861
July	Summer/Autumn		0.163	0.875	0.861
August	Summer/Autumn		0.163	0.875	0.861
September	Summer/Autumn		0.163	0.875	0.861
October	Summer/Autumn		0.163	0.875	0.861
November	Autumn		0.174	1.736	0.861
December	Autumn		0.174	1.736	0.861
January	Autumn	6	0.168	1.436	0.700
February	Spring		0.134	0.733	0.700
March	Spring		0.134	0.733	0.700
April	Summer		0.142	1.434	0.700
May	Summer		0.142	1.434	0.700
June	Summer		0.142	1.434	0.700
July	Summer/Autumn		0.155	0.732	0.700
August	Summer/Autumn		0.155	0.732	0.700
September	Summer/Autumn		0.155	0.732	0.700
October	Summer/Autumn		0.155	0.732	0.700
November	Autumn		0.168	1.436	0.700
December	Autumn		0.168	1.436	0.700

Berth 47

Month	SEASON	Sector No.	July 2005- June 2006 Albedo	Bowen Ratio	Surface Roughness
January	Autumn	1	0.161	1.042	0.211
February	Spring		0.131	0.545	0.215
March	Spring		0.131	0.545	0.215
April	Summer		0.131	1.039	0.217
May	Summer		0.131	1.039	0.217
June	Summer		0.131	1.039	0.217
July	Summer/Autumn		0.146	0.545	0.215
August	Summer/Autumn		0.146	0.545	0.215
September	Summer/Autumn		0.146	0.545	0.215
October	Summer/Autumn		0.146	0.545	0.215
November	Autumn		0.161	1.042	0.211
December	Autumn		0.161	1.042	0.211
January	Autumn	2	0.178	1.897	0.945
February	Spring		0.139	0.951	0.945
March	Spring		0.139	0.951	0.945
April	Summer		0.157	1.897	0.945
May	Summer		0.157	1.897	0.945
June	Summer		0.157	1.897	0.945
July	Summer/Autumn		0.167	0.951	0.945
August	Summer/Autumn		0.167	0.951	0.945
September	Summer/Autumn		0.167	0.951	0.945
October	Summer/Autumn		0.167	0.951	0.945
November	Autumn		0.178	1.897	0.945
December	Autumn		0.178	1.897	0.945
January	Autumn	3	0.161	1.111	0.054
February	Spring		0.131	0.579	0.054
March	Spring		0.131	0.579	0.054
April	Summer		0.132	1.111	0.054
May	Summer		0.132	1.111	0.054
June	Summer		0.132	1.111	0.054
July	Summer/Autumn		0.147	0.579	0.054
August	Summer/Autumn		0.147	0.579	0.054
September	Summer/Autumn		0.147	0.579	0.054
October	Summer/Autumn		0.147	0.579	0.054
November	Autumn		0.161	1.111	0.054
December	Autumn		0.161	1.111	0.054
January	Autumn	4	0.159	0.994	0.095
February	Spring		0.130	0.522	0.099
March	Spring		0.130	0.522	0.099
April	Summer		0.129	0.992	0.101
May	Summer		0.129	0.992	0.101
June	Summer		0.129	0.992	0.101
July	Summer/Autumn		0.144	0.523	0.100
August	Summer/Autumn		0.144	0.523	0.100
September	Summer/Autumn		0.144	0.523	0.100
October	Summer/Autumn		0.144	0.523	0.100
November	Autumn		0.159	0.994	0.095
December	Autumn		0.159	0.994	0.095
January	Autumn	5	0.141	0.155	0.003
February	Spring		0.122	0.127	0.003
March	Spring		0.122	0.127	0.003
April	Summer		0.102	0.137	0.003
May	Summer		0.102	0.137	0.003
June	Summer		0.102	0.137	0.003
July	Summer/Autumn		0.122	0.116	0.003
August	Summer/Autumn		0.122	0.116	0.003
September	Summer/Autumn		0.122	0.116	0.003
October	Summer/Autumn		0.122	0.116	0.003
November	Autumn		0.141	0.155	0.003
December	Autumn		0.141	0.155	0.003
January	Autumn	6	0.141	0.131	0.016
February	Spring		0.120	0.115	0.016
March	Spring		0.120	0.115	0.016
April	Summer		0.101	0.129	0.016
May	Summer		0.101	0.129	0.016
June	Summer		0.101	0.129	0.016
July	Summer/Autumn		0.121	0.114	0.016
August	Summer/Autumn		0.121	0.114	0.016
September	Summer/Autumn		0.121	0.114	0.016
October	Summer/Autumn		0.121	0.114	0.016
November	Autumn		0.141	0.131	0.016
December	Autumn		0.141	0.131	0.016

Figures



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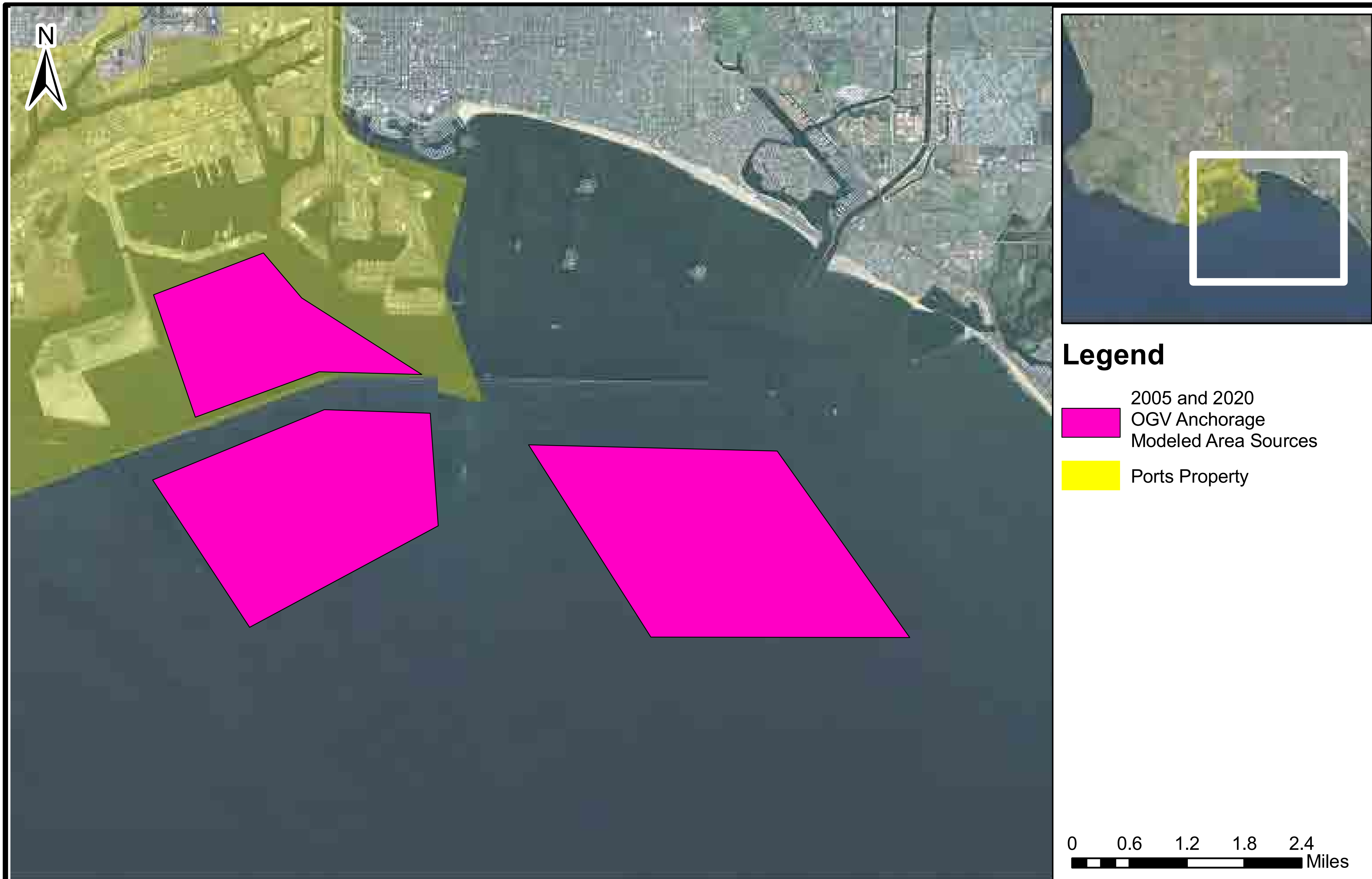
6001 Shellmound St., Suite 700, Emeryville, CA 94608

Locations of Modeled Sources
Ocean-Going Vessels At Berth Modeled Point Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-1



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Locations of Modeled Sources
Ocean-Going Vessels Anchorage Modeled Area Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-2

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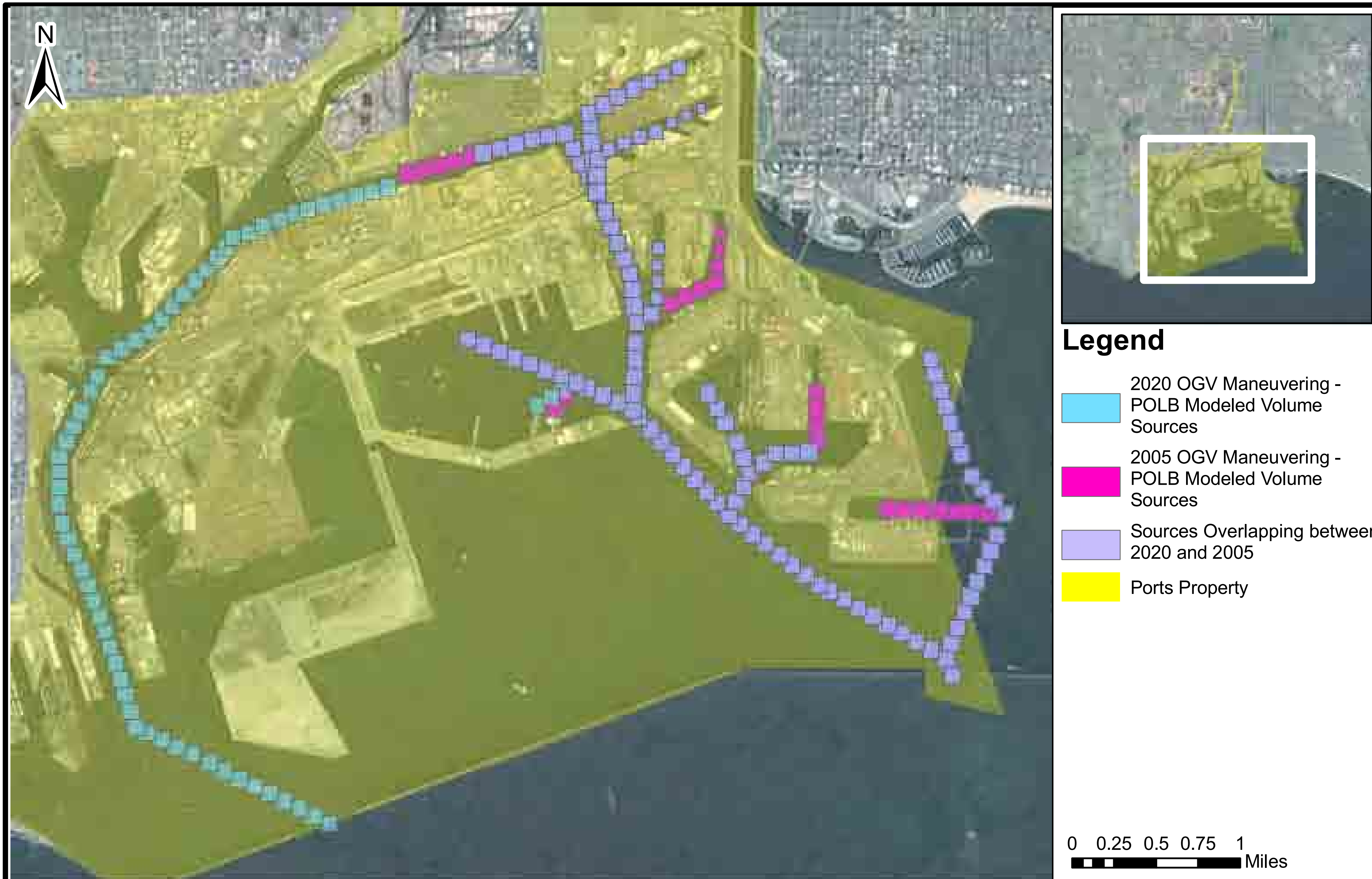
Locations of Modeled Sources
Ocean-Going Vessels POLA Maneuvering Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-3



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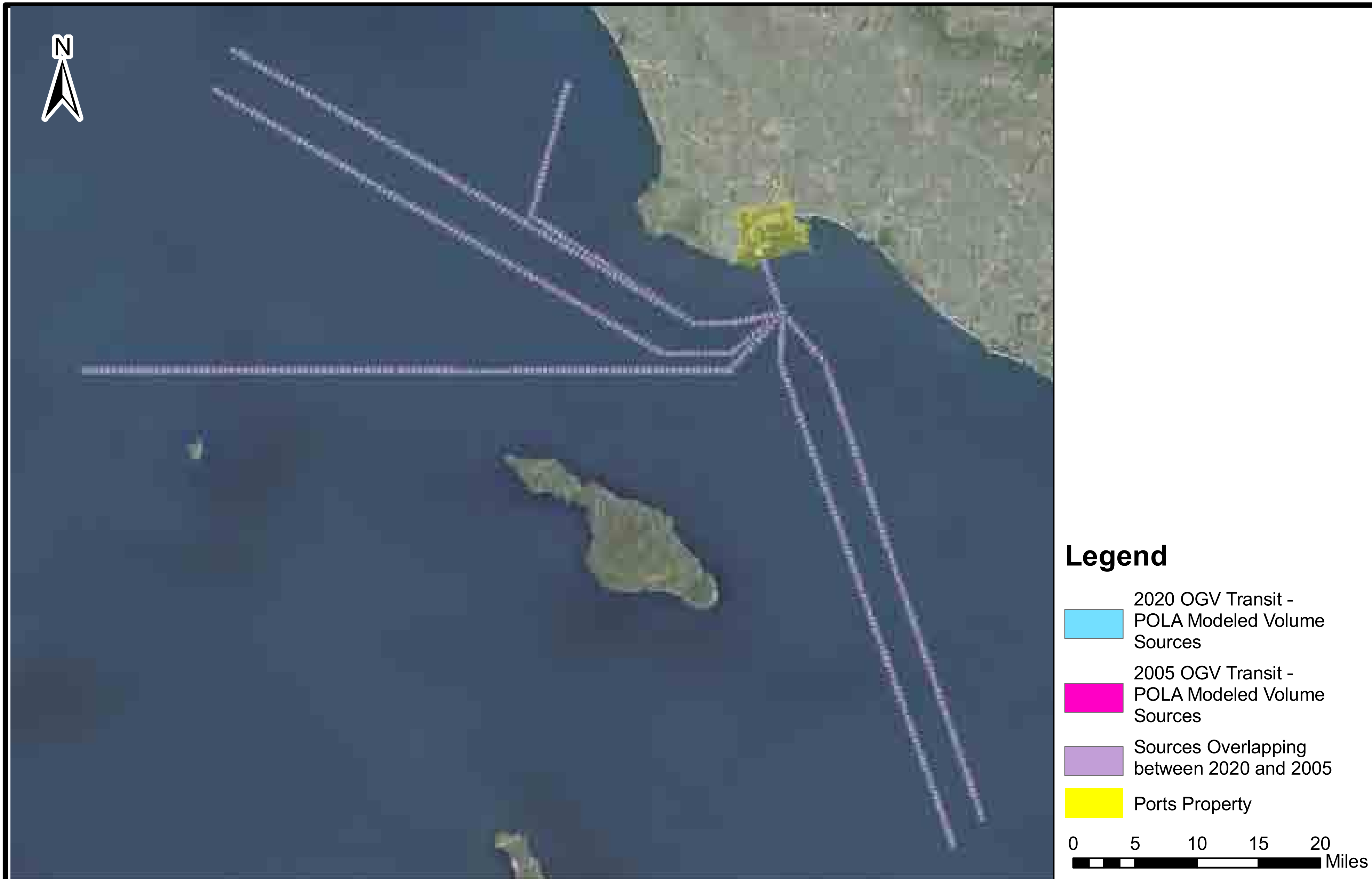
Locations of Modeled Sources
Ocean-Going Vessels POLB Maneuvering Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-4



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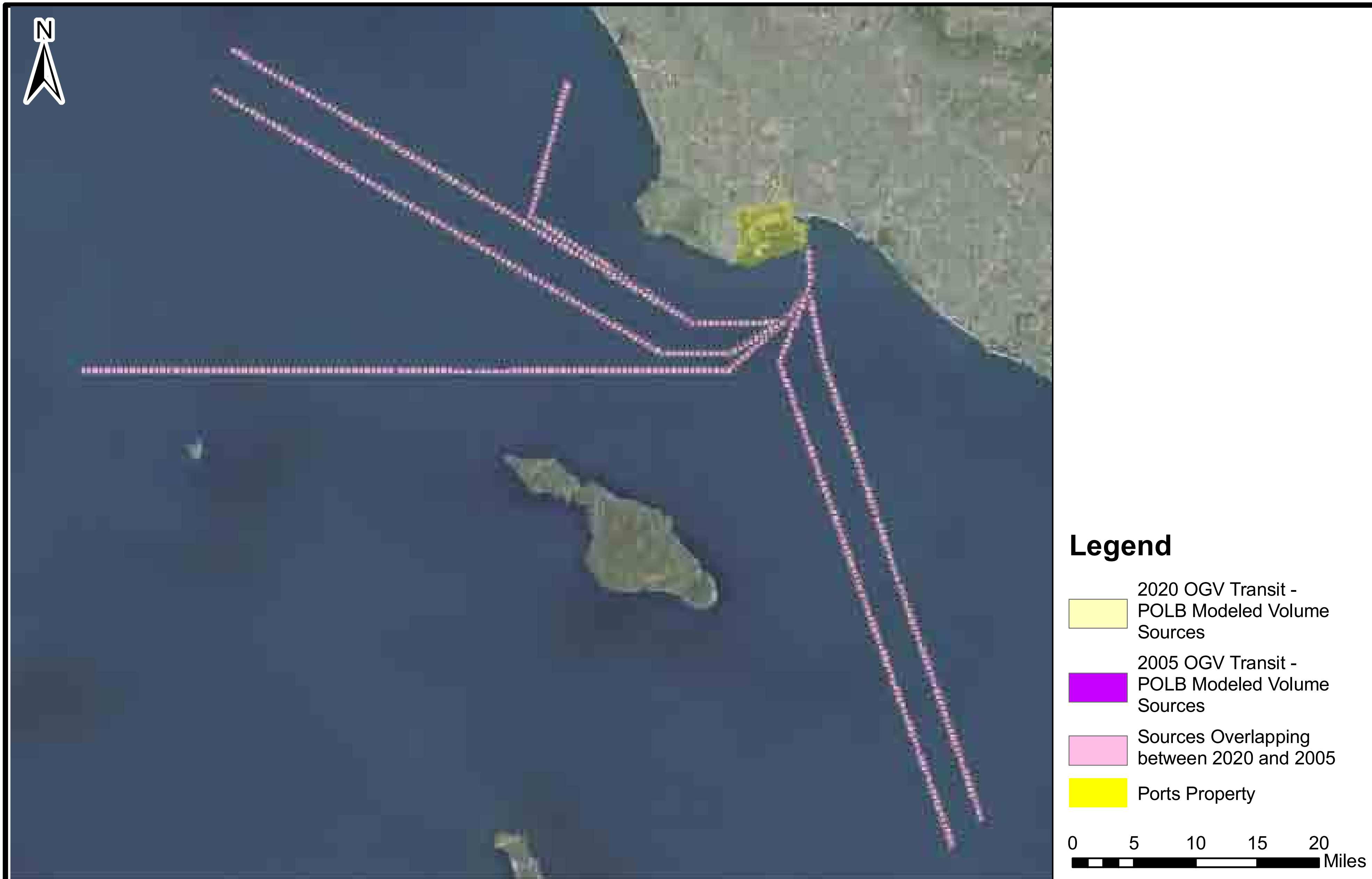
Locations of Modeled Sources
Ocean-Going Vessels POLA Transit Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-5



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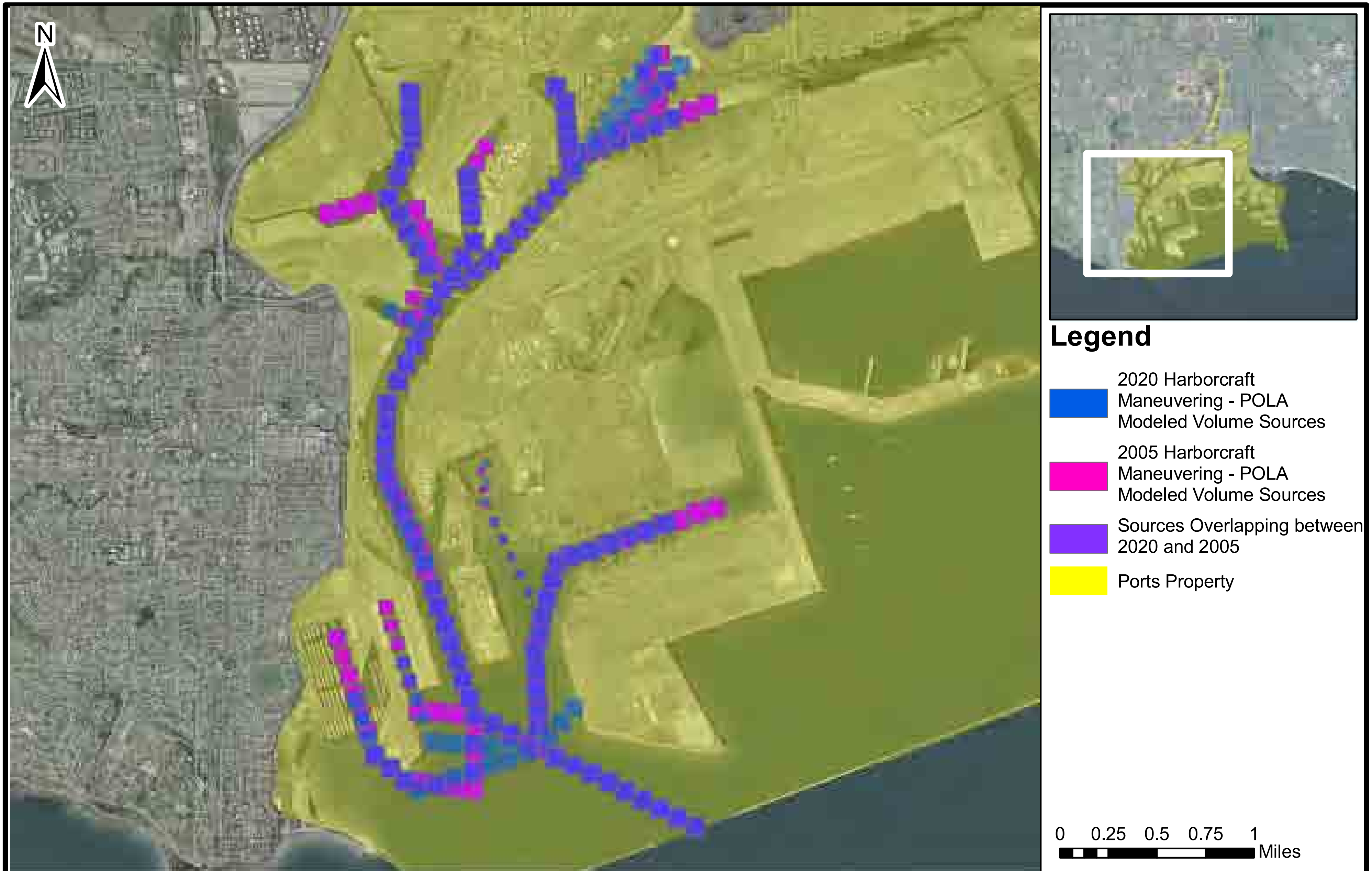
Locations of Modeled Sources
Ocean-Going Vessels POLB Transit Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-6



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Locations of Modeled Sources
Harborcraft POLA Maneuvering Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-7

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Locations of Modeled Sources
Harborcraft POLB Maneuvering Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-8

ENVIRON

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Locations of Modeled Sources
Harborcraft POLA Transit Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-9

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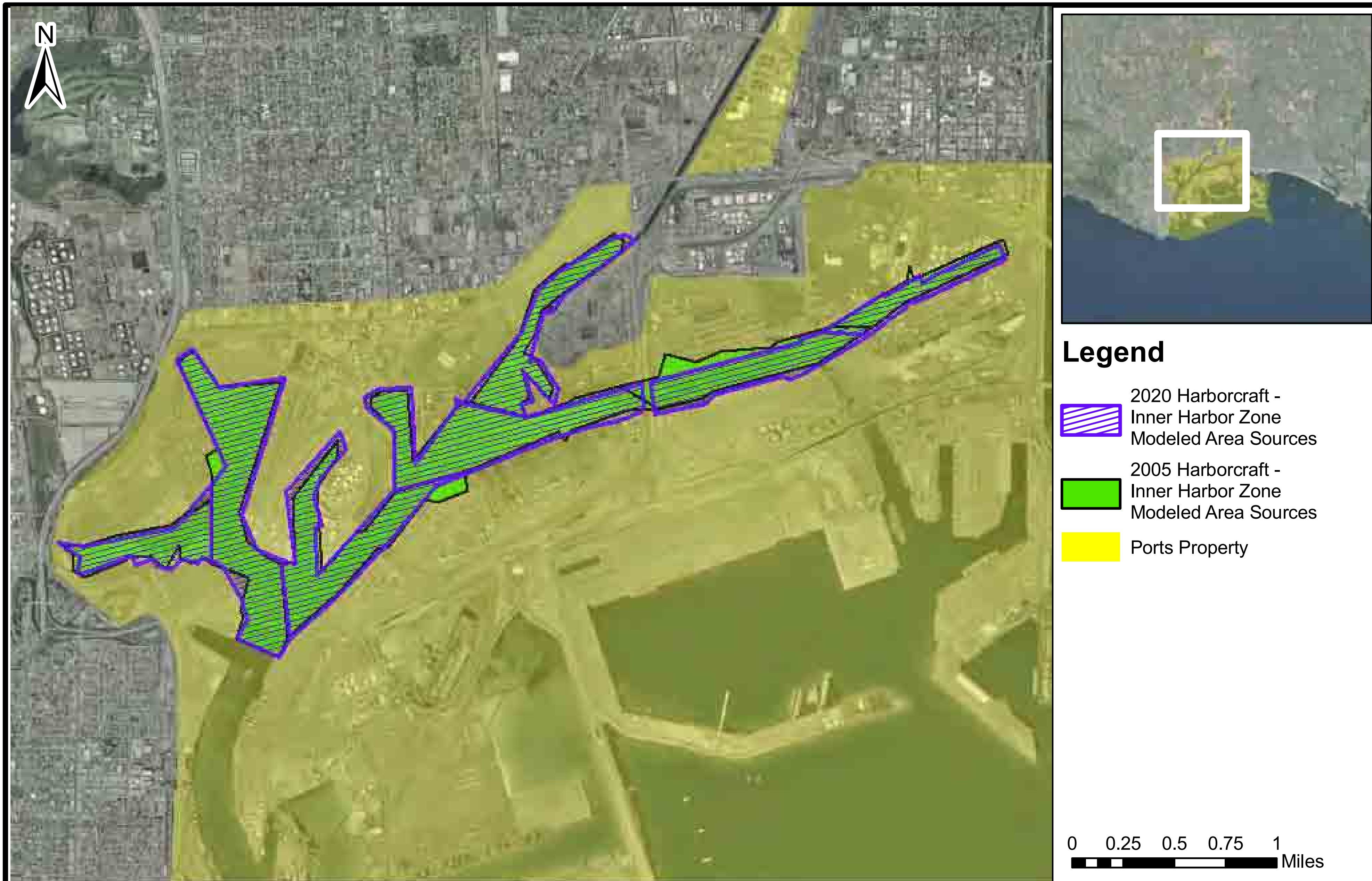
Locations of Modeled Sources
Harborcraft POLB Transit Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-10



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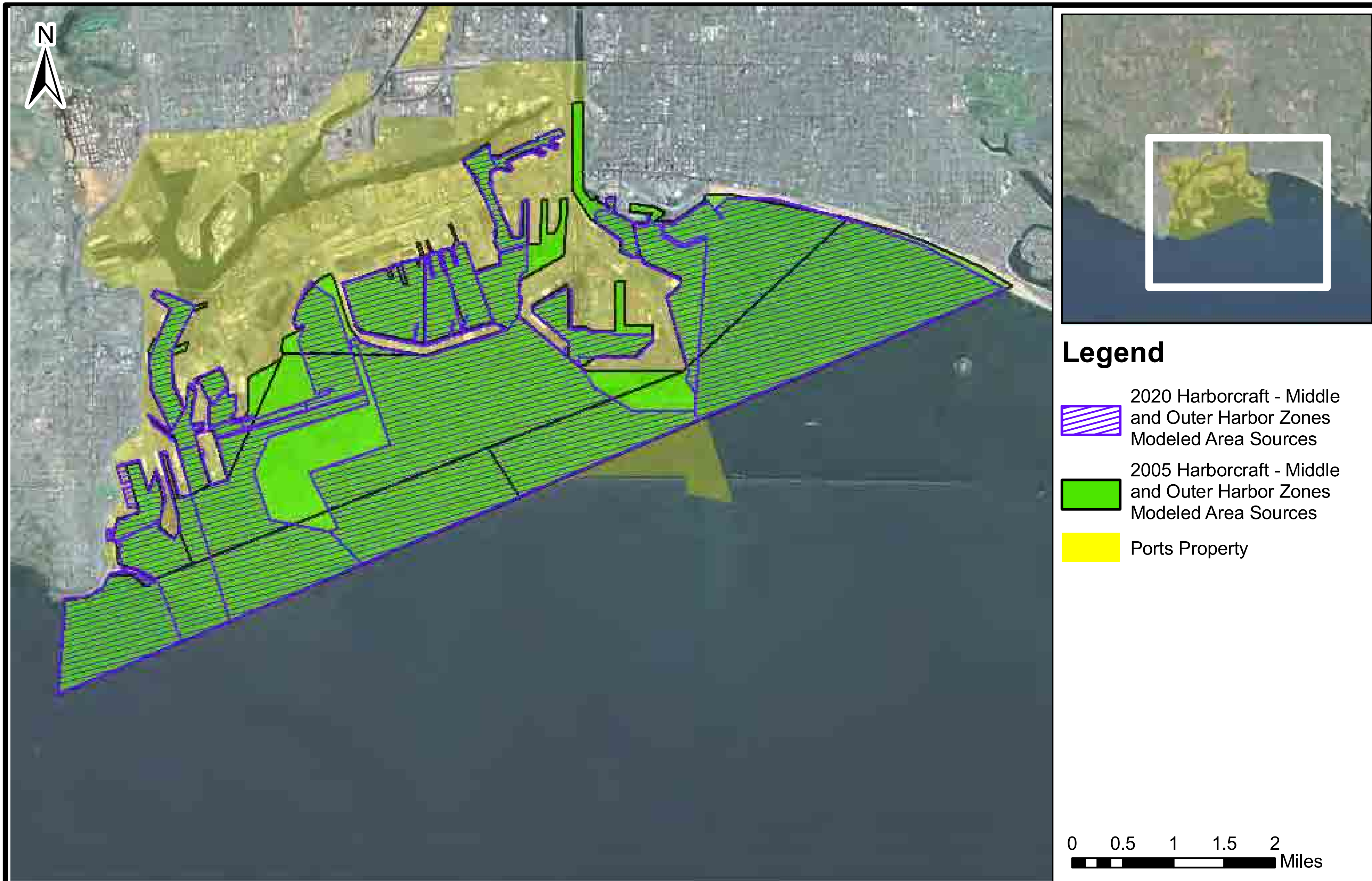
Locations of Modeled Sources
Harborcraft Near Ports Modeled Area Sources: Inner Harbor Zone
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure
B-11



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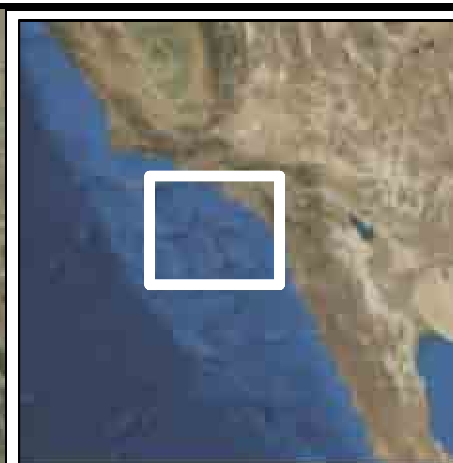
Locations of Modeled Sources
Harborcraft Near Ports Modeled Area Sources: Middle and Outer Harbor Zones
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-12



Legend

- 2005 and 2020 Harborcraft - Beyond the Breakwater Zone Modeled Area Sources (within 50 km)
- 2005 and 2020 Harborcraft - Beyond the Breakwater Zone Modeled Area Sources (beyond 50 km)
- Ports Property

0 8 16 24 32 Miles

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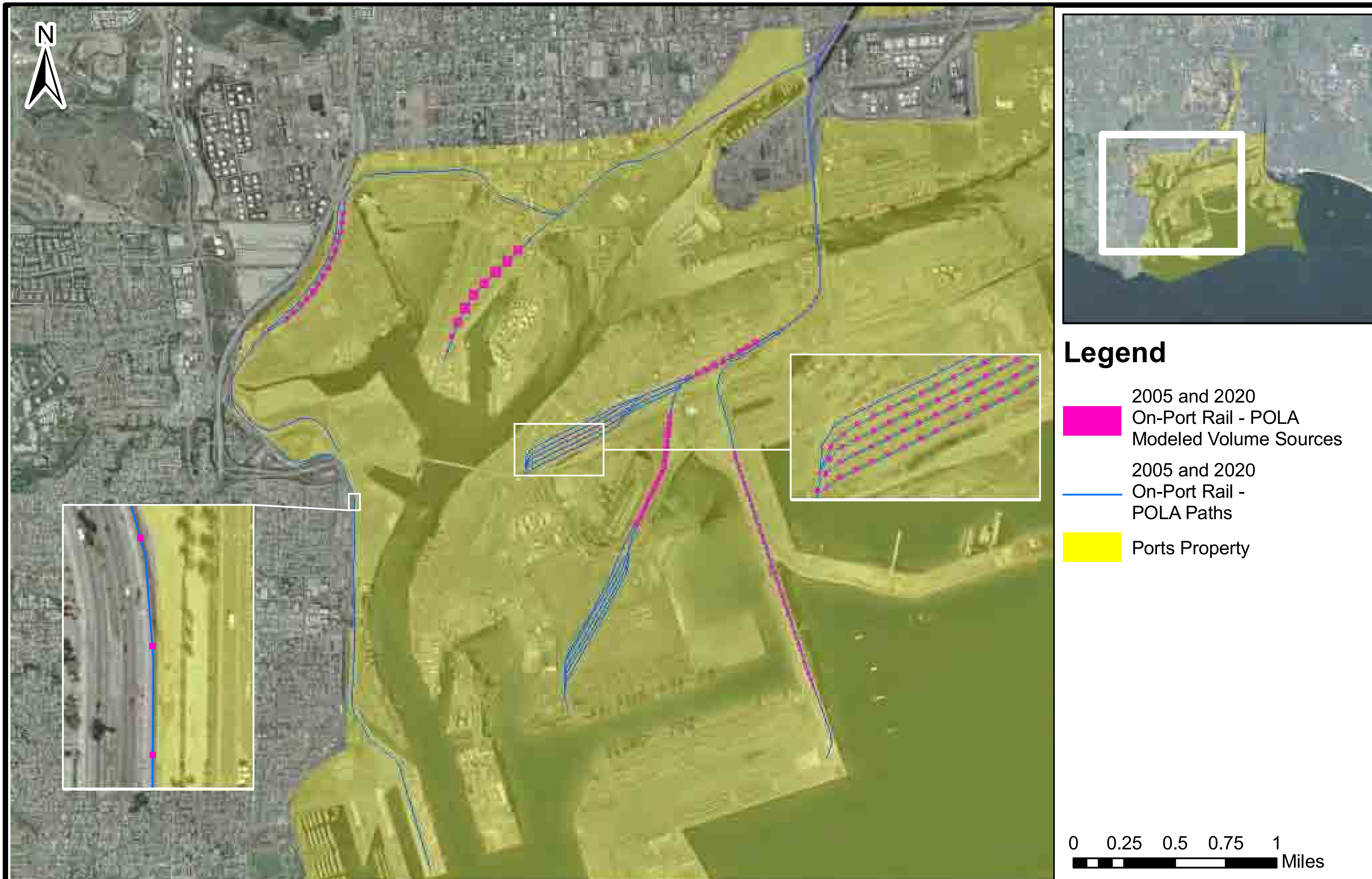
Locations of Modeled Sources
Harborcraft Within and Beyond 50 Kilmeters from the Ports
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-13



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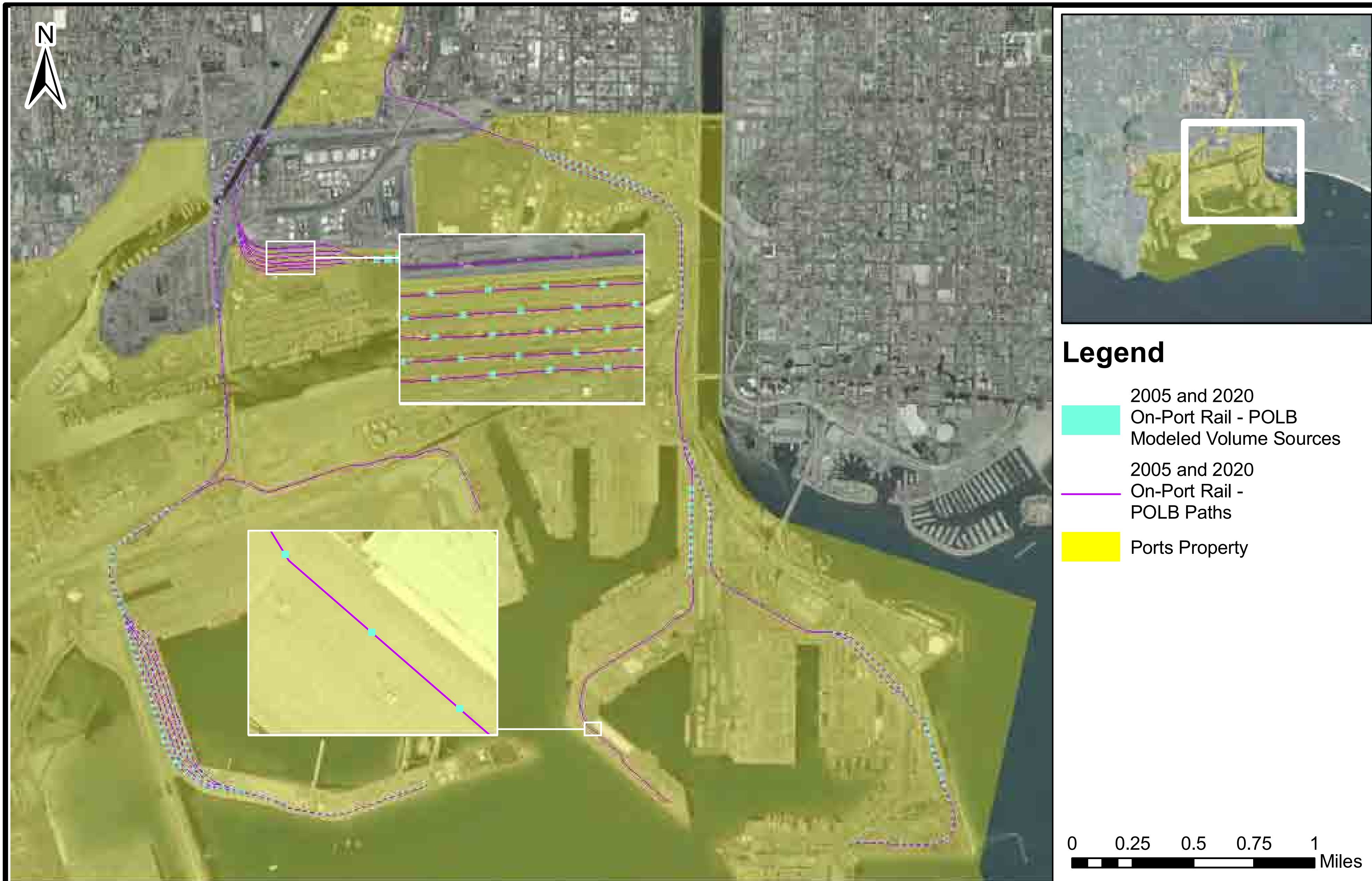
Locations of Modeled Sources
On-Port Rail POLA Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-14



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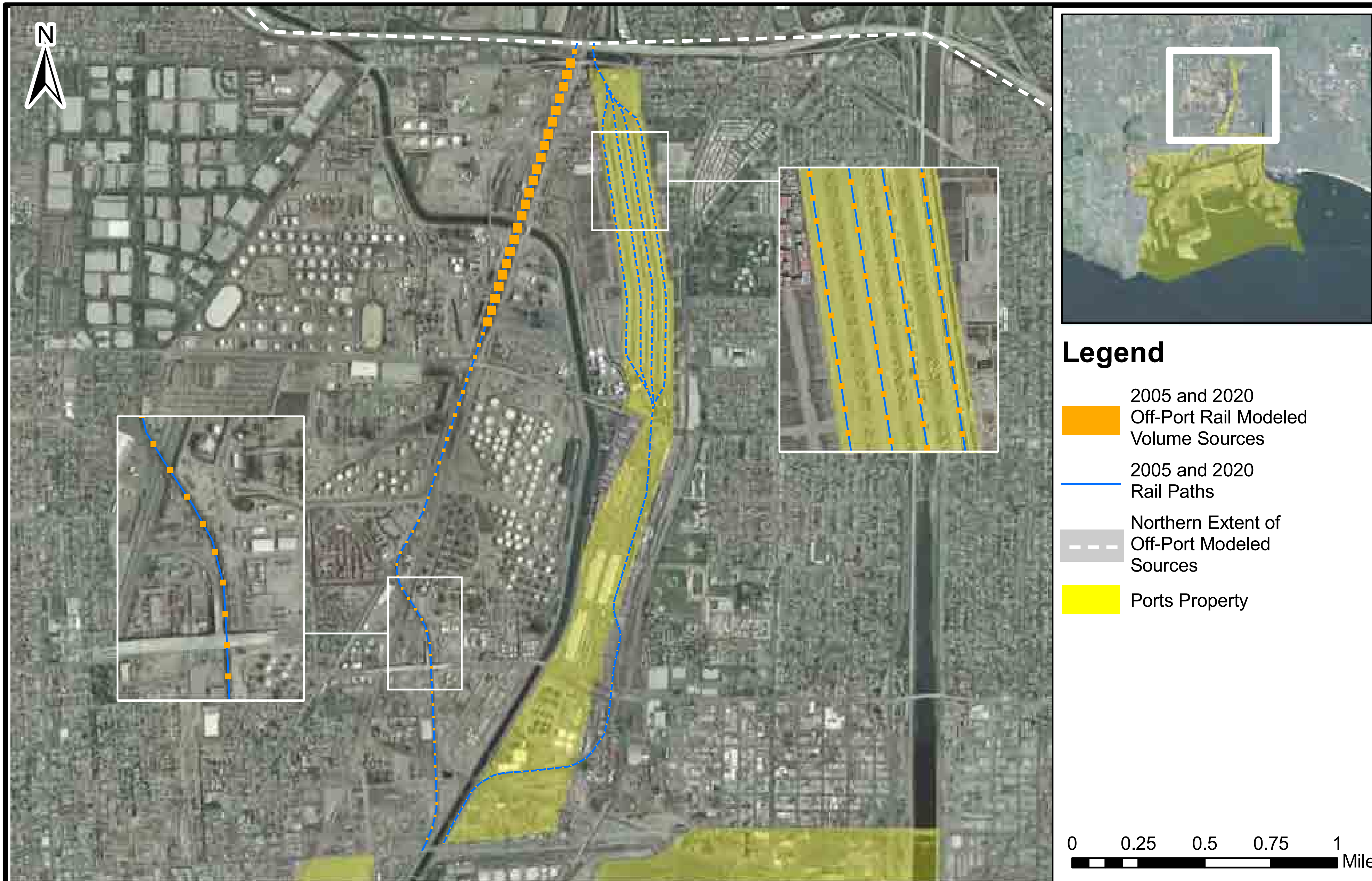
Locations of Modeled Sources
On-Port Rail POLB Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-15



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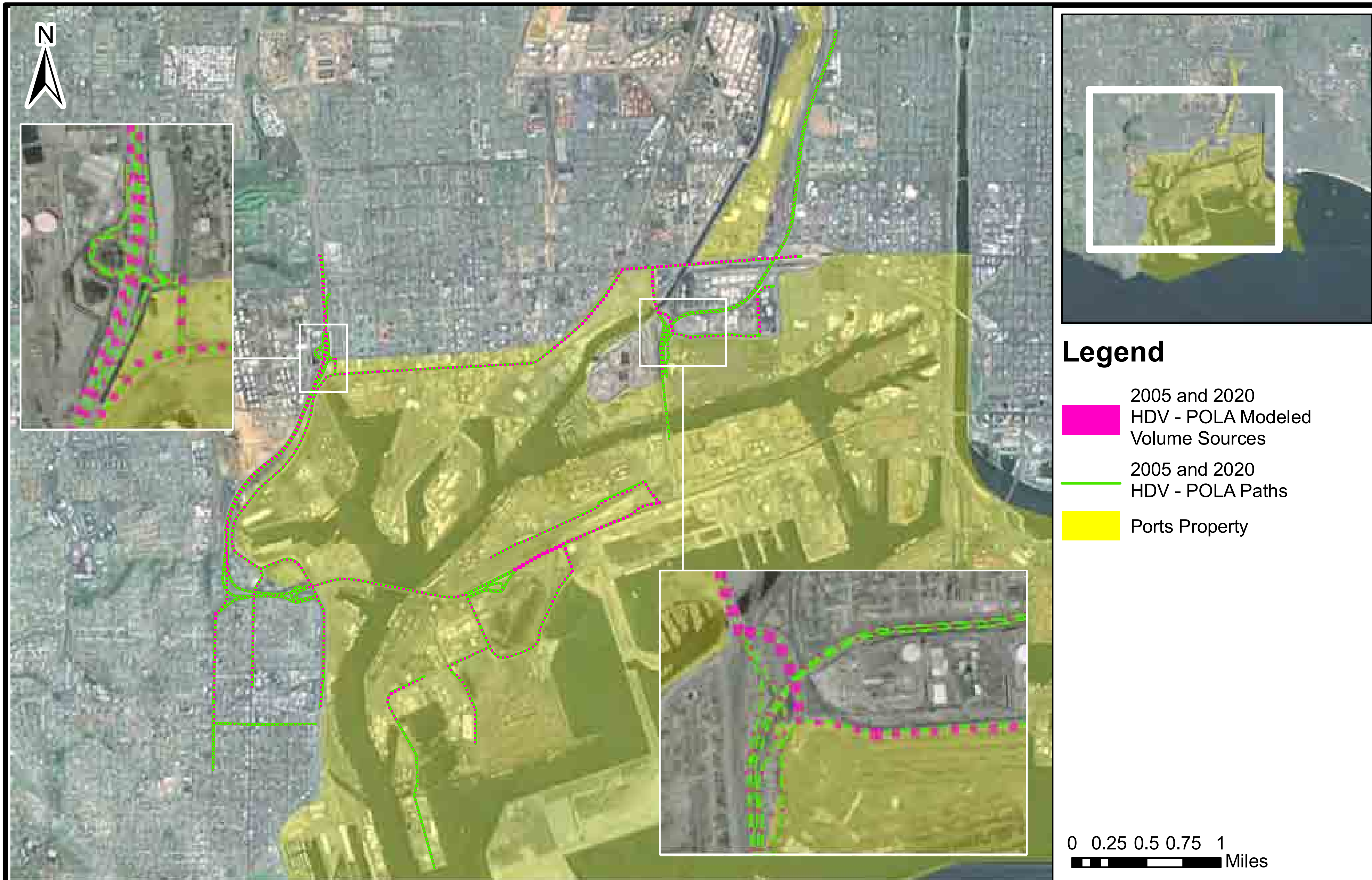
Locations of Modeled Sources
On-Port and Off-Port Rail Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure
B-16



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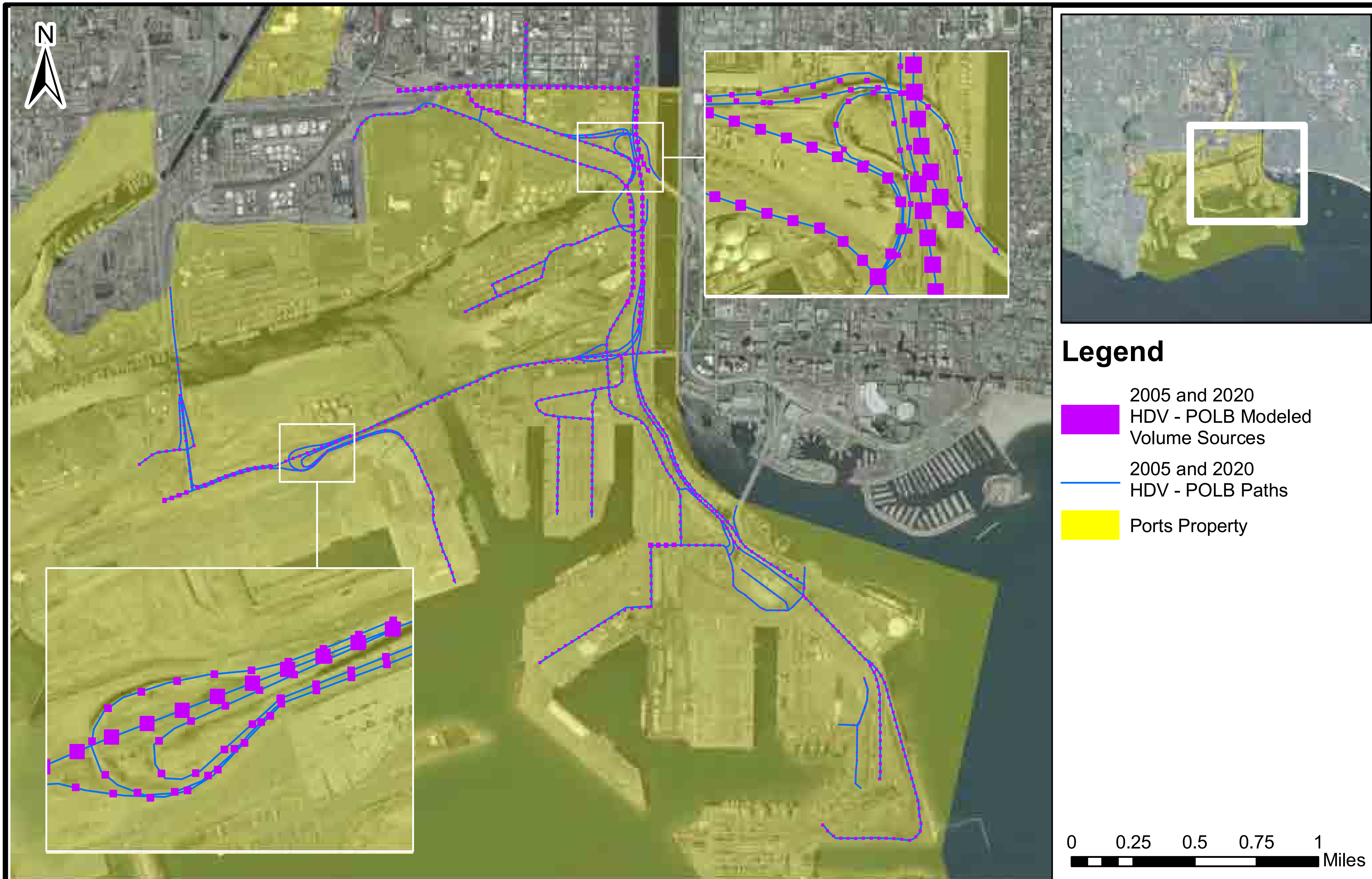
Locations of Modeled Sources
Heavy Duty Vehicles On-Port, On-Road POLA Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-17



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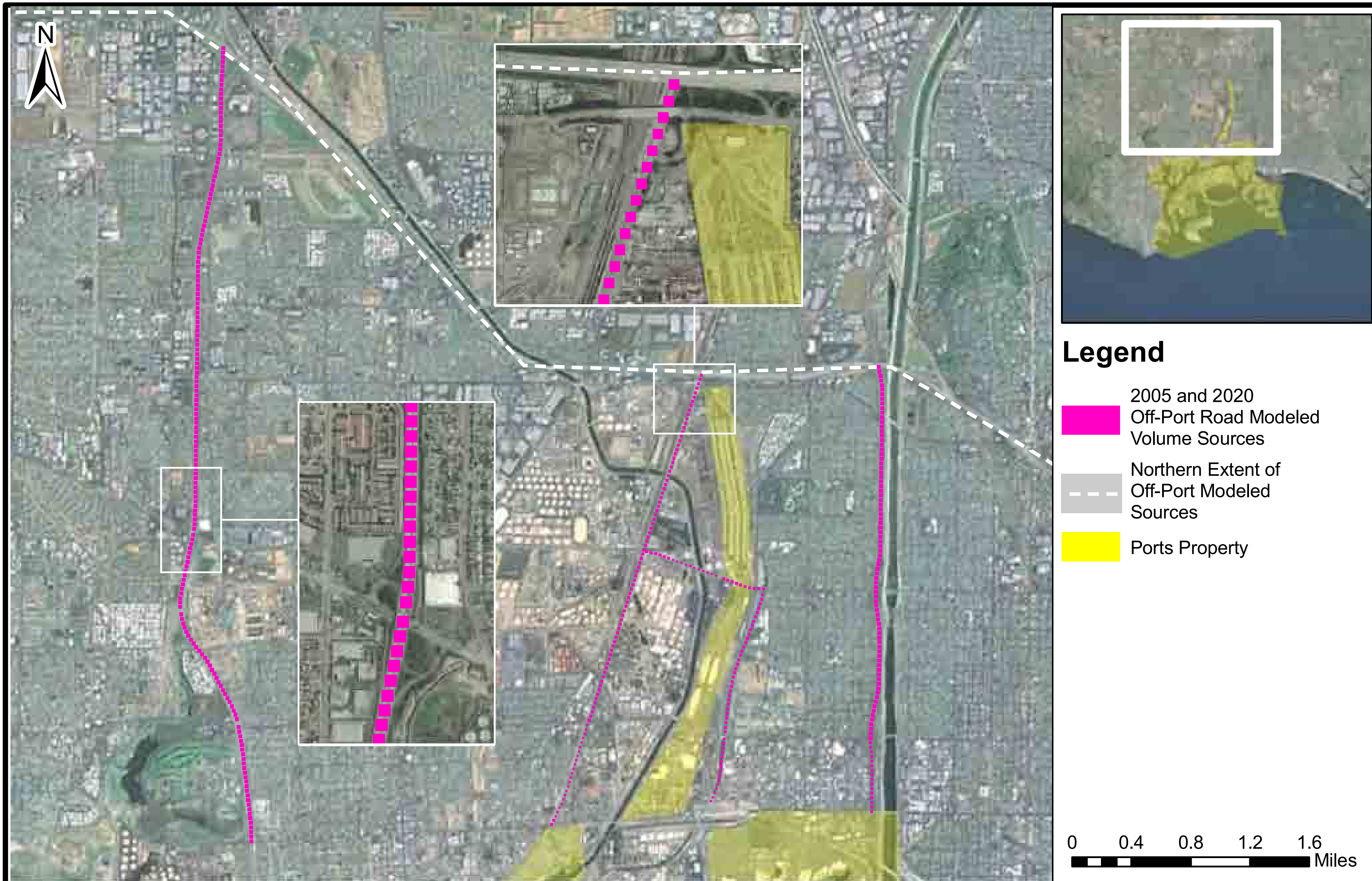
Locations of Modeled Sources
Heavy Duty Vehicles On-Port, On-Road POLB Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro By Ports, California

Figure

B-18

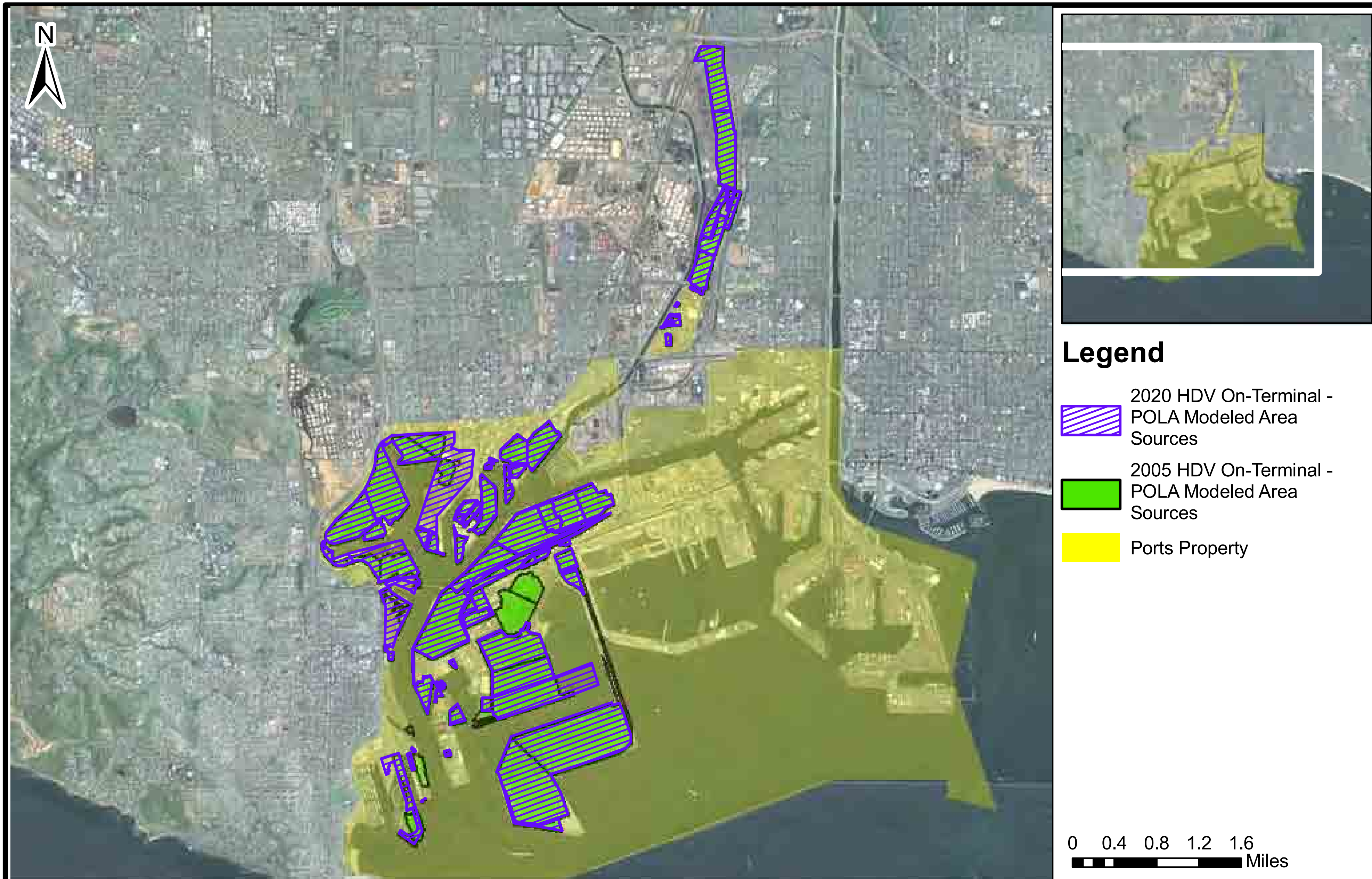


ENVIRON

6001 Shellmound St., Suite 700, Emeryville, CA 94608

Locations of Modeled Sources
Heavy Duty Vehicles Off-Port Road Modeled Volume Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure B-19



ENVIRON

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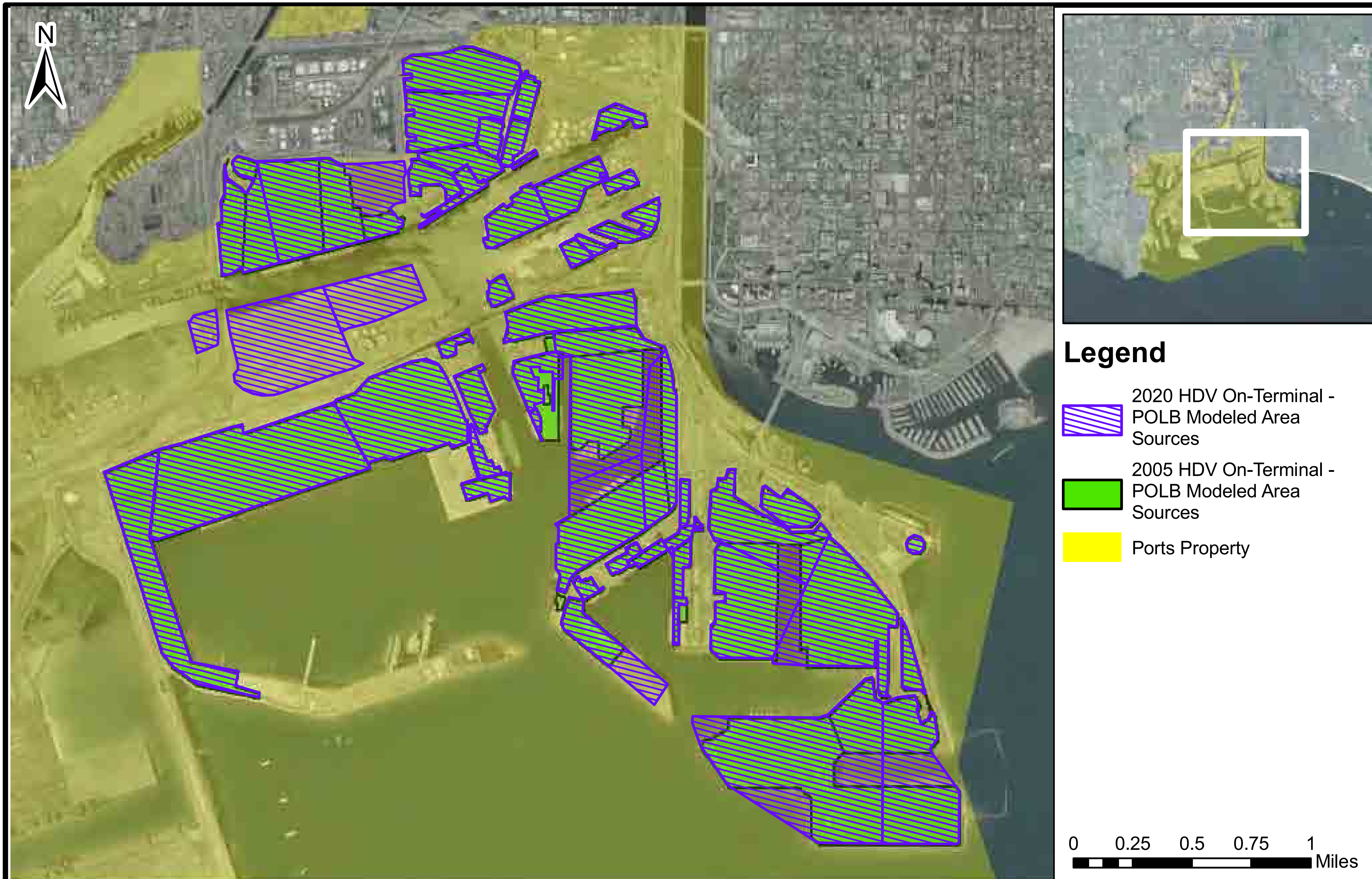
Locations of Modeled Sources
Heavy Duty Vehicles On-Terminal POLA Modeled Area Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-20



ENVIRON

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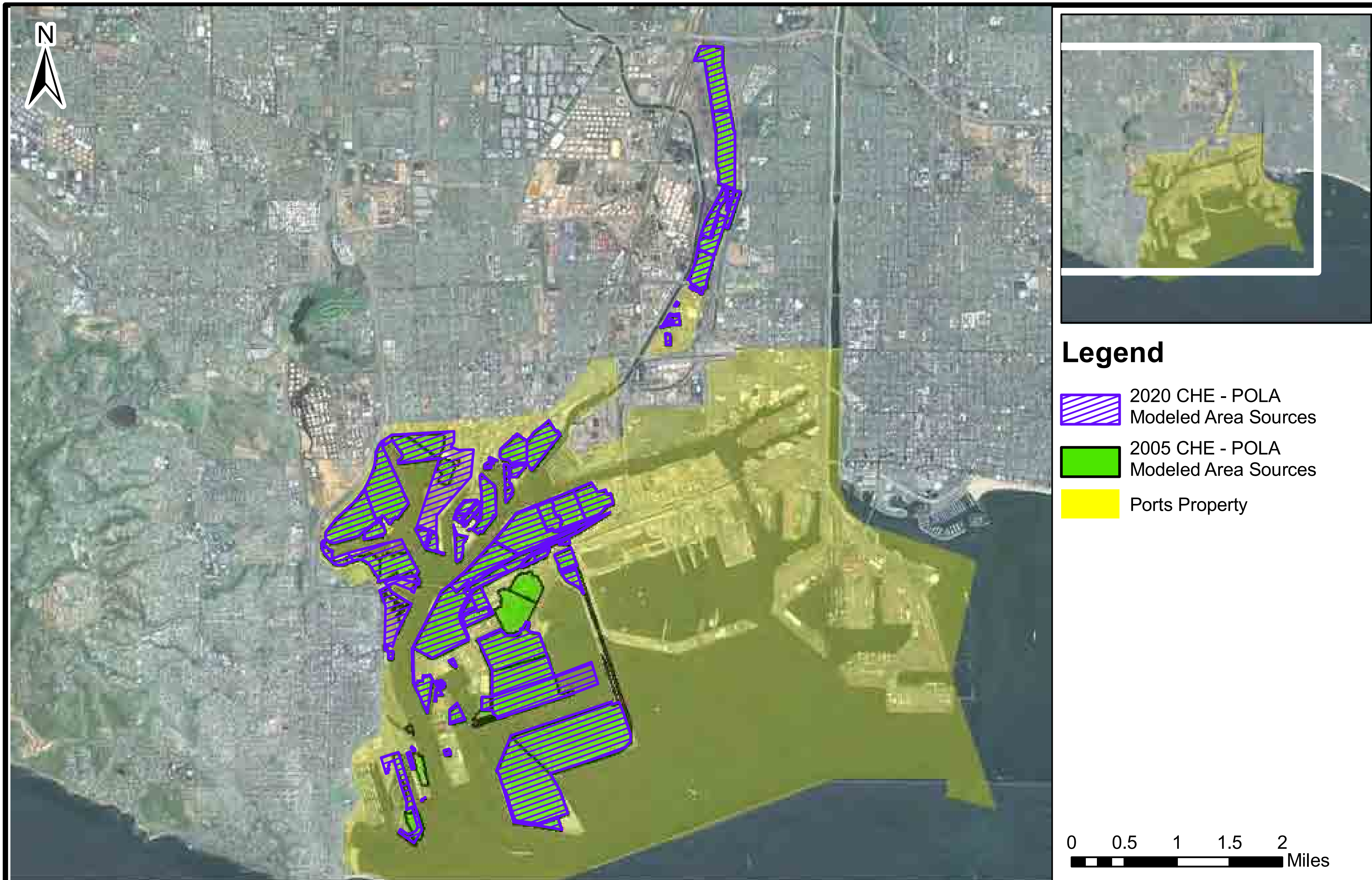
Locations of Modeled Sources
Heavy Duty Vehicles On-Terminal POLB Modeled Area Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-21



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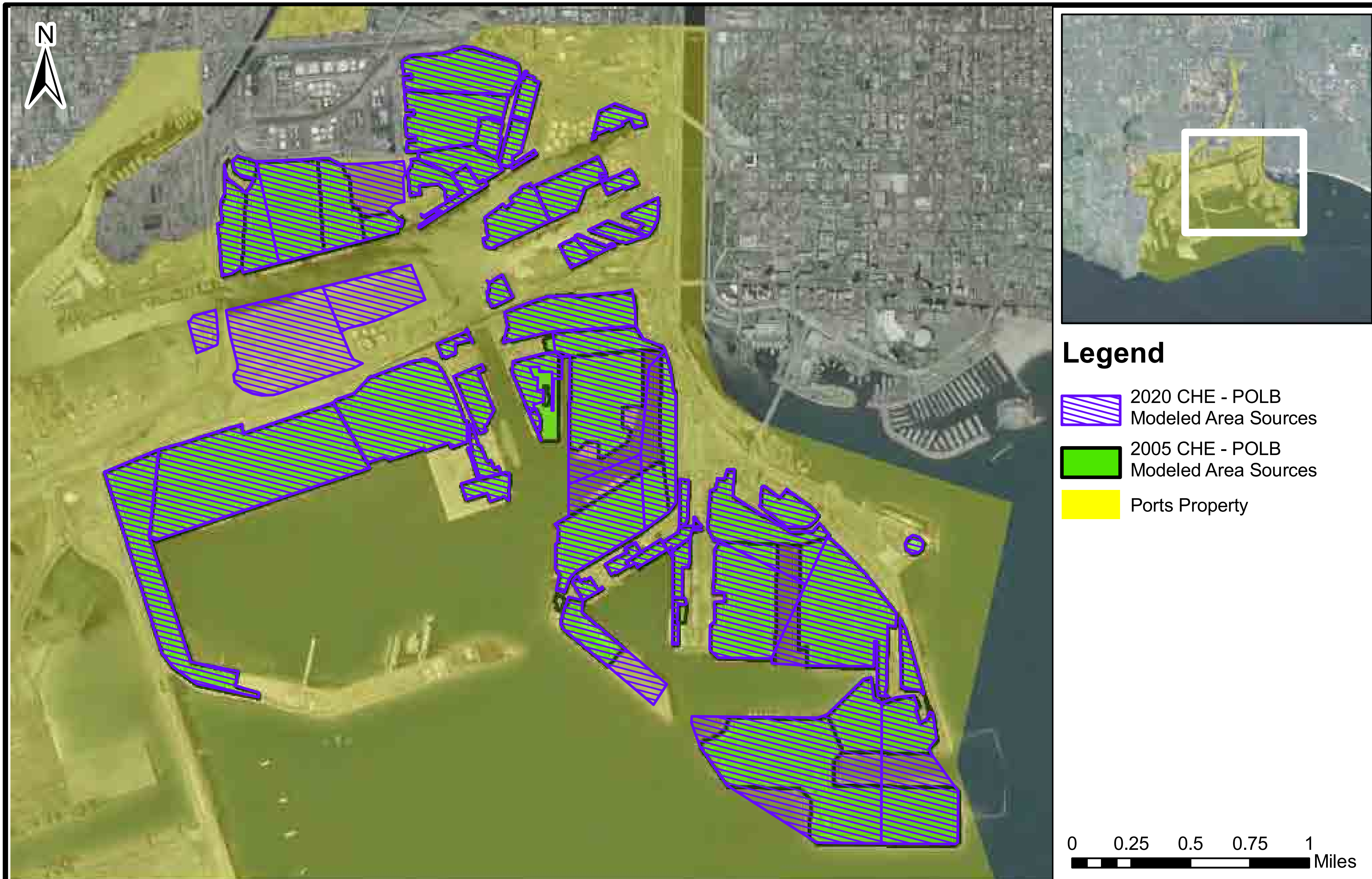
Locations of Modeled Sources
Cargo Handling Equipment POLA Modeled Area Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

B-22



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Locations of Modeled Sources
Cargo Handling Equipment POLB Modeled Area Sources
2005 and 2020 Spatial Allocation
San Pedro Bay Ports, California

Figure

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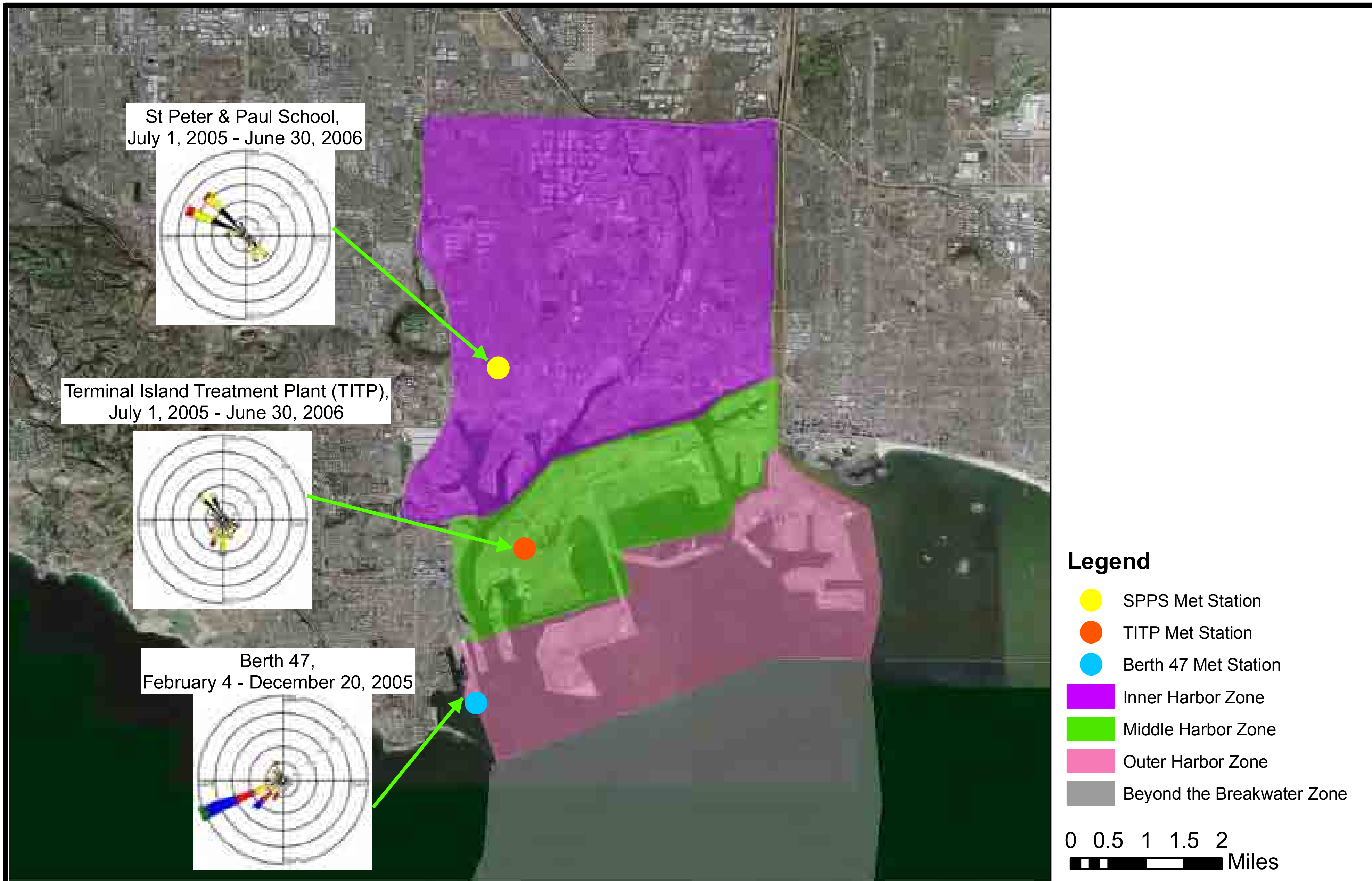

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Wind Patterns for Surface Meteorological Stations and Zones of Operations
San Pedro Bay Ports, California

Figure

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Appendix C:
Health Risk Assessment Methodology
Supplemental Information

Appendix C:

Health Risk Assessment Methodology, Supplemental Information

Contents

ACRONYMS and ABBREVIATIONS

ARB	Air Resources Board
BWHRA	Bay-Wide Health Risk Assessment
Cal/EPA	California Environmental Protection Agency
CEQ	Council on Environmental Quality
CEQA	California Environmental Quality Act
CSF	Cancer Slope Factor
DPM	Diesel Exhaust Particulate Matter
EC	Elemental Carbon
HEI	Health Effects Institute
kg	Kilogram
km	Kilometer
L	Liter
m^3	Cubic Meter
mg	Milligram
NRC	National Research Council
OEHHA	California's Office of Environmental Health Hazard Assessment
SCAQMD	South Coast Air Quality Management District
SRP	Scientific Review Panel
µg	Microgram
URF	Unit Risk Factor
USEPA	US Environmental Protection Agency
USGS	United States Geological Survey
WHO	World Health Organization

1 Health Risk Assessment Methodology, Supplemental Information

This Appendix provides details of the methodology used in the Bay Wide Health Risk Assessment (BWHRA) Tool to calculate exposure, individual cancer risk, and population-weighted cancer risk from Ports-associated sources of diesel exhaust particulate matter (DPM). Information is also provided regarding the basis of the DPM cancer slope factor (CSF). The Appendix concludes with a discussion of some of the key uncertainties of the health risk assessment.

1.1 Calculation of Exposure

In the BWHRA Tool, exposure of residential receptors to DPM in ambient air was calculated from the following equation:

$$Exposure = \frac{Ca \times BR \times EF \times ED \times CF}{AT} \quad \text{(Eq. C-1)}$$

C_a = Concentration of DPM in Air (mg/ m^3)
BR = Breathing Rate (302 L/kg-day)
EF = Exposure Frequency (350 days/year)
ED = Exposure Duration (70 years)
CF = Conversion Factor (1000 L/m^3).
AT = Averaging Time (25,550 days)

Exposures were calculated using discrete DPM emission rates estimated for 2005 and 2020 and held constant over the subsequent respective 70-year averaging periods (see Appendix B).

1.1.1 Calculation of Individual Cancer-Risk Attributable to DPM

Individual cancer risk was estimated by calculating the upper-bound incremental probability that an individual will develop cancer over a lifetime as a direct result of exposure to DPM. The equation used to calculate potential excess cancer risk is:

$$Risk = Exposure \times CSF \quad \text{(Eq. C-2)}$$

*Exposure = Exposure to DPM in air (*mg/kg-d)
CSF = DPM cancer slope factor 1.1 $(mg/kg\text{-}d)^{-1}$.

1.1.2 Calculation of Population-Weighted Cancer-Risk Attributable to DPM

Cancer risks were also analyzed by calculating population-weighted average risk associated with Ports DPM sources for the baseline year of 2005 and for predicted emissions in 2020. Population-weighted risk was calculated as:

$$\text{Risk}_{\text{population-weighted}} = \frac{\sum \text{Risk}_i \times \text{Population}_i}{\sum \text{Population}_i} \qquad \text{(Eq. C-3.)}$$

Where:

$Risk_i$ = estimated cancer risk at receptor i*;*
$Population_i$ = population of area around receptor i.

In the context of population-weighted average risk, receptors represent point locations on two Cartesian grids distributed throughout the modeling domain. The spacing of the receptors within the grids, and the basis for that spacing, are described in section 3.5 of the main BWHRA Tool report. United States Census Bureau data for the year 2000 were used to calculate the population for both 2005 and 2020. Cancer risk for the population within the vicinity of each receptor was estimated by first calculating DPM-attributable cancer risk (Eq. C-2) and then multiplying that risk by the population in the area around the specific modeled receptor ($Risk_i \times Population_i$). Population-weighted average residential cancer risk for the modeling domain was calculated by summing all receptor-related risks and dividing by the population within the modeling domain as shown in Eq.C-3.

1.2 OEHHA's Cancer Slope Factor for Diesel Exhaust Particulate Matter

In 1998, the Scientific Review Panel (SRP) of the California Environmental Protection Agency (Cal/EPA) determined that diesel exhaust is carcinogenic to humans (Office of Environmental Health Hazard Assessment [OEHHA] 1998b), and the Air Resources Board (ARB) subsequently listed diesel exhaust as a toxic air contaminant (1998c). A key supporting document for the SRP determination was a human health risk assessment of diesel exhaust conducted by the OEHHA (1998a). OEHHA's assessment focused on evaluating epidemiologic evidence of the relationship between exposure to diesel exhaust and the likelihood of developing lung cancer. Although multiple epidemiologic studies were considered by OEHHA (1998a), a study of railroad workers (Garshick et al. 1988) served as the primary basis for OEHHA's unit risk factor (URF). Cal/EPA's analysis (OEHHA 1999, 2002) resulted in a range of URFs for DPM, 1.3×10^{-4} to 2.4×10^{-3} $(\mu g/m^3)^{-1}$, with a "reasonable estimate" recommended by the SRP of 3.4×10^{-3} $(\mu g/m^3)^{-1}$. That URF translates to a CSF of 1.1 $(mg/kg)^{-1}$.

At approximately the time the OEHHA diesel exhaust risk assessment was finalized, the Diesel Epidemiology Expert Panel was formed by the Health Effects Institute (HEI) – a group that was jointly funded by the United States Environmental Protection Agency (USEPA) and by industry (HEI 1999). One of the specific goals of this Panel was to evaluate the Garshick et al. (1988)

data and to determine its suitability for quantitative risk assessment. Relying in part on the findings of the HEI Panel as well as on an independent analysis of the Garshick et al. (1988) data by Crump et al. (1991), the USEPA concluded that the existing epidemiological data on diesel exhaust were not adequate to support a quantitative assessment of the relationship between exposure and effect. As a consequence of this determination, the USEPA opted not to develop or otherwise identify a CSF or URF for diesel exhaust (USEPA 2002; 2004). This conclusion does not affect the USEPA's classification of diesel exhaust as a probable human carcinogen, but rather, only addresses the adequacy of available data to quantify the relationship between exposure and cancer in humans.

The limitations of the Garshick et al. (1988) data as identified by the HEI Panel (1999), Crump (1991), and the USEPA (2002, 2004) included: inadequate information on exposure to diesel exhaust (i.e., assigning who was exposed and who was not exposed); lack of knowledge of when workers first began working with diesel equipment; and lack of information on smoking and other lifestyle correlates of lung cancer risk. Of particular note, and a fact acknowledged by Garshick in a follow-up publication, is that lung cancer risks among the exposed cohort decreased with increasing length of exposure – the opposite trend from what is expected for a carcinogen. The results of a subsequent study (Garshick et al. 2004), in which the study cohort were followed for a longer period of time, found the same trend (Garshick et al. 2004). This suggests that the original observation of a negative correlation between exposure and lung cancer risk was not an artifact attributable to a truncated follow-up period. Nonetheless, OEHHA has retained its original recommendation for the URF for diesel exhaust of 3.4×10^{-3} $(\mu g/m^3)^{-1}$. Those values are recommended for use in risk assessments conducted to support Proposition 65, the California Environmental Quality Act (CEQA), and various air toxics programs in California. Consistent with this usage, cancer risks in the BWHRA Tool associated with exposure to DPM are calculated based on the CSF derived from OEHHA's URF for DPM.

2 Uncertainties Associated with Health Risk Assessment

There is inherent uncertainty in all health risk assessments, with the source(s) of that uncertainty dependent on the specific assumptions and models used to estimate risk (Council on Environmental Quality [CEQ] 1989).

In accordance with recommendations for an uncertainty analysis described in CEQ (1989) and the National Research Council (NRC 1994), the key uncertainties and critical assumptions associated with the health risk estimation of the BWHRA Tool are described below. The uncertainties associated with air dispersion modeling used in the BWHRA Tool are discussed in Appendix B.

2.1 Uncertainty in the Carcinogenicity of DPM

Although there is general agreement among key US and European regulatory agencies (e.g., the World Health Organization [WHO] 1996) that DPM is a likely human carcinogen, there is considerable uncertainty in the nature of the relationship between DPM exposure and the likelihood of developing cancer. That uncertainty stems in part from a "general lack of understanding" of the mechanism(s) by which DPM elicits toxicity in humans (USEPA 2002). Additionally, it is not understood whether health effects linked to diesel emissions from older diesel engines are relevant to current emission profiles and their effects (USEPA 2002). There are also specific and significant questions regarding the appropriateness of the epidemiologic data used by OEHHA (1998a) to develop the CSF for DPM. Each of these factors, alone or in combination, have the potential to significantly affect the dose-response relationship – and thus the DPM CSF – and as a consequence, the level of risk attributed to DPM exposure. To illustrate the magnitude of potential uncertainty in risk estimates of DPM, it is informative to consider risk levels for DPM calculated using the component-based methodology contained in the USEPA's *Guidelines for the Health Risk Assessment of Chemical Mixtures* (USEPA 1986) and the subsequent *Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures* (USEPA 2000). Distinct from the approach taken in the BWHRA Tool, this methodology involves the identification of key toxicologically-significant components of a mixture, and the estimation of risk attributable to each component. Estimates of total risk are developed by assuming additivity of risk from all component carcinogens. Although the approach contained in these USEPA (1986, 2000) guidance documents is typically recommended for relatively simple mixtures with approximately a dozen or fewer components (USEPA 2000), use of this methodology may be appropriate when information is lacking on the health effects of a mixture. Risk assessments of DPM performed using this component type of approach have calculated health risks that were one to two orders of magnitude lower than the risk estimated using OEHHA's CSF developed from that value (Muller 2002; ENVIRON 2006). Since completion of these analyses, both the USEPA and OEHHA have identified naphthalene, a DPM component, as a carcinogen. Had Muller (2002) and ENVIRON (2006) included naphthalene in the cancer risk calculated using the components-based approach, the difference in estimated risks between that method and that of the OEHHA CSF would likely decrease.

2.2 Uncertainty in the Role of DPM in Health Effects from Exposure to Particulate Matter Pollution

The evidence that links particulate matter (PM) to adverse health effects is substantial; reports have consistently demonstrated a correlation between long-term exposure to either PM_{10} or $PM_{2.5}$ (PM with aerodynamic diameters of 10 or 2.5 microns or less, respectively) to non-cancer adverse health effects (see review by Pope and Dockery 2006). Documented health effects from chronic exposure to PM include premature mortality (Pope et al. 1995; Krewski et al. 2000; Laden et al. 2006), respiratory disease (Abbey et al. 1995), and impaired lung development in children (Gauderman et al. 2007). A recent review and analysis of PM health effects (ARB 2008a) cited evidence that premature mortality is associated with chronic exposure to $PM_{2.5}$ levels as low as $5 \mu g/m^3$, and the World Health Organization (2005) has concluded that adverse health effects from $PM_{2.5}$ can occur from chronic exposure to 3-5 $\mu g/m^3$ - levels that are at (or just above) background for the US and Europe.

Determining the contribution of DPM to these effects requires identifying the extent to which health effects attributable to PM_{10} or $PM_{2.5}$ are due to the DPM fraction of PM. This question is the source of significant controversy and uncertainty, due in large part to the fact that there is no currently-available method to measure and attribute DPM's contribution to the PM fractions in ambient air. DPM is emitted from the combustion of diesel fuel by on-road and off-road vehicles and equipment, becoming a component of ambient PM; however, estimates of DPM as a percentage of the PM inventory vary widely. The primary component of DPM, elemental carbon (EC) (USEPA 2002), is often measured as a surrogate for DPM. However, EC is also a combustion product of gasoline-fueled engines, barbeques, fuel wood, and other lesser sources, making it a highly inaccurate surrogate. While there have been efforts to identify specific and quantifiable indicators of DPM as a component of PM, these efforts have not yielded definitive results. Consequently, while DPM emissions contribute to PM levels, and likely contribute to health effects other than cancer, the uncertainties in current estimation methods of these effects (e.g., ARB 2008b) remain substantial.

2.3 Uncertainties in Exposure Assumptions

Consistent with OEHHA and South Coast Air Quality Management District (SCAQMD) guidance (OEHHA 2003; SCAQMD 2005), individual cancer risks were estimated assuming that residents at the receptor points spend 70 years at one location. Use of the 70-year exposure duration in risk assessments is intended to produce a hypothetical estimate of risk that does not underestimate actual risks and that can be viewed as an upper-bound estimate. To illustrate the conservative nature of the 70-year assumption, it is worth noting that the USEPA has estimated that 50% of the U.S. population lives in the same residence for only nine years, while only 10% remain in the same house for 30 years (USEPA 1997). Adults, moreover, spend only 68-73% of their total daily time at home (USEPA 1997), rather than the 100% assumed in the BWHRA Tool. In addition, due to potential filtration provided by building envelopes and ventilation systems, indoor DPM concentrations resulting from Ports operations are likely to be lower than the outdoor concentrations assumed in this analysis (OEHHA 2003). Accordingly, the actual risks to hypothetical residential receptors are likely to be significantly lower than those calculated in this assessment.

2.4 Uncertainties in Population-weighted Average Risk

The population weighted risk calculations were based on 2000 census data that was applied to both 2005 and 2020. Although this assumption is likely to be reasonably accurate for the 2005 calculations of population-weighted average risk, in introduces uncertainty into the 2020 risk estimates. Notwithstanding that fact, predicting 2020 populations within the modeling domain would have likely introduced greater uncertainty into risk estimates, although the magnitude of that uncertainty cannot be readily quantified.

An additional component of uncertainty in the population-weighted average risk calculations is attributable to the fact that census tracts were divided in order to approximate the population of the receptor grid used to calculate population-weighted risk for each receptor location. This approach likely does not reflect actual population distributions, nor does it address potential changes in population distribution over time.

2.5 Summary

The risks calculated in the BWHRA Tool were estimated using a series of conservative assumptions regarding exposure concentrations, magnitude and duration of exposure, and carcinogenic potency of DPM. These assumptions, applied in a manner consistent with current guidance (OEHHA 2003; ARB 2003), tend to produce upper-bound estimates of risk, ensuring that these values do not underestimate the actual risks posed by DPM emissions from the ports. It is important to note that the risks calculated in the BWHRA Tool do not necessarily represent the actual risks experienced by populations in the modeling domain. By using standardized conservative assumptions in a risk assessment, the USEPA (1989) has noted that:

> *"These values [risk estimates] are upper-bound estimates of excess cancer risk potentially arising from lifetime exposure to the chemical in question. A number of assumptions have been made in the derivation of these values, many of which are likely to overestimate exposure and toxicity. The actual incidence of cancer is likely to be lower than these estimates and may be zero."*

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Appendix C: Analysis of Original CAAP Progress Metrics

In the original CAAP, published in November of 2006, the expected emissions reductions to be achieved by the plan were forecasted from the 2005 CAAP baseline year through 2011. Emission reduction estimates were developed using the emissions reductions expected to be achieved by the various control measures compared to "uncontrolled" emissions, grown based upon anticipated cargo activity increases.

The original CAAP 2005 baseline emission estimates were based on the 2001 POLA and 2002 POLB ocean-going vessel (OGV) and heavy-duty truck (HDV) emissions grown to 2005 activity levels, and draft 2005 CHE emissions from both ports. It is important to note that the CAAP was released prior to finalization of the 2005 inventories and only the draft 2005 CHE emission estimates were available at that time. Rail and harbor craft emissions were not included in the original CAAP emission reduction estimates because of uncertainties in both fleet characteristics and control strategy implementation.

In Section 6.1 of the original CAAP document, Effects of Growth on Emissions Reduction Measures, there were three tables (6.1 through 6.3) that estimated the effectiveness of the CAAP measures based on CARB's Goods Movement Plan (GMP) growth forecast. These tables, which presented percent reductions of controlled versus uncontrolled emissions estimates for OGV, CHE, and HDV each year from 2007 through 2011, are provided below for reference.

Table 6.1: Effect of Growth & Clean Air Action Plan on DPM Emissions

Category	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
DPM Emissions with Growth, no Control Measures											
OGVs	1,231	1,436	1,641	1,847	2,052	2,175	2,298	2,421	2,544	2,667	2,780
CHE	181	174	166	159	152	152	152	152	152	152	152
HDVs	1,236	1,168	1,101	1,033	966	966	966	966	966	966	966
Total	2,648	2,778	2,909	3,039	3,170	3,293	3,416	3,539	3,662	3,785	3,898
DPM Emissions with Growth and CAAP Control Measures											
OGVs	1,231	1,436	1,641	1,847	2,052	2,175	2,196	2,116	1,921	1,864	1,836
CHE	181	174	166	159	152	152	138	100	67	58	48
HDVs	1,236	1,168	1,101	1,033	966	966	944	730	524	354	184
Total	2,648	2,778	2,909	3,039	3,170	3,293	3,278	2,946	2,512	2,276	2,068
Percent Reduction							4%	17%	31%	40%	47%

Table 6.2: Effect of Growth & Clean Air Action Plan on NOx Emissions

Category	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NOx Emissions with Growth, no Control Measures											
OGVs	13,574	15,452	17,329	19,207	21,085	22,207	23,329	24,451	25,573	26,696	27,800
CHE	4,352	4,243	4,134	4,025	3,916	3,916	3,916	3,916	3,916	3,916	3,916
HDVs	9,569	9,744	9,919	10,094	10,269	10,269	10,269	10,269	10,269	10,269	10,269
Total	27,495	29,439	31,383	33,326	35,270	36,392	37,514	38,636	39,758	40,881	41,985
NOx Emissions with Growth and CAAP Control Measures											
OGVs	13,574	15,452	17,329	19,207	21,085	22,207	20,174	19,255	17,653	17,304	16,828
CHE	4,352	4,243	4,134	4,025	3,916	3,916	3,665	2,949	2,330	2,279	2,163
HDVs	9,569	9,744	9,919	10,094	10,269	10,269	10,102	8,498	6,940	5,491	4,041
Total	27,495	29,439	31,383	33,326	35,270	36,392	33,940	30,703	26,924	25,074	23,032
Percent Reduction							10%	21%	32%	39%	45%

Table 6.3: Effect of Growth & Clean Air Action Plan on SOx Emissions

Category	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
SOx Emissions with Growth, no Control Measures											
OGVs	7,749	8,902	10,054	11,207	12,360	13,119	13,878	14,638	15,397	16,157	16,916
CHE	8	8	8	8	8	8	8	8	8	8	8
HDVs	9	9	9	9	9	9	9	9	9	9	9
Total	7,766	8,919	10,071	11,224	12,377	13,136	13,895	14,655	15,414	16,174	16,933
SOx Emissions with Growth and CAAP Control Measures											
OGVs	7,749	8,902	10,054	11,207	12,360	13,119	11,939	10,174	8,895	8,474	8,046
CHE	8	8	8	8	8	8	8	8	8	8	8
HDVs	9	9	9	9	9	9	9	8	8	7	7
Total	7,766	8,919	10,071	11,224	12,377	13,136	11,956	10,191	8,910	8,490	8,061
Percent Reduction							14%	30%	42%	48%	52%

The 2011 goals of the CAAP's effectiveness as represented in these tables were:

- Reduce DPM by 47% compared to uncontrolled emissions growth
- Reduce NOx by 45% compared to uncontrolled emissions growth
- Reduce SOx by 52% compared to uncontrolled emissions growth

It's important again to note that in the original CAAP the forecasted 2011 controlled and uncontrolled emission estimates were based on CARB's GMP growth forecast and regulations that were in effect in May of 2005.

Comparing Actual Progress to the Original CAAP Estimates

To complete a comparison of the original CAAP's estimated effectiveness and actual progress, the following steps must be performed:

Step 1. For 2007 through 2009, controlled emission estimates are based on actual activity data modeled with the 2005 methods and assumptions with the exception of HDV emissions where actual call weighted emissions are included. For calendar year 2005 there was no significant difference in call weighted versus population weighted HDV emissions. However, this difference became more pronounced in recent years due to the implementation of ports' Clean Truck Program and the disincentive for using older trucks.

Step 2. Forecast 2010 through 2014 controlled and uncontrolled emission estimates using the 2005 methods and assumptions and the updated 2007 cargo forecast for HDVs , emissions for forecasted years are based on population weighted age distribution forecasted from 2005. The difference between the population weighted and call weighted approach is no longer expected to be significant as the CTP becomes fully implemented in 2012 and all trucks are required to meet the same performance standard.

These steps are further detailed in the findings presented below.

Step 1 - Actual 2007, 2008 and 2009 activity for both ports was reloaded into the 2005 emissions inventory databases and modeled with the 2005 methods and assumptions with the exception of HDV as mentioned above. The results are presented below in Tables C-1 through C-3.

Table C-1: 2007 to 2009 DPM Uncontrolled & Controlled Emission Estimates

Using 2005 Methodology

Sources	DPM, tpy 2007	2008	2009
Uncontrolled			
OGV, HDV, CHE	1,994	2,063	2,132
Controlled			
OGV, HDV, CHE	1,396	1,368	894
Percent Reduced	***30%***	***34%***	***58%***

Table C-2: 2007 to 2009 NOx Uncontrolled & Controlled Emission Estimates Using 2005 Methodology

Sources	NOx, tpy 2007	2008	2009
Uncontrolled			
OGV, HDV, CHE	32,253	33,740	35,292
Controlled			
OGV, HDV, CHE	29,778	26,128	18,396
Percent Reduced	***8%***	***23%***	***48%***

Table C-3: 2007 to 2009 SOx Uncontrolled & Controlled Emission Estimates Using 2005 Methodology

Sources	SOx, tpy 2007	2008	2009
Uncontrolled			
OGV, HDV, CHE	14,223	15,210	16,163
Controlled			
OGV, HDV, CHE	9,176	9,817	6,345
Percent Reduced	***35%***	***35%***	***61%***

Step 2 – Forecasting future-year emissions (2010 through 2011) for both controlled and uncontrolled emissions is based on growing uncontrolled emissions by the growth estimates in the 2007 cargo growth forecast and then applying the emissions controls of the CAAP measures and applicable regulations to those emissions, similar to what was done in developing tables 6.1 through 6.3 in the original CAAP. Regulations that were not promulgated prior to May 2005 were not included. The results are presented below in Tables C-4 through C-6.

Table C-4: 2007-2011 DPM Uncontrolled & Controlled Emission Estimates Using 2005 Methodology*

	DPM, tpy				
Sources	**2007**	**2008**	**2009**	**2010**	**2011**
Uncontrolled					
OGV, HDV, CHE	1,994	2,063	2,132	2,232	2,324
Controlled					
OGV, HDV, CHE	1,396	1,368	894	654	659
Percent Reduced	***30%***	***34%***	***58%***	***71%***	***72%***

Table C-5: 2007-2011 NOx Uncontrolled & Controlled Emission Estimates Using 2005 Methodology*

	NOx, tpy				
Sources	**2007**	**2008**	**2009**	**2010**	**2011**
Uncontrolled					
OGV, HDV, CHE	32,253	33,740	35,292	35,938	36,528
Controlled					
OGV, HDV, CHE	29,778	26,128	18,396	27,969	28,444
Percent Reduced	***8%***	***23%***	***48%***	***22%***	***22%***

Table C-6: 2007-2011 SOx Uncontrolled & Controlled Emission Estimates Using 2005 Methodology*

	SOx, tpy				
Sources	**2007**	**2008**	**2009**	**2010**	**2011**
Uncontrolled					
OGV, HDV, CHE	14,223	15,210	16,163	17,189	18,090
Controlled					
OGV, HDV, CHE	9,176	9,817	6,345	4,237	4,271
Percent Reduced	***35%***	***35%***	***61%***	***75%***	***76%***

* Except for HDV emissions where actual call weighted emissions were used for 2007 to 2009

As shown above, in 2009, the ports exceeded the original CAAP goals established for 2011 for DPM and SOx (based on the original CAAP methods and assumptions, and utilizing actual activity data and an updated forecast) and are forecasted (even with the higher 2007 cargo forecast) to go even further throughout 2010 and 2011. The 2011 NOx estimate, using the 2007 cargo forecast and the described modeling methodology, indicates that the ports would fall short of the 45% NOx reduction estimate included in the original CAAP. This estimated shortfall is due to changes from the assumptions that were made for the original CAAP analysis, including changes to the implementation timeline and changes in the fleet mix. For example opportunities to implement requirements through new or renewed leases have not come about on the schedule originally anticipated. Finally, the decrease in NOx emissions in 2010 is less than 2007 through 2009 because uncontrolled emissions are based on estimated higher growth from the 2007 cargo forecast, whereas controlled emissions in 2007 and 2009 reflect the actual decline in growth that occurred during those years.

Despite the modeled estimates, the ports anticipate they will actually meet or exceed the original NOx goal before 2011. This is expected to a result from the recent economic downturn, where actual cargo volumes are lower than predicted by the 2007 cargo forecast. Actual emissions from the ports will continue to be calculated and made available through each port's annual Emission Inventory.