Updated Health Risk Assessment

Focusing on Diesel Particulate Matter at the District's Marine Cargo Terminals

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Updated Health Risk Assessment for the Port of San Diego Maritime Clean Air Strategy

Contributing Port Staff

Larry Hofreiter, AICP, Program Director, Planning

Peter Eichar, Senior Environmental Specialist, Planning

Jason Giffen, Vice President, Planning & Environment

Consultant Team

Matthew McFalls, Senior Air Quality and Climate Change Manager, Ascent Environmental

Blake Barroso, Senior Technical Analyst, Environmental Review Partners, Inc.

Edward Carr, Technical Director Air Quality and Health Risk, ICF

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Executive Summary

This report summarizes the results of the Health Risk Assessment (HRA) performed to support the Port of San Diego (Port) Maritime Clean Air Strategy (MCAS) health objectives. Health Objective 1 in the MCAS directed staff to identify existing health risk levels generated from the Port's Tenth Avenue Marine Terminal (TAMT) and the National City Marine Terminal (NCMT) for diesel particulate matter (DPM) emissions and other toxic air contaminants (TAC).[1] Health Objective 2 in the MCAS further directed Port staff to provide the San Diego Air Pollution Control District (San Diego APCD) and California Air Resources Board (CARB) with the Port's HRA and to assist CARB and San Diego APCD with preparing an independent and separate cumulative health risk analysis, also referred to as CARB's Regional Air Toxics Modeling, for the broader region, as well as the Portside Community (See Figure 1 for Portside Community Boundary).

The HRA focused on health risks from exposure to DPM emitted by emissions sources from TAMT and NCMT. DPM was the main TAC of concern because the majority of Port-related emission sources are diesel-powered. Although not related to cargo movement, DPM emissions from commuter ferries were included in the HRA since the ferry service operates immediately adjacent to the Portside Community. More details regarding the intent of the HRA and the emission sources included in the analysis are provided in the sections that follow.

The HRA evaluated health risks for three emissions scenarios: 2019 Baseline, Forecasted 2026, and Forecasted 2030 with implementation of MCAS measures. The 2019 Baseline scenario emissions were estimated based on the 2019 emissions inventory, developed as part of the MCAS. The Forecasted 2026 and 2030 scenarios represent the change in emissions from the 2019 Baseline scenario with implementation of MCAS measures (e.g., shore power, electric trucks).

The HRA evaluated cancer risks for residents near the terminals and in the surrounding areas. Table ES-1 shows the maximum 30-year residential cancer risk for the four highest locations in the modeling domain. The results of the HRA indicate that the 2019 Baseline risk was highest in the communities closest to TAMT and NCMT, which included National City and Barrio Logan, with other communities in the modeling domain (Downtown and Coronado) showing lower risk. As shown, residential cancer risk is reduced within these communities with implementation of short-term (2026) and long-term (2030) MCAS measures. The MCAS measures achieved over a 40% cancer risk reduction in three of the four highest communities. The maximum residential cancer risk location in Downtown does not achieve similar reductions because cancer risk is driven by emissions associated with rail activity, which is operated by the Burlington Northern Santa Fe Rail Company (BNSF) and is largely outside the control and/or influence of the Port.

Also, the HRA looked at supplemental information for chronic (non-cancer) risks for residents, as well as cancer risks and chronic (non-cancer) risks for children at schools and children at parks. The HRA also conducted a population-weighted cancer risk analysis for residents located within the Portside Community. The population-weighted risk differs from maximum cancer risk in that it analyzes risks at census block receptors over a 70-year exposure duration compared to maximum risk which uses receptors located at individual residential locations and a 30-year exposure duration. The maximum residential cancer risks, chronic (non-cancer) risks, and population-weighted cancer risk are presented in this report.

The sections below provide background to understand the intent of this HRA, emission sources included and excluded, and key findings. The appendices provide additional details regarding the

[1] TACs are defined as air pollutants which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health. CARB has identified over 200 TACs. Diesel Particulate Matter (DPM) was identified as a TAC in 1998 and is generally the most impactful TAC in urban areas. See key definitions in Appendix E.

emissions inventory (Appendix A), dispersion modeling methodology (Appendix B), health risk calculation methodology (Appendix C), and modeling results (Appendix D). A copy of the presentation provided the Board of Port Commissioners on June 14, 2022, is available at https://www.portofsandiego.org/mcas.

TABLE ES-1: MAXIMUM RESIDENTIAL CANCER RISK BY COMMUNITY AND FORECASTED CANCER RISK REDUCTION FOR 2026 AND 2030 EMISSION SCENARIOS

Community Area	Maximum Cancer Risk (per million)			Forecasted Reduction from 2019 Baseline	
	2019 Baseline	Forecasted 2026 with MCAS	Forecasted 2030 with MCAS	2026 with MCAS	2030 with MCAS
National City	20.6	14.4	11.9	-30%	-42%
Barrio Logan	19.7	11.7	10.5	-40%	-46%
Downtown	18.9	16.6	16.4	-12%	-13%
Coronado	16.0	9.3	8.2	-42%	-49%

Introduction

Background

The Portside Environmental Justice Community (Portside Community)[2] is identified as having a high cumulative air pollution exposure burden, a significant number of sensitive receptors, and it includes census tracts that have been designated as disadvantaged communities. Polluted air can contribute to higher rates of asthma, cardiovascular disease, and a variety of other health related impacts including an increased risk of cancer. Multiple sources contribute to the Portside Community's poor air quality, including freeway traffic, industrial and manufacturing facilities, as well as off-road mobile sources, such as ocean-going vessels (OGVs) and other diesel equipment. The Portside Community is located in close proximity to the Port's two marine cargo terminals. The Portside Community boundary is shown in **Figure 1**.

On October 12, 2021, the San Diego Board of Port Commissioners (Board) adopted the MCAS to provide goals and a framework to develop future programs, projects and initiatives that reduce emissions and improve health for all who live, work, and play on and around San Diego Bay.

Key references in this report include the adopted MCAS,[3] approved by the Board of Port Commissioners on October 12, 2021, and CARB's *San Diego Regional & Portside Community Modeling* presentation for the Portside Community Steering Community, given on May 24, 2022.[4]

This HRA has been prepared in accordance with Health Objective 1 in the MCAS, which directs staff to identify existing health risk levels generated from TAMT and NCMT for DPM and other TACs. A preliminary analysis was completed in October 2021 and the *Preliminary Health Risk Assessment and Summary Report* (Preliminary HRA) was presented to the Board on December 13, 2021.[5] Between December 2021 and June 2022, staff revised the Preliminary HRA in response to stakeholder feedback and additional data that was provided (e.g., updated fuel consumption). Modeling revisions also take into account discussions and feedback from both CARB and San Diego APCD.[6]

Health Objective 2 in the MCAS further directed Port staff to provide the San Diego APCD and CARB with the Port's HRA and to assist them with preparing an independent and separate cumulative health risk analysis for the Portside Community.[7] Following completion of the Preliminary HRA in December 2021, Port staff met regularly with CARB and San Diego APCD staff to ensure both modeling efforts – the update to the Port's HRA, and CARB's San Diego Regional & Portside Community Modeling Presentation (which is CARB's cumulative health risk analysis, also referred to as the CARB's Regional Air Toxics Modeling) – were using the best and most accurate information. In addition to soliciting ways to clarify and/or improve the Port's HRA, Port staff provided CARB with data and information related to the Port's marine cargo terminal operations and nearby ferry activity. However, due to the additional emission sources included in CARB's scope of work, as well as the larger geographic region it was modeling, different modeling methodologies, with different software and data sets, were used. CARB's

[2] The Portside Community includes Barrio Logan, Logan Heights, Sherman Heights, and west National City. The California Air Resources Board (CARB) selected it for additional air monitoring in 2018 and to develop a Community Air Emission's Reduction Plan (CERP) in 2019. The Portside Community's CERP was approved by the San Diego Air Pollution Control District Governing Board in July 2021 and was adopted by CARB on October 14, 2021.

[3] The adopted MCAS is available on the Port's website, here: https://www.portofsandiego.org/mcas

[4] CARB's May 24, 2022 presentation for the Portside Community Steering Community , is available on the SDAPCD website, here: https://www.sdapcd.org/content/sdapcd/community/community-air-protection-program/portside-community/portside-meetings.html

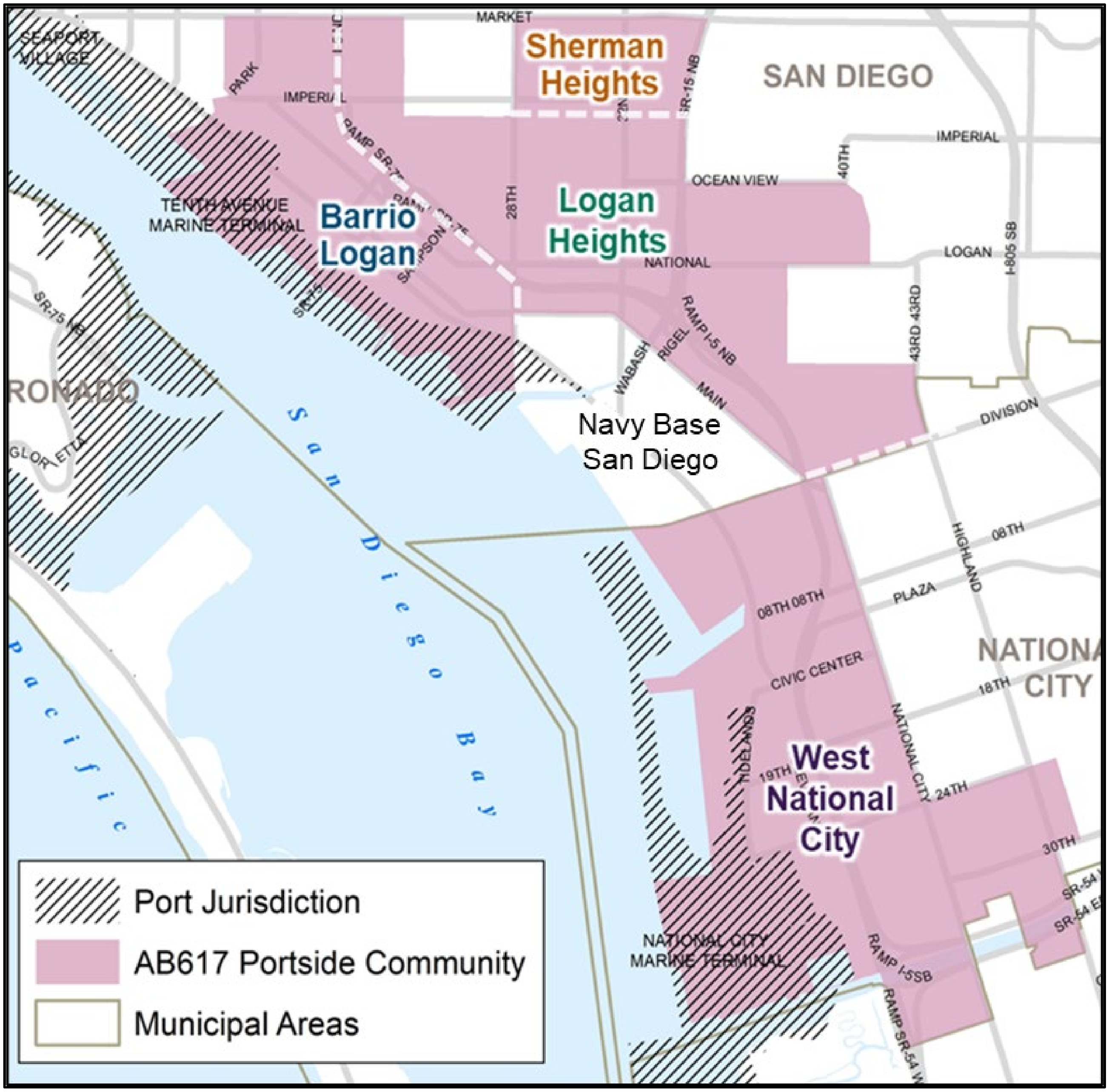
[5] The December 2021 HRA is available on the Port's website, here: https://www.portofsandiego.org/mcas

[6] For a complete list of modeling changes that were made to the Preliminary HRA and Summary Report (December 2021), please refer to the *HRA Methodology* section below.

[7] Please note that Goal #7 (c) in the Portside Community CERP (Final, July 2021) acknowledges that the Port will assist SDAPCD and CARB with preparing a Cumulative Health Risk Assessment for the AB 617 Portside Community by providing them with the Port's Health Risk Assessment and the other operational related information.

San Diego Regional & Portside Community Modeling Presentation results were presented to the AB 617 Portside Community Steering Committee on May 24, 2022, and are discussed briefly in the population-weighted cancer risk section of this report.[8] This report satisfies completion of Health Objective 1 and Health Objective 2 in the MCAS.

FIGURE 1: PORTSIDE COMMUNITY BOUNDARY



[8] Although results from CARB's Regional Air Toxics Model were presented at the May 24, 2022, AB 617 Portside Community Steering Committee meeting, the completed technical report was not available at the time of this writing. However, the modeling results that CARB provided to the Portside Steering Committee are referenced in this report to provide regional context for the Port's population-weighted average analysis that it conducted for its two marine cargo terminals and ferry activity.

Purpose

This HRA establishes a health risk baseline for the areas near and adjacent to the Port's two marine cargo terminals based on their 2019 activity and operations. Because the Port's marine cargo terminals are not subject to San Diego APCD's Toxic Air Contaminant Public Health Risk (or Hot Spots, Rule 1210), preparation of an HRA was identified as a near-term objective in the MCAS. This HRA also explains how some key emission reduction strategies identified in the Port's MCAS may help reduce health-related impacts. The MCAS notes that a quantitative HRA may be used to identify existing health risk levels and to inform DPM emission reduction goals and/or cancer risk reduction goals.[9] It is important to note that there is uncertainty in any risk assessment. The assumptions used in this HRA are based on guidelines that are designed to err on the side of health protection to avoid underestimation of risk to the public. Risk estimates generated by an HRA should not be interpreted as the expected rates of disease in the exposed population, but rather as estimates of potential for disease, based on current knowledge and several assumptions.

This HRA serves several purposes:

1. Establishes a baseline 30-year cancer risk estimate[10] in the Portside Community due to 2019 cargo throughput activities at the Ports two marine cargo terminals (TAMT and NCMT), as well as 2019 commuter ferry activity.
2. Provides a quantified comparison between the 2019 baseline 30-year cancer risk and a forecasted (or future) 30-year cancer risk with implementation of specific near-term (2026) and long-term (2030) emission reduction goals, programs, and strategies in the MCAS.
3. Supplements San Diego APCD's and CARB's San Diego Regional & Portside Community Modeling efforts, which is an independent and separate analysis that is being developed for the Portside Community.
4. May be used to prioritize emission reduction strategies and/or inform the formulation of a DPM emission reduction goal(s) and/or cancer risk reduction goal(s) at the Port's two marine cargo terminals, based on direction from the Board of Port Commissioners.

Intended Uses of this HRA

Consistent with the purposes noted above, this HRA is intended to provide the Port, including the Board of Commissioners, members of the Portside Community Steering Committee and the general public with information to better prioritize and more effectively advance the goals and objectives identified in the MCAS. This information may also be used by partner agencies and/or other stakeholders to solicit additional funding and investment for emission reduction projects and initiatives that would improve public health.

Emission Sources

Sources Included

As noted above, the focus of this HRA is limited to the major emission sources related to cargo movement activities at the TAMT and NCMT, as well as commuter ferry activities. The specific sources evaluated in the HRA are described below and the sources and their general location are summarized in **Table 1**. Appendix A provides detailed information on the assumptions and data used to develop the

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[9] Please note that preparing a health risk assessment at the Port's two marine cargo terminals was also identified as Goal #7 in the Portside Community CERP (Final, July 2021).

[10] Cancer risk is defined as the probability of developing cancer if an individual is exposed continuously to a TAC(s) over an extended period of time. See key definitions in Appendix E.

emissions inventories for each scenario, and Appendix B provides detailed information on how these emission sources were represented in the dispersion model.

- Ocean-going vessels (OGVs), including transit, maneuvering, and at berth (or hoteling) emissions associated with OGVs that call on TAMT and NCMT. No activity associated with US Navy vessels, cruise ships, and/or other pass-by trips (i.e., vessels that do not enter San Diego Bay and/or do not call on TAMT and NCMT) were included. It is important to note that OGVs do not idle and wait for tugboat assistance, nor do they wait for an available terminal berth inside San Diego Bay. Should OGVs need to wait for berthing availability or tugboat assistance, they anchor outside of San Diego Bay until they can be escorted into the Bay and to one of the marine cargo terminals. While not common, emissions associated with time OGV's spent idling outside of the Bay were accounted for in this HRA.
- Assist tugs activity associated with OGV maneuvering/berthing and escorting vessels into and out of San Diego Bay, when needed.
- Heavy-duty drayage and non-drayage trucks calling to TAMT and NCMT, which includes idling and movements within the terminals, travel along the designated truck route, travel on some Barrio Logan surface streets (or outside the designated truck route), and regional travel on Interstate 5 and Interstate 15.[11] This HRA does not include non-cargo related truck activity or heavy-duty trucks that do not travel to and from the Port's two marine cargo terminals.
- Cargo handling equipment (CHE) at both TAMT and NCMT.
- Freight rail activity, including both train switching and line-haul activity associated with moving freight to and from TAMT and NCMT. This HRA does not include train switching and line-haul activity that do not travel to and from the Port's two marine cargo terminals.

This HRA also incorporated emissions from fixed route ferries which, includes commuter ferry activity between the Coronado Ferry Landing and the Downtown Broadway Pier and the Downtown Convention Center landings, because the Convention Center landing is located near TAMT and the Portside Community, notably Barrio Logan. Ferry data was readily obtainable, and MCAS Harbor Craft Objective 1 targets transitioning all short run ferries to zero emissions by January 1, 2026. Estimating and documenting the contribution ferries have on cancer risk may help ferry operators secure additional State and/or federal funding to transition ferry operations to zero emission technologies.

[11] For more information about the designated truck routes, surface streets and freeway segments that were modeled, please see heavy duty trucks discussion in Appendix A – Diesel Particulate Matter Emissions Inventory, pages A-14 to A-20.

TABLE 1: SUMMARY OF EMISSION SOURCES INCLUDED IN HRA

Source Type	Location
Ocean-Going Vessels	Transit and Anchorage Outside of the Bay
	Maneuvering Inside the Bay
	Hoteling At berth
Commercial Harbor Craft (Assist Tugs)	Inside the Bay and at terminal during berthing (same geometry as OGV maneuvering)
Commercial Harbor Craft (Ferries)	Commuter Ferry Path
Cargo Handling Equipment	Equipment activity within terminals
Truck Travel outside of Terminals (Truck Offsite)	Truck travel path on surface streets and freeways
Truck Travel within Terminals (Truck Onsite)	Truck travel within terminals
Freight Rail - Line-Haul	Burlington Northern Santa Fe Rail (BNSF) right-of-way from NCMT and TAMT, through Downtown
Freight Rail - Switching	Switching area at NCMT and between BNSF and TAMT

Sources Excluded

The HRA focused on activity related to TAMT and NCMT, as well as commuter ferries, thus, activities not related to TAMT, NCMT, or commuter ferries were not included in the HRA. Activities not included are associated with the Cruise Ship Terminal (CST), commercial and sport fishing, excursions, recreational boating, and other harbor craft or truck activity that do not serve or operate near the cargo terminals. Additionally, while the shipyards operate near the Portside Community, they fall under the regulatory umbrella of CARB and San Diego APCD, and are thus not included in this HRA.

However, Port staff and consultant team have provided relevant information on these other vessel emissions to CARB and San Diego APCD in an effort to assist them with the *San Diego Regional & Portside Community Modeling Presentation* for the Portside Community Steering Community, which is an independent, separate and more extensive analysis. Additional information on some of these excluded emission sources are described below.

Shipyards

Shipyards involve the mooring of vessels for maintenance, repair, overhaul, and conversion (MROC) activities, typically of larger naval and commercial vessels. These shipyard activities were not captured by this HRA, but have been accounted for in CARB's *San Diego Regional & Portside Community Modeling*, because the emissions from the shipyards included sources other than diesel powered engines, and are deemed "stationary sources" and are thus regulated by the San Diego APCD via Rule 1210 and others.[12] Due to this long-standing regulatory relationship between San Diego APCD and the

[12] Although the Port tenant's shipyard facilities produce localized emissions that also impact nearby community residents, these facilities are subject to the San Diego APCD's Toxic Air Contaminant Public Health Risk - Public Notification and Risk Reduction (Rule 1210), which requires facilities to implement a risk reduction plan if their public health risk assessment shows potential risks above a specified level. On November 4, 2021, the San Diego APCD Governing Board voted to amend Rule 1210, which (1) lowered the significant

shipyards, San Diego APCD is in a unique position to better understand TAC emission sources and possibilities to curtail their creation as staff from these agencies are experts in the fields of air quality impact assessment and San Diego APCD has the legal authority to develop and implement emission abatement regulations and programs.

Many shipyards are endeavoring to make improvements to their operations that will reduce emissions in the long run, and many have begun the transition away from diesel powered equipment toward electrical equipment. Shipyards continue to advance operational efficiencies in an effort to reduce the usage of diesel-powered equipment to improve air quality and public health[13].

Cruise Ship Terminal

Cruise ship operations are not included in this HRA. Similar to the shipyards, the Port is relying on the expertise and regulatory authority of the San Diego APCD and CARB to comprehensively evaluate emissions from cruise ship operations. Moreover, the Cruise Ship Terminal is not located within or near the Portside Community.

However, the Port is expanding shore power capacity at the B-Street Cruise Terminal in accordance with Ocean-going At Berth Objective 2A in the MCAS and CARB's new At Berth Regulation ("2020 Regulation"), which appears in sections 93130 through 93130.22 of Title 17, California Code of Regulations. Additional shore power capabilities for cruise ships are anticipated to be operational prior to January 1, 2023.

Other Harbor Craft

Commercial Harbor Craft activities within San Diego Bay include commercial fishing, sport fishing, and whale watching and harbor cruise excursions, and recreational boating are not included in this HRA because their usage, aside from tugboats used to assist OGV calls, are not associated with cargo operations at the two marine cargo terminals. Moreover, the majority of their usage is outside of the Portside Community area. Commercial fishing vessels berth at Shelter Island and Tuna Harbor, and sportfishing vessels berth at Shelter Island. These vessels typically travel between the ocean and berth locations, while rarely if ever traveling in other parts of the Bay.

Port Adjacent Emissions

There are several emission sources that originate immediately adjacent to Port maritime operations but are not associated with one of the marine terminals. Moreover, these sources are not under the authority or control of the Port but are regulated by the San Diego APCD and/or CARB. These mobile sources include but are not limited to vehicular traffic on Interstate 5, Interstate 15, State Route 75, as well as the movement of cargo on rail that does not arrive or depart from one the Port's two marine terminals. Similarly, Amtrak passenger rail, local roads and industrial operations within Portside Community, and emissions associated with US Naval Base San Diego are not addressed in the Port's HRA. These sources have, however, been preliminarily captured as part of CARB's *San Diego Regional & Portside Community Modeling.*

risk threshold for cancer from 100 in one million to 10 in one million, (2) enhanced the public notification protocols and public meeting requirements; and (3) provided additional time for facilities where it is not feasible to reduce health risks within a 5-year timeframe. Because the TAMT and NCMT are not subject to Rule 1210, this HRA focuses on emissions at (and near) the Port's two marine cargo terminals.

[13] For more information on shipyard related emissions, as well as the emission reduction strategies included in the Portside Community's CERP (July 2021), please see page IV.5-1 through IV.5-11 in the MCAS (October 2021).

Health Risk Assessment Methodology

Three main components were required to conduct the Port's HRA. These components included the following:

1) Emissions Inventory (i.e., the amount of emissions emitted by a source, the HRA used the annual emissions from emissions sources in tons per year) for each analysis year (more on this below);

2) Dispersion Modeling (i.e., use of mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source, resulting in predicted pollutant concentrations at selected sensitive receptor locations)[14]; and

3) Health Risk Calculations (i.e., assess the risk associated with pollutants at pre-defined sensitive receptor locations based on the amount and type of pollutant).

Each of these components are described in detail in their respective appendices. Appendix A provides information on the DPM emissions inventory for each analysis year, including emission reductions associated with short- and long-term MCAS measures; Appendix B provides the methodology to conduct the dispersion modeling; and Appendix C describes the methodology to estimate health risks. This HRA was conducted in accordance with methodologies and procedures recommended by Office of Environmental Health Hazard Assessment (OEHHA), CARB, and San Diego APCD. Moreover, the approach was consistent with other recent assessments for ports performed by CARB, Bay Area Air Quality Management District, and the Port of Los Angeles. The OEHHA Guidelines were revised in 2015 to incorporate age sensitivity factors, which accounted for increased sensitivity to carcinogens during early-in-life exposure, the Port's HRA utilized the updated guidance.

The HRA evaluated the maximum cancer risk and chronic (non-cancer) risk for residents, children at schools, and children at parks. The exposure duration for residents was 30 years, 12 years for children at schools, and 9 years for children at parks. In addition to these analyses, the HRA conducted a population-weighted cancer risk analysis for residents within the Portside Community. The population-based analysis is independent of individual risk and assumes that a population (not necessarily the same individuals) will live in the impacted zone (Portside Community) over a 70-year period. The population-weighted risk analysis incorporated census block and population data to evaluate risk within the Portside Community rather than risk at an individual residential location. Health risks for residential cancer risk, residential chronic risk, and population-weighted cancer risk are presented in this report. Details of cancer risk and chronic risk for children at schools and parks are provided in Appendix D.

As noted, an emissions inventory was developed for 2019 Baseline and forecasted 2026 and 2030 conditions. The 2026 and 2030 forecasted emission inventories take into account the following short-term and long-term MCAS implementation measures:

- Cargo Handling Equipment
  - 20 new zero emission (ZE) electric pieces of CHE at TAMT, resulting in an 80% reduction in DPM at TAMT by 2025.
  - 100% of CHE at both TAMT and NCMT is ZE by 2030.

[14] Sensitive receptors are locations that may contain a high concentration of these sensitive population groups include residential areas, hospitals, daycare facilities, elder-care facilities, elementary schools, and parks. This HRA evaluates health impacts to residences, schools and parks because they may contain high concentrations of sensitive receptors near the marine cargo terminals. See key definitions in Appendix E.

- Ocean-Going Vessels
  - Two shore power plugs at NCMT by 2025.
  - Vessel Speed Reduction (VSR) compliance at 90% and 40 nautical miles.
- Commercial Harbor Craft
  - One all-electric ZE tugboat and two ZE short-run ferries by 2026.
- Heavy-duty Trucks
  - 40% of truck trips will be ZE by 2026.
  - 100% truck trips will be ZE by 2030.

Emission reductions from each measure are based on emission reductions shown in the adopted MCAS or, in the case of the electric tugboat, are based on the estimated fuel consumption reductions provided by the tug operator.

To more accurately evaluate the effect that the short-term and long-term MCAS measures may have on the forecasted cancer risk, the forecast analysis for 2026 and 2030 used 2019 operational assumptions. In other words, keeping cargo throughput, hours of operation, fuel consumption, number of vessels and trucks, and other operational parameters the same as 2019 baseline levels, allows for a more accurate assessment of how the different MCAS strategies could reduce risk and improve public health.

Updates Since December 2021

Following completion of the Preliminary HRA in October 2021 and then followed by the presentation of the Preliminary HRA to the Board in December 2021, Port staff received feedback from various stakeholders. Additionally, staff has been involved in ongoing discussions with CARB and the San Diego APCD staff about CARB's and the Port's modeling efforts. Based on the discussions with CARB and San Diego APCD, feedback from stakeholders, and updated information on activity data, the HRA modeling was updated to incorporate this feedback.

Modeling revisions included updated emission factors from CARB for harbor craft, updated fuel consumption information for harbor craft, additional information regarding truck travel on surface streets, inclusion of truck travel on freeways adjacent to or within the Portside Community, and refinements to some modeling parameters (such as OGV exhaust stack release heights) to be consistent with other, more recent modeling efforts for ports.

Health Risk Results and Forecasts

This section provides the results for the HRA, focusing on residential cancer risk and chronic risks under the three emissions scenarios. Details of health risk results for all receptor types and analyses are provided in Appendix D, *Health Risk Results*.

Residential Cancer Risk

As discussed above, cancer risk for residents was based on 30 years of exposure to Port-related DPM emissions, beginning in the 3rd trimester of pregnancy and ending at age 30. The HRA evaluated residential cancer risks for the 2019 Baseline scenario, and then the forecasted risk with implementation of short-term (2026) and long-term (2030) MCAS measures. **Table 2** summarizes the maximally exposed individual resident (MEIR) in the communities with the highest risk for all scenarios. As shown in **Table 2**, residential cancer risk is reduced assuming implementation of some key MCAS measures, with reductions of at least 40 percent in three of the highest communities. The maximum cancer risk location in Downtown does not achieve similar reductions because cancer risk is driven by emissions associated with rail activity, which is operated by BNSF and is largely outside the control and/or influence of the Port.

TABLE 2: MAXIMUM RESIDENTIAL CANCER RISK BY COMMUNITY AND FORECASTED CANCER RISK REDUCTION WITH MCAS FOR 2026 AND 2030 EMISSION SCENARIOS

Community Area	Maximum Cancer Risk (per million)			Percent Reduction from 2019 Baseline	
	2019 Baseline	Forecasted 2026 with MCAS	Forecasted 2030 with MCAS	2026 with MCAS	2030 with MCAS
National City	20.6	14.4	11.9	-30%	-42%
Barrio Logan	19.7	11.7	10.5	-40%	-46%
Downtown	18.9	16.6	16.4	-12%	-13%
Coronado	16.0	9.3	8.2	-42%	-49%

Figure 2 shows the source contribution to the MEIR in each community under the 2019 Baseline scenario. For National City, the largest contributors to the MEIR were rail activity and OGV activity, accounting for 83% of the cancer risk. In Barrio Logan, the largest contributors to the MEIR were CHE and OGV activity, accounting for 75% of the cancer risk. For Downtown, the largest contributors to the MEIR were rail activity and OGV activity accounting for 84% of the cancer risk. Lastly, in Coronado, the largest contributors to the MEIR were OGV activity and CHE, accounting for 72% of the cancer risk. **Figure 3** shows the cancer risk contours for the 2019 Baseline residential cancer risk.

Figure 4 shows the forecasted source contribution in 2026 to the MEIR in each community assuming implementation of short-term (2026) MCAS measures. For National City, the largest contributors to the MEIR in National City were forecasted to be rail activity and OGV activity, accounting for 81% of the cancer risk. In Barrio Logan, the largest contributors to the MEIR were forecasted to be OGV activity and rail activity, accounting for 80% of the cancer risk. For Downtown, the largest contributors to the MEIR were forecasted to be rail activity and OGV activity, accounting for 94% of the cancer risk. Lastly, the largest contributors to the MEIR in Coronado are forecasted to be OGV activity, tugs, and CHE, accounting for 85% of the cancer risk. As shown in **Figure 4**, ferries did not contribute to the MEIR due to MCAS measures that would electrify ferries – thus eliminating their contributions. **Figure 5** shows the cancer risk contours for the forecasted 2026 residential cancer risk with implementation of short-term MCAS measures.

Figure 6 shows the forecasted source contribution in 2030 to the MEIR in each community assuming implementation of short-term (2026) and long-term (2030) MCAS measures. For National City, the largest contributors to the MEIR in National City were forecasted to be rail activity and OGV activity, accounting for 97% of the cancer risk. In Barrio Logan, the largest contributors to the MEIR were forecasted to be OGV activity and rail activity, accounting for 95% of cancer risk. For Downtown, the largest contributors to the MEIR were forecasted to be rail activity and OGV activity, accounting for 95% of cancer risk. Lastly, the largest contributors to the MEIR in Coronado are forecasted to be OGV activity and tugs, accounting for 85% of the cancer risk. As shown in **Figure 6**, ferries, CHE, and heavy-duty trucks did not contribute to the MEIR due to the assumption that MCAS measures would electrify ferries, CHE, and heavy-duty trucks by 2030. **Figure 7** shows the cancer risk contours for the forecasted 2030 residential cancer risk with implementation of both short and long-term MCAS measures.

FIGURE 2: 2019 BASELINE SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM CANCER RISK RECEPTOR BY COMMUNITY

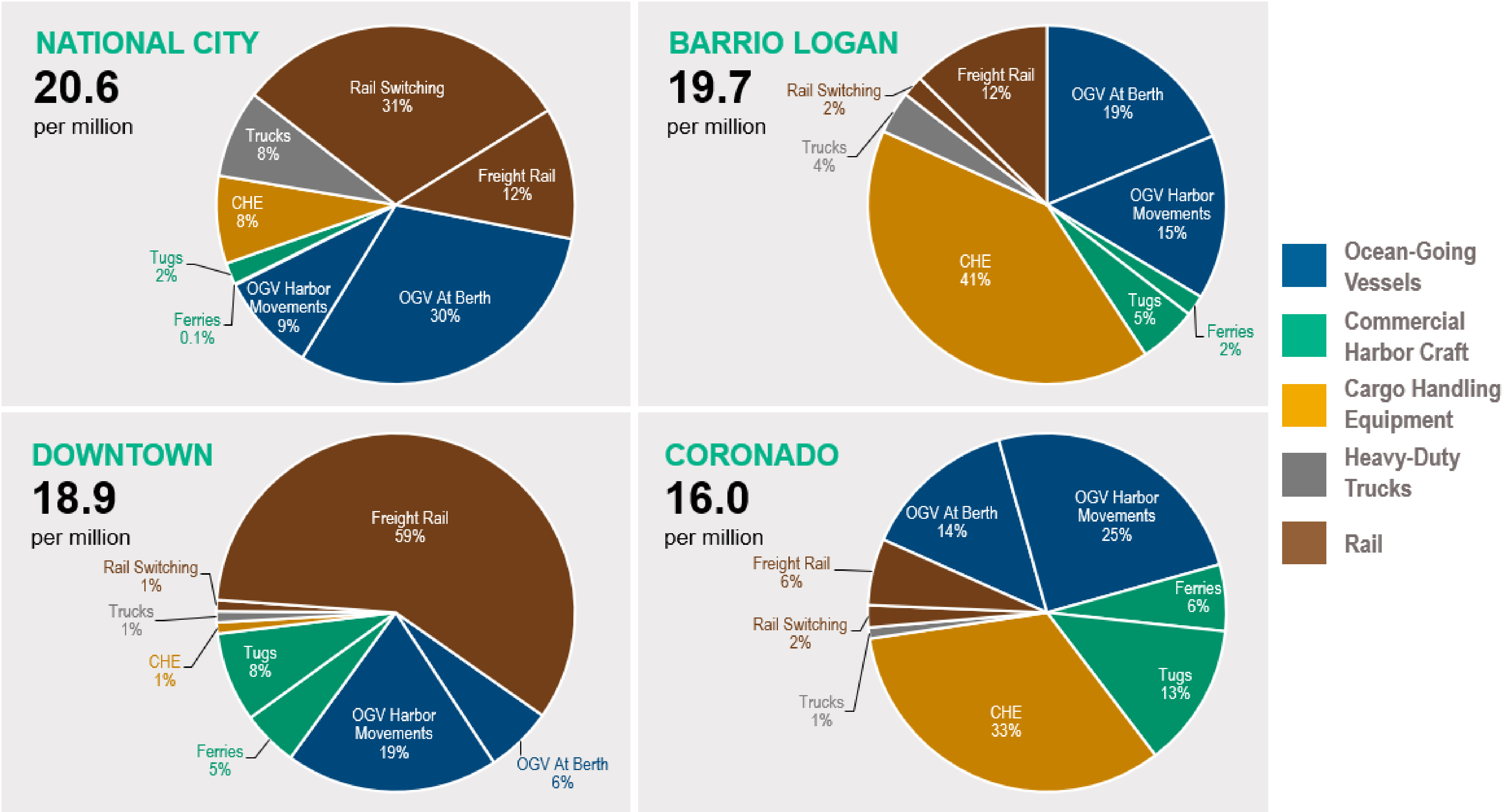


FIGURE 3: 2019 BASELINE RESIDENTIAL CANCER RISK CONTOUR MAP

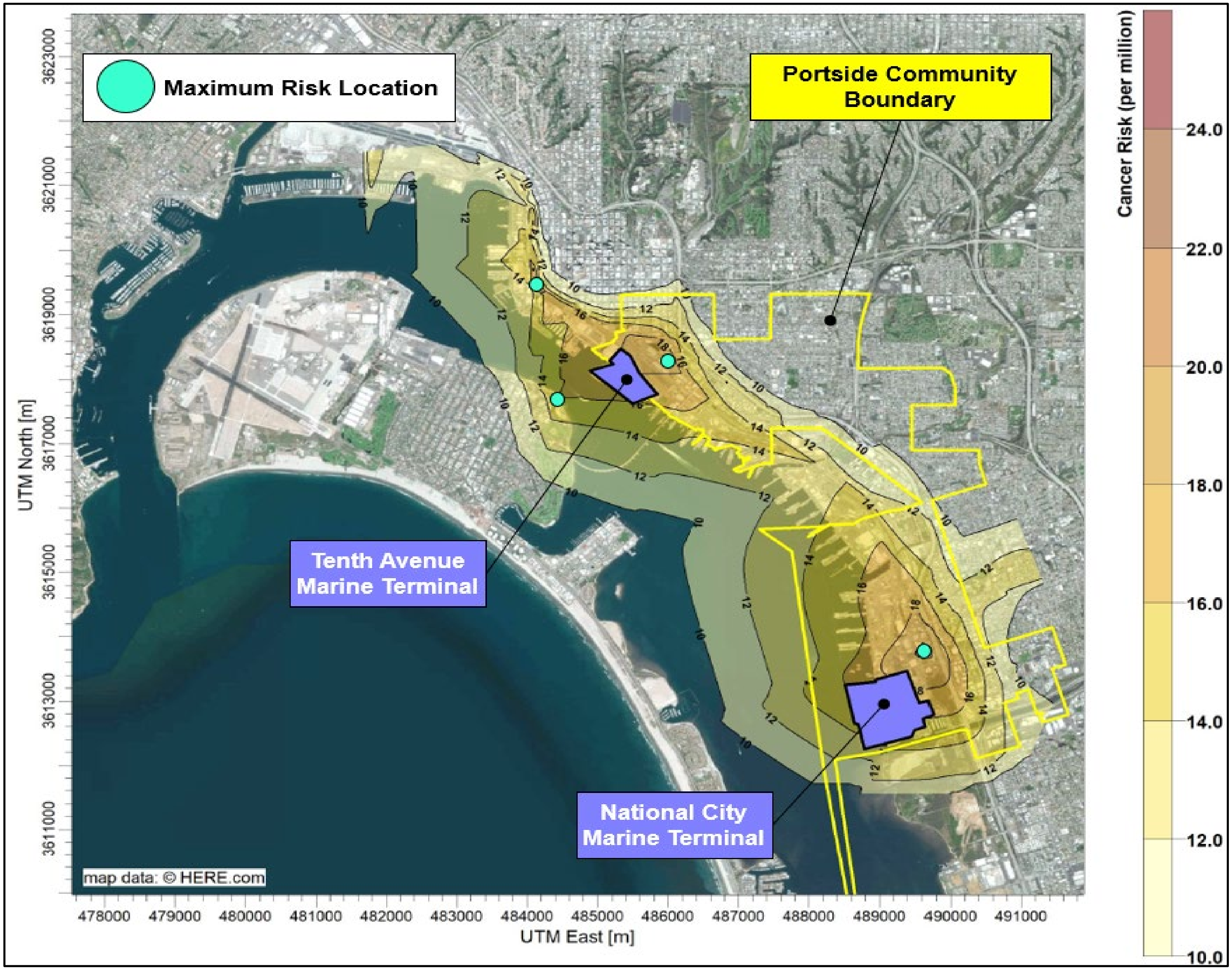


FIGURE 4: FORECASTED 2026 SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM CANCER RISK RECEPTOR BY COMMUNITY WITH IMPLEMENTATION OF SHORT-TERM MCAS MEASURES

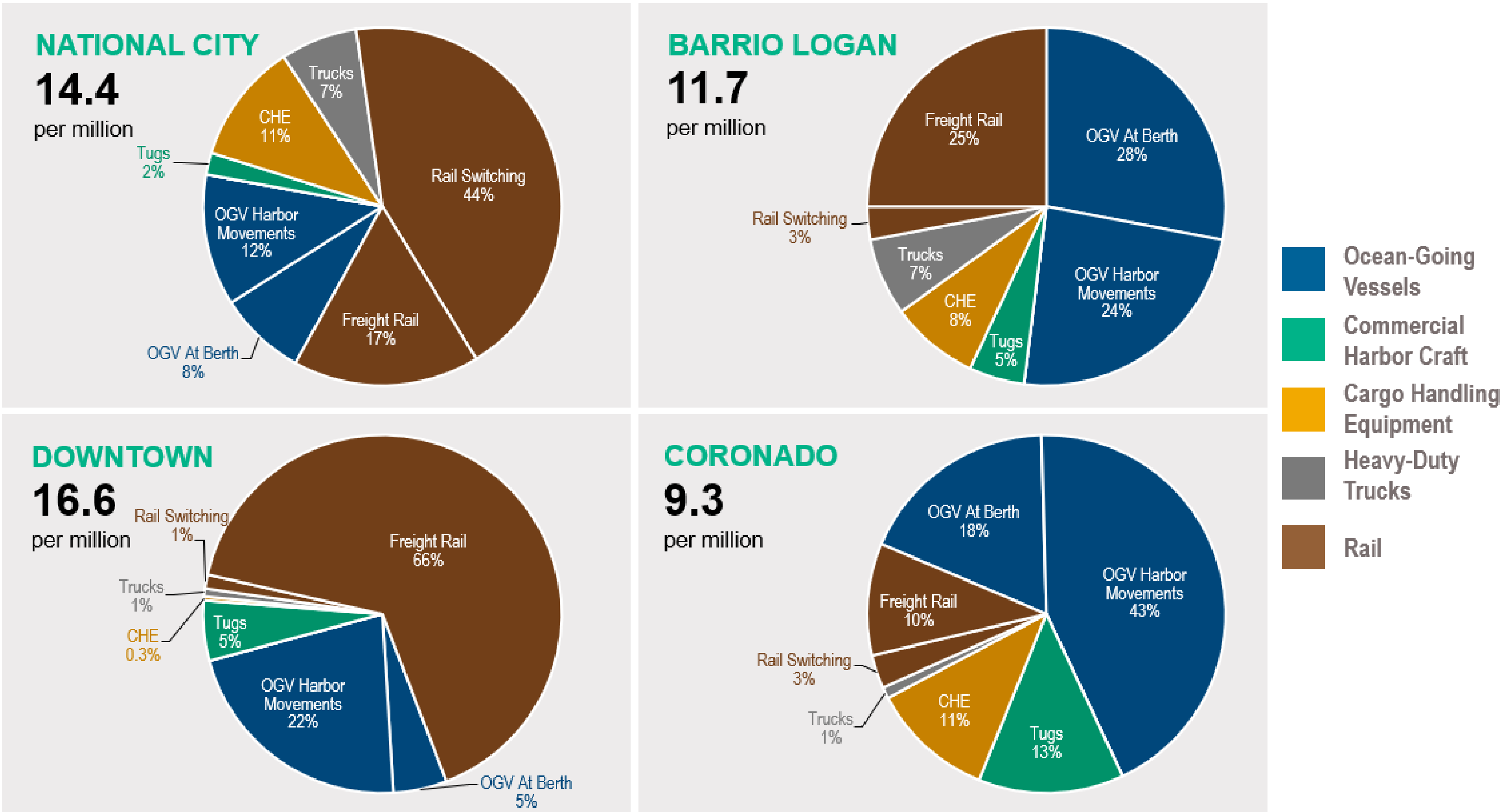


FIGURE 5: FORECASTED 2026 MCAS RESIDENTIAL CANCER RISK CONTOUR MAP WITH IMPLEMENTATION OF SHORT-TERM MCAS MEASURES

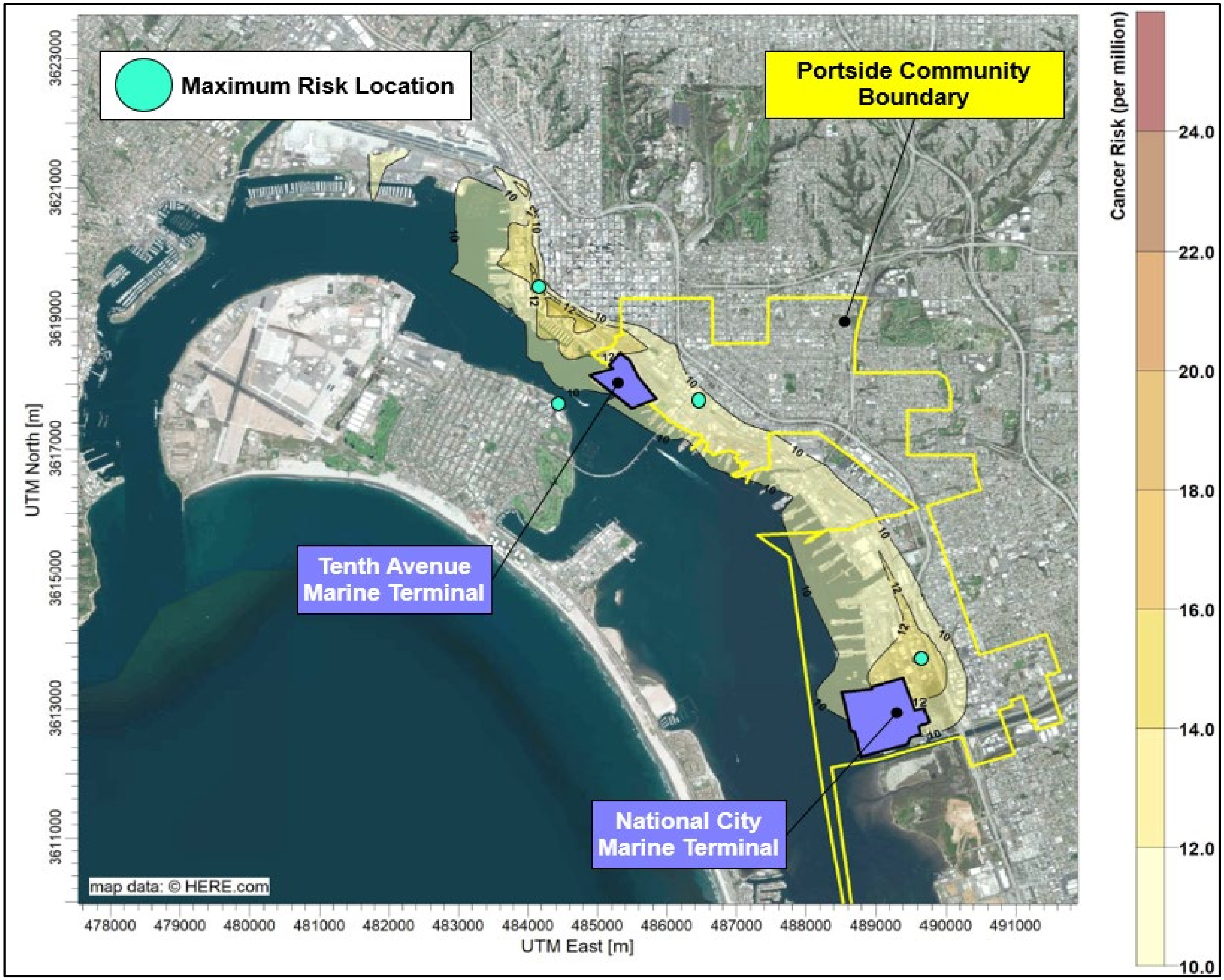


FIGURE 6: FORECASTED 2030 SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM CANCER RISK RECEPTOR BY COMMUNITY WITH IMPLEMENTATION OF SHORT AND LONG-TERM MCAS MEASURES

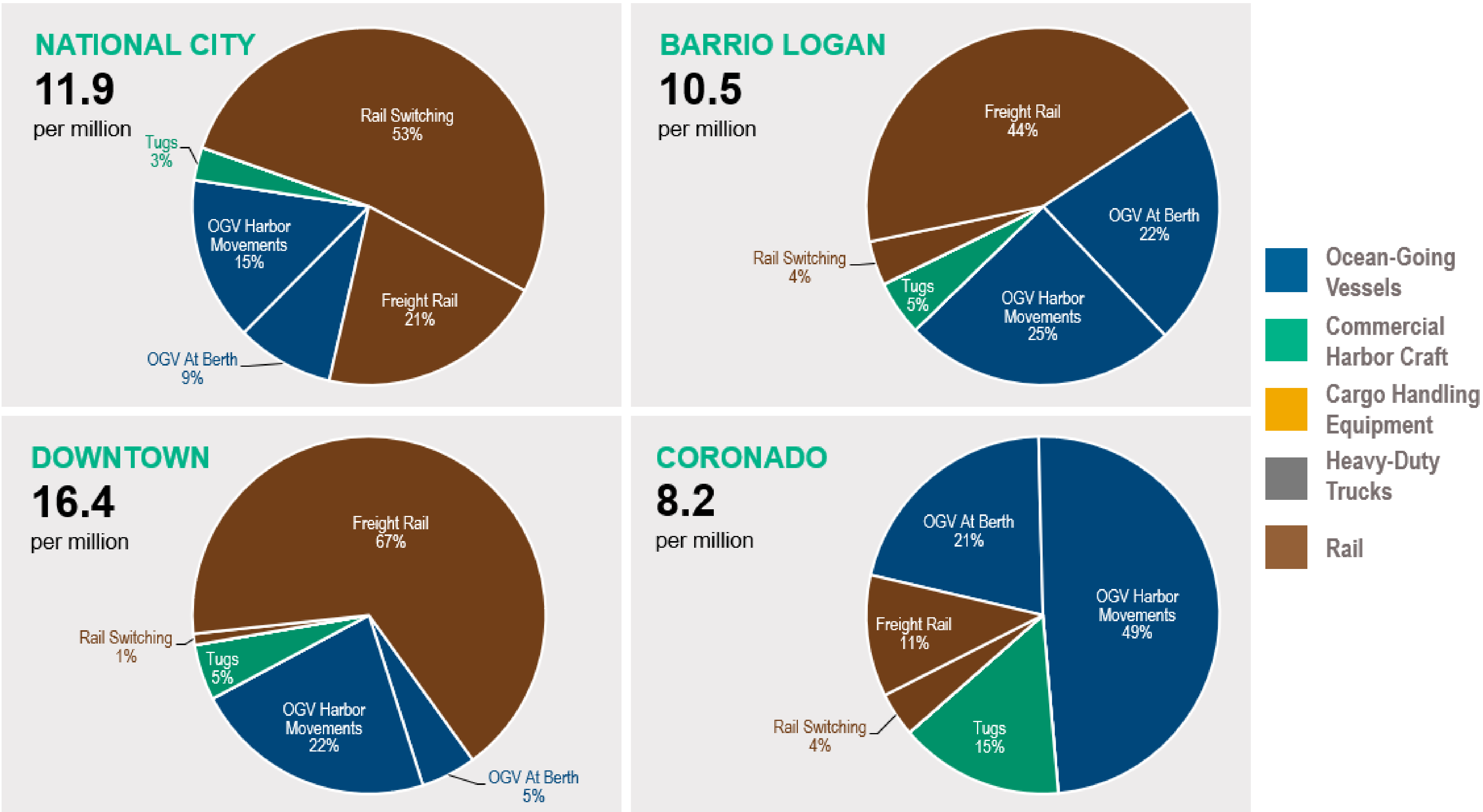
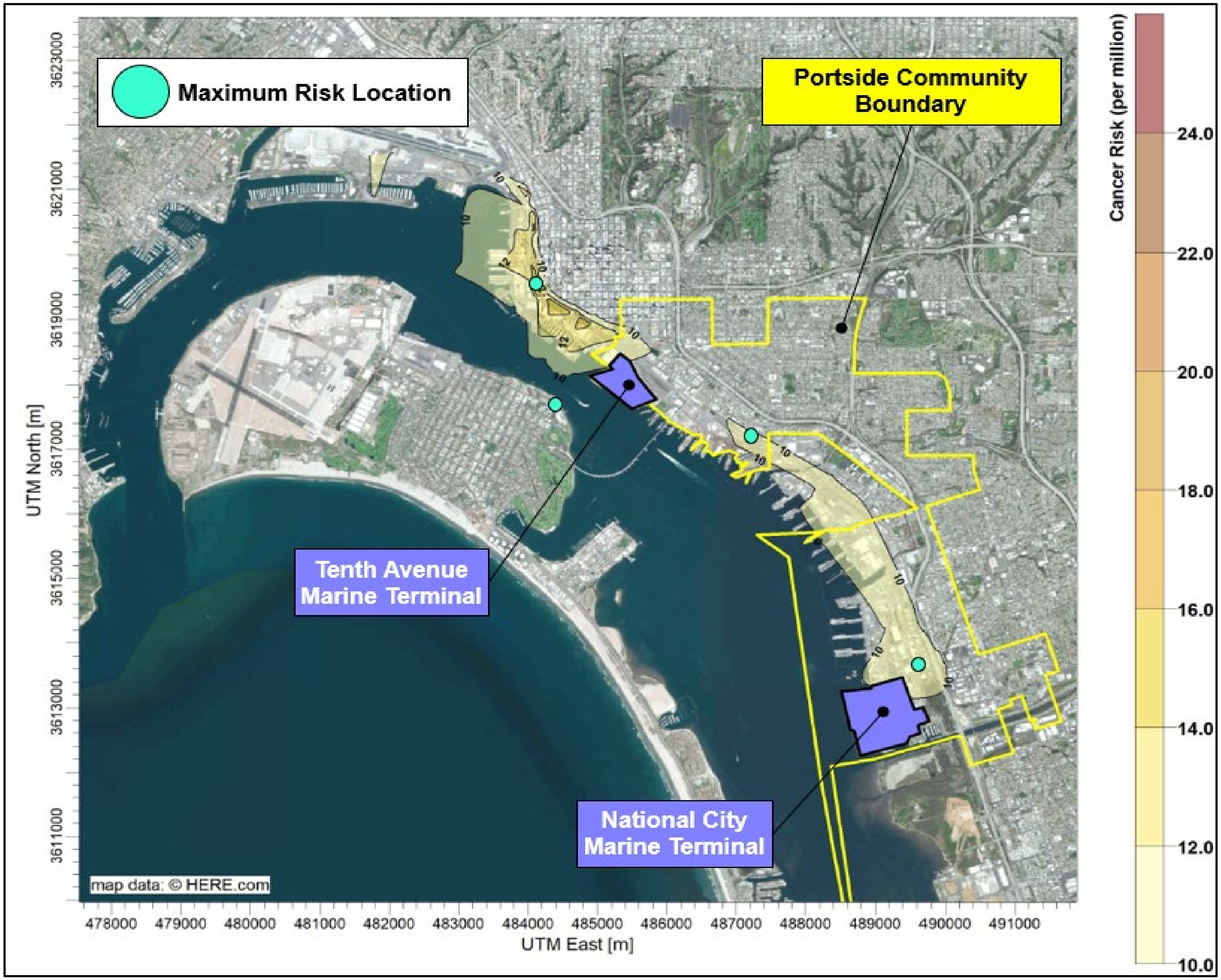


FIGURE 7: FORECASTED 2030 MCAS RESIDENTIAL CANCER RISK CONTOUR MAP WITH IMPLEMENTATION OF SHORT AND LONG-TERM MCAS MEASURES



Residential Chronic Risk

Chronic (non-cancer) risks for residents were evaluated using the hazard quotient (HQ) approach, see Appendix C for further details. Chronic impacts were based on the average annual concentrations of DPM under each emissions scenario. OEHHA states that a hazard quotient value of 1.0 or less indicates that adverse health effects, such as incidence of cough, phlegm, chronic bronchitis, lung inflammation, and reductions in pulmonary function, are not expected to result from exposure to DPM emissions. The San Diego APCD further notes that if the HQ is below 1.0, then the estimated level of exposure is not likely to result in adverse health effects for anyone, including sensitive individuals such as children and the elderly.[15] **Table 3** summarizes the maximum chronic non-cancer hazard quotients for residents. All HQ values are significantly below 1.0, therefore, adverse health impacts are unlikely to occur.

TABLE 3: RESIDENTIAL CHRONIC HAZARD QUOTIENT BY COMMUNITY AREA

	Chronic Hazard Quotient		
Community Area	**2019 Baseline**	**Forecasted 2026 with MCAS**	**Forecasted 2030 with MCAS**
Barrio Logan	0.005	0.003	0.003
Downtown	0.005	0.004	0.004
Coronado	0.004	0.003	0.002
National City	0.006	0.004	0.003

Population-Weighted Cancer Risk

As discussed previously, a population-weighted cancer risk analysis was conducted to evaluate the potential residential cancer risk within the Portside Community. The population-based analysis used receptors placed at the centroid of census blocks rather than individual receptors located at residential land uses. It should be noted that calculations for the population-weighed risk were based on a 70-year exposure duration compared to a 30-year exposure duration for the maximum cancer risk analysis for individual residential receptor locations.

Table 4 summarizes the population-weighted residential cancer risk results under the 2019 Baseline, with implementation of both short-term (2026) MCAS measures, and long-term (2030) MCAS measures. **Figure 8** shows the source contribution to the population-weighted residential cancer risk for each scenario.

TABLE 4: 70-YEAR POPULATION-WEIGHTED RESIDENTIAL CANCER RISK

70-Year Population-Weighted Residential Cancer Risk (per million)		
2019 Baseline	**Forecasted 2026 with MCAS**	**Forecasted 2030 with MCAS**
12	8	7

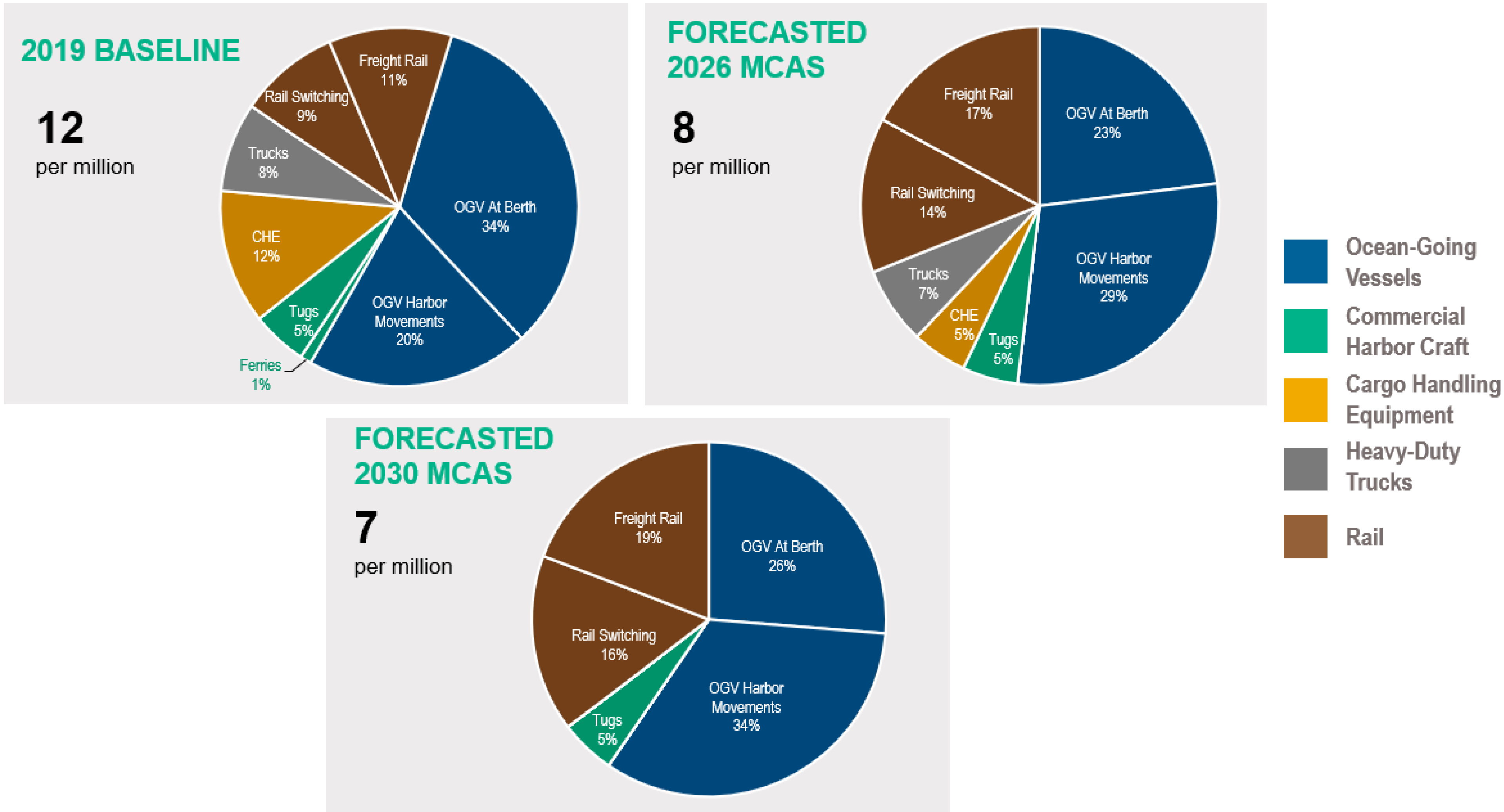
[15] San Diego Air Pollution Control District. 2021. *2021 California Air Toxics "Hot Spots" Annual Report,* Background page 4. Available at: https://www.sdapcd.org/content/dam/sdapcd/documents/permits/air-toxics/2021-California-Air-Toxics-Hot-Spots-Annual-Report.pdf

In May 2022, CARB presented preliminary results for its *San Diego Regional & Portside Community Modeling.*[16] CARB's analysis evaluated cancer risk for areas within the Portside Community from exposure to DPM and other TACs including metals (e.g., chromium VI, lead) and volatile organic compounds (e.g., benzene, formaldehyde). CARB's analysis included TAC emissions from all major sources of emissions, including automobiles and trucks traveling on surface streets and freeways, permitted stationary and area sources, locomotives (freight and passenger rail), marine vessels, commercial harbor craft, and shipyards, as well as emissions from Mexico.

CARB's preliminary modeling resulted in a population-weighted cancer risk of approximately 700 per million for the Portside Community from exposure to DPM. As shown in Table 4, the Port's highest population-weighted cancer risk of 12 per million from DPM exposure represents approximately 2% of CARB's population-weighted cancer risk. This information is being provided for comparison purposes and as previously explained the HRA's primary focus in on maximum residential cancer risk.

[16] San Diego Air Pollution Control District, Portside Steering Committee Meetings:05//24/22 III. CARB SD Portside Risk Modeling. Available at: https://www.sdapcd.org/content/dam/sdapcd/documents/capp/meetings/portside-csc/052422/III.%20CARB%20SD%20Portside%20Risk%20Modeling_Eng.pdf.

FIGURE 8: SOURCE CONTRIBUTION AS A PERCENTAGE TO POPULATION-WEIGHTED CANCER RISK RECEPTOR BY COMMUNITY FOR 2019 BASELINE AND WITH IMPLEMENTATION OF SHORT AND LONG-TERM MCAS MEASURES



Next Steps

This HRA Report is a useful tool for establishing the existing 2019 Baseline risk based on 2019 marine cargo terminal operations and ferry activity. The HRA analysis shows the maximum residential cancer risk (2019 Baseline risk) ranges from a high of 20.6 per million in National City followed by Barrio Logan at 19.7. The HRA analysis also forecasts potential cancer risk reductions assuming completion of some of the key MCAS goals and objectives. Cancer risk reductions are forecasted to range between 13% and 49% by 2030, based on the specific MCAS goals and objectives identified and indicate a downward trend in health risk from the Ports marine cargo terminals may be anticipated.

The results of the HRA analysis are another tool to help the Port guide and prioritize emission reduction projects and to inform future updates to the MCAS. Staff will continue to work with its partners to advance transition to zero emission technologies and will continue to explore private-public partnerships. Additionally, Staff will remain engaged with CARB and the San Diego APCD as they complete the final Regional Air Toxics Risk Modeling report for the AB 617 Portside Community.

Finally, staff will continue to diligently implement the MCAS's goals and objectives for all maritime emission sources. As implementation of the MCAS continues, staff will continue to explore and identify any new strategies, partnerships, and/or projects to fulfil the MCAS vision of "Health Equity for All".

Appendix A Diesel Particulate Matter Emissions Inventory

Appendix A Diesel Particulate Matter Emissions Inventory

Introduction

The Port of San Diego's (Port) Maritime Clean Air Strategy (MCAS) health risk assessment (HRA) has three main components and are as follows:

1. DPM Emissions Inventory (i.e., the amount of emissions emitted by a source, represented in tons per year), for each analysis year.
2. Dispersion Modeling (i.e., use of mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source, resulting in predicted pollutant concentrations at selected downwind receptor locations).
3. Health Risk Calculations (i.e., assess the risk associated with pollutants at pre-defined sensitive receptor locations based on the amount and type of pollutant)

This appendix describes the first component of the Port's HRA, *DPM Emissions Inventory*. This appendix provides information on the assumptions and methods used to estimate annual diesel particulate matter (DPM) emissions associated with the various emission sources in the HRA for each year modeled in the HRA (2019, 2026, and 2030).

The Air Dispersion Modeling Methodology is presented in Appendix B and the Health Risk Calculation Methodology is presented in Appendix C.

2019 Emissions Inventory

Pollutants of Concern

The majority of Port-related emission sources at its two marine cargo terminals[17] are diesel-powered resulting in diesel particulate matter (DPM) emissions. DPM is typically composed of carbon particles also known as soot or black carbon, and numerous organic compounds, including known cancer-causing organic substances including polycyclic aromatic hydrocarbons, benzene, formaldehyde, acetaldehyde, acrolein, and 1,3-butadiene (CARB 2021a). The California Environmental Protection Agency's (CalEPA) Office of Environmental Health Hazard Assessment (OEHHA) has developed health risk values (cancer potency factors and/or reference exposure levels) for numerous toxic air contaminants (TACs), including DPM. Health risk values for DPM are discussed further in Appendix C. Although the Port has emission sources powered by non-diesel sources (e.g., gasoline, liquefied petroleum gas, etc.), these sources represent a minority of the Port's emission sources. Therefore, the HRA focused only on diesel emissions associated with marine cargo terminal operations and commuter ferries, and the corresponding health risks related to DPM exposure. When evaluating health risks for DPM, particulate matter with a diameter of 10 microns or less (PM_{10}) was selected as a surrogate for DPM (OEHHA 2015).

Emissions Scenarios

Emissions scenarios included a baseline scenario and reduction scenario(s), which modeled reductions assuming completion of MCAS measures, objectives, or initiatives. The reduction scenarios are intended to provide an illustrative example of the potential reductions that may be achieved through the

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[17] Ferry emissions are also included in this HRA because of their proximity to the TAMT, the data was readily available, and the ferries operate on a regularly scheduled, fixed, short-route service which can be easily modeled. The ferries are currently diesel powered and MCAS Harbor Craft Objective 1 targets transitioning them to zero emission technologies by January 1, 2026.

implementation of source-based measures. The baseline scenario emissions were estimated based on the 2019 air emissions inventory, developed as part of the MCAS. The future scenarios assumed MCAS measures would be completed in 2026 and 2030, and it holds all other variables constant (such as annual cargo throughput, hours of operation, number of vessel calls, State regulations, etc.) to allow for an "apples to apples" comparison. This approach allowed the Port to better evaluate how some key MCAS measures could help reduce the health risk in nearby residential communities over time.

Emission Sources

The focus of the HRA was on the major emission sources related to cargo movements within and near the Portside Community. **Figure A-1** shows the boundaries for the Portside Community which were established by the California Air Resources Board (CARB) in 2018 as part of AB 617 Community Air Protection Program (CARB 2018). Therefore, the focus was on activities within and near the Tenth Avenue Marine Terminal (TAMT) and the National City Marine Terminal (NCMT). As noted earlier, the HRA also included commuter ferry activity between Coronado and Downtown Broadway Pier/Convention Center, since the ferry service operates immediately adjacent to the Portside Community, with a scheduled, fixed route service, and the ferries operate with diesel engines.

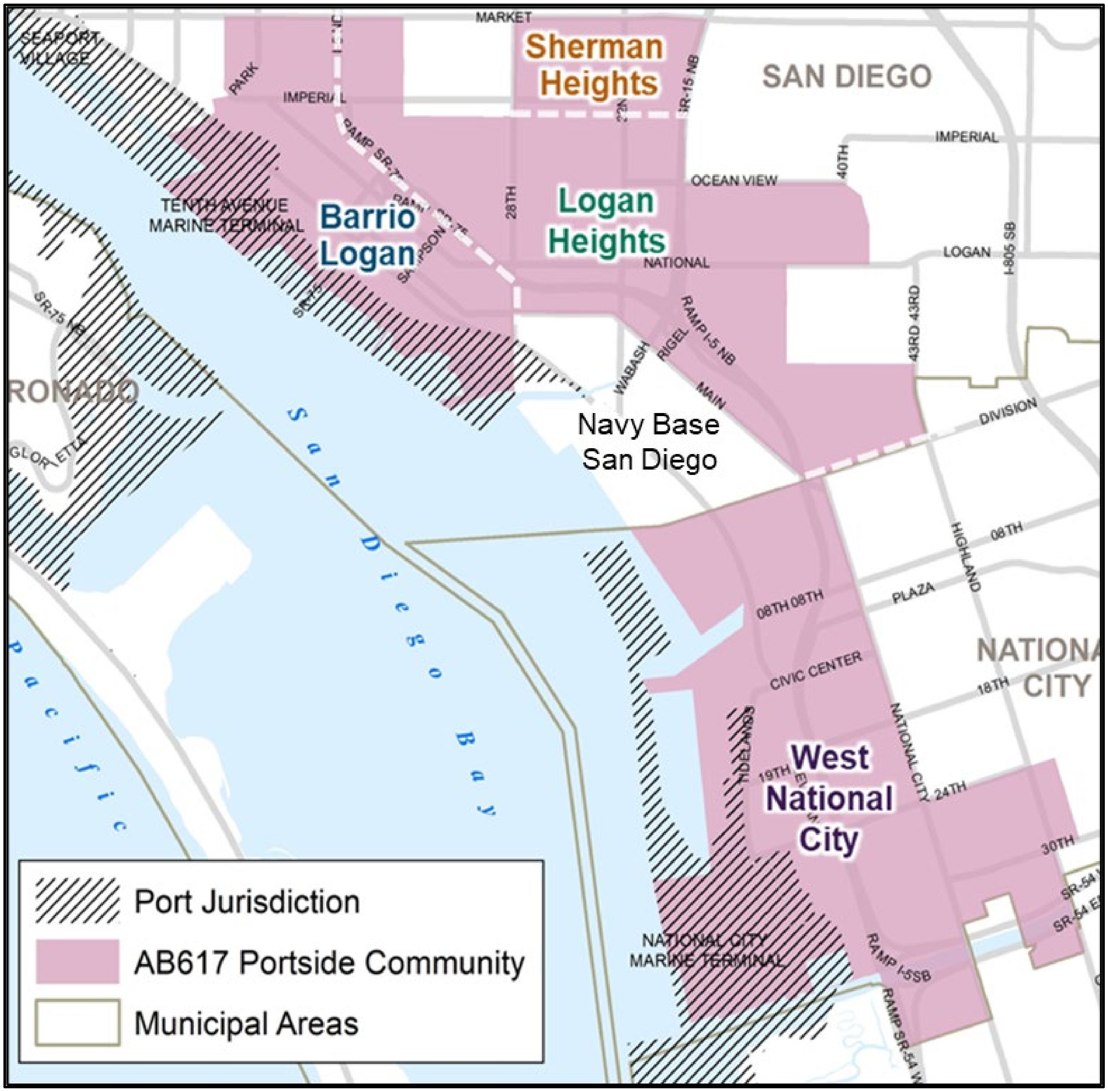
This section provides an overview of the emissions sources and the emissions associated with baseline (2019) conditions. A summary of emissions (tons of DPM), emission rates (grams per second), and the temporal profiles for each emissions scenario (2019, 2026, and 2030) are provided at the end of this appendix.

Table A-1 provides a summary of the emissions sources and their associated operating activities and locations. Figures showing the locations of each source type are provided in Appendix B.

TABLE A-1: SUMMARY OF SOURCES INCLUDED IN HRA

Source Type	Activity and Location
Ocean-Going Vessels	Transit and Anchorage Outside the Bay
	Maneuvering Inside the Bay
	Hoteling At Berth
Commercial Harbor Craft – Assist Tugs	Inside the Bay and at terminal during berthing (same geometry as OGV maneuvering)
Commercial Harbor Craft – Ferries	Commuter Ferry Path
Cargo Handling Equipment	Equipment activity within terminals
Heavy-Duty Trucks	Truck idling and travel within terminals Truck travel on surface streets Truck travel on freeways
Freight Rail – Line-Haul	Freight Rail travel along rail path
Freight Rail – Switching	Freight Rail switching (train loading and building) within terminal areas

FIGURE A-1: PORTSIDE COMMUNITY BOUNDARY



Given the focus on activities near TAMT and NCMT, activities that occur away from these terminals, including activity at the Cruise Ship Terminal (CST), commercial and sport fishing, excursions, recreational boating, and other harbor craft that do not serve or operate near the cargo terminals, were not included in the HRA. However, the Port staff and consultant team provided relevant information on these other vessel emissions to CARB and the San Diego Air Pollution Control District (San Diego APCD) to assist with the Cumulative Health Risk Assessment (or San Diego Regional & Portside Community Modeling), as outlined in the MCAS.[18]

Ocean-Going Vessels

Ocean-going vessels (OGVs) are used to transport goods and people to and from domestic and international ports. Emission sources from OGVs include propulsion engines, auxiliary engines, and auxiliary boilers. Propulsion engines are used to propel the ship and are usually either medium-speed diesel (MSD) or slow-speed diesel (SSD). Auxiliary engines are used to power the ship's electrical needs. Auxiliary boilers are used to heat residual oil in the fuel tanks (used outside the 200-nautical-mile North American Emission Control Area boundary). Auxiliary boilers also supply heat for engines as well as heat and hot water for crew or passenger needs.

This emissions inventory accounted for the various vessel activity modes.

- Transit included vessel movement outside of San Diego Bay (Bay), both inside the vessel speed reduction (VSR) zone and outside of the VSR zone.
- Maneuvering included vessel movement within the Bay, transiting from the mouth of the Bay to the berth areas.
- Hoteling included activity associated with time stopped at berth.
- Anchorage included activity when OGVs are stopped outside of the Bay while waiting for a pilot vessel and berth access.

OGV emissions were based on vessel call data from the Port, Automatic Identification System (AIS) data, and Lloyd's data (OCCURRED Markit 2020). The scope of the inventory included all OGV calls at both marine cargo terminals (TAMT and NCMT) in 2019. The emissions inventory (at the regional scale) included Port-related maritime operations within a waterside boundary that extended 24 nautical miles (nm) from the coastline as well as the landside boundaries of San Diego County, consistent with previous Port air emission inventories. A summary of the regional DPM emissions from OGV travel are summarized in **Table A-2.** Since the regional emissions for OGV travel outside of the Bay were based on a travel length of 24 nm beyond the Bay, these emissions were scaled to develop an emissions inventory for local OGV emissions that would occur closer to the Bay and near the Portside Community.

[18] Port of San Diego. *Maritime Clean Air Strategy Final (October 2021)* page S-8. Health Objective 2: Assist the San Diego Air Pollution Control District and the California Air Resources Board with preparing a cumulative or community health risk analysis for the AB 617 Portside Community by providing them with the Port's Health Risk Assessment (October 2021) and other operational related information.

TABLE A-2: REGIONAL OCEAN-GOING VESSEL EMISSIONS

		DPM Emissions (Tons per Year)				
Terminal	**Vessel Type**	**Outside VSR**	**Inside VSR**	**Maneuvering**	**Hotel**	**Anchorage**
TAMT	Bulk Carriers	0.008	0.016	0.007	0.052	-
	Container Ships	-	0.057	0.072	0.083	-
	General Cargo	0.005	0.038	0.023	0.297	0.014
	Total TAMT	0.013	0.111	0.102	0.432	0.014
NCMT	Auto Carriers	0.297	0.607	0.448	1.207	0.369
	RoRo	0.0004	0.003	0.002	0.030	-
	Total NCMT	0.298	0.609	0.449	1.238	0.369

Notes:
Bulk Carriers are dry-cargo vessels that carry loose cargo; Container Ships are vessels that carry containerized cargo; General Cargo vessels are carry a variety of dry cargo; Auto Carriers and Roll-on/Roll-off (RoRo) vessels carry automotives and other wheeled cargo.

For the HRA, OGV travel emissions outside of the Bay (Outside VSR and Inside VSR emissions) were scaled down to the size of the transit area within the HRA modeling domain to account for those emissions that occur within the modeling domain. The average vessel transit length outside of the Bay in the regional inventory is 21.0 nm, while the transit source in the HRA was 4.47 nm, which resulted in a 0.213 scaling factor (4.47 nm/21.0 nm). This scaling factor was applied to Outside VSR and Inside VSR emissions.

Anchorage emissions occur outside of the Bay but were within the modeling domain and near the Portside community. All anchorage emission were included in the HRA and applied to the “outside of the Bay” OGV source.

In-harbor maneuvering and hotel (at berth) emissions all occurred within the Bay and were included in the HRA. All in-harbor maneuvering emissions were included in the separate in-harbor sources for TAMT and NCMT calls, and emissions in each in-harbor source were based on emissions associated with TAMT and NCMT vessel calls, specifically.

Hotel (at berth) emissions were applied to each respective terminal based on the number of berths for each cargo type at each terminal. At TAMT, hotel emissions were applied to each berth assuming the following breakdown by cargo type: refrigerated containers (4 berths, 10/1 – 10/4), general cargo (2 berths, 10/5 – 10/6), and dry bulk (2 berths, 10/7 – 10/8). Hotel emissions at NCMT assumed activity and emissions were evenly split between the seven berths that receive activity (the eighth berth does not receive vessel calls). A summary of the local DPM emissions from OGV in-harbor and hoteling included in the HRA are summarized in **Table A-3.**

TABLE A-3: LOCAL OCEAN-GOING VESSEL EMISSIONS INCLUDED IN THE HRA

		2019 Baseline DPM Emissions (Tons per Year)				
Terminal	**Vessel Type**	**Outside VSR**	**Inside VSR**	**Maneuvering**	**Hotel**	**Anchorage**
TAMT	Bulk Carriers	0.002	0.003	0.007	0.052	-
	Container Ships	-	0.012	0.072	0.083	-
	General Cargo	0.001	0.008	0.023	0.297	0.014
	Total TAMT	0.003	0.024	0.102	0.432	0.014
NCMT	Auto Carriers	0.063	0.129	0.448	1.207	0.369
	RoRo	0.0001	0.001	0.002	0.030	-
	Total NCMT	0.063	0.130	0.449	1.238	0.369

Commercial Harbor Craft

Commercial harbor craft (CHC) includes a variety of vessel and boat types that serve many functions within and near the Bay. For this HRA, CHC emissions were evaluated for assist tugboats and ferries. Assist tugboats help OGVs maneuver in the Bay during arrival and departure, and shifts from berth, as well as provide an escort for OGVs. Ferries transport people within the Bay. The two ferry routes evaluated were the Broadway Pier-Coronado Landing route and Convention Center-Coronado Landing route. Although ferry operations are independent of operations at TAMT and NCMT, DPM emissions from ferries were included in the HRA due to their proximity to the Portside Community.

Assist Tugboats

Crowley operates two assist tugboats in San Diego. Assist tugboats operate completely within the Bay. Emissions from assist tugboats were based on fuel and engine data provided by Crowley Maritime. Tugboat engine information and activity and emissions are summarized in T**able A-4**. Emissions were based on model year-specific emission factors and fuel consumption factors from CARB's 2021 harbor craft inventory and fuel consumption by engine (CARB 2021b) along with engine and fuel information provided by Crowley.

TABLE A-4: ASSIST TUGBOATS ACTIVITY AND EMISSIONS

Vessel	Engine	Engine Year	Engine Tier	Fuel Consumed (gallons)	2019 Baseline DPM Emissions (Tons per Year)
Assist Tug 1	Main	2009	2	22,038	0.0445
	Main	2009	2	22,038	0.0445
	Auxiliary	2018	3	1,134	0.0012
	Auxiliary	2018	3	1,454	0.0016
Assist Tug 2	Main	2013	3	12,317	0.0145
	Main	2013	3	12,317	0.0145
	Auxiliary	2013	3	978	0.0010
	Auxiliary	2013	3	1,090	0.0012
Total	-	-	-	73,366	0.1231

Commuter Ferries

Emissions from commuter ferries were based on fuel and engine data provided by Flagship Cruises & Events. Flagship operates two commuter ferries in San Diego. Commuter ferries – the Cabrillo and the Silvergate – operate completely within the Bay along fixed routes between Coronado and Downtown Broadway and Downtown Convention Center. Ferry engine information, activity, and emissions are summarized in T**able A-5.** Emissions were based on model year- and horsepower-specific emission factors, fuel consumption factors from CARB's 2021 harbor craft inventory (CARB 2021b), and fuel consumption by engine and engine data provided by Flagship.

TABLE A-5: COMMUTER FERRY ACTIVITY AND EMISSIONS

Vessel	Engine	Engine Year	Engine Tier	Fuel Consumed (gallons per year)	2019 Baseline DPM Emissions (Tons per Year)
Ferry 1	Main	2011	2	12,901	0.0224
	Auxiliary	2011	2	263	0.0009
Ferry 2	Main	2019	3	6,473	0.0063
	Auxiliary	2019	3	132	0.0004
Total	**-**	**-**	**-**	**19,769**	**0.0300**

Cargo Handling Equipment

CHE is used to support terminal activities and move cargo on and off OGVs, harbor craft, rail, and trucks. A wide range of CHE types operate at the Port due to the diversity of cargo handled at each terminal, which ranges from large containers to dry bulk. The types of CHE at TAMT and NCMT include container handling equipment (e.g., reach stackers), yard tractors (or yard trucks or hostlers), forklifts, construction equipment (e.g., rubber-tired loaders), and general industrial equipment. CHE emissions were estimated for CHE operating within the boundaries of each terminal.

CHE emissions by terminal are summarized in **Table A-6.** Emissions were based on model year- and horsepower-specific emission factors from CARB's 2011 CHE inventory, activity (hours), horsepower, and model year information for each piece of equipment identified in the 2019 MCAS Emissions Inventory.[19]

TABLE A-6: CARGO HANDLING EQUIPMENT EMISSIONS

Terminal	2019 Baseline DPM Emissions (Tons per Year)
TAMT	0.096
NCMT	0.030
Total	0.127

Freight Rail

Rail locomotives carry freight cargo between the Port and regional destinations. Activity associated with locomotives includes activity at or near the terminals to load and unload cargo as well as rail activity regionally to and from the terminals. Freight rail service at the Port is provided exclusively by Burlington Northern Santa Fe (BNSF) Railway. Freight movements are made to and from TAMT and NCMT along the north-south BNSF right-of-way. Commodities moved by rail include automobiles moved in and out of NCMT, as well as bulk and multi-purpose cargo moved in and out of TAMT.

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[19] Port of San Diego. *Maritime Clean Air Strategy Final (October 2021).* The 2019 Cargo Handling Equipment Inventory can be found in Table A-7 on page A-8 (or pdf page 192). The Summary of Cargo Handling Equipment Emissions by Terminal in 2019 can be found in Table A-9 on page A-10 (or pdf page 194). Information can be accessed at: https://pantheonstorage.blob.core.windows.net/environment/20211214-Final-MCAS.pdf

Emissions from rail activity was split between switching (or switch-duty) and regional travel (or line-haul). The approach used in the HRA was based on gross tonnage, consistent with previous maritime air emission inventories.

Line-Haul

Emissions from freight rail line-haul were based on cargo tonnage moved by rail, obtained from the Port, fuel consumption estimates based on BNSF reporting, and emission factors from BNSF's reporting to CARB. Cargo tonnage by terminal for 2019 activity is summarized in **Table A-7**.

Fuel consumption was calculated by multiplying gross ton-miles by BNSF's system-wide fuel efficiency in 2019 of 1.031 gallons per thousand gross ton-miles (or 970.2 ton-miles per gallon).[20] The fuel consumption estimate is shown in **Table A-7**.

Emission factors were based on BNSF's Memorandum of Understanding (MOU) compliance data that is submitted annually to CARB, and locomotive emission factors by tier from EPA and CARB, 2019 emission factor data was used.[21] Emission factor weighting by tier for PM_{10} (DPM) is provided in **Table A-8**.

[20] Based on the gross tonnage and fuel consumption submissions in BNSF's 2019 financial reporting, available here: https://www.bnsf.com/about-bnsf/financial-information/

[21] See BNSF's emission factor submissions, available here: https://ww2.arb.ca.gov/1998-mou-summary-data-archive

TABLE A-7: LOCOMOTIVE GROSS TON-MILE ESTIMATES, OFF-PORT REGIONAL LINE HAUL

						Regional		Local for HRA
Terminal	Direction	Item	Number	Tons/ Item	Total Tons	Total Ton-Miles [a]	Total Gallons [b]	Total Gallons [c]
NCMT	Loaded	Automobiles	251,743	1.54	387,684	25,470,853	-	-
		Railcars	18,375	51.5	946,333	62,174,090	-	-
		Locomotives	950	214	203,300	13,356,810	-	-
		Total	-	-	1,537,317	101,001,753	104,108	11,676
	Empty	Automobiles	-	1.54	-	-	-	-
		Railcars	18,375	51.5	946,333	62,174,090	-	-
		Locomotives	950	214	203,300	13,356,810	-	-
		Total			1,149,633	75,530,900	77,854	8,734
		Total NCMT	-	-	2,686,951	176,532,652	181,962	20,413
TAMT	Loaded	Soda Ash	179	111	19,839	1,228,034	-	-
		Hoppers	179	32	5,728	354,563	-	-
		Locomotives	15	214	3,210	198,699	-	-
		Total	-	-	28,777	5,247,387	1,836	219
	Empty	Soda Ash	-	111	-	-	-	-
		Hoppers	179	32	5,728	354,563	-	-
		Locomotives	15	214	3,210	198,699	-	-
		Total	-	-	8,938	553,262	570	68
		Total TAMT	-	-	37,715	2,334,559	2,406	287
Overall Total					**2,724,666**	**178,867,211**	**184,368**	**20,700**

Notes:
[a] Regional Ton-miles estimates based on 65.7 miles from NCMT to Orange County and 61.9 miles from TAMT to Orange County
[b] Regional gallons estimates are based on the BNSF system efficiency of 970.2 Gross Ton Miles per Gallon
[c] Gallons estimates for the HRA domain are based on a 7.371-mile source length

TABLE A-8: LINE-HAUL EMISSION FACTOR WEIGHTING

Tier	BNSF Agreement Locomotive Compliance Summary Information [a]		PM_{10}/DPM Emissions Weighting	
	Sum of MWh	%MWh by Tier	g/bhp-hr	g/gallon[b]
Pre-Tier 0	1,150	0.4	0.32	6.66
Tier 0	11,007	4.0	0.32	6.66
Tier 1	98,968	36.3	0.32	6.66
Tier 2	97,310	35.7	0.18	3.74
Tier 3	52,724	19.3	0.08	1.66
Tier 4	11,418	4.2	0.015	0.31
Total	272,577	100	0.21	4.39

Source: BNSF 2019, EPA 2009
Notes:
[a] Based on BNSF's 2019 compliance data.
[b] Based on brake horsepower-hr per gallon conversion factors of 20.8
MWh = megawatt-hours
g/bhp-hr = grams per brake horsepower-hour
g/gallon = grams per gallon

Switching Activities

Rail switching activity involves the loading and unloading of cargo and movements around the yard and/or terminal to position railcars. Rail switching activity and emissions were assumed to be unchanged from the *2016 Maritime Air Emissions Inventory* (POSD 2018). See Table 5-3 of the 2016 Maritime Air Emissions Inventory. Freight rail and rail switching emissions are summarized in **Table A-9.**

TABLE A-9: FREIGHT RAIL AND SWITCHING EMISSIONS

Rail Activity	Terminal	2019 Baseline DPM Emissions (Tons per Year)	
		Regional	Local for HRA
Line-Haul	TAMT	0.012	0.001
	NCMT	0.880	0.099
	Total	0.891	0.100
Switching	TAMT	0.001	0.001
	NCMT	0.296	0.296
	Total	0.297	0.297

Heavy-Duty Trucks

Heavy-duty trucks are used to transport Port-related cargo between TAMT and NCMT and regional destinations. At TAMT, trucks mainly consist of refrigerated container trucks, dry bulk and unibody trucks to move dry bulk (e.g., cement, bauxite, and fertilizers) and multi-purpose general cargo (e.g., windmill parts), as well as other miscellaneous deliveries. At NCMT, trucks mainly consist of car carriers, along with flatbeds and trailers to move project (general) cargo and material (parts) deliveries for automobile services.

Trucks emissions were estimated for trucks operating inside and outside of terminal boundaries. Truck travel and idling emissions were estimated for truck activity within each terminal. Emissions were also estimated for truck travel outside of the terminals, including truck travel along designated surface streets, freeway onramps and offramps, and freeway mainlines, including Interstate Highway 5 (I-5) and Interstate Highway 15 (I-15).

Truck trip and cargo destination information was obtained from Port staff. The distribution of trucks within the terminal boundaries, on surface streets, and on freeways, is based on discussions with Port staff, which takes into account assumed travel path to freeways, and the assumed travel path (e.g., I-15) to the ultimate destination (e.g., Riverside County).

Additionally, Portside stakeholders had concerns of Port-related trucks, specifically from TAMT, traveling through local neighborhoods along non-designated routes. In response to this, the Port conducted a study in 2017 to evaluate the amount of truck traffic using non-designated routes. The study identified three non-designated routes that Port-related trucks were using, as well as the quantity of Port-related trucks using the routes. To ensure the HRA accounted for all potential impacts from trucks, the three non-designated routes were included in the HRA modeling. The three non-designated routes identified are listed below.

- **Sigsbee Street to Freeway:** Trucks exiting the TAMT exit only gate, turn left onto Sigsbee Street, then left of Logan Ave, then right onto Commercial Street, then left onto 19th Street, and travel onto the Interstate 5 Northbound Onramp.
- **Cesar Chavez Parkway to Freeway:** Trucks exiting the TAMT Main Gate, travel straight onto Cesar Chavez Parkways, then turn left onto Kearney Avenue, then through to 19th Street, and travel onto the Interstate 5 Northbound Onramp.
- **Main St to 28th Street:** Trucks exiting the TAMT Main Gate, turn right onto Harbor Drive, then left onto Schley St, then right onto Main Street, and then left onto 28th Street to travel onto the Interstate 5 Northbound Onramp.

Truck emissions were estimated using annual truck trip data, emissions factors from CARB's Emission FACtor model, Version 2021 (EMFAC2021), and trip lengths associated with each truck route. The EMFAC vehicle category used for traveling to TAMT and NCMT was T7 Other Port Class 8 and T7 Tractor Class 8, respectively. Emission factors for trucks incorporated the average fleet year for trucks at TAMT and NCMT which was based on a 2021 truck survey conducted as part of the Port's *Final Heavy Duty Zero Emission Truck Transition Plan* (June 30, 2022).[22] For trucks calling on TAMT, the average truck model year was 2014. For trucks calling on NCMT, the average truck model year was 2016.

Truck Route Composition

Trucks travel from various locations in the region to move cargo to and from TAMT and NCMT, and the routes used by inbound and outbound trucks are composed of various segments of surface streets and freeways.

For example, an inbound truck traveling from Orange County to TAMT, would travel along I-5 South, then exit to the 28th Street offramp, turn right onto 28th Street, turn right onto Harbor Drive, then left onto Crosby Street entering the TAMT main gate. This truck route is composed of several segments, including multiple surface streets, a freeway offramp, and a freeway mainline.

To accurately reflect the emissions related to this truck route, the route was separated into two categories: surface street segments and freeway mainline. The surface street segments included: the

[22] Port of San Diego. *Final Heavy-Duty Zero Emission Truck Transition Plan (June 30, 2022), Appendix A.* See page A-10 of Appendix A for the Tenth Avenue Marine Terminal Heavy Duty Truck Operating Profile From the Fleet Manager and Truck Driver Survey Statistics and page A-14 for the National City Marine Terminal Heavy-Duty Truck Operating Profile From the Fleet Manager and Truck Driver Survey Statistics.

28th Street offramp, 28th Street, Harbor Drive, and Crosby Street. These surface street segments were grouped together to form the surface street route that inbound trucks would use when exiting I-5 S to 28th Street. The freeway mainline segment of this route was assumed to be I-5 South. This approach was applied to all inbound and outbound truck routes.

Truck routes were categorized as inbound and outbound to accurately represent the spatial component of truck travel within the Portside area. **Table A-10** summarizes total truck emissions for each activity (within terminals, and travel along surface streets and along freeways). **Table A-11** through **Table A-15** provide detailed breakdown of emissions by terminal and route type.

TABLE A-10: HEAVY-DUTY TRUCK EMISSIONS

Terminal	Truck Activity	2019 Baseline DPM Emissions (Tons per Year)
TAMT	Travel and Idling within Terminal	0.00065
	Travel Along Surface Streets	0.00462
	Interstate 5	0.0036
	Interstate 15	0.0010
NCMT	Travel and Idling within Terminal	0.0056
	Travel Along Surface Streets	0.0033
	Interstate 5	0.020

TABLE A-11: HEAVY-DUTY TRUCK TRAVEL AND IDLING WITHIN TERMINALS

Activity	Terminal	EMFAC Vehicle Category	Annual Truck Trips	Route Length (miles)	2019 Baseline DPM Emissions (Tons per Year)
Truck Travel within Terminal	TAMT	T7 Other Port Class 8	37,886	0.50	0.00048
	NCMT	T7 Tractor Class 8	48,737	0.50	0.0011
Activity	**Terminal**	**EMFAC Vehicle Category**	**Annual Truck Trips**	**Idling Duration per Truck (hours)**	**2019 Baseline DPM Emissions (Tons per Year)**
Truck Idling	TAMT	T7 Other Port Class 8	37,886	0.4	0.00017
	NCMT	T7 Tractor Class 8	48,737	1.50	0.0044

TABLE A-12: INBOUND HEAVY-DUTY TRUCK EMISSIONS ALONG SURFACE STREETS

Terminal	Truck Route	Street Segments	EMFAC Vehicle Category	Annual Truck Trips	Route Length (miles)	2019 Baseline DPM Emissions (Tons per Year)
TAMT	Inbound Route 1: To TAMT from I-5 SB	I-5 SB Offramp to 28th St 28th Street to Harbor Dr Harbor Drive to Crosby St Crosby St to TAMT	T7 Other Port Class 8	17,278	1.6	0.00072
TAMT	Inbound Route 2: To TAMT from I-5 NB	I-5 NB Offramp to 28th St 28th Street to Harbor Dr Harbor Drive to Crosby St Crosby St to TAMT	T7 Other Port Class 8	2,991	1.9	0.00014
TAMT	Inbound Route 3: To TAMT from I-15 SB	I-15 SB Offramp to 32nd St 32nd Street to Harbor Dr Harbor Drive to Crosby St Crosby St to TAMT	T7 Other Port Class 8	17,616	2.7	0.00120
NCMT	Inbound Route 4: To NCMT from I-5 SB to Bay Marina Dr	I-5 SB Offramp to Bay Marina Dr Bay Marina Dr	T7 Tractor Class 8	20,704	0.8	0.00074
NCMT	Inbound Route 5: To NCMT from I-5 NB to Bay Marina Dr	I-5 NB Offramp to Bay Marina Dr Bay Marina Dr	T7 Tractor Class 8	28,033	0.7	0.00089
Notes: I-5 NB = Interstate 5 Northbound, I-5 SB = Interstate 5 Southbound, I-15 NB = Interstate 15 Northbound, I-15 SB = Interstate 15 Southbound						

TABLE A-13: OUTBOUND TRUCK ROUTES ALONG SURFACE STREETS

Terminal	Truck Route	Street Segments	EMFAC Vehicle Category	Annual Truck Trips	Route Length (miles)	2019 Baseline Emissions (Tons per Year)
TAMT	Outbound Route 1: TAMT Gates to 32nd St to I-15 NB	Crosby Street (Exiting TAMT)	T7 Other Port Class 8	14,034	2.7	0.00097
		Harbor Drive to 32nd St				
		32nd St to I-15 NB Onramp				
		I-15 NB Onramp				
TAMT	Outbound Route 2: TAMT Gates to Harbor to 28th St to I-5 NB	Crosby Street (Exiting TAMT)	T7 Other Port Class 8	8,935	1.9	0.00042
		Harbor Drive to 28th St				
		28th St from Harbor Dr				
		I-5 NB Onramp from 28th St				
TAMT	Outbound Route 3: TAMT Gates to Harbor Dr to Civic Center St to I-5 SB	Crosby Street (Exiting TAMT)	T7 Other Port Class 8	2,216	3.4	0.00019
		Harbor Drive across Civic Center Dr				
		I-5 SB Onramp from Harbor Dr				
TAMT	Outbound Route 4: TAMT Gates to Harbor Dr to 32nd St to Main to Yara Yard	Crosby Street (Exiting TAMT)	T7 Other Port Class 8	1,680	2.6	0.00011
		Harbor Drive to 32nd St				
		32nd St to Main St				
		Main St from 32nd St				
TAMT		Harbor Drive to Tidelands	T7 Other Port Class 8	5,804	4.6	0.00067

Terminal	Truck Route	Street Segments	EMFAC Vehicle Category	Annual Truck Trips	Route Length (miles)	2019 Baseline Emissions (Tons per Year)
	Outbound Route 5: TAMT Exit Only Gate to Harbor Dr to NDC	Tidelands-Bay Marina				
NCMT	Outbound Route 6: NCMT Gates to I-5 NB	Bay Marina Drive From Bay Marina Drive to I-5 NB Onramp	T7 Tractor Class 8	24,624	0.8	0.00087
NCMT	Outbound Route 7: NCMT Gates to I-5 SB	Bay Marina Drive From Bay Marina Drive to I-5 SB Onramp	T7 Tractor Class 8	24,113	0.7	0.00082
TAMT	Outbound Route 8 (Non-Designated) Truck Route 1: Sigsbee St	One Complete Segment	T7 Other Port Class 8	99	1.3	0.0000033
TAMT	Outbound Route 9 (Non-Designated): Cesar Chavez Pkwy	One Complete Segment	T7 Other Port Class 8	296	1.2	0.0000091
TAMT	Outbound Route 10 (Non-Designated): Main St to 28th	Crosby Street (Exiting TAMT) Harbor Street to Schley Schley-Main St to I-5 NB Onramp	T7 Other Port Class 8	4,822	1.4	0.00017

Notes:
I-5 NB = Interstate 5 Northbound, I-5 SB = Interstate 5 Southbound, I-15 NB = Interstate 15 Northbound, I-15 SB = Interstate 15 Southbound

TABLE A-14: INBOUND HEAVY-DUTY TRUCK EMISSIONS ALONG FREEWAY ROUTES

Terminal	Truck Route	EMFAC Vehicle Category	Annual Truck Trips	Route Length (miles)	2019 Baseline DPM Emissions (Tons per Year)
TAMT	Inbound Trucks from I-5 SB exiting to 28th St	T7 Other Port Class 8	17,278	3.92	0.0017
TAMT	Inbound Trucks from I-5 NB exiting to 28th St (via National Ave)	T7 Other Port Class 8	2,991	4.44	0.00034
TAMT	Inbound Trucks from I-15 SB exiting to 32nd St	T7 Other Port Class 8	17,616	1.27	0.00056
NCMT	Inbound Trucks from I-5 SB exiting to Bay Marina Dr	T7 Tractor Class 8	28,033	7.17	0.0095
NCMT	Inbound Trucks from I-5 NB exiting to Bay Marina Dr	T7 Tractor Class 8	20,704	1.24	0.0012

Notes:

I-5 NB = Interstate 5 Northbound, I-5 SB = Interstate 5 Southbound, I-15 NB = Interstate 15 Northbound, I-15 SB = Interstate 15 Southbound

TABLE A-15: OUTBOUND HEAVY-DUTY TRUCK EMISSIONS ALONG FREEWAY ROUTES

Terminal	Truck Route	EMFAC Vehicle Category	Annual Truck Trips	Route Length (miles)	2019 Baseline DPM Emissions (Tons per Year)
TAMT	Outbound trucks from 28th St to I-5 North	T7 Other Port Class 8	13,757	3.92	0.0014
TAMT	Outbound trucks from 19th St to I-5 North	T7 Other Port Class 8	395	2.74	0.000027
TAMT	Outbound trucks from Harbor Dr to I-5 South	T7 Other Port Class 8	2,216	1.87	0.00010
TAMT	Outbound trucks from 32nd St to I-15 North	T7 Other Port Class 8	14,034	1.27	0.00045
NCMT	Outbound trucks from Bay Marina Dr to I-5 North	T7 Tractor Class 8	24,624	7.17	0.0083
NCMT	Outbound trucks from Bay Marina Dr to I-5 South	T7 Tractor Class 8	24,113	1.18	0.0013

Notes:

I-5 NB = Interstate 5 Northbound, I-5 SB = Interstate 5 Southbound, I-15 NB = Interstate 15 Northbound, I-15 SB = Interstate 15 Southbound

2026 and 2030 Emissions Inventory with MCAS Measures

Emission inventories were developed assuming implementation of near- and long-term goals and objectives identified in the MCAS. The list of measures included in the 2026 and 2030 scenarios are provided below. T**able A-16** summarizes the specific MCAS measures and their timeframe for implementation, with their expected DPM reduction by emission source.

Tables A-17 through **A-19** summarize emissions by source for the 2019, 2026, and 2030 scenarios.

Note that the estimated reduction in cancer risk from MCAS implementation currently does not account for amplified ferry operations or increased cargo throughput at NCMT or at TAMT to provide a clearer comparison the 2019 emission inventory and the forecasted 2026 and 2030 inventory assuming implementation of the MCAS, as outlined above.

Emission reductions have been projected in the near-term following MCAS implementation of the following measures by 2025:

- Cargo Handling Equipment
  - 20 zero emission (ZE) electric pieces of CHE at TAMT, including one mobile harbor crane, one reach stacker, two top handlers, and 15-yard trucks.
- Ocean Going Vessels
  - Two shore power plugs at NCMT.
  - Vessel Speed Reduction (VSR) compliance at 90% and 40nm.

In addition, the following were assumed to be in place by 2026:

- Commercial Harbor Craft
  - One all-electric ZE tugboat.
  - Two ZE ferries.
- Heavy-duty Trucks
  - 40 percent of truck trips will be ZE.

The following long-term measures were assumed to be in place by 2030:

- Cargo Handling Equipment
  - 100 percent of CHE at both TAMT and NCMT is ZE.
- Heavy-duty Trucks
  - 100 percent of truck trips are ZE.

TABLE A-16: SUMMARY OF NEAR-TERM MCAS MEASURE REDUCTIONS

Source Category	Measure	Overview	DPM reduction	% Reduction in Source Category	Date Objective is Targeted for Completion
CHC	Commercial Harbor Craft Objective #1: All-Electric Tugboat	Assumes reducing diesel consumption from assist tug activity 30,000 gallons per year. Assumes proportionately displaces existing Crowley operations (both tugs are 2015 model year Tier 3 tugs).	0.0503 tons of DPM reduced, which reduces assist tug DPM by 41%.	41%	June 30, 2026
	Commercial Harbor Craft Objective #2: Electric Short-Run Ferries	Assumes elimination of all diesel DPM from ferry operations.	0.2646 ton of DPM reduced, which is 100% of ferry DPM.	100%	January 1, 2026
CHE	Cargo Handling Equipment Objective #1: Electric CHE at TAMT	Assumes 80% reduction in DPM per year (replacement of 20 diesel pieces with electric models) at TAMT.	0.077 tons of DPM reduced from TAMT.	80%	January 1, 2025
	Long-term Goal for Cargo Handling Equipment: 100% ZE CHE by 2030 at TAMT and NCMT	Assumes 100% reduction in DPM at both TAMT and NCMT per year starting in 2030.	0.096 tons of DPM reduced from TAMT, 0.030 tons of DPM reduced from NCMT	100%	January 1, 2030
Truck	Truck Objective #1: Electric Trucks	Assumes 40% of all truck trips are ZE. Assumes one-to-one reduction with emissions.	0.0032 tons of DPM reduced from local roads, 0.01 tons of DPM reduced from freeways	40%	June 30, 2026
	Long-term Goal for Trucks: 100% ZE Trucks by 2030	Assumes 100% of all truck trips are ZE. Assumes one-to-one reduction with emissions.	0.008 tons of DPM reduced from local roads, 0.02 tons of DPM reduced from freeways	100%	January 1, 2030
OGV	Ocean-Going Vessels in-Transit Objective #1: Vessel Speed Reduction	Assumes VSR reduces OGV emissions from activity outside of the Bay. Objective pursues a 90% compliance rate within 40 nautical miles.	4.3 tons of DPM reduced for all OGV types.	Negligible and not quantified	January 1, 2022
	Ocean Going Vessels At-Berth Objective #2b: Shore Power at NCMT	Assumes two shore power plugs at NCMT, which captures all calls.	1.09 of DPM, which is an 88% reduction in at-berth emissions at NCMT.	88%	January 1, 2025

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Emission Inventory Summaries

TABLE A-16: BASELINE 2019 EMISSIONS INVENTORY

Source Category	Source Description	2019 Annual DPM (Tons per Year)	Emission Rate (g/s)	Emissions Profile
OGVs	OGV Cruise Outside Bay	0.60	1.73E-02	24 hours/365 days
	OGV Cruise Inside Bay-TAMT	0.10	2.94E-03	24 hours/365 days
	OGV Cruise Inside Bay-NCMT	0.45	1.29E-02	24 hours/365 days
	TAMT-Berth 10-1	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-2	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-3	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-4	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-5	0.15	4.28E-03	24 hours/365 days
	TAMT-Berth 10-6	0.15	4.28E-03	24 hours/365 days
	TAMT-Berth 10-7	0.026	7.53E-04	24 hours/365 days
	TAMT-Berth 10-8	0.026	7.53E-04	24 hours/365 days
	NCMT-Berth-24-1	0.18	5.09E-03	24 hours/365 days
	NCMT-Berth-24-2	0.18	5.09E-03	24 hours/365 days
	NCMT-Berth-24-3	0.18	5.09E-03	24 hours/365 days
	NCMT-Berth-24-4	0.18	5.09E-03	24 hours/365 days
	NCMT-Berth-24-5	0.18	5.09E-03	24 hours/365 days
	NCMT-Berth-24-10	0.18	5.09E-03	24 hours/365 days
	NCMT-Berth-24-11	0.18	5.09E-03	24 hours/365 days
Ferries	Broadway Ave-Coronado (CABRILLO)	0.023	8.91E-04	5AM-11PM (18 hours)/365 days
	Convention Ctr-Coronado (SILVERGATE)	0.0068	3.34E-04	9AM-11PM (14 hours)/365 days
Tugboats	Assist Tug at TAMT	0.032	9.15E-04	24 hours/365 days
	Assist Tug at NCMT	0.091	2.63E-03	24 hours/365 days
CHE	CHE at TAMT	0.096	2.77E-03	24 hours/365 days
	CHE at NCMT	0.030	8.77E-04	24 hours/365 days
Rail	Switchers at TAMT-Daytime	0.00072	4.15E-05	7AM-7PM (12 hours)/365 days
	Switchers at TAMT-Nighttime	0.00072	4.15E-05	7PM-7AM (12 hours)/365 days
	Switchers at NCMT-Daytime	0.15	8.52E-03	7AM-7PM (12 hours)/365 days
	Switchers at NCMT-Nighttime	0.15	8.52E-03	7PM-7AM (12 hours)/365 days
	Line-Haul Travel-Daytime	0.050	2.88E-03	7AM-7PM (12 hours)/365 days
	Line-Haul Travel-Nighttime	0.050	2.88E-03	7PM-7AM (12 hours)/365 days
Onsite Trucks at Terminals	Trucks Traveling and Idling Onsite within TAMT boundary	0.00065	1.86E-05	24 hours/365 days
	Trucks Traveling and Idling Onsite within NCMT boundary	0.0056	1.61E-04	24 hours/365 days
Surface Streets: Inbound to Terminals	Inbound Route 1: To TAMT from I-5 SB	0.00072	2.07E-05	24 hours/365 days
	Inbound Route 2: To TAMT from I-5 NB	0.000142	4.09E-06	24 hours/365 days
	Inbound Route 3: To TAMT from I-15 SB	0.00120	3.47E-05	24 hours/365 days
	Inbound Route 4: To NCMT from I-5 SB to Bay Marina	0.00074	2.12E-05	24 hours/365 days
	Inbound Route 5: To NCMT from I-5 NB to Bay Marina	0.00089	2.56E-05	24 hours/365 days
Surface Streets: Outbound from Terminals	Outbound Route 1: TAMT Gates to 32nd to I-15 NB	0.00097	2.80E-05	24 hours/365 days
	Outbound Route 2: TAMT Gates to Harbor to 28th to I-5 NB	0.00042	1.21E-05	24 hours/365 days
	Outbound Route 3: TAMT Gates to Harbor Dr to Civic Center St to I-5 SB	0.00019	5.57E-06	24 hours/365 days

Source Category	Source Description	2019 Annual DPM (Tons per Year)	Emission Rate (g/s)	Emissions Profile
	Outbound Route 4: TAMT Gates to Harbor Dr to 32nd to Main to Yara Yard	0.00011	3.22E-06	24 hours/365 days
	Outbound Route 5: TAMT Exit Only Gate to Harbor Dr to NDC	0.00067	1.94E-05	24 hours/365 days
	Outbound Route 6: NCMT Gates to I-5 NB	0.00087	2.51E-05	24 hours/365 days
	Outbound Route 7: NCMT Gates to I-5 SB	0.00082	2.37E-05	24 hours/365 days
	Outbound Route 8: Sigsbee St	0.0000033	9.50E-08	24 hours/365 days
	Outbound Route 9: Cesar Chavez Pkwy	0.0000091	2.63E-07	24 hours/365 days
	Outbound Route 10: Main St	0.00017	5.00E-06	24 hours/365 days
Freeways: Inbound to Terminals	Inbound Trucks from I-5 SB exiting to 28th St	0.0017	4.94E-05	24 hours/365 days
	Inbound Trucks from I-5 NB exiting to 28th St (via National Ave)	0.00034	9.68E-06	24 hours/365 days
	Inbound Trucks from I-15 SB exiting to 32nd St	0.00056	1.62E-05	24 hours/365 days
	Inbound Trucks from I-5 SB exiting to Bay Marina	0.0095	2.72E-04	24 hours/365 days
	Inbound Trucks from I-5 NB exiting to Bay Marina	0.0012	3.47E-05	24 hours/365 days
Freeways: Outbound from Terminals	Outbound trucks from 28th St to I-5 NB	0.0014	3.93E-05	24 hours/365 days
	Outbound trucks from 19th St to I-5 NB	0.000027	7.89E-07	24 hours/365 days
	Outbound trucks from Harbor Dr to I-5 SB	0.00010	3.02E-06	24 hours/365 days
	Outbound trucks from 32nd St to I-15 NB	0.00045	1.30E-05	24 hours/365 days
	Outbound trucks from Bay Marina Dr to I-5 NB	0.0083	2.39E-04	24 hours/365 days
	Outbound trucks from Bay Marina Dr to I-5 SB	0.0013	3.87E-05	24 hours/365 days

Notes:
I-5 NB = Interstate 5 Northbound, I-5 SB = Interstate 5 Southbound, I-15 NB = Interstate 15 Northbound, I-15 SB = Interstate 15 Southbound

TABLE A-17: FORECASTED 2026 MCAS EMISSIONS INVENTORY

Source Category	Source Description	2026 Annual DPM (tons/year)	Emission Rate (g/s)	Emissions Profile
OGVs	OGV Cruise Outside Bay	0.60	1.73E-02	24 hours/365 days
	OGV Cruise Inside Bay-TAMT	0.10	2.94E-03	24 hours/365 days
	OGV Cruise Inside Bay-NCMT	0.45	1.29E-02	24 hours/365 days
	TAMT-Berth 10-1	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-2	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-3	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-4	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-5	0.15	4.28E-03	24 hours/365 days
	TAMT-Berth 10-6	0.15	4.28E-03	24 hours/365 days
	TAMT-Berth 10-7	0.026	7.53E-04	24 hours/365 days
	TAMT-Berth 10-8	0.026	7.53E-04	24 hours/365 days
	NCMT-Berth-24-1	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-2	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-3	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-4	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-5	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-10	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-11	0.021	6.08E-04	24 hours/365 days
Ferries	Broadway Ave-Coronado (CABRILLO)	—	—	5AM-11PM (18 hours)/365 days
	Convention Ctr-Coronado (SILVERGATE)	—	—	9AM-11PM (14 hours)/365 days
Tugboats	Assist Tug at TAMT	0.019	5.41E-04	24 hours/365 days
	Assist Tug at NCMT	0.054	1.55E-03	24 hours/365 days
CHE	CHE at TAMT	0.019	5.54E-04	24 hours/365 days
	CHE at NCMT	0.030	8.77E-04	24 hours/365 days
Rail	Switchers at TAMT-Daytime	0.00072	4.15E-05	7AM-7PM (12 hours)/365 days
	Switchers at TAMT-Nighttime	0.00072	4.15E-05	7PM-7AM (12 hours)/365 days
	Switchers at NCMT-Daytime	0.15	8.52E-03	7AM-7PM (12 hours)/365 days
	Switchers at NCMT-Nighttime	0.15	8.52E-03	7PM-7AM (12 hours)/365 days
	Line-Haul Travel-Daytime	0.050	2.88E-03	7AM-7PM (12 hours)/365 days
	Line-Haul Travel-Nighttime	0.050	2.88E-03	7PM-7AM (12 hours)/365 days
Onsite Trucks at Terminals	Trucks Traveling and Idling Onsite within TAMT boundary	0.00039	1.12E-05	24 hours/365 days
	Trucks Traveling and Idling Onsite within NCMT boundary	0.0033	9.64E-05	24 hours/365 days

Source Category	Source Description	2026 Annual DPM (tons/year)	Emission Rate (g/s)	Emissions Profile
Surface Streets: Inbound to Terminals	Inbound Route 1: To TAMT from I-5 SB	0.00043	1.24E-05	24 hours/365 days
	Inbound Route 2: To TAMT from I-5 NB	0.000085	2.46E-06	24 hours/365 days
	Inbound Route 3: To TAMT from I-15 SB	0.00072	2.08E-05	24 hours/365 days
	Inbound Route 4: To NCMT from I-5 SB to Bay Marina	0.00044	1.27E-05	24 hours/365 days
	Inbound Route 5: To NCMT from I-5 NB to Bay Marina	0.00053	1.53E-05	24 hours/365 days
Surface Streets: Outbound from Terminals	Outbound Route 1: TAMT Gates to 32nd to I-15 NB	0.00058	1.68E-05	24 hours/365 days
	Outbound Route 2: TAMT Gates to Harbor to 28th to I-5 NB	0.00025	7.25E-06	24 hours/365 days
	Outbound Route 3: TAMT Gates to Harbor Dr to Civic Center St to I-5 SB	0.00012	3.34E-06	24 hours/365 days
	Outbound Route 4: TAMT Gates to Harbor Dr to 32nd to Main to Yara Yard	0.000067	1.93E-06	24 hours/365 days
	Outbound Route 5: TAMT Exit Only Gate to Harbor Dr to NDC	0.00040	1.16E-05	24 hours/365 days
	Outbound Route 6: NCMT Gates to I-5 NB	0.00052	1.51E-05	24 hours/365 days
	Outbound Route 7: NCMT Gates to I-5 SB	0.00049	1.42E-05	24 hours/365 days
	Outbound Route 8: Sigsbee St	0.0000020	5.70E-08	24 hours/365 days
	Outbound Route 9: Cesar Chavez Pkwy	0.0000055	1.58E-07	24 hours/365 days
	Outbound Route 10: Main St	0.00010	3.00E-06	24 hours/365 days
Freeways: Inbound to Terminals	Inbound Trucks from I-5 SB exiting to 28th St	0.0010	2.96E-05	24 hours/365 days
	Inbound Trucks from I-5 NB exiting to 28th St (via National Ave)	0.00020	5.81E-06	24 hours/365 days
	Inbound Trucks from I-15 SB exiting to 32nd St	0.00034	9.75E-06	24 hours/365 days
	Inbound Trucks from I-5 SB exiting to Bay Marina	0.0057	1.63E-04	24 hours/365 days
	Inbound Trucks from I-5 NB exiting to Bay Marina	0.00072	2.08E-05	24 hours/365 days
Freeways: Outbound from Terminals	Outbound trucks from 28th St to I-5 NB	0.00082	2.36E-05	24 hours/365 days
	Outbound trucks from 19th St to I-5 NB	0.000016	4.73E-07	24 hours/365 days
	Outbound trucks from Harbor Dr to I-5 SB	0.000063	1.81E-06	24 hours/365 days
	Outbound trucks from 32nd St to I-15 NB	0.00027	7.78E-06	24 hours/365 days
	Outbound trucks from Bay Marina Dr to I-5 NB	0.0050	1.43E-04	24 hours/365 days
	Outbound trucks from Bay Marina Dr to I-5 SB	0.00081	2.32E-05	24 hours/365 days

Notes:
I-5 NB = Interstate 5 Northbound, I-5 SB = Interstate 5 Southbound, I-15 NB = Interstate 15 Northbound, I-15 SB = Interstate 15 Southbound

TABLE A-18: FORECASTED 2030 MCAS EMISSIONS INVENTORY

Source Category	Source Description	2030 Annual DPM (tons/year)	Emission Rate (g/s)	Emissions Profile
OGVs	OGV Cruise Outside Bay	0.60	1.73E-02	24 hours/365 days
	OGV Cruise Inside Bay-TAMT	0.10	2.94E-03	24 hours/365 days
	OGV Cruise Inside Bay-NCMT	0.45	1.29E-02	24 hours/365 days
	TAMT-Berth 10-1	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-2	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-3	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-4	0.021	5.94E-04	24 hours/365 days
	TAMT-Berth 10-5	0.15	4.28E-03	24 hours/365 days
	TAMT-Berth 10-6	0.15	4.28E-03	24 hours/365 days
	TAMT-Berth 10-7	0.026	7.53E-04	24 hours/365 days
	TAMT-Berth 10-8	0.026	7.53E-04	24 hours/365 days
	NCMT-Berth-24-1	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-2	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-3	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-4	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-5	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-10	0.021	6.08E-04	24 hours/365 days
	NCMT-Berth-24-11	0.021	6.08E-04	24 hours/365 days
Ferries	Broadway Ave-Coronado (CABRILLO)	—	—	5AM-11PM (18 hours)/365 days
	Convention Ctr-Coronado (SILVERGATE)	—	—	9AM-11PM (14 hours)/365 days
Tugboats	Assist Tug at TAMT	0.019	5.41E-04	24 hours/365 days
	Assist Tug at NCMT	0.054	1.55E-03	24 hours/365 days
CHE	CHE at TAMT	—	—	24 hours/365 days
	CHE at NCMT	—	—	24 hours/365 days
Rail	Switchers at TAMT-Daytime	0.00072	4.15E-05	7AM-7PM (12 hours)/365 days
	Switchers at TAMT-Nighttime	0.00072	4.15E-05	7PM-7AM (12 hours)/365 days
	Switchers at NCMT-Daytime	0.15	8.52E-03	7AM-7PM (12 hours)/365 days
	Switchers at NCMT-Nighttime	0.15	8.52E-03	7PM-7AM (12 hours)/365 days
	Line-Haul Travel-Daytime	0.050	2.88E-03	7AM-7PM (12 hours)/365 days
	Line-Haul Travel-Nighttime	0.050	2.88E-03	7PM-7AM (12 hours)/365 days
Onsite Trucks at Terminals	Trucks Traveling and Idling Onsite within TAMT boundary	—	—	24 hours/365 days
	Trucks Traveling and Idling Onsite within NCMT boundary	—	—	24 hours/365 days
	Inbound Route 1: To TAMT from I-5 SB	—	—	24 hours/365 days

Source Category	Source Description	2030 Annual DPM (tons/year)	Emission Rate (g/s)	Emissions Profile
Surface Streets: Inbound to Terminals	Inbound Route 2: To TAMT from I-5 NB	—	—	24 hours/365 days
	Inbound Route 3: To TAMT from I-15 SB	—	—	24 hours/365 days
	Inbound Route 4: To NCMT from I-5 SB to Bay Marina	—	—	24 hours/365 days
	Inbound Route 5: To NCMT from I-5 NB to Bay Marina	—	—	24 hours/365 days
Surface Streets: Outbound from Terminals	Outbound Route 1: TAMT Gates to 32nd to I-15 NB	—	—	24 hours/365 days
	Outbound Route 2: TAMT Gates to Harbor to 28th to I-5 NB	—	—	24 hours/365 days
	Outbound Route 3: TAMT Gates to Harbor Dr to Civic Center St to I-5 SB	—	—	24 hours/365 days
	Outbound Route 4: TAMT Gates to Harbor Dr to 32nd to Main to Yara Yard	—	—	24 hours/365 days
	Outbound Route 5: TAMT Exit Only Gate to Harbor Dr to NDC	—	—	24 hours/365 days
	Outbound Route 6: NCMT Gates to I-5 NB	—	—	24 hours/365 days
	Outbound Route 7: NCMT Gates to I-5 SB	—	—	24 hours/365 days
	Outbound Route 8: Sigsbee St	—	—	24 hours/365 days
	Outbound Route 9: Cesar Chavez Pkwy	—	—	24 hours/365 days
	Outbound Route 10: Main St	—	—	24 hours/365 days
Freeways: Inbound to Terminals	Inbound Trucks from I-5 SB exiting to 28th St	—	—	24 hours/365 days
	Inbound Trucks from I-5 NB exiting to 28th St (via National Ave)	—	—	24 hours/365 days
	Inbound Trucks from I-15 SB exiting to 32nd St	—	—	24 hours/365 days
	Inbound Trucks from I-5 SB exiting to Bay Marina	—	—	24 hours/365 days
	Inbound Trucks from I-5 NB exiting to Bay Marina	—	—	24 hours/365 days
Freeways: Outbound from Terminals	Outbound trucks from 28th St to I-5 NB	—	—	24 hours/365 days
	Outbound trucks from 19th St to I-5 NB	—	—	24 hours/365 days
	Outbound trucks from Harbor Dr to I-5 SB	—	—	24 hours/365 days
	Outbound trucks from 32nd St to I-15 NB	—	—	24 hours/365 days
	Outbound trucks from Bay Marina Dr to I-5 NB	—	—	24 hours/365 days
	Outbound trucks from Bay Marina Dr to I-5 SB	—	—	24 hours/365 days

Notes:
I-5 NB = Interstate 5 Northbound, I-5 SB = Interstate 5 Southbound, I-15 NB = Interstate 15 Northbound, I-15 SB = Interstate 15 Southbound

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Appendix B Air Dispersion Modeling Methodology

Appendix B Air Dispersion Modeling Methodology

Introduction

As previously discussed, the Port of San Diego's (Port) Maritime Clean Air Strategy (MCAS) health risk assessment (HRA) has three main components and are as follows:

4. DPM Emissions Inventory (i.e., the amount of emissions emitted by a source, represented in tons per year)
5. Dispersion Modeling (i.e., use of mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source, resulting in predicted pollutant concentrations at selected downwind receptor locations).
6. Health Risk Calculations (i.e., assess the risk associated with pollutants at pre-defined sensitive receptor locations based on the amount and type of pollutant)

This appendix describes the second component of the Port's HRA, *Dispersion Modeling*. This appendix provides information on the assumptions and methods used to conduct the dispersion modeling for the various emission sources in the HRA.

The DPM Emissions Inventory is presented in Appendix A, and the Health Risk Calculation Methodology is presented in Appendix C.

Dispersion Modeling

Dispersion modeling was conducted to estimate concentrations of diesel particulate matter (DPM) at downwind receptor locations. The HRA conducted dispersion modeling using the American Meteorological Society/Environmental Protection Agency (EPA) Regulatory Model, AERMOD, version 21112. AERMOD is a steady-state, multiple-source, Gaussian dispersion model designed for use with emission sources and is suitable for assessing both elevated point sources and low-level emissions sources. AERMOD is EPA's regulatory dispersion model, specified in the EPA Guideline for Air Quality Methods (Code of Federal Regulations, Title 40, Part 51, Appendix W) (EPA 2017).

AERMOD requires a variety of input parameters to provide a comprehensive analysis, these include:

- Emission Source Characterization
- Meteorological Data
- Temporal Distributions
- Terrain and Dispersion Coefficients
- Modeling Domain and Receptor Network

Emission Source Characterization

This section provides the information used to characterize the emission sources in AERMOD. The dispersion modeling incorporated all emissions sources described in Appendix A, which included ocean-going vessels (OGVs), tugboats, ferries, cargo handling equipment (CHE), line-haul and switching locomotives, and heavy-duty trucks. All emission source locations used the Universal Transverse Mercator (UTM) coordinate system and the North American Datum 1983. Figures that provide visual context to the narrative description of the emission source configurations are provided at the end of this appendix.

OGV Travel Outside the San Diego Bay

OGVs traveling outside the San Diego Bay (Bay) were represented using a line volume source, which is a series of volume sources. The travel path outside of the Bay was based on historic ship position data provided by the National Oceanic and Atmospheric Administration (NOAA 2017). OGV source parameters were based on similar OGVs analyzed in the Port of Los Angeles (POLA) San Pedro Waterfront Project (POLA 2008) and the San Francisco Department of Public Health (SFDPH) Citywide

Health Risk Assessment (SFDPH 2020). The release height for OGVs traveling outside the Bay was 50 meters. The initial vertical dimension was based on the release height (50 meters) divided by 2.15, resulting in 23.26 meters.[23] Each line volume source had a width of 100 meters and an adjacent configuration. The initial lateral dimension was based on the line volume source width (100 meters) divided by 2.15, which resulted in 46.51 meters.[24] **Table B-1** summarizes the input parameters for OGVs traveling outside the Bay. **Figure B-1** shows the spatial location of OGVs traveling outside the Bay. Note, all figures referenced are compiled at the end of the appendix.

Note that the release height for vessels transiting (moving) both inside and outside the bay is higher than the release height for vessels that are stationary at berth (discussed below) in order to account for plume rise from ships in transit. This approach is consistent with other modeling efforts that analyze both vessels in transit and vessels at berth, including the HRA for the San Pedro Waterfront Project at POLA and the Citywide Health HRA for SFDPH (POLA 2008, SFDPH 2020).

TABLE B-1: AERMOD PARAMETERS FOR OGV TRAVEL OUTSIDE THE BAY

Source Type	Source Width (m)	Initial Lateral Dimension (m)[a]	Release Height (m)	Initial Vertical Dimension (m)[b]
Line Volume (Adjacent)	100	46.51	50	23.26

Source: POLA 2008, SFDPH 2020
Notes:
[a] Initial lateral dimension is based on the line volume source width divided by 2.15.
[b] Initial vertical dimension is based on the release height divided by 2.15.
m = meters

OGV Travel Inside the San Diego Bay

OGVs traveling inside the Bay were represented using a line volume source. The travel path inside the Bay was based on historic ship position data provided by the National Oceanic and Atmospheric Administration (NOAA 2017). OGV source parameters were based on similar OGVs analyzed in the Port of Los Angeles (POLA) San Pedro Waterfront Project (POLA 2008) and the San Francisco Department of Public Health (SFDPH) Citywide Health Risk Assessment (SFDPH 2020). The release height for OGVs traveling inside the Bay was 50 meters. The initial vertical dimension was based on the release height (50 meters) divided by 2.15, resulting in 23.26 meters. Each line volume source had a width of 100 meters and an adjacent configuration. The initial lateral dimension was based on the line volume source width (100 meters) divided by 2.15, which resulted in 46.51 meters. **Table B-2** summarizes the input parameters for OGVs traveling inside the Bay. **Figure B-1** shows the spatial location of OGVs traveling inside the Bay.

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[23] The initial vertical dimension is used to account for the initial growth of the plume vertically after it is released.
[24] The initial lateral dimension is used to account for the initial growth of the plume horizontally after it is released.

TABLE B-2: AERMOD PARAMETERS FOR OGV TRAVEL INSIDE THE BAY

Source Type	Source Width (m)	Initial Lateral Dimension (m)[a]	Release Height (m)	Initial Vertical Dimension (m)[b]
Line Volume (Adjacent)	100	46.51	50	23.26

Source: POLA 2008, SFDPH 2020
Notes:
[a] Initial lateral dimension is based on the line volume source width divided by 2.15.
[b] Initial vertical dimension is based on the release height divided by 2.15.
m = meters

OGVs At Berth

OGV emissions while at berth were represented as point sources. Point sources were placed at locations that represented the berths at TAMT and NCMT for each vessel and cargo type. TAMT had eight berth locations, and NCMT had seven berth locations. **Table B-3** summarizes the point source parameters for OGVs at berth. These source parameters are consistent with information from the California Air Resources Board (CARB) *Preliminary Health Analyses: Control Measure for Ocean-Going Vessels At Berth and At Anchor* (CARB 2018). **Figure B-2** shows the spatial location of OGVs at berth.

TABLE B-3: AERMOD PARAMETERS FOR OGVS AT BERTH

Source Type	Release Height (m)	Gas Exit Temperature (K)	Stack Diameter (m)	Exit Velocity (m/s)	Exit Flow Rate (m^3/s)
Point	43	618	0.50	16.0	3.14

Source: CARB 2018
Notes:
m = meters
K = Kelvin
m/s = meters per second
m^3/s = cubic meters per second

A summary of berth assignments by ship type is as follows for TAMT:

- Container Ships call on Berths 10/1 – 10/4
- General Cargo Ships call on Berths 10/5 – 10/6
- Bulk Cargo Ships call on Berths 10/7 – 10/8

At NCMT, auto carrier and Roll-on/Roll-off or RoRo ships call to each berth. At berth emissions were distributed evenly among the seven berths at NCMT with recurring calls.

Heavy-Duty Truck Travel on Surface Streets and Freeways

Surface Streets

Surface street routes were based on designated truck routes for Port-related trucks. They were modeled primarily as single lanes: Surface streets are fairly narrow, and it was assumed that lane changes by trucks would be minimal during travel from freeways to terminals and vice versa. The exception is travel on Harbor Drive, which was modeled with two lanes. Harbor Drive is a major thoroughfare that connects to other surface streets which lead to freeways and also links TAMT to NCMT via Tidelands Avenue. Harbor Drive was modeled using two lanes to capture the variability in truck lane travel. Additionally, three non-designated truck routes were included in the dispersion modeling, and each were modeled with a single-lane width.

Freeways

All freeway onramps and offramps were modeled using single lanes. For trucks traveling along I-5 and I-15 mainlines, the I-5 mainline had four lanes and I-15 had three lanes in the northbound and southbound directions.

Truck Route Composition

Trucks travel from all over the region to TAMT and NCMT, and the routes used by inbound and outbound trucks are composed of various segments of surface streets and freeways. For example, an inbound truck traveling from Orange County to TAMT would travel along I-5 South, exit to the 28th Street offramp, turn right onto 28th Street, turn right onto Harbor Drive, and then turn left onto Crosby Street, entering the TAMT main gate. This truck route is composed of several segments: multiple surface streets, a freeway offramp, and a freeway mainline.

To accurately reflect this truck route in the dispersion modeling, the route was separated into two categories: surface street segments and a freeway mainline. The surface street segments included: the 28th Street offramp, 28th Street, Harbor Drive, and Crosby Street. These surface street segments were grouped together to form the surface street route that inbound trucks would use when exiting I-5 S to 28th Street. The freeway mainline segment of this route was the I-5 South. This approach was applied to all inbound and outbound truck routes. Truck routes were categorized as inbound and outbound to accurately represent the spatial component of truck travel within the Portside area. **Table B-11** through **Table B-14** provided at the end of this appendix summarize the source parameters for inbound and outbound truck routes.

Release Parameters

Heavy-duty trucks traveling on surface streets and freeway onramps and offramps in the vicinity of TAMT and NCMT were represented as line area sources. Line volume sources were used to represent travel along freeway mainlines. Source parameters for modeling mobile sources were based on guidance from EPA's Transportation Conformity Guidance for Particulate Matter (EPA 2021).

The source width of a line area source or line volume source was based on the road width plus 6 meters (3 meters on each side) to account for vehicle-induced turbulence. The road width was based on the average number of lanes along the road segments. For surface streets and freeway on/offramps, lane widths were based on collector and arterial roads, which have a lane width of 3.3 meters (EPA 2021). For freeway mainline segments, lane widths were based on high volume roadways, which have a lane width of 3.7 meters (EPA 2021).

For all truck routes, the release height for heavy-duty trucks was based on half of the plume height. The plume height was equal to the vehicle height multiplied by a factor of 1.7 to account for vehicle-induced turbulence. Heavy-duty trucks had a vehicle height of 4.0 meters, which resulted in a plume height of 6.8 meters. With a plume height of 6.8 meters, the release height was 3.4 meters. The initial vertical dimension was based on the plume height divided by 2.15, which resulted in 3.16 meters.

Table B-4 summarizes the source parameters for truck travel. **Figure B-3** through **Figure B-5** at the end of this appendix show the spatial location of heavy-duty trucks traveling along surface streets and freeways.

TABLE B-4: AERMOD PARAMETERS FOR OFFSITE HEAVY-DUTY TRUCK TRAVEL

Emission Source (Source Type)	# of Lanes	Lane Width (m)	Road Width (m)	Turbulence Addition (m)	Plume Width (m)	Vehicle Height (m)	Plume Height Factor	Plume Height (m)	Release Height (m)	Initial Vertical Dimension (m)[a]
Surface Streets (Line Area)	1	3.3	3.3	6.0	9.3	4.0	1.7	6.8	3.4	3.16
	2	3.3	6.6	6.0	12.6	4.0	1.7	6.8	3.4	3.16
Freeway Onramps & Offramps (Line Area)	1	3.3	3.3	6.0	9.3	4.0	1.7	6.8	3.4	3.16
Freeway Mainlines (Line Volume)	3	3.7	11.1	6.0	17.1	4.0	1.7	6.8	3.4	3.16
	4	3.7	14.8	6.0	20.8	4.0	1.7	6.8	3.4	3.16

Source: EPA 2021
Notes:
[a] Initial vertical dimension is based on the plume height divided by 2.15.
m = meters

Heavy-Duty Truck Activity within the TAMT and NCMT Boundaries

Heavy-duty truck activity (travel and idling) within TAMT and NCMT boundaries was represented as polygon area sources. The area sources encompassed the boundaries of TAMT and NCMT and had a release height of 5.5 meters. The initial vertical dimension was based on the release height divided by 2.15, which resulted in 2.56 meters. **Table B-5** summarizes the input parameters for heavy-duty truck activity within the terminal boundaries. **Figure B-6** shows the spatial location of heavy-duty trucks operating within each terminal.

TABLE B-5: AERMOD PARAMETERS FOR HEAVY-DUTY TRUCKS WITHIN TERMINAL BOUNDARIES

Source Type	Release Height (m)	Initial Vertical Dimension (m)[a]
Polygon Area	5.5	2.56

Source: BAAQMD 2019
Notes:
[a] Initial vertical dimension based on release height divided by 2.15.
m = meters

Tugboats

Tugboats were represented using a line volume source. The travel path was the same as that for OGV travel inside the Bay for TAMT and NCMT, but their release parameters are different because of the smaller sizes of tugboats. Tugboat source parameters were based on similar tugboats analyzed in previous studies for the Ports of Los Angeles and Long Beach (CARB 2006) and the West Oakland Community Action Plan (BAAQMD 2019). Each line volume source had a width of 100 meters and an adjacent configuration. The initial lateral dimension was based on the line volume source width (100 meters) divided by 2.15, which resulted in 46.51 meters. The release height for tugboats traveling inside the Bay was 6.0 meters. The initial vertical dimension was based on the release height (6.0 meters) divided by 2.15, which resulted in 2.79 meters. **Table B-6** summarizes the input parameters for tugboats. **Figure B-7** shows the spatial location of tugboats traveling inside the Bay.

TABLE B-6: AERMOD PARAMETERS FOR TUGBOATS

Source Type	Source Width (m)	Initial Lateral Dimension (m)[a]	Release Height (m)	Initial Vertical Dimension (m)[b]
Line Volume (Adjacent)	100	46.51	6.0	2.79

Source: CARB 2006, BAAQMD 2019
Notes:
[a] Initial lateral dimension is based on the line volume source width divided by 2.15.
[b] Initial vertical dimension is based on the release height divided by 2.15.

Ferry Travel

Ferry emissions from the Cabrillo and Silvergate ferries were represented using multiple volume sources. The volume sources encompassed the boundaries of where the Cabrillo and Silvergate travel during their routes and were based on calendar year 2019 Automatic Identification System (AIS) travel data from PortVision, provided by Port staff. Ferry source parameters were based on previous studies for the Ports of Los Angeles and Long Beach (CARB 2006) and the San Pedro Waterfront Project (POLA 2008). Ferries had a release height of 6.0 meters. The initial vertical dimension was based on the release height divided by 2.15, which resulted in 2.79 meters. Each of the volume sources that encompassed the ferry route had a side length of 45 meters. The initial lateral dimension of each volume source was based on the side length divided by 4.3, resulting in 10.47 meters. Ferries were modeled with a variable emissions profile to reflect the actual operating schedule for each ferry. The Cabrillo Ferry had a daily operating schedule from 5 a.m. to 11 p.m. and the Silvergate Ferry had a daily operating schedule from 9 a.m. to 11 p.m. **Table B-7** summarizes the parameters for ferry travel. **Figure B-8** shows the spatial location of the ferry routes.

TABLE B-7: AERMOD PARAMETERS FOR FERRIES

Source (Source Type)[a]	# of Volume Sources	Volume Source Length of Side (m)	Initial Lateral Dimension (m)[b]	Release Height (m)	Initial Vertical Dimension (m)[c]
Cabrillo Ferry (Multiple Volume)	287	45	10.47	6.0	2.79
Silvergate Ferry (Multiple Volume)	68	45	10.47	6.0	2.79

Source: CARB 2006
Notes:
[a] Ferry sources reflect actual area where ferry travel would occur for the Cabrillo and Silvergate ferries.
[b] Initial lateral dimension for each volume source is based on the length of the side divided by 4.3.
[c] Initial vertical dimension is based on the release height divided by 2.15.
m =meters

Cargo Handling Equipment

CHE at TAMT and NCMT was represented as polygon area sources. The area sources encompassed the boundaries of TAMT and NCMT and had a release height of 5.5 meters. The initial vertical dimension was based on the release height divided by 2.15, which resulted in 2.56 meters. **Table B-8** summarizes the input parameters for CHE operating at TAMT and NCMT. **Figure B-9** shows the spatial location of CHE operating within the terminals.

TABLE B-8: AERMOD PARAMETERS FOR CARGO HANDLING EQUIPMENT

Source Type	Release Height (m)	Initial Vertical Dimension (m)[a]
Polygon Area	5.5	2.56

Source: BAAQMD 2019
Notes:
[a] Initial vertical dimension based on release height divided by 2.15.
m =meters

Line-Haul Locomotive Travel

Line-haul (freight rail) locomotives carrying cargo from TAMT and NCMT were represented as a line volume source with an alignment along the BNSF right-of-way, stretching from NCMT to the Downtown San Diego area. Source parameters were consistent with guidance from CARB's railyard study for the BNSF San Diego yard (CARB 2008). Freight rail sources accounted for daytime (7 a.m. to 7 p.m.) and nighttime (7 p.m. to 7 a.m.) conditions to evaluate varying meteorological effects. The source width and the initial lateral dimension would be the same under daytime and nighttime conditions. The line volume source had a width of 5.01 meters. The initial lateral dimension was based on the source width divided by 2.15, which resulted in 2.33 meters.

For daytime conditions, the release height was 4.76 meters. The daytime initial vertical dimension was based on the release height divided by 2.15, which resulted in 2.21 meters. For nighttime conditions, the release height was 11.25 meters. The nighttime initial vertical dimension was based on the release height divided by 2.15, which resulted in 5.23 meters. The release heights were dependent on the travel speeds of locomotives, as well as atmospheric conditions, such as wind speed and stability class during the daytime and nighttime. **Table B-9** summarizes the input parameters for line-haul locomotives. **Figure B-10 through Figure B-12** show the spatial location of the linehaul route.

TABLE B-9: AERMOD PARAMETERS FOR LINE-HAUL LOCOMOTIVE TRAVEL

Source Type	Time of Day	Source Width (m)	Initial Lateral Dimension (m)[a]	Release Height (m)	Initial Vertical Dimension (m)[b]
Line Volume (Adjacent)	Daytime (7 a.m. to 7 p.m.)	5.01	2.33	4.76	2.21
	Nighttime (7 p.m. to 7 a.m.)	5.01	2.33	11.25	5.23

Source: CARB 2008
Notes:
[a] Initial lateral dimension based on source width divided by 2.15.
[b] Initial vertical dimension based on release height divided by 2.15.
m = meters

Rail Switching

Rail switching activities at TAMT and NCMT were represented as multiple volume sources. The volume sources were placed in the areas where switching activities would occur near TAMT and within NCMT. Source parameters were consistent with guidance from CARB's railyard study for the BNSF San Diego yard (CARB 2008). Switching activity sources accounted for daytime (7a.m. to 7 p.m.) and nighttime (7 p.m. to 7 a.m.) conditions to evaluate varying meteorological effects. The source width and initial lateral dimension would be the same under daytime and nighttime conditions. Volume sources at TAMT and NCMT had source widths of 45 meters and 35 meters, respectively. The initial lateral dimensions were based on the source width divided by 4.3 meters, which resulted in 10.47 meters for TAMT and 8.14 meters for NCMT. Note that rail switching only accounted for Port-related switching activity and did not account for switching that occurs for non-Port cargo movements.

For daytime conditions, the release height was 37.76 meters. The daytime initial vertical dimension was based on the release height divided by 2.15, which resulted in 17.56 meters. For nighttime conditions, the release height was 37.30 meters. The nighttime initial vertical dimension was based on the release height divided by 2.15, which resulted in 17.35 meters. **Table B-10** summarizes the input parameters for switching activities. **Figure B-10 through Figure B-12** show the spatial locations of switching activities at TAMT and NCMT.

TABLE B-10: AERMOD PARAMETERS FOR SWITCHING ACTIVITIES WITHIN OR NEAR TERMINAL BOUNDARIES

Terminal	Source Type	Time of Day	Plume Width (m)	Initial Lateral Dimension (m)[a]	Release Height (m)	Initial Vertical Dimension (m)[b]
TAMT	Multiple Volume	Daytime (7 a.m. to 7 p.m.)	45	10.47	37.76	17.56
		Nighttime (7 p.m. to 7 a.m.)	45	10.47	37.30	17.35
NCMT	Multiple Volume	Daytime (7 a.m. to 7 p.m.)	35	8.14	37.76	17.56
		Nighttime (7 p.m. to 7 a.m.)	35	8.14	37.30	17.35

Source: CARB 2008.
Notes:
[a] Initial lateral dimension for each volume source is based on the length of the side divided by 4.3.
[b] Initial vertical dimension based on release height divided by 2.15.
m= meters

Averaging Time and Unitized Emission Rate

For evaluating health risks of DPM, particulate matter with a diameter of 10 microns or less (PM_{10}) was selected as the pollutant in AERMOD as a surrogate for DPM (OEHHA 2015). The PERIOD averaging time was used to estimate annual average concentrations. The PERIOD averaging time refers to the average for the entire meteorological data period rather than a single year of meteorological data. The meteorological data used in AERMOD included three years of data from 2010 to 2012, and the average annual concentrations were based on the average over these three years.

Each source in AERMOD was modeled using a unitized emission rate, or 1 gram per second (g/s), to estimate ground level concentrations (GLCs) in micrograms per cubic meter (µg/m^3) at each receptor. Since a unitized emission rate is used for all sources, the output concentrations from AERMOD can be used as dispersion factors (or scaling factors). The dispersion factor ([µg/m^3]/[1 g/s]) represents the AERMOD output concentration based on an emission rate of 1 g/s. The dispersion factor ([µg/m^3]/[1 g/s]) and the actual emission rate of the source (g/s) were multiplied together to estimate the GLC (µg/m^3) at a receptor. An example calculation for estimating GLCs is provided below.

Annual GLC (µg/m^3) = Actual Emission Rate (g/s) x [Dispersion Factor (µg/m^3)/ 1 (g/s)]

Where:

- Actual Emission Rate: 10 g/s
- Dispersion Factor: 5 µg/m^3/[1 g/s]
- 50 µg/m^3 = 10 g/s x 5 ([µg/m^3]/[1 g/s])

A unitized emission rate was used for the analysis to 1) reduce the amount of modeling runs and 2) provide the ability to estimate GLCs for a large number of sources efficiently. This approach was consistent with guidelines from the Office of Environmental Health Hazard Assessment (OEHHA).

Meteorological Data

To run AERMOD, the following hourly surface meteorological data are required: wind speed, wind direction, ambient temperature, and opaque cloud cover. In addition to surface data, upper air sounding data is required. The upper air sounding data provides information on the vertical structure of the atmosphere beyond the effective range of surface weather.

These meteorological variables were used to estimate air dispersion of pollutants in the atmosphere. Wind speed determines how rapidly pollutants are transported away from the source, while wind direction determines where pollutants are transported. The difference in ambient temperature and the exhaust temperature determines the initial buoyancy of emissions from point sources. The opaque cloud cover, upper air sounding data, surface roughness, the Bowen ratio (ratio of sensible to latent heat flux), and albedo (reflectiveness of the earth's surface back to space without absorption) are all used in determining other dispersion parameters using similarity theory to develop profiles of the boundary layer parameters and determine the rate of turbulent mixing. These parameters include atmospheric stability (a measure of atmospheric turbulence that determines the rate at which pollutants are mixed laterally and vertically), the aloft vertical temperature gradient, and the convective and mechanical boundary layer height (the vertical depth through which pollutants may be dispersed).

Meteorological data for the dispersion modeling was based on data from the San Diego Air Pollution Control District's (San Diego APCD) monitoring station at Perkins Elementary School, which is located less than a mile from the TAMT boundaries as shown in **Figure B-13**.[25] The pre-processed meteorological data from this station was collected for the years between 2010–2012 and was processed with turbulence data (sigma-theta data). **Figure B-14** through **Figure B-16** show wind roses for the Perkins Elementary School station. The wind roses show predominant winds from the west and southwest throughout the entire day (1.91 meters per second [m/s] on average) (**Figure B-14**) and during the daytime hours (2.50 m/s on average) (**Figure B-15**), with less dominant patterns at night (1.26 m/s on average) (**Figure B-16**). Moreover, winds tend to be higher in the daytime, and nighttime winds show much more calm periods (calm winds 4.06% of the time during the day, and calm winds 16.28% of the time at night).

Temporal Distributions

Meteorological conditions can affect how pollutants are dispersed based on atmospheric stability. Unstable conditions occur during the day when there is solar heating of the surface and air near the surface, which allows air to move freely up and down. Stable conditions begin at sunset and occur throughout the night and early morning hours prior to sunrise. During stable conditions, the surface cools because of the release of radiative heat to the atmosphere, and conditions can be stagnant, resulting in less air movement. Unstable conditions increase air dispersion for sources operating during daytime hours and typically result in lower pollutant concentrations compared to sources operating during nighttime hours.

The cargo terminals are open year-round, and sources operate at various times throughout a 24-hour period. Based on this, the majority of emission sources were modeled in AERMOD with an operating schedule of 24 hours per day, 7 days per week, with the exception of rail sources (freight and switching activities), which had daytime (7 a.m. to 7 p.m.) and nighttime (7 p.m. to 7 a.m.) profiles, and ferry travel. The Cabrillo ferry operated from 5 a.m. to 11 p.m., and the Silvergate ferry operated from 9 a.m. to 11 p.m. Although some sources realistically operate more frequently during daytime hours, using the 24-hour operating schedule for most sources is likely to result in conservative (or more impactful)

[25] While the Perkins monitoring station was closed in 2016, the meteorological data for the 2010-2012 period remains the best available data for use at the Port.

results, since modeled sources would operate during nighttime hours when air dispersion decreases, resulting in higher concentrations at receptor locations near the Port.

Terrain and Dispersion Coefficients

The dispersion modeling analysis also included terrain data to accurately assess impacts in three dimensions. The terrain data used for the analysis consisted of the United States Geological Survey's (USGS) National Elevation Dataset (NED) data, which was downloaded in AERMOD for the project area.

The urban dispersion coefficient was selected in AERMOD based on the characteristics of land uses in the Portside area (high density of industrial, commercial, and compact residential). These land uses typically have lower vegetation and higher hardscape (asphalt or concrete) conditions compared to rural areas. The urban dispersion coefficient accounts for the effects of increased nighttime surface heating from an urban area on pollutant dispersion under stable atmospheric conditions. The nighttime surface heating is due to the urban heat island effect, in which structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more so than natural landscapes such as forest or agricultural lands. In other words, even at nighttime, urban surfaces continue to release heat, resulting in some mixing compared to rural areas. This effect is dependent on a number of factors but has been parameterized in AERMOD as a function of urban population and the surface friction velocity. When selecting the urban dispersion option, AERMOD requires the input of population data. Based on population data from the U.S. Census, the modeling incorporated the 2017 population for the City of San Diego of 1,419,516 (City of San Diego 2018).

Modeling Domain and Receptor Network

The modeling domain included the Portside Community, the ocean surrounding the Port, and locations of various receptors within the vicinity of the Port. All receptors in the analysis used a 0-meter receptor height (i.e., ground level). The HRA receptor grids for each analysis scenario (i.e., residents at home and children at schools and parks) were developed based on land use data generated using Geographic Information Systems (GIS). All receptor locations used the UTM coordinate system. All receptor types (residential, schools, and parks) within the Portside Community, as well as any receptor located within a quarter mile of an emission source were evaluated. For example, the I-15 mainline source extends outside of the Portside Community boundary, but the modeling identifies receptors that are within a quarter mile of the I-15 mainline source. The receptor grid for each scenario used a cartesian grid with 50-meter spacing. Additionally, individual receptors were placed in locations where the cartesian grids did not capture the land use of interest (i.e., resident, school, or park). All receptors that did not correlate to these land uses were removed from the receptor grid. **Figure B-17** through **Figure B-20** depict the receptor grids for residents, schools, and parks.

Census Block Receptors

For the population-based risk analysis, all census blocks located within the Portside Community were identified. Once identified, coordinates for the centroids of each census block (geometric center of census block) were generated using GIS. Census block data was based on information from the 2010 U.S. Census and American Community Survey (ACS) population and household statistics at the census block level (M. Venecek, personal communication, November 12, 2021). The centroid receptors of each census block used a 0-meter receptor height (i.e., ground level). **Figure B-21** depicts the census block receptor grid used in the population-based risk analysis.

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Heavy-Duty Truck Source Configurations for Surface Streets and Freeway Routes

TABLE B-11: INBOUND TRUCK ROUTES ALONG SURFACE STREETS

Terminal	Truck Route	Street Segments	# of Lanes	Plume Width (m)	Segment Length (m)	Source Area (m^2)	AERMOD Unitized Emission Rate (g/s)	Total Route Length (m)	Total Route Length (mi)
TAMT	Inbound Route 1: To TAMT from I-5 SB	I-5 SB Offramp to 28th St	1	9.3	320.1	2976.93	0.101	2645.6	1.64
		28th Street to Harbor Dr	1	9.3	374.0	3478.2	0.118		
		Harbor Drive to Crosby St	2	12.6	1507.1	18989.46	0.642		
		Crosby St to TAMT	1	9.3	444.4	4132.92	0.140		
TAMT	Inbound Route 2: To TAMT from I-5 NB	I-5 NB Offramp to 28th St	1	9.3	698.1	6492.33	0.196	3023.6	1.88
		28th Street to Harbor Dr	1	9.3	374.0	3478.2	0.105		
		Harbor Drive to Crosby St	2	12.6	1507.1	18989.46	0.574		
		Crosby St to TAMT	1	9.3	444.4	4132.92	0.125		
TAMT	Inbound Route 3: To TAMT from I-15 SB	I-15 SB Offramp to 32nd St	1	9.3	1191.3	11079.09	0.228	4345.7	2.70
		32nd Street to Harbor Dr	1	9.3	254.9	2370.57	0.049		
		Harbor Drive to Crosby St	2	12.6	2455.1	30934.26	0.638		
		Crosby St to TAMT	1	9.3	444.4	4132.92	0.085		
NCMT	Inbound Route 4: To NCMT from I-5 SB to Bay Marina Dr	I-5 SB Offramp to Bay Marina Dr	1	9.3	365.7	3401.01	0.241	1215.6	0.76
		Bay Marina Dr	2	12.6	849.9	10708.74	0.759		
NCMT	Inbound Route 5: To NCMT from I-5 NB to Bay Marina Dr	I-5 NB Offramp to Bay Marina Dr	1	9.3	233.9	2175.27	0.169	1083.8	0.67
		Bay Marina Dr	2	12.6	849.9	10708.74	0.831		

Notes:
Unitized emission rates (1 g/s) were used for source groups in AERMOD. Truck routes were composed of several street segments, thus the emission rate for each segment needed to sum to 1.0. The emission rate for each segment was based on the area of the segment (segment length x segment width) divided by the total area of the route (sum of each segment's area).
I-5 NB = Interstate 5 Northbound, I-5 SB = Interstate 5 Southbound, I-15 NB = Interstate 15 Northbound, I-15 SB = Interstate 15 Southbound
g/s = grams per second
m = meters
mi = miles
m^2 =square meters

TABLE B-12: OUTBOUND TRUCK ROUTES ALONG SURFACE STREETS

Terminal	Truck Route	Street Segments	# of Lanes	Plume Width (m)	Segment Length (m)	Source Area (m^2)	AERMOD Unitized Emission Rate (g/s)	Total Segment Length (m)	Total Segment Length (mi)
TAMT	Outbound Route 1: TAMT Gates to 32nd St to I-15 NB	Crosby Street (Exiting TAMT)	1	9.3	442.3	4113.39	0.084	4407.2	2.74
		Harbor Drive to 32nd St	2	12.6	2502.0	31525.2	0.640		
		32nd St to I-15 NB Onramp	1	9.3	239.2	2224.56	0.045		
		I-15 NB Onramp	1	9.3	1223.7	11380.41	0.231		
TAMT	Outbound Route 2: TAMT Gates to Harbor to 28th St to I-5 NB	Crosby Street (Exiting TAMT)	1	9.3	442.3	4113.39	0.125	2986.8	1.86
		Harbor Drive to 28th St	2	12.6	1520.2	19154.52	0.584		
		28th St from Harbor Dr	1	9.3	525.5	4887.15	0.149		
		I-5 NB Onramp from 28th St	1	9.3	498.8	4638.84	0.141		
TAMT	Outbound Route 3: TAMT Gates to Harbor Dr to Civic Center St to I-5 SB	Crosby Street (Exiting TAMT)	1	9.3	442.3	4113.39	0.061	5549.8	3.45
		Harbor Drive across Civic Center Dr	2	12.6	4745.9	59798.34	0.889		
		I-5 SB Onramp from Harbor Dr	1	9.3	361.6	3362.88	0.050		
TAMT	Outbound Route 4: TAMT Gates to Harbor Dr to 32nd St to Main to Yara Yard	Crosby Street (Exiting TAMT)	1	9.3	442.3	4113.39	0.086	4238.4	2.63
		Harbor Drive to 32nd St	2	12.6	2502.0	31525.2	0.661		
		32nd St to Main St	1	9.3	721.6	6710.88	0.141		
		Main St from 32nd St	1	9.3	572.5	5324.25	0.112		
TAMT	Outbound Route 5: TAMT Exit Only Gate to Harbor Dr to NDC	Harbor Drive to Tidelands	2	12.6	5849.7	73706.22	0.839	7367.8	4.58
		Tidelands-Bay Marina	1	9.3	1518.1	14118.33	0.161		
NCMT	Outbound Route 6: NCMT Gates to I-5 NB	Bay Marina Drive	2	12.6	850.2	10712.52	0.761	1211.2	0.75
		From Bay Marina Drive to I-5 NB Onramp	1	9.3	361.0	3357.3	0.239		

Terminal	Truck Route	Street Segments	# of Lanes	Plume Width (m)	Segment Length (m)	Source Area (m^2)	AERMOD Unitized Emission Rate (g/s)	Total Segment Length (m)	Total Segment Length (mi)
NCMT	Outbound Route 7: NCMT Gates to I-5 SB	Bay Marina Drive	2	12.6	850.2	10712.52	0.784	1168.4	0.73
		From Bay Marina Drive to I-5 SB Onramp	1	9.3	318.2	2959.26	0.216		
TAMT	Outbound Route 8 (Non-Designated): Sigsbee St	One Complete Segment	1	9.3	2120.8	19723.44	1.00	2120.8	1.32
TAMT	Outbound Route 9 (Non-Designated): Cesar Chavez Pkwy	One Complete Segment	1	9.3	1961.0	18237.3	1.00	1961	1.22
TAMT	Outbound Route 10 (Non-Designated): Main St to 28th	Crosby Street (Exiting TAMT)	1	9.3	442.3	4113.39	0.168	2292.1	1.42
		Harbor Street to Schley	2	12.6	966.2	12174.12	0.497		
		Schley-Main St to I-5 NB Onramp	1	9.3	883.6	8217.48	0.335		

Notes:
Unitized emission rates (1 g/s) were used for source groups in AERMOD. Truck routes were composed of several street segments, thus the emission rate for each segment needed to sum to 1.0. The emission rate for each segment was based on the area of the segment (segment length x segment width) divided by the total area of the route (sum of each segment's area).
I-5 NB = Interstate 5 Northbound, I-5 SB = Interstate 5 Southbound, I-15 NB = Interstate 15 Northbound, I-15 SB = Interstate 15 Southbound
g/s = grams per second
m = meters
mi = miles
m^2 =square meters

TABLE B-13: FREEWAY ROUTES-INBOUND FROM TERMINALS

Terminal	Truck Route	# of Lanes	Lane Width (m)	Road Width (m)	Turbulence Addition (m)	Plume Width (m)[b]	Total Segment Length (m)	Total Segment Length (mi)
TAMT	Inbound Trucks from I-5 SB exiting to 28th St	4	3.7	14.8	6	20.8	6312.1	3.92
TAMT	Inbound Trucks from I-5 NB exiting to 28th St (via National Ave)	4	3.7	14.8	6	20.8	7150.0	4.44
TAMT	Inbound Trucks from I-15 SB exiting to 32nd St	3	3.7	11.1	6	17.1	2037.0	1.27
NCMT	Inbound Trucks from I-5 SB exiting to Bay Marina Dr	4	3.7	14.8	6	20.8	11533.6	7.17
NCMT	Inbound Trucks from I-5 NB exiting to Bay Marina Dr	4	3.7	14.8	6	20.8	1991.6	1.24

Notes:
All freeway sources used a unitized emission rate of 1 g/s.
I-5 NB = Interstate 5 Northbound, I-5 SB = Interstate 5 Southbound, I-15 NB = Interstate 15 Northbound, I-15 SB = Interstate 15 Southbound
m = meters
mi = miles
m^2 =square meters

TABLE B-14: FREEWAY ROUTES-OUTBOUND FROM TERMINALS

Terminal	Truck Route	# of Lanes	Lane Width (m)	Road Width (m)	Turbulence Addition (m)	Plume Width (m)[b]	Total Segment Length (m)	Total Segment Length (mi)
TAMT	Outbound trucks from 28th St to I-5 NB	4	3.7	14.8	6	20.8	6313.1	3.92
TAMT	Outbound trucks from 19th St to I-5 NB	4	3.7	14.8	6	20.8	4409.6	2.74
TAMT	Outbound trucks from Harbor Dr to I-5 SB	4	3.7	14.8	6	20.8	3005.6	1.87
TAMT	Outbound trucks from 32nd St to I-15 NB	3	3.7	11.1	6	17.1	2040.3	1.27
NCMT	Outbound trucks from Bay Marina Dr to I-5 NB	4	3.7	14.8	6	20.8	11533.6	7.17
NCMT	Outbound trucks from Bay Marina Dr to I-5 SB	4	3.7	14.8	6	20.8	1905.8	1.18

Notes:
All freeway sources used a unitized emission rate of 1 g/s.
I-5 NB = Interstate 5 Northbound, I-5 SB = Interstate 5 Southbound, I-15 NB = Interstate 15 Northbound, I-15 SB = Interstate 15 Southbound
m = meters
mi = miles
m^2 =square meters

Figures for AERMOD Source Configurations, Meteorological Data, and Receptor Grids

AERMOD Source Configurations

FIGURE B-1: OCEAN-GOING VESSEL TRAVEL PATH INSIDE AND OUTSIDE THE BAY

FIGURE B-2: OCEAN-GOING VESSELS AT BERTH

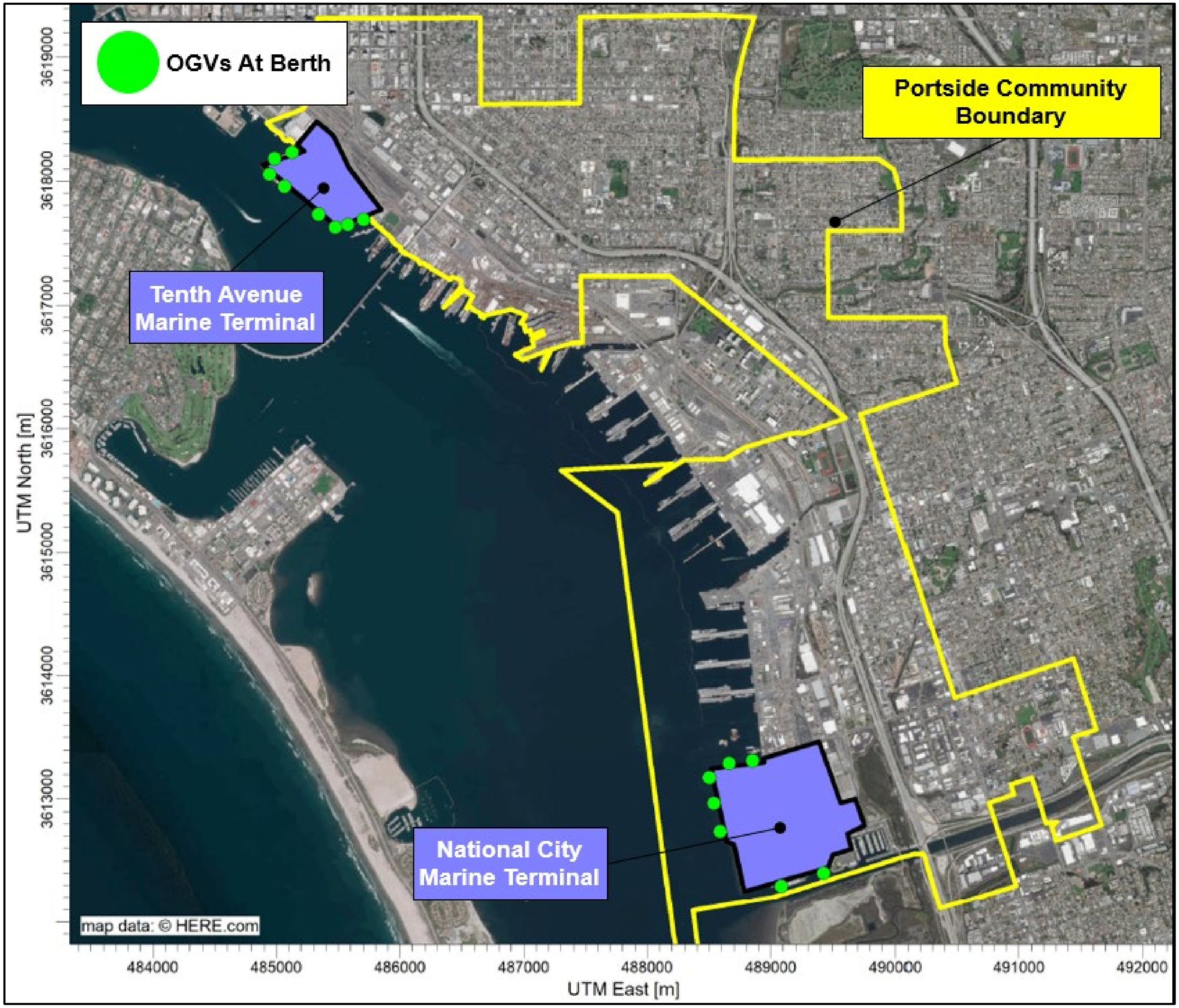


FIGURE B-3: TRUCK ROUTES ALONG SURFACE STREETS AND FREEWAYS

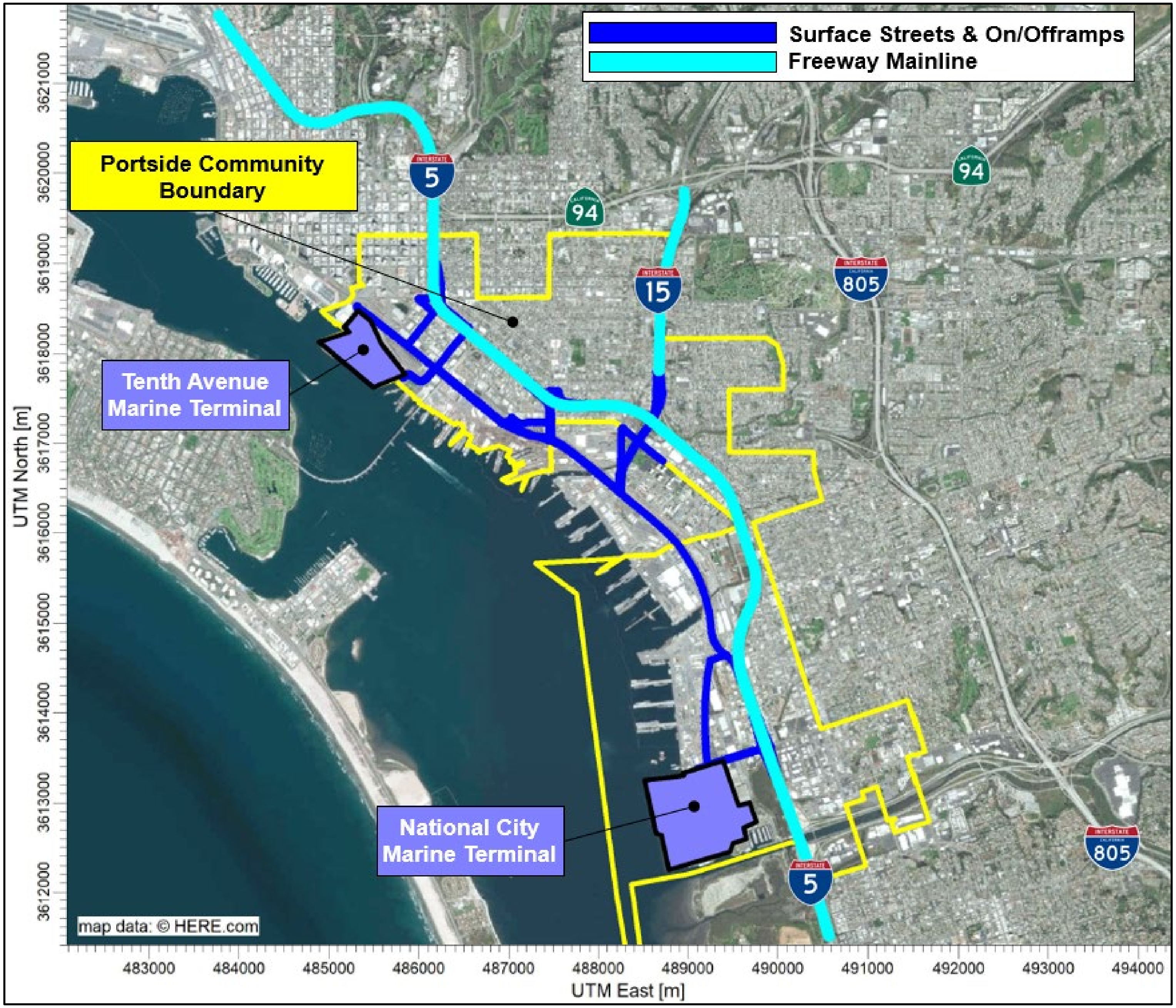
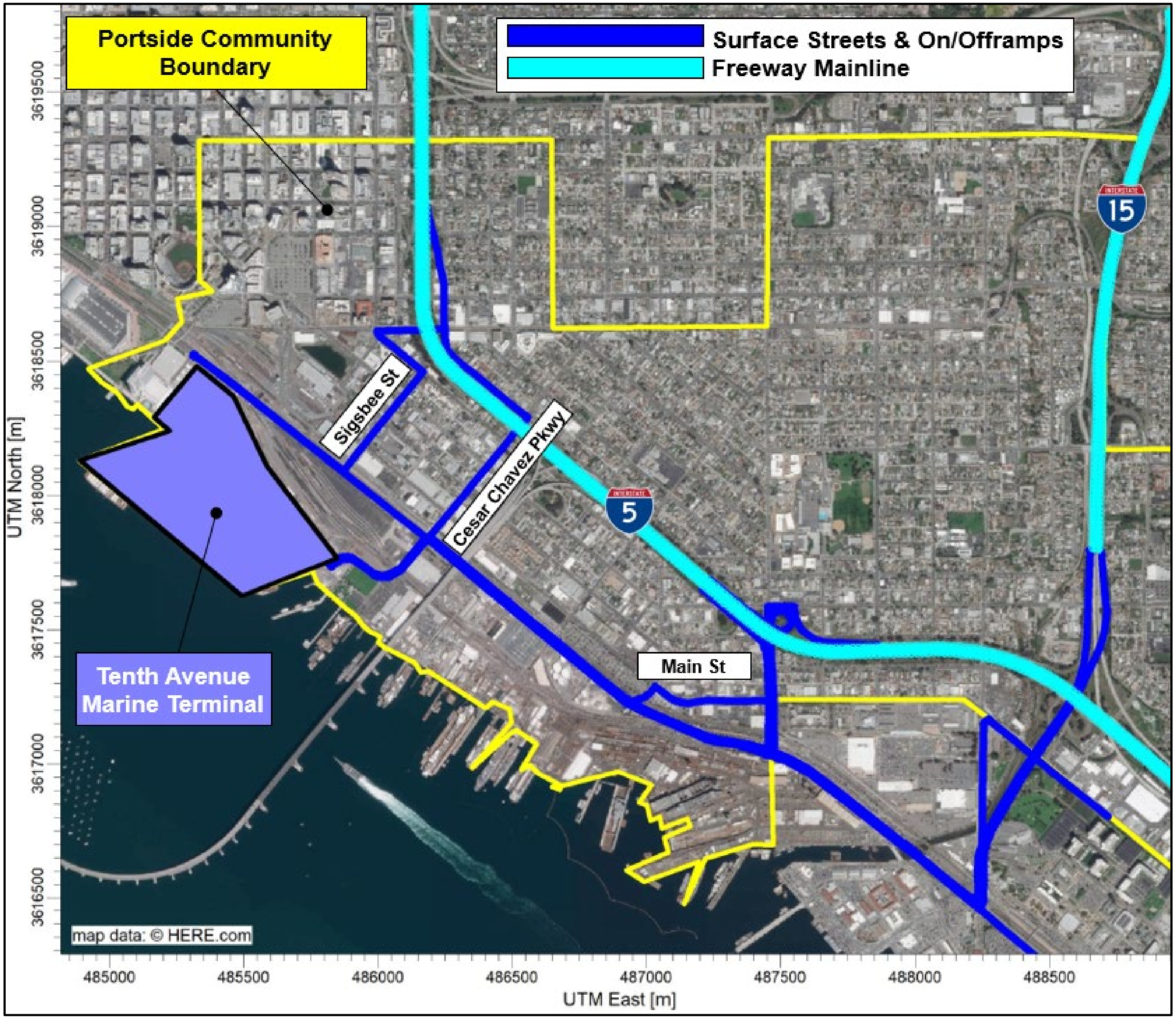


FIGURE B-4: TRUCK ROUTES ALONG SURFACE STREETS AND FREEWAYS NEAR TAMT



Note: Non-Designated Routes Denoted

FIGURE B-5: TRUCK ROUTES ALONG SURFACE STREETS AND FREEWAYS NEAR NCMT

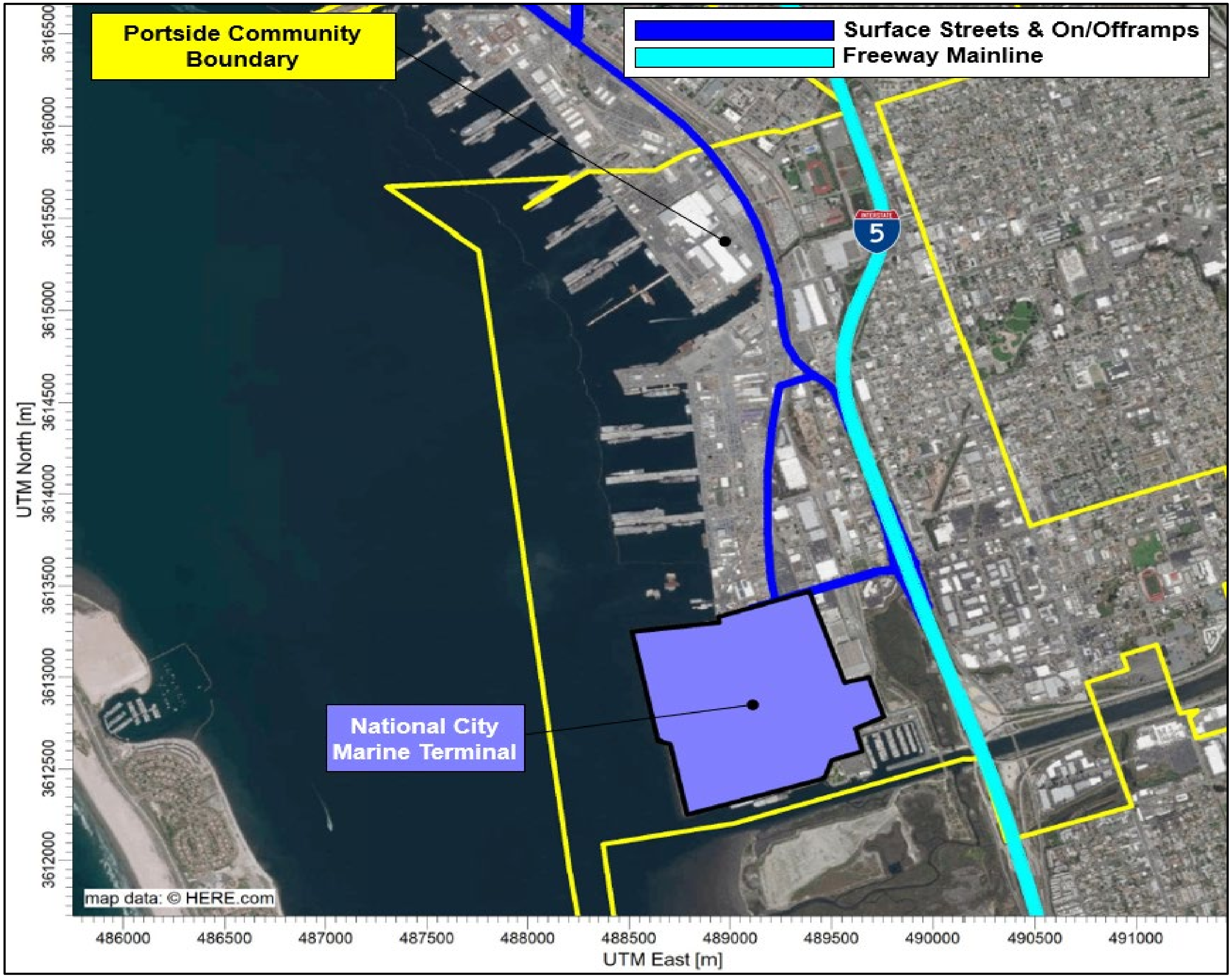


FIGURE B-6: TRUCK TRAVEL AND IDLING ACTIVITY AT TERMINALS

FIGURE B-7: TUGBOAT TRAVEL PATH

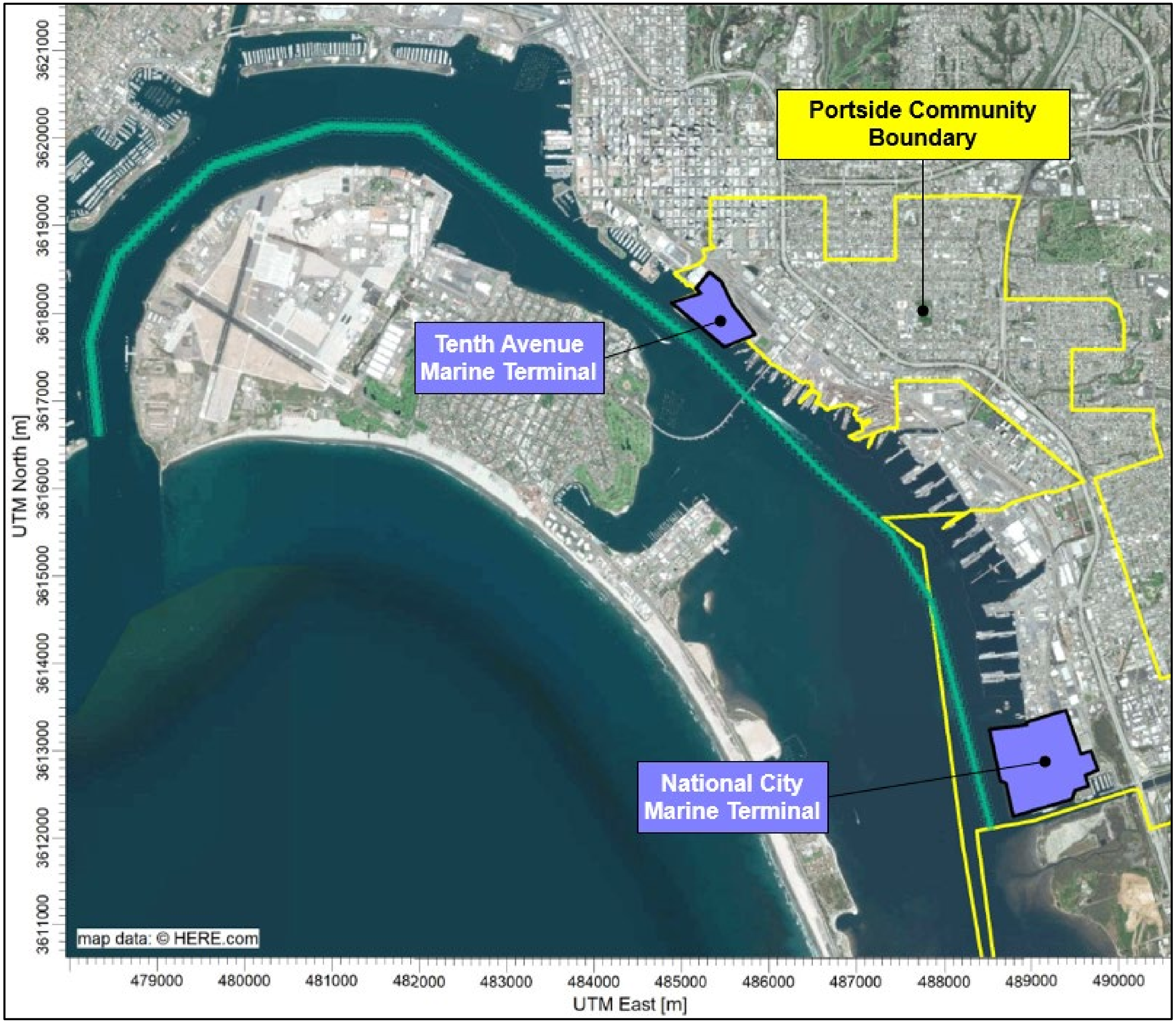


FIGURE B-8: CABRILLO AND SILVERGATE FERRY TRAVEL PATHS

FIGURE B-9: CARGO HANDLING EQUIPMENT AT TERMINALS

FIGURE B-10: LINE-HAUL ROUTE AND SWITCHING ACTIVITY

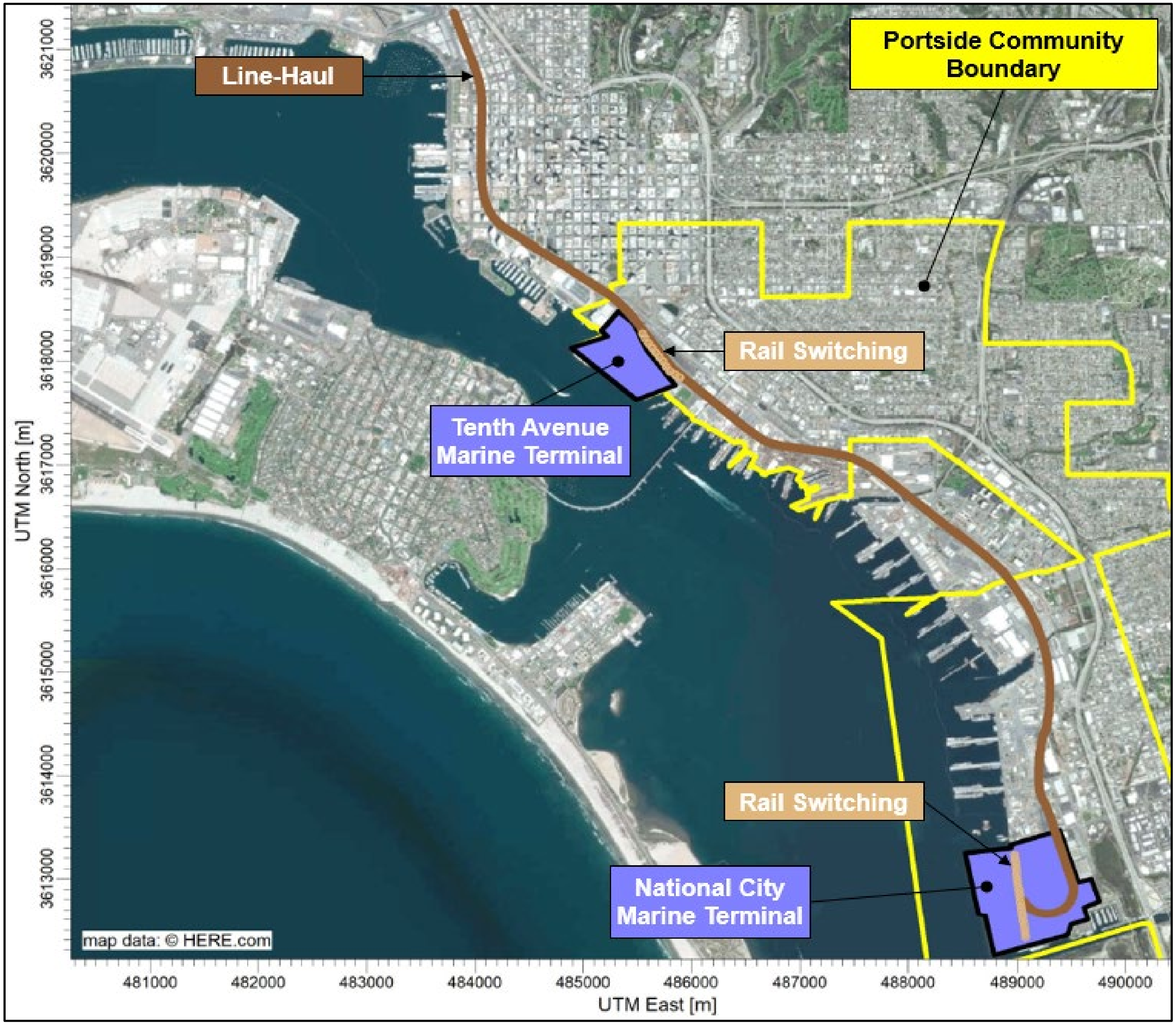


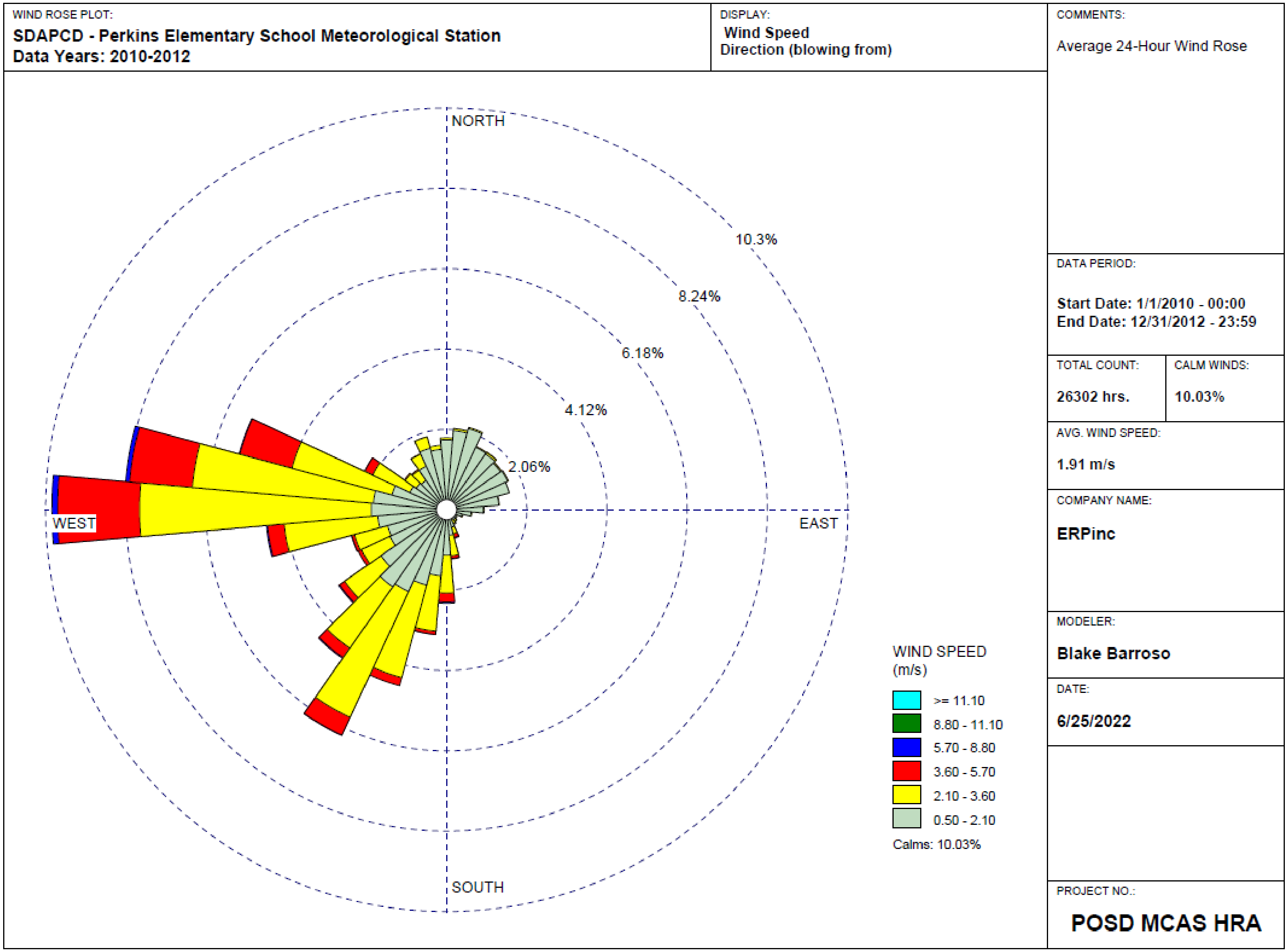
FIGURE B-11: LINE-HAUL ROUTE AND SWITCHING ACTIVITY NEAR TAMT

FIGURE B-12: LINE-HAUL ROUTE AND SWITCHING ACTIVITY NEAR NCMT

Perkins Elementary School Meteorological Station

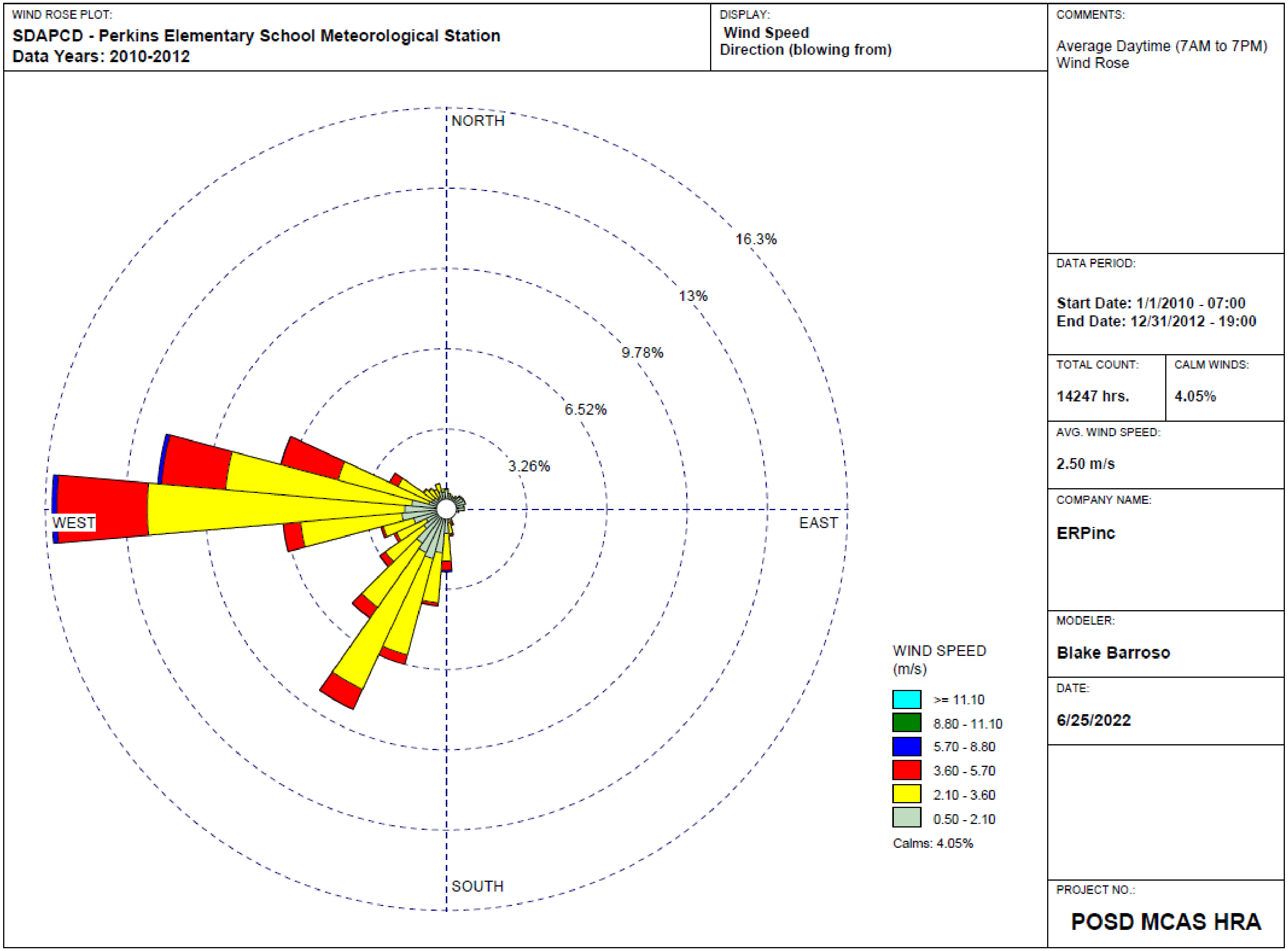
FIGURE B-13: PERKINS ELEMENTARY SCHOOL METEOROLOGICAL STATION

FIGURE B-14: PERKINS ELEMENTARY SCHOOL METEOROLOGICAL STATION – 24-HOUR WIND CONDITIONS



WRPLOT View - Lakes Environmental Software

FIGURE B-15: PERKINS ELEMENTARY SCHOOL METEOROLOGICAL STATION – DAYTIME WIND CONDITIONS

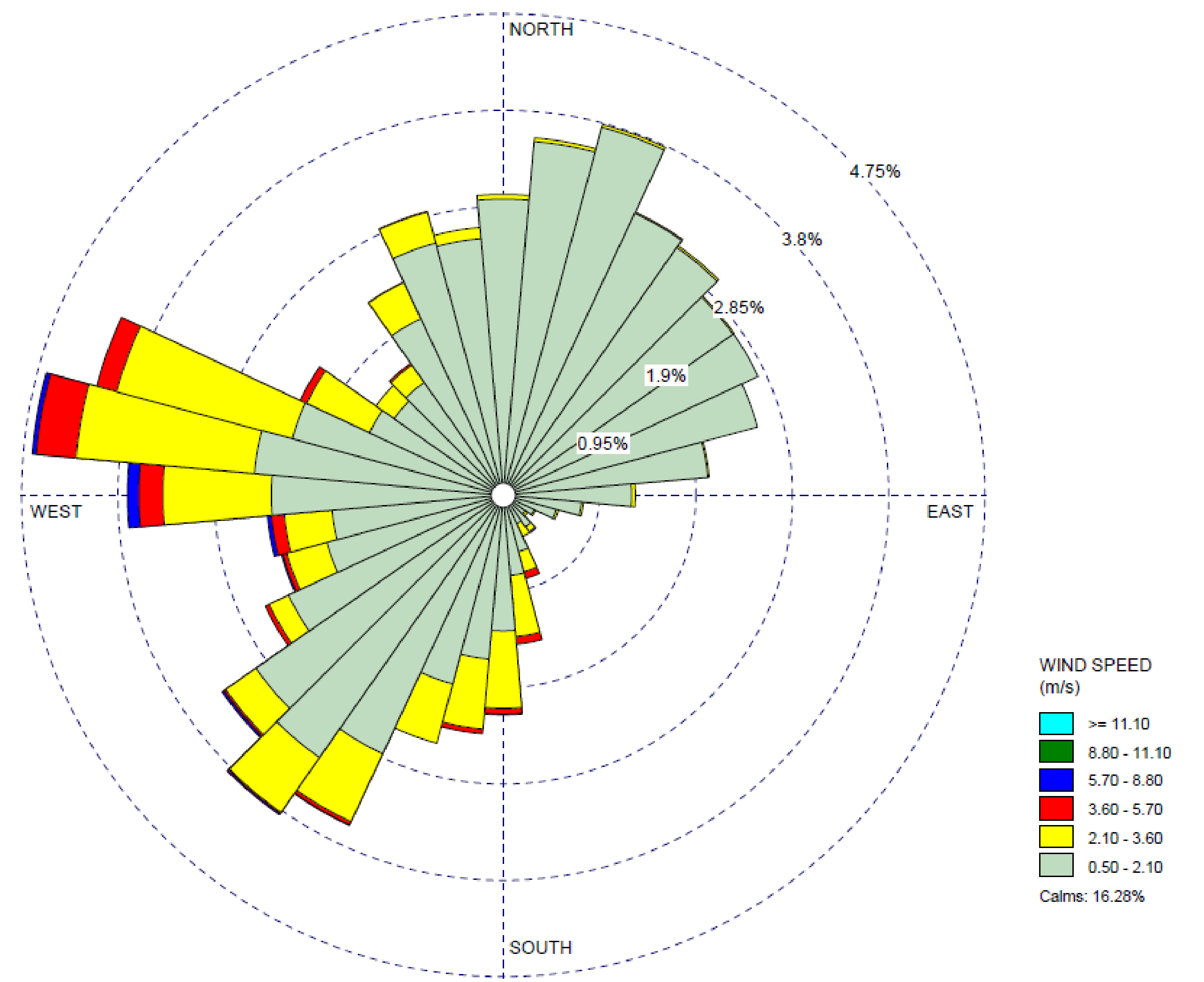


WRPLOT View - Lakes Environmental Software

FIGURE B-16: PERKINS ELEMENTARY SCHOOL METEOROLOGICAL STATION – NIGHTTIME WIND CONDITIONS

WIND ROSE PLOT:
SDAPCD - Perkins Elementary School Meteorological Station
Data Years: 2010-2012

DISPLAY:
Wind Speed
Direction (blowing from)



COMMENTS:
Average Nighttime (7PM to 7AM) Wind Rose

DATA PERIOD:
Start Date: 1/1/2010 - 00:00
End Date: 12/31/2012 - 23:59

TOTAL COUNT:	CALM WINDS:
14247 hrs.	**16.28%**

AVG. WIND SPEED:
1.26 m/s

COMPANY NAME:
ERPinc

MODELER:
Blake Barroso

DATE:
6/25/2022

PROJECT NO.:
POSD MCAS HRA

WRPLOT View - Lakes Environmental Software

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AERMOD Receptor Grids for Residents, Schools, Parks, and Census Blocks

FIGURE B-17: RESIDENTIAL RECEPTOR GRID

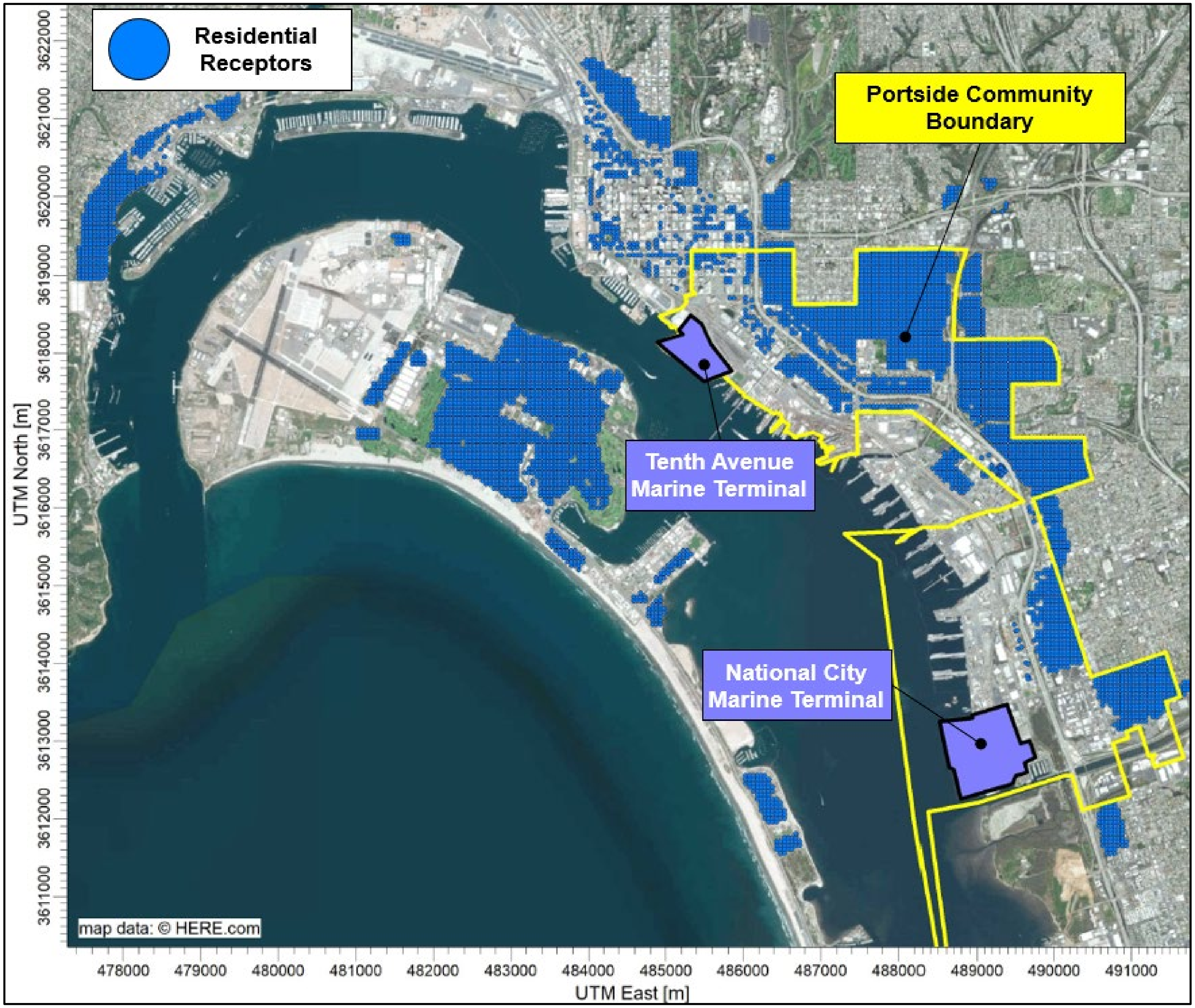


FIGURE B-18: RESIDENTIAL RECEPTORS BY COMMUNITY AREA

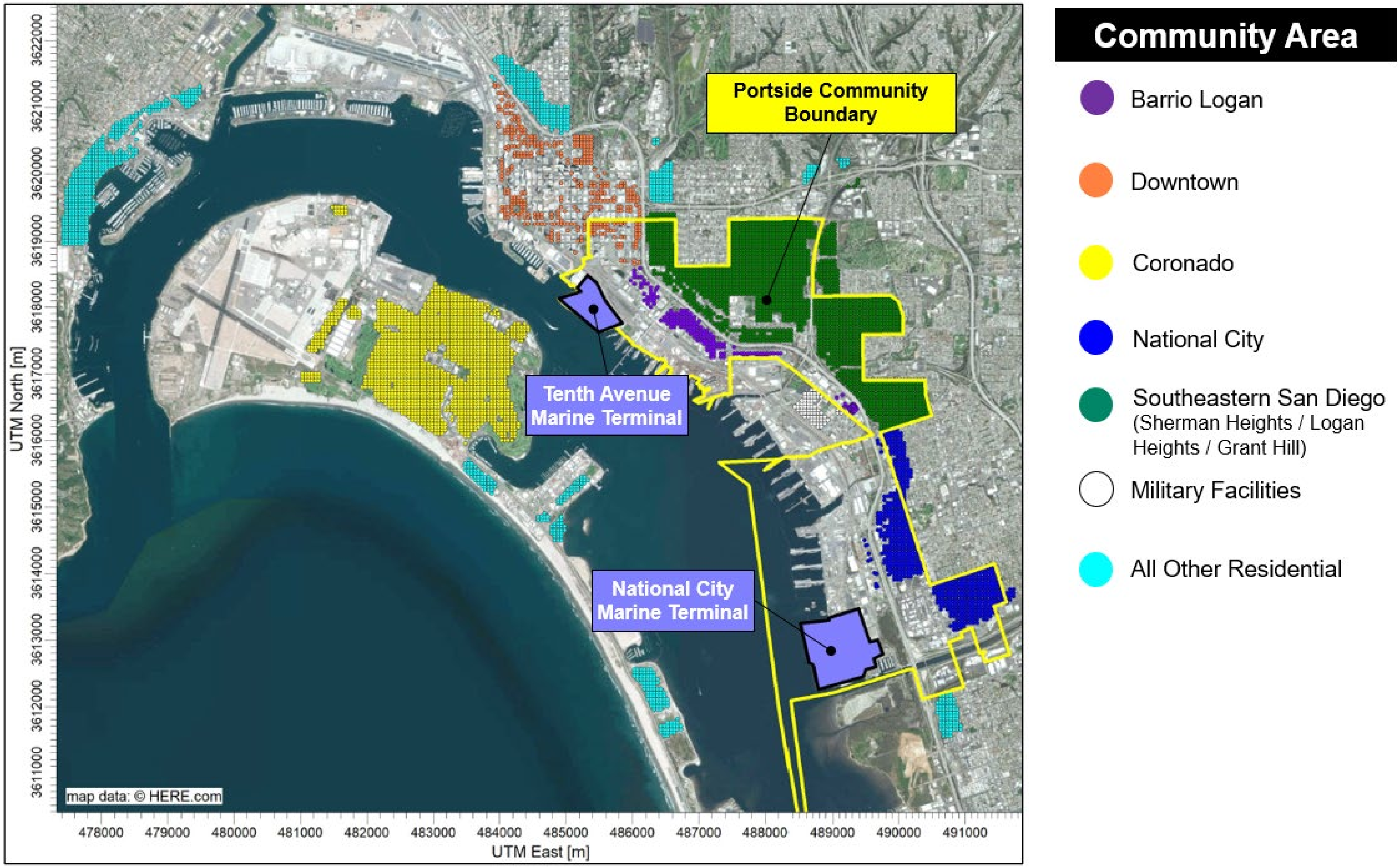


FIGURE B-19: SCHOOL RECEPTOR GRID

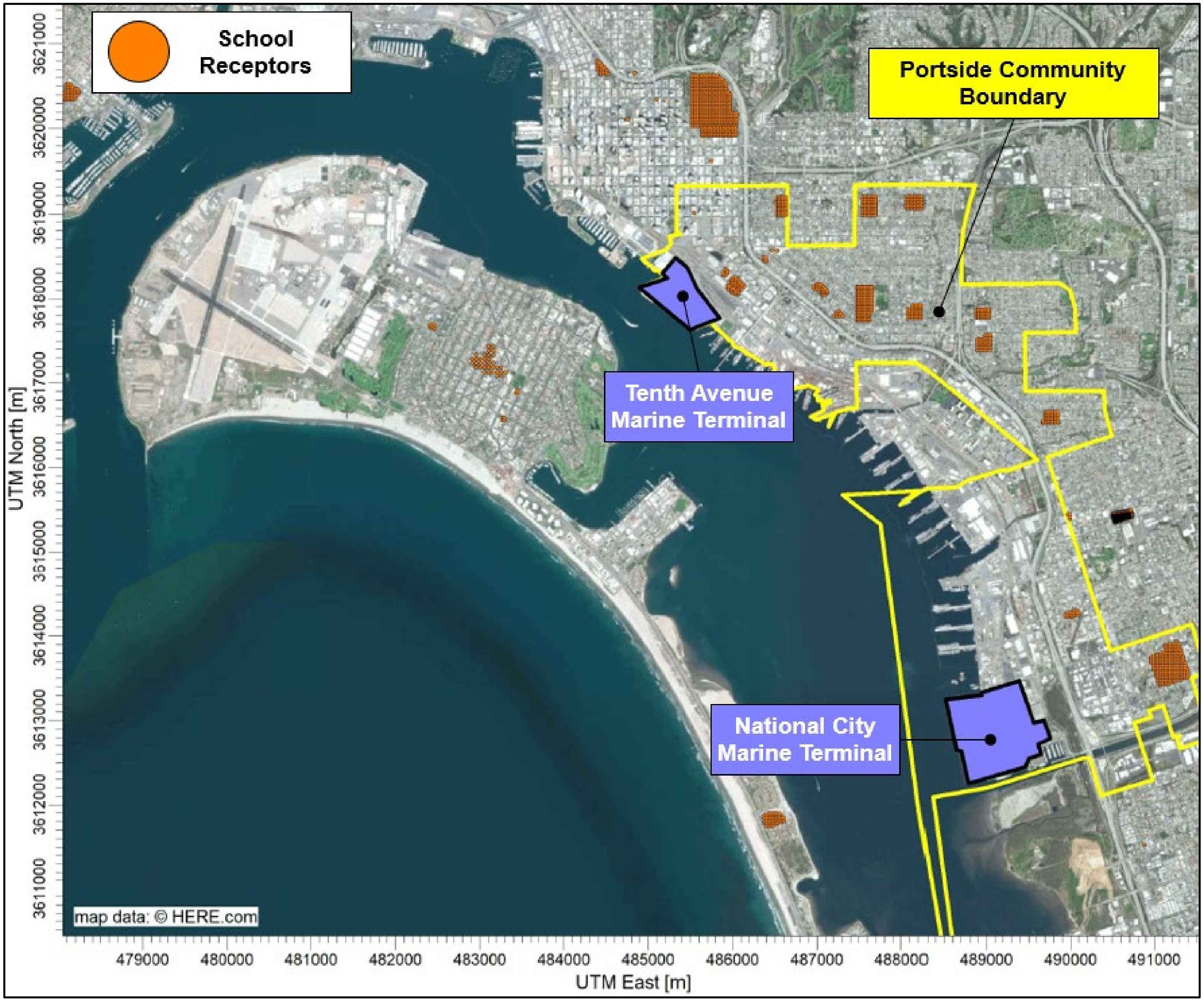


FIGURE B-20: PARK RECEPTOR GRID

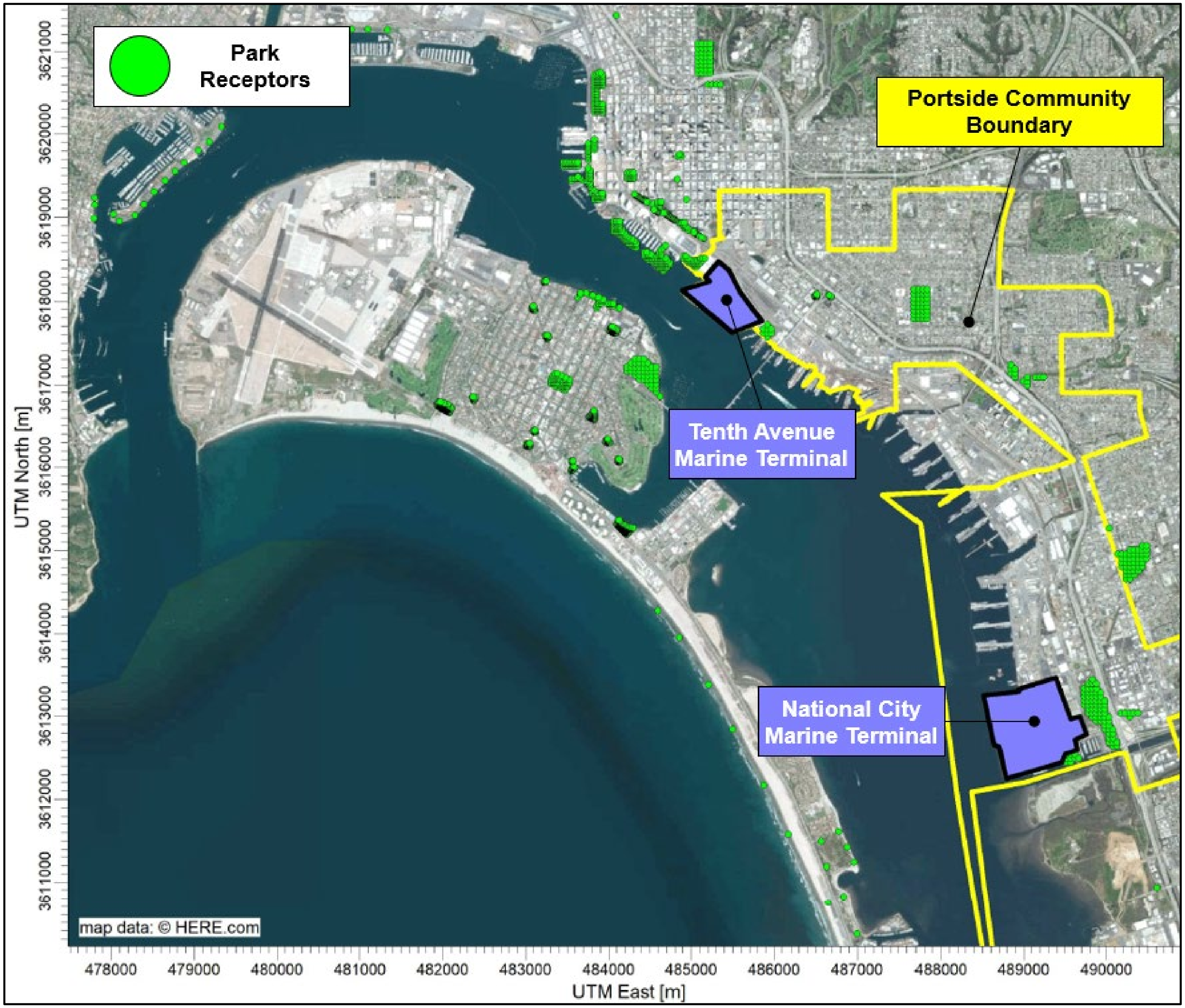
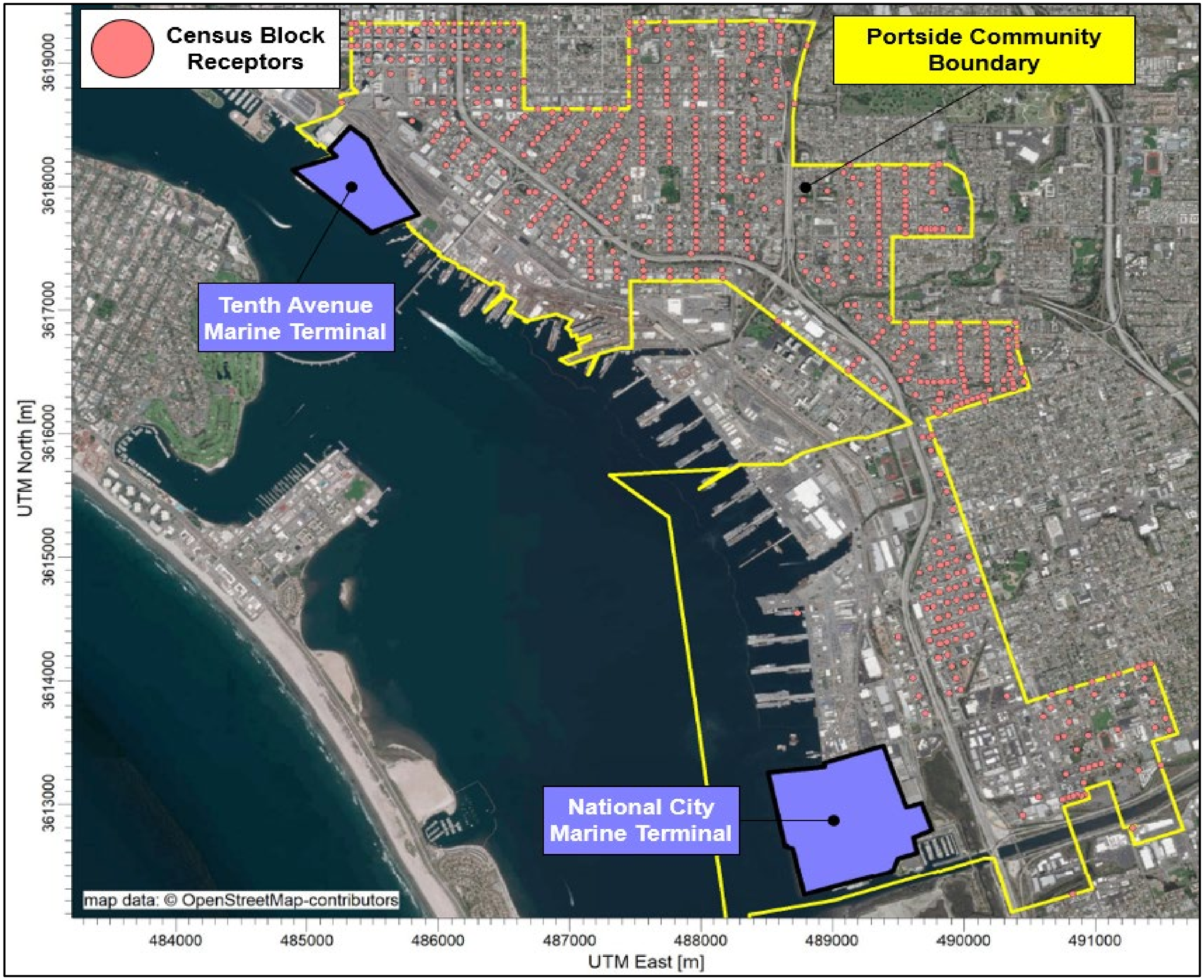


FIGURE B-21: CENSUS BLOCK RECEPTOR GRID WITHIN PORTSIDE COMMUNITY



Appendix C Health Risk Calculation Methodology

Appendix C Health Risk Calculation Methodology

Introduction

As previously discussed, the Port of San Diego's (Port) Maritime Clean Air Strategy (MCAS) health risk assessment (HRA) has three main components and are as follows:

1. DPM Emissions Inventory (i.e., the amount of emissions emitted by a source, represented in tons per year)
2. Dispersion Modeling (i.e., use of mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source, resulting in predicted pollutant concentrations at selected downwind receptor locations).
3. Health Risk Calculations (i.e., assess the risk associated with pollutants at pre-defined sensitive receptor locations based on the amount and type of pollutant)

This appendix describes the third component of the Port's HRA, *Health Risk Calculations*. This appendix provides information on the assumptions and methods used to estimate cancer risk, chronic (non-cancer) risk, and population-based risk.

The DPM Emissions Inventory is presented in Appendix A and the Air Dispersion Modeling Methodology is presented in Appendix B.

Health Risk Calculations

Health risk calculations were conducted in accordance with guidance from the San Diego Air Pollution Control District's (San Diego APCD) *Supplemental Guidelines for Submission of Air Toxics "Hot Spots" Program Health Risk Assessments* and the Office of Environmental Health Hazard Assessment's (OEHHA) *Air Toxics Hot Spots Program Guidance Manual for the Preparation of Risk Assessments* (OEHHA Guidelines) (San Diego APCD 2022, OEHHA 2015). The OEHHA Guidelines were revised in 2015 to incorporate age sensitivity factors, which accounted for increased sensitivity to carcinogens during early-in-life exposure. Health risks were estimated using a spreadsheet that incorporated methodologies consistent with tools from the California Air Resource Board's (CARB) Hotspots Analysis and Reporting Program (HARP) and OEHHA. Estimation of health risks has three components: 1) Exposure Assessment, 2) Dose-Response Assessment, and 3) Risk Characterization. Each of these components is described in further detail below.

OEHHA developed a tiered approach to risk assessment to accommodate consideration of site-specific data that may be more appropriate for a given facility than default exposure variables. Tier 1 is the simplest approach which uses average and high-end (95^{th} percentile) point estimates for exposure variables. Per OEHHA and San Diego APCD, all Tier 1 evaluations are required for all HRAs prepared for the Hot Spots Program to promote consistency across the state for all facility risk assessments and allow comparisons across facilities (OEHHA 2015, San Diego APCD 2022). More refined analyses, such as the Tier 2 approach, can be performed, which allows the use of justifiable site-specific exposure variates (e.g., breathing rates). Tier 3 and 4 analyses use a stochastic, or probabilistic, approach that incorporates a distribution for the exposure variables resulting in a range of potential cancer risk rather than a point estimate (single value) (OEHHA 2015).

The Port's HRA utilized a Tier 1 approach. This approach uses the high-end exposure estimates for the pathways that are the main drivers of exposure and the average point estimate for other non-driving exposure pathways (OEHHA 2015). The Tier 1 approach provides a health-protective approach for the more important exposure pathways.

Exposure Assessment

Exposure Pathways

Exposure to toxic air contaminants (TACs) can occur through various exposure pathways, which include inhalation and non-inhalation pathways (e.g., soil ingestion, mother's milk ingestion, homegrown produce ingestion). As discussed in Appendix A, the pollutant of concern for the HRA is diesel particulate matter (DPM). OEHHA has developed a cancer potency factor for DPM and non-cancer reference exposure level (REL) via the inhalation pathway only. Based on this, only the inhalation pathway was evaluated for receptor exposure.

Exposure Scenarios

The Port's HRA estimated cancer risk and chronic (non-cancer) risk at sensitive receptors locations including residents, children at schools, and children at parks. When evaluating cancer risk for residents, two approaches were used. The primary approach estimated the maximum 30-year cancer risk at an individual residential location. The secondary approach was a population-based analysis which incorporated census block receptors and population data associated with each census block.

In addition to residents, the HRA identified the maximum impacts at schools and parks. For evaluating impacts at parks, exposure factors for children were selected since they are health-protective by accounting for increased sensitivity to carcinogens during early-in-life exposure. Although patrons of parks could include the elderly or other individuals sensitive to toxic exposures, using exposure factors for children would result in the most conservative analysis for any park patron. These approaches are detailed further in the *Risk Characterization* section.

Health risk impacts were evaluated for residences, children at schools, and children at parks within a quarter of a mile of the Port's emissions sources. Although not required per OEHHA guidance, park receptors were evaluated to address local stakeholder concerns as some parks and recreational areas are in close proximity to the Port terminals. In accordance with OEHHA guidelines, residential cancer risk was based on a 30-year exposure duration, beginning in the third trimester of pregnancy. For children at schools, an exposure duration of 12 years beginning at age 2 was assumed and an exposure duration of 9 years, beginning at birth, was assumed for children at parks. Per OEHHA guidance, the population-based risk analysis assumed a 70-year exposure, beginning in the third trimester of pregnancy. Chronic (non-cancer) risks were based on exposure to annual emissions. **Table C-1** summarizes the exposure scenarios for the HRA.

TABLE C-1: EXPOSURE DURATIONS BY RECEPTOR TYPE

Receptor Type	Exposure Duration (years)
Resident[a]	30
Students at Schools[b]	12
Children at Parks[c]	9
Census Block (Population-Based Risk)	70

Notes:

[a] OEHHA recommends a 30-year exposure duration for residential analyses

[b] Student exposure duration based on children attending Pre-Kindergarten from Age 2 to Grade 8 at Age 13.

[c] Children at park exposure based on children visiting park from birth to Age 9.

Dose-Response Assessment

Dose-response assessment is the process of characterizing the relationship between exposure to an agent (i.e., DPM) and incidence of an adverse health effect in exposed populations (OEHHA 2015).

When evaluating cancer risk, the dose-response relationship is expressed using a potency slope and can be referred to as a cancer potency factor (CPF). CPFs are used to assess the probability of risk of cancer associated with exposure to a carcinogen. CPFs represent the 95th percent upper confidence limit of the dose-response curve and are expressed as inverse dose in units of milligrams per kilograms body weight per day $[mg/kg/day]^{-1}$). According to the OEHHA Guidelines, “cancer risk is proportional to dose and there is no threshold for carcinogenesis”, meaning there is no safe level of exposure to carcinogens and there is some increment of risk even at very low exposures. CARB and OEHHA have established a CPF for DPM which accounts for the individual TACs contained in diesel exhaust. The CPF for DPM is 1.1 $(mg/kg/day)^{-1}$.

For evaluating health impacts related to non-carcinogens, RELs were used. RELs are defined as the concentration ($\mu g/m^3$) at which no adverse non-cancer health effects are anticipated for the specified exposure duration (OEHHA 2015). Contrary to carcinogens, RELs are based on factors to err on the side of public health to protect the most sensitive individuals in the population. Unlike carcinogens, non-cancer TACs are assumed to have thresholds for adverse effects. In other words, adverse health effects would not occur until that TAC has reached or exceeded a certain concentration (i.e., threshold) and/or dose (OEHHA 2015).

Risk Characterization

Cancer Risk

Excess lifetime cancer risks are conservatively estimated as the upper-bound incremental probability that an individual will develop cancer over a lifetime as a result of exposure to potential human carcinogens. The estimated cancer risk is expressed as a unitless probability but can be contextualized as the estimated probability an individual has of developing cancer per one million people exposed. Further, the risk estimates generated by the analysis should not be interpreted as the expected rate of cancer in the exposed population, but rather as estimates of potential for cancer, based on current knowledge and assumptions.

As discussed previously, cancer risk was based solely on exposure to DPM emissions through the inhalation pathway. Per OEHHA (2015), the inhalation pathway is the only pathway for DPM exposure, and the Risk Management Policy (RMP) approach was used in the calculations for residential cancer risk (CARB 2015). The RMP approach uses the 95th percentile (high-end) breathing rates for women in their 3rd trimester of pregnancy and 0 to 2 age groups, and it uses the 80th percentile breathing rates for all other age groups. When evaluating risk to children at schools and parks, the analysis conservatively used the 95th percentile breathing rates to account for activities of moderate intensity.

Cancer risk attributed to DPM is calculated by multiplying the chemical dose at the inhalation boundary (e.g., lungs) by the CPF. For cancer risk, the risk for each age group is calculated using the appropriate daily breathing rates, age sensitivity factors, and exposure durations. The cancer risk calculated for individual age groups are summed to estimate the total cancer risk for each receptor. Exposure parameters for cancer risk by receptor type are provided in **Table C-2** and **Table C-3**. Additionally, the equations used to estimate cancer risk are provided at the end of this appendix.

TABLE C-2: 30-YEAR RESIDENTIAL CANCER RISK EXPOSURE FACTORS BY AGE GROUP

		Age Group			
Parameter	**Abbr.**	**3rd Trimester**	**0<2**	**2<16**	**16<30**
Daily Breathing Rate (mg/kg/day)[a]	DBR	361	1,090	572	261
Inhalation Absorption Factor (unitless)	A	1.0	1.0	1.0	1.0
Exposure Frequency (unitless)[b]	EF	0.96	0.96	0.96	0.96
Conversion Factor (µg to mg, L to m^3)	CF	1.00E-06	1.00E-06	1.00E-06	1.00E-06
Age Sensitivity Factor (unitless)[c]	ASF	10	10	3	1
Exposure Duration (years)	ED	0.25	2	14	14
Averaging Time for Lifetime (years)[d]	AT	70	70	70	70
Fraction of Time at Home (unitless)[e]	FAH	1.0	1.0	1.0	0.73
Adjustment Factor (unitless)	AF	n/a	n/a	n/a	n/a
Cancer Conversion Factor (unitless)[f]	CCF	1.00E+06	1.00E+06	1.00E+06	1.00E+06
Cancer Potency Factor $(mg/kg/day)^{-1}$	CPF[g]	1.1	1.1	1.1	1.1

Source: OEHHA 2015

Notes:

[a] OEHHA Table 5.7, 95th percentile for 3rd Tri and 0<2, 80th percentile all other age groups.

[b] Based on 350 days per year.

[c] OEHHA 2015, Table 8.3.

[d] Averaging time is always 70 years.

[e] Assumed 1.0 for 3rd Trimester to 2<16 since schools are within the one in a million isopleth.

[f] Conversion factor used to convert cancer risk to chances per million.

[g] OEHHA 2015, Table 7.1.

TABLE C-3: SCHOOLS AND PARK CANCER RISK EXPOSURE FACTORS BY AGE GROUP

		School		Park	
		Age Group		Age Group	
Parameter	**Abbr.**	**2<9**	**2<16**	**0<2**	**2<9**
Daily Breathing Rate (mg/kg/day)[a]	DBR	640	520	1,200	640
Inhalation Absorption Factor (unitless)	A	1.0	1.0	1.0	1.0
Exposure Frequency (unitless)[b]	EF	0.16	0.16	0.08	0.08
Conversion Factor (µg to mg, L to m^3)	CF	1.00E-06	1.00E-06	1.00E-06	1.00E-06
Age Sensitivity Factor (unitless)[c]	ASF	3	3	10	3
Exposure Duration (years)	ED	7	5	2	7
Averaging Time for Lifetime (years)[d]	AT	70	70	70	70
Fraction of Time at Home (unitless)[e]	FAH	1.0	1.0	1.0	1.0
Adjustment Factor (unitless)[f]	AF	n/a	n/a	n/a	n/a
Cancer Conversion Factor (unitless)[g]	CCF	1.00E+06	1.00E+06	1.00E+06	1.00E+06
Cancer Potency Factor $(mg/kg/day)^{-1}$	CPF[h]	1.1	1.1	1.1	1.1

Source: OEHHA 2015

Notes:

[a] OEHHA Table 5.8, 95th percentile, moderate activity for 0<2, 2<9, and 2<16.

[b] School exposure duration based on 180 days per year and 8 hours per day. Park exposure duration based on 350 days per year and 2 hours per day. These receptor types used the same approach as the residential analysis, but adjustments to the exposure duration for each were necessary since residential analysis is based on daily exposure of 24 hours. See Equation # 1 for more details.

[c] OEHHA 2015, Table 8.3.

[d] Averaging time is always 70 years.

[e] School and park analysis used the same approach as the residential analysis. Although "Fraction of Time at Home" does not necessarily apply to schools and parks, a value of 1.0 is used to ensure the receptors were at their respective locations for the full daily exposure of 8 hours for students at schools and 2 hours for children at parks.

[f] Adjustment factor not included for school and park receptors since the Port sources would operate continuously.

[g] Conversion factor used to convert cancer risk to chances per million.

[h] OEHHA 2015, Table 7.1.

Chronic (Non-Cancer) Risk

OEHHA has developed reference exposure levels (RELs) to determine potential non-cancer health impacts from TACs. An REL is used as an indicator of potential non-cancer health impacts and is defined as the concentration at which no adverse non-cancer health effects are anticipated. RELs incorporate uncertainty factors to help ensure that the REL is protective for nearly all individuals, including sensitive populations (OEHHA 2015). RELs have been developed for a number of TACs, exposure pathways, and exposure durations including acute, 8-hour, and chronic. However, OEHHA has not developed an acute or 8-hour REL for DPM; therefore, acute and 8-hour impacts of DPM were not evaluated.

When a health impact for a single pollutant is conducted, this is called the hazard quotient (HQ). Individual TACs can affect multiple organ systems (e.g., respiratory system, cardiovascular system, reproductive. etc.) and an HQ is calculated for each organ system. When multiple TACs are being evaluated, the sum of the HQs of all TACs emitted that impact the same target organ is termed the Hazard Index (HI). However, the Port's HRA focused on a single pollutant (DPM), and the HQ is estimated by dividing the annual pollutant concentration by the pollutant's REL. Chronic RELs protect against long-term exposure to the annual average air concentration.

The Port's HRA evaluated the chronic non-cancer impacts of DPM at all receptor locations within the Portside Community and surrounding areas. For chronic risks, DPM primarily affects the respiratory system as the "target organ system". Based on occupational studies (i.e., human exposure to DPM while at work), potential non-cancer health effects include incidence of cough, phlegm, chronic bronchitis, lung inflammation, and reductions in pulmonary function (CARB 1998). OEHHA states that a hazard quotient or hazard index value of 1.0 or less indicates that adverse health effects, such as the ones previously mentioned, are not expected to result from exposure to DPM emissions. The potential for DPM exposure to result in adverse chronic non-cancer effects is evaluated by comparing the estimated annual average concentration to the non-cancer chronic REL. DPM was the only pollutant evaluated for chronic risks and DPM's REL is only associated with the inhalation pathway. The chronic REL for DPM is 5.0 $\mu g/m^3$. The equations used to calculate the potential non-cancer health impacts for chronic risk are provided at the end of this appendix.

Population-Weighted Cancer Risk

The OEHHA Guidelines recommends facilities with large emissions footprints such as ports, provide information on population-based health impacts since a large number of people may be exposed to the facility's emissions. Population-based risk is independent of individual risk and assumes that a population (not necessarily the same individuals) will live in the impacted zone over a 70-year period (OEHHA 2015). The HRA evaluated the population-weighted average cancer risk for residents associated with exposure to DPM.

To estimate the population-weighted average residential cancer risk, a population-based analysis was conducted and required a 70-year exposure duration per OEHHA guidance. The population-based analysis used receptors placed at the centroid of census blocks rather than individual receptors located at residential land uses. For the population-based analysis, only census blocks within the Portside Community were evaluated. Population-weighted residential cancer risk was estimated by summing the receptor-related risks within the Portside Community and dividing by the total population exposed in the Portside Community. The following equation and steps provide further information on the population-weighted analysis methodology.

$$Population - Weighted\ Cancer\ Risk\ (per\ million) = \frac{\sum Cancer\ Risk_i\ x\ Population_i}{\sum Population_i} x\ 1{,}000{,}000$$

Where:

- Cancer Risk$_i$ = estimated cancer risk at census block receptor i
- Population$_i$ = population associated with census block receptor i

The steps to estimate the population-weighted cancer risk are as follows:

1. Cancer risk was estimated for each census block using the same equations for residential risk (see Equation 1 and Equation 2) and the exposure parameters in **Table C-4.**
2. The cancer risk for each census block receptor was multiplied by the population of the associated census block.
3. The values calculated in Step 2 were summed together then divided by the total population of the census blocks.

TABLE C-4: POPULATION-WEIGHTED RESIDENTIAL EXPOSURE FACTORS BY AGE GROUP

		Age Group			
Parameter	**Abbr.**	**3rd Trimester**	**0<2**	**2<16**	**16<70**
Daily Breathing Rate (mg/kg/day)[a]	DBR	361	1,090	572	233
Inhalation Absorption Factor (unitless)	A	1.0	1.0	1.0	1.0
Exposure Frequency (unitless)[b]	EF	0.96	0.96	0.96	0.96
Conversion Factor (µg to mg, L to m^3)	CF	1.00E-06	1.00E-06	1.00E-06	1.00E-06
Age Sensitivity Factor (unitless)[c]	ASF	10	10	3	1
Exposure Duration (years)	ED	0.25	2	14	54
Averaging Time for Lifetime (years)[d]	AT	70	70	70	70
Fraction of Time at Home (unitless)[e]	FAH	1.0	1.0	1.0	1.0
Adjustment Factor (unitless)	AF	n/a	n/a	n/a	n/a
Cancer Conversion Factor (unitless)[f]	CCF	1.00E+06	1.00E+06	1.00E+06	1.00E+06
Cancer Potency Factor $(mg/kg/day)^{-1}$	CPF[g]	1.1	1.1	1.1	1.1

Source: OEHHA 2015
Notes:
[a] OEHHA Table 5.7, 95th percentile for 3rd Tri and 0<2, 80th percentile all other age groups.
[b] Based on 350 days per year.
[c] OEHHA 2015, Table 8.3.
[d] Averaging time is always 70 years.
[e] Assumed 1.0 for 3rd Trimester to 2<16.
[f] Conversion factor used to convert cancer risk to chances per million.
[g] OEHHA 2015, Table 7.1.

Health Risk Equations

Cancer Risk

$$\textbf{Equation 1}: Dose_{Inhalation} = C_{AIR}\ x\ DBR\ x\ A\ x\ EF\ x\ CF$$

Where:

- **$Dose_{INHALATION}$** = Dose through inhalation in milligrams per kilograms body weight per day (mg/kg/day)
- **C_{AIR}** = Concentration in air (µg/m^3)
- **DBR** = Daily Breathing Rate normalized to body weight (Liters/kg body weight-day)
- **A** = Inhalation absorption factor (1 for DPM, unitless)
- **EF** = Exposure frequency (unitless)
  - **Resident:** 0.96 = (350 days / 365 days)
  - **School:** 0.16 = (180 days of school / 365 days) x (8 hours at school / 24 hours)
  - **Park:** 0.08 = (360 days at park / 365 days) x (2 hours at park / 24 hours)
- **CF** = 10^{-6}, conversion factor, micrograms to milligrams, liters to cubic meters

$$\textbf{Equation 2}: Cancer\ Risk_{Inhalation} = Dose\ x\ CPF\ x\ ASF\ x\ ED\ x\ AT\ x\ FAH\ x\ CCF$$

Where:

- **$Cancer\ Risk_{INHALATION}$** = Inhalation cancer risk in chances per million
- **$Dose_{AIR}$** = daily inhalation dose (mg/kg/day)
- **CPF** = cancer potency factor (mg/kg/day)$^{-1}$
- **ASF** = age sensitivity factor (unitless)
- **ED** = exposure duration (years)
- **AT** = averaging time for lifetime cancer risk (always 70 years)
- **FAH** = fraction of time spent at home (unitless)
- **CCF =** 1,000,000, cancer conversion factor to translate into chances per million

Chronic (Non-cancer) Hazard Quotient

$$\textbf{Equation 3}: Chronic\ HQ = C_{Annual} \div C_{REL}$$

Where:

- **Chronic HQ** = Chronic Hazard Quotient (unitless)
- **C_{Annual}** = Annual average concentration of DPM (µg/m^3)
- **C_{REL}** = Chronic REL for DPM (µg/m^3)

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Appendix D Health Risk Results

Appendix D Health Risk Results

Introduction

This appendix provides the cancer risk and chronic (non-cancer) risk results for the Port of San Diego's (Port) Maritime Clean Air Strategy (MCAS) health risk assessment (HRA). The HRA evaluated the maximum cancer risk at individual receptor locations for residents, children at schools, and children at parks. Chronic (non-cancer) risks were also evaluated for these receptor types. This appendix also presents the results for the population-weighted residential cancer risk analysis, which evaluates the population-weighted cancer risk for the population within the Portside Community.

Health risks were evaluated under three emissions scenarios. First, a baseline emissions inventory was developed based on Port-related activity for calendar year 2019. Then, future year health risks were forecasted assuming implementation of MCAS measures by or in 2026 and 2030.

Cancer Risk

Residential

Residential cancer risks were evaluated for all individual residential receptor locations in the receptor grid. Additionally, nearby communities were identified, and the maximum cancer risk in each community was identified. As previously noted, this was the primary focus of the HRA.

2019 Baseline Residential Cancer Risk

Table D-1 summarizes 2019 Baseline maximum residential cancer risks for the communities with the highest risk.

TABLE D-1: 2019 BASELINE MAXIMUM 30-YEAR CANCER RISK BY COMMUNITY AREA

Community Area	30-Year Cancer Risk (chances per million)
National City*	20.6
Barrio Logan	19.7
Downtown	18.9
Coronado	16.0
Notes: *Represents the highest cancer risk in the modeling domain.	

Figure D-1 shows the source contribution to the maximally exposed individual resident (MEIR) in each community under the 2019 Baseline scenario. For National City, the largest contributors to the MEIR were rail activity and ocean-going vessel (OGV) activity, accounting for 83% of the cancer risk. In Barrio Logan, the largest contributors to the MEIR were cargo handling equipment (CHE) and OGV activity, accounting for 75% of the cancer risk. For Downtown, the largest contributors to the MEIR were rail activity and OGV activity accounting for 84% of the cancer risk. Lastly, in Coronado, the largest contributors to the MEIR were OGV activity and CHE, accounting for 72% of the cancer risk. **Figure D-2** shows the cancer risk contours for the 2019 baseline residential cancer risk.

FIGURE D-1: 2019 BASELINE SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM CANCER RISK RECEPTOR BY COMMUNITY

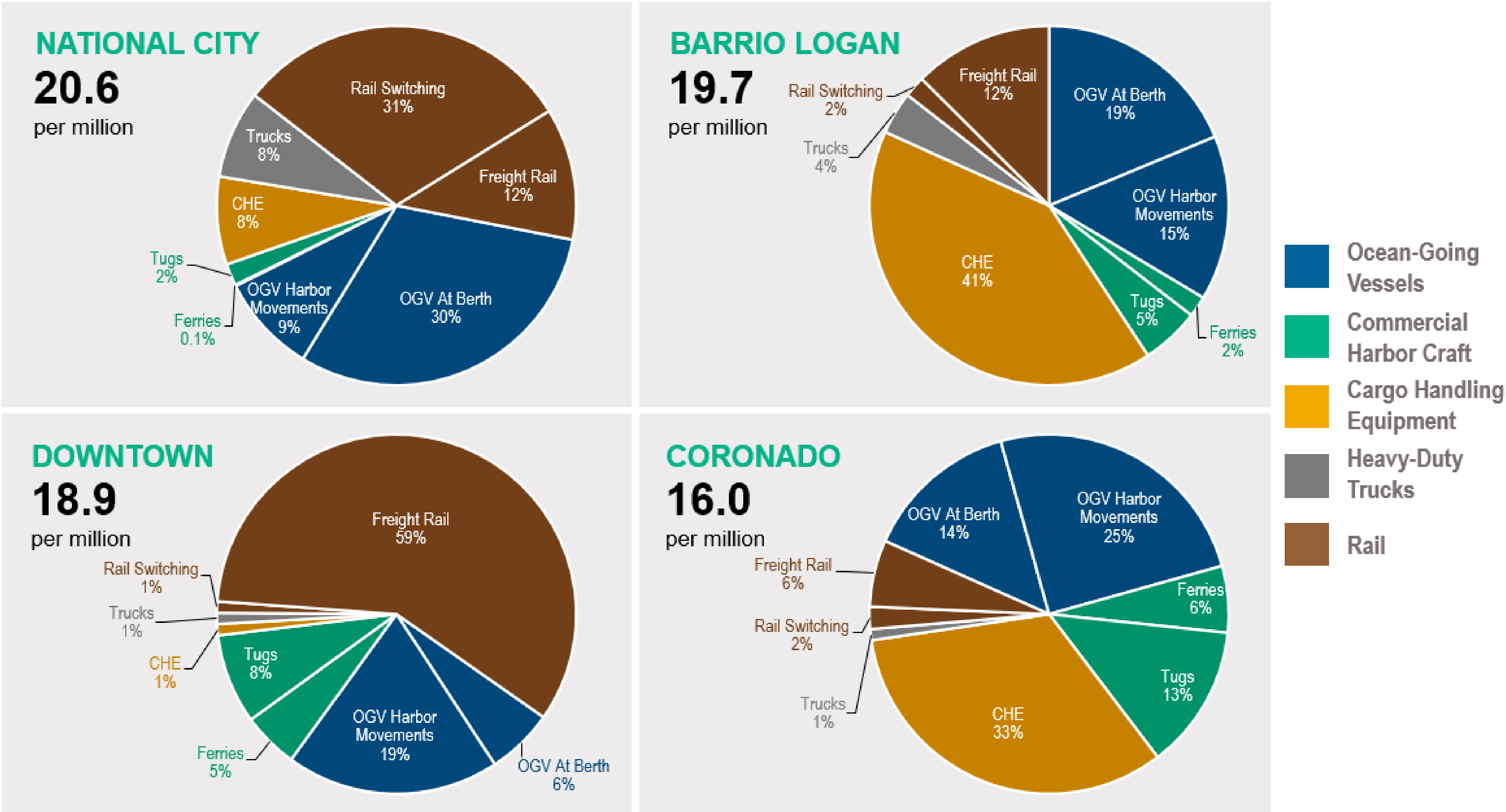
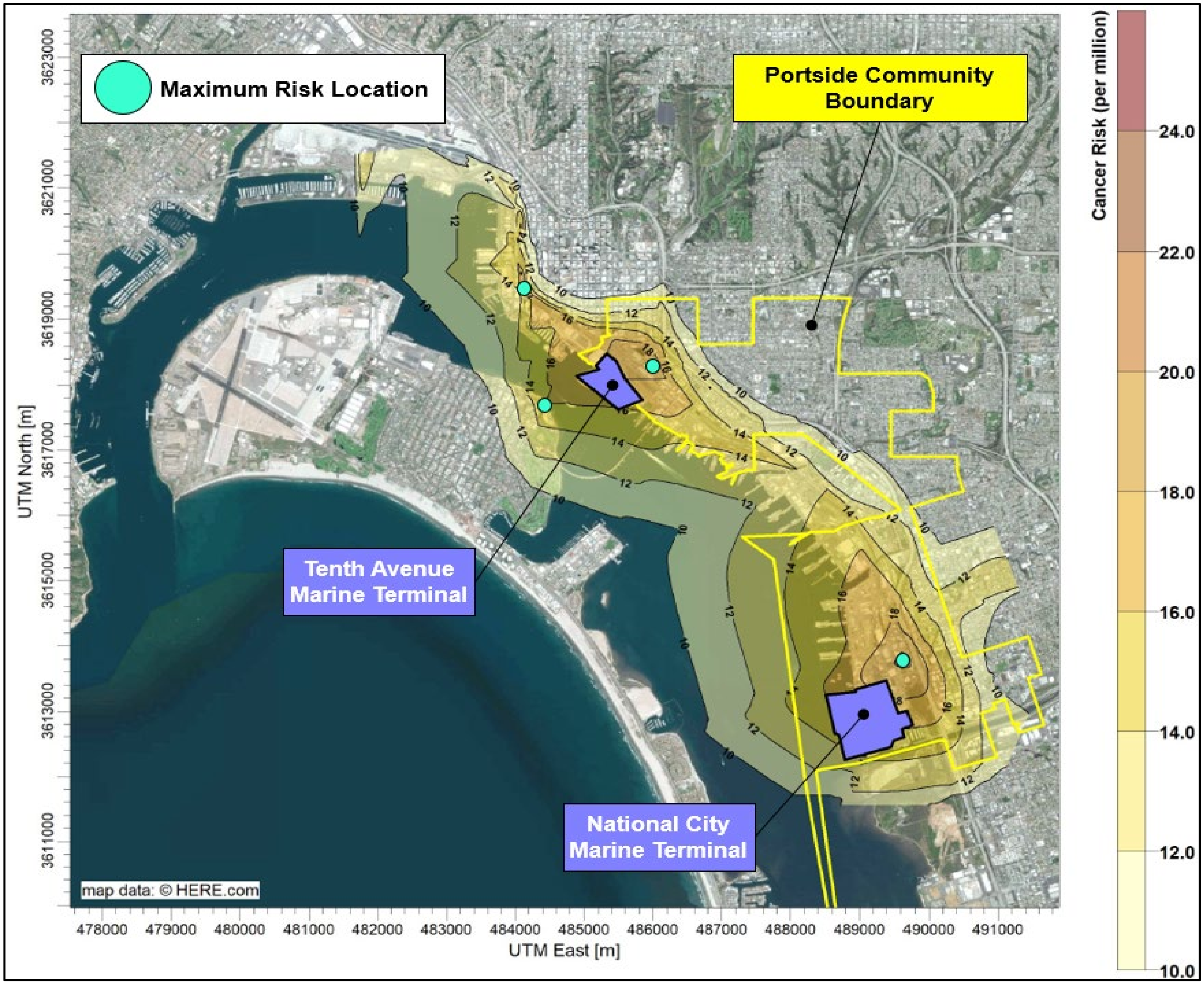


FIGURE D-2: 2019 BASELINE RESIDENTIAL CANCER RISK CONTOUR MAP



2026 MCAS Forecasted Residential Cancer Risk

Table D-2 forecasts the 2026 maximum residential cancer risk, assuming implementation of the following near-term MCAS measures:

- **Cargo Handling Equipment Objective 1:** Replacement of 20 pieces of cargo handling equipment at TAMT with zero emission alternatives.
- **Ocean-Going Vessels In-Transit Objective 1A:** Achievement of the Port's Updated Vessel Speed Reduction (VSR) Program that targets 90% compliance within the 40 nautical mile vessel speed reduction zone.
- **Ocean-Going Vessels At Berth Objective 2B:** Installation of two shore power plugs at NCMT.
- **Harbor Craft Objective 1:** Implementation of the first all-electric tugboat in the United States.
- **Harbor Craft Objective 2:** Short-run ferry operations are performed with zero emission technologies.
- **Truck Objective 1A:** 40% of the heavy-duty truck trips calling to both marine cargo terminals are performed by zero emission trucks (by 2026).

TABLE D-2: 2026 MCAS FORECASTED MAXIMUM 30-YEAR CANCER RISK BY COMMUNITY AREA

Community Area	30-Year Cancer Risk (chances per million)
National City	14.4
Barrio Logan	11.7
Downtown*	16.6
Coronado	9.3
Notes: *Represents the highest cancer risk in the modeling domain.	

Figure D-3 shows the forecasted source contribution to the MEIR in each community with implementation of short-term (2026) MCAS measures. For National City, the largest contributors to the MEIR in National City were forecasted to be rail activity and OGV activity, accounting for 81% of the cancer risk. In Barrio Logan, the largest contributors to the MEIR were forecasted to be OGV activity and rail activity, accounting for 80% of the cancer risk. For Downtown, the largest contributors to the MEIR were forecasted to be rail activity and OGV activity, accounting for 94% of the cancer risk. Lastly, the largest contributors to the MEIR in Coronado are forecasted to be OGV activity, tugs, and CHE, accounting for 85% of the cancer risk. As shown in **Figure D-3**, ferries did not contribute to the MEIR due to MCAS measures that would electrify ferries. **Figure D-4** shows the cancer risk contours for the forecasted 2026 residential cancer risk with assumed implementation of short-term MCAS measures.

FIGURE D-3: FORECASTED 2026 SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM CANCER RISK RECEPTOR BY COMMUNITY WITH SHORT-TERM MCAS MEASURES

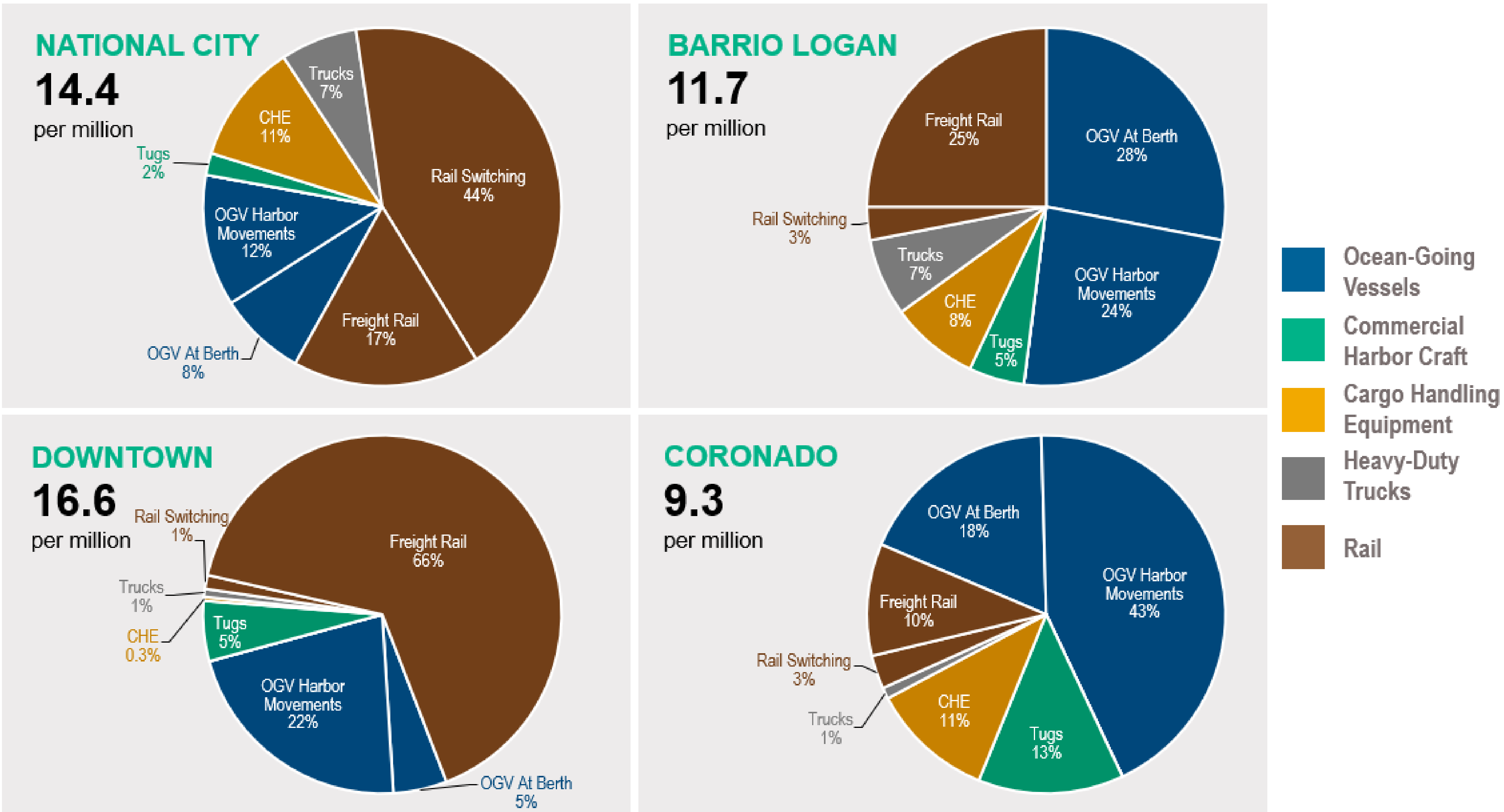
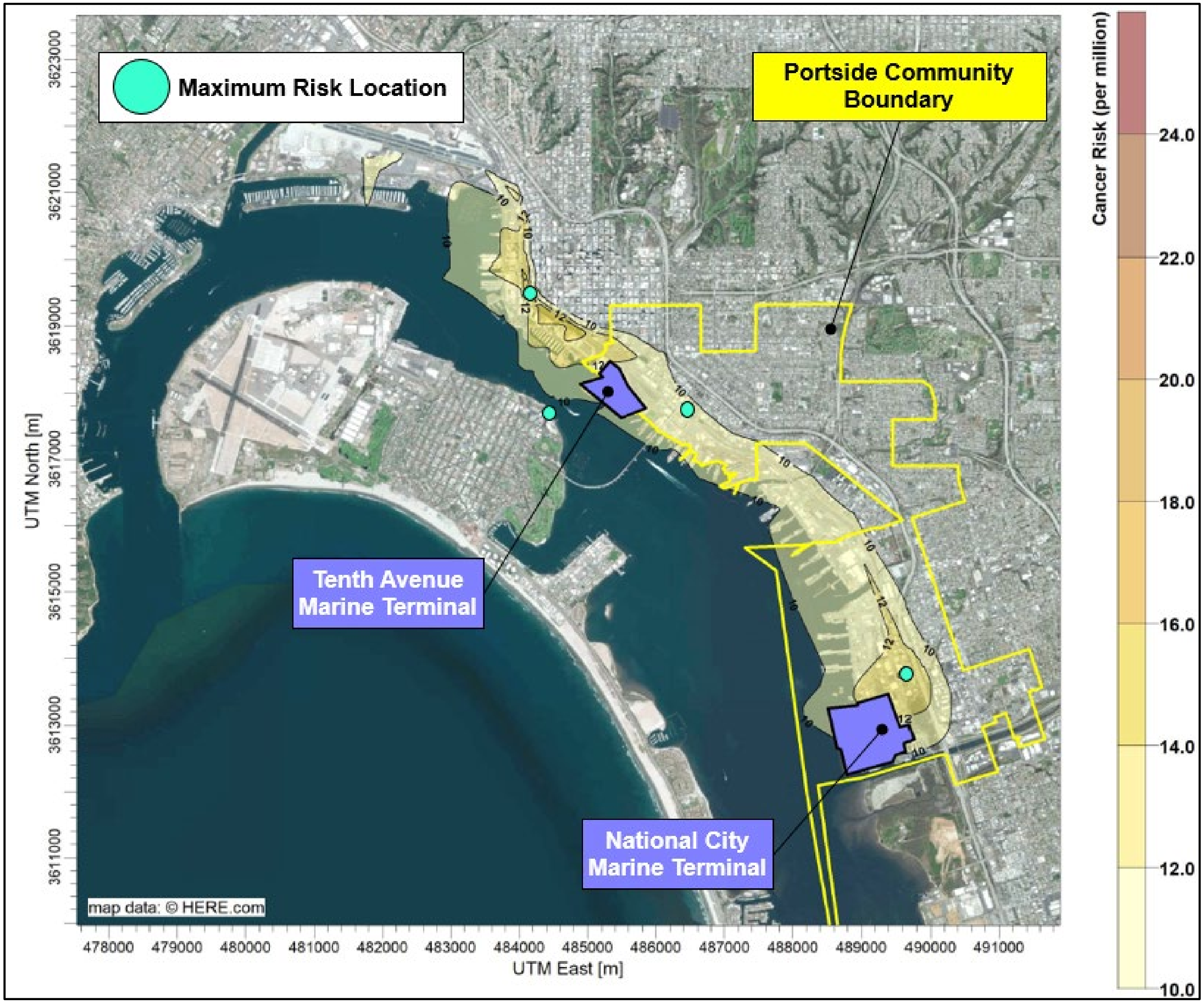


FIGURE D-4: FORECASTED 2026 MCAS RESIDENTIAL CANCER RISK CONTOUR MAP WITH SHORT-TERM MCAS MEASURES



2030 MCAS Forecasted Residential Cancer Risk

Table D-3 presents forecasted 2030 MCAS maximum residential cancer risks for the four communities, assuming implementation of the following long-term MCAS measures:

- **Trucks 2030 Goal:** 100% of the heavy-duty truck trips calling to both marine cargo terminals are performed by zero emission trucks.
- **Cargo Handling Equipment 2030 Goal:** 100% of cargo handling equipment at both marine cargo terminals have been transitioned to zero emission technologies.

TABLE D-3: 2030 MCAS MAXIMUM 30-YEAR CANCER RISK BY COMMUNITY AREA

Community Area	30-Year Cancer Risk (chances per million)
National City	11.9
Barrio Logan	10.5
Downtown*	16.4
Coronado	8.2

Notes:

*Represents the highest cancer risk in the modeling domain.

Figure D-5 shows the forecasted source contribution to the MEIR in each community with implementation of long-term (2030) MCAS measures. For National City, the largest contributors to the MEIR were forecasted to be rail activity and OGV activity, accounting for 97% of the cancer risk. In Barrio Logan, the largest contributors to the MEIR were forecasted to be OGV activity and rail activity, accounting for 95% of cancer risk. For Downtown, the largest contributors to the MEIR were forecasted to be rail activity and OGV activity, accounting for 95% of cancer risk. Lastly, the largest contributors to the MEIR in Coronado are forecasted to be OGV activity and tugs, accounting for 85% of the cancer risk. As shown in **Figure D-5**, ferries, CHE, and heavy-duty trucks did not contribute to the MEIR due to MCAS measures that would electrify ferries, CHE, and heavy-duty trucks. **Figure D-6** shows the cancer risk contours for the 2030 forecasted residential cancer risk with assumed implementation of long-term MCAS measures.

FIGURE D-5: FORECASTED 2030 SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM CANCER RISK RECEPTOR BY COMMUNITY WITH LONG-TERM MCAS MEASURES

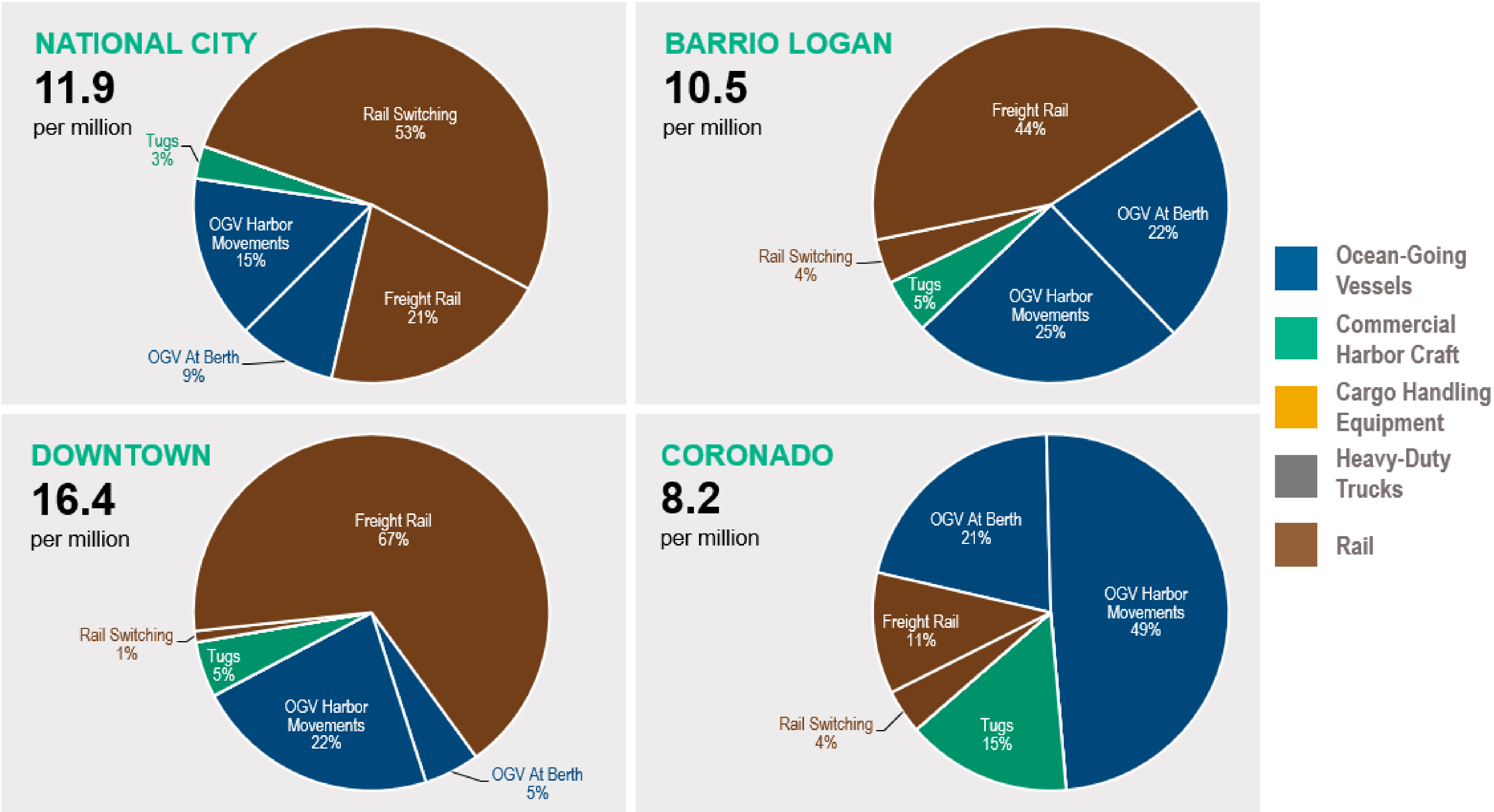


FIGURE D-6: FORECASTED 2030 MCAS RESIDENTIAL CANCER RISK CONTOUR MAP WITH LONG-TERM MCAS MEASURES

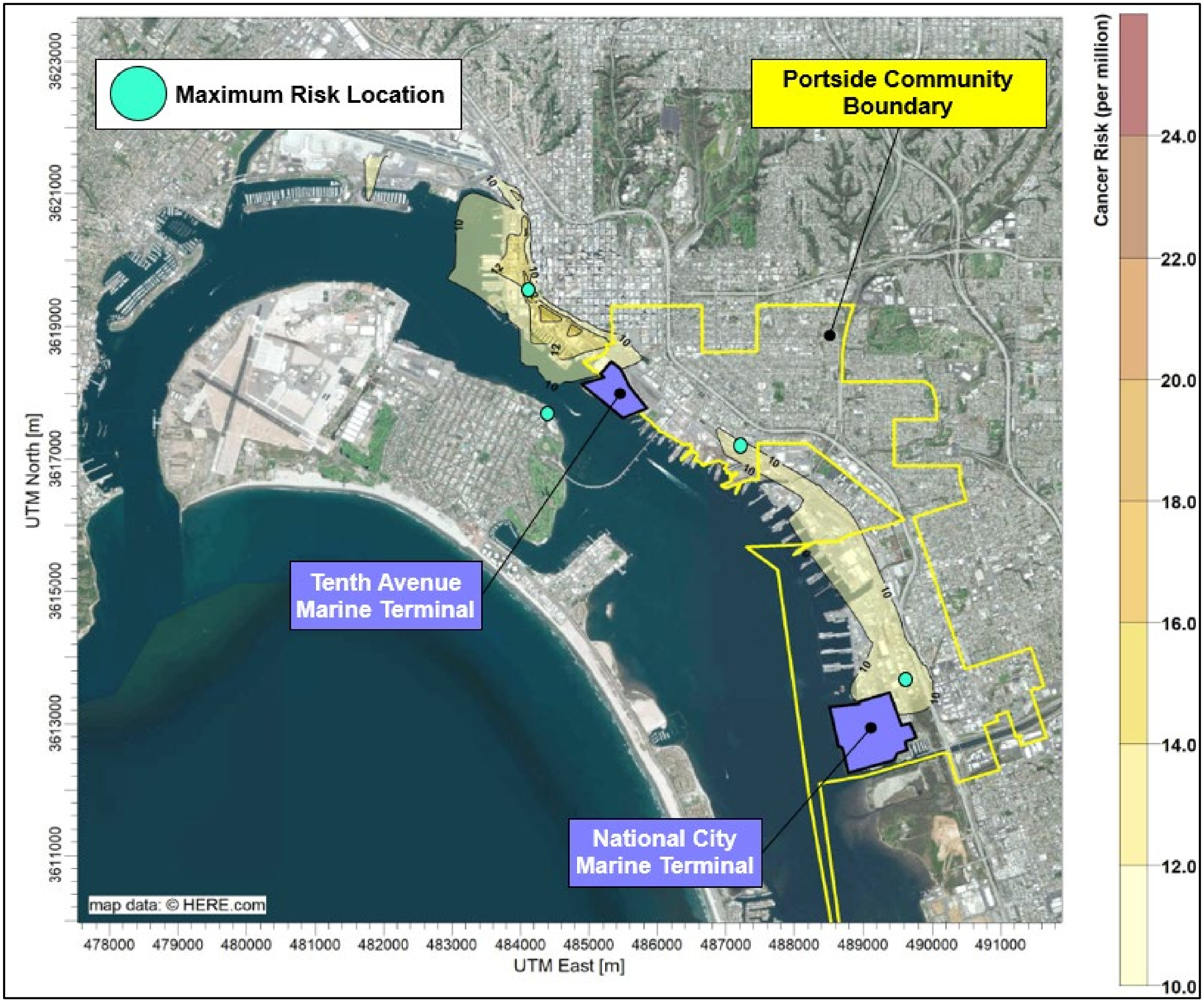


Table D-4 provides a detailed breakdown of the source contributions to the MEIR in National City for each emissions scenario. Assuming implementation of short-term (2026) MCAS measures, the maximum cancer risk would decrease from 20.6 to 14.4, resulting in an approximately 30% reduction from the 2019 Baseline scenario. Then assuming implementation of long-term (2030) MCAS measures, the maximum cancer risk would decrease from 20.6 to 11.9, resulting in an approximately 42% reduction from the 2019 Baseline scenario.

TABLE D-4: RESIDENTIAL CANCER RISK SOURCE CONTRIBUTION FOR NATIONAL CITY

		2019 Baseline		Forecasted 2026 MCAS		Forecasted 2030 MCAS	
Terminal	**Source Category**	**Cancer Risk (per million)**	**% of Total Risk**	**Cancer Risk (per million)**	**% of Total Risk**	**Cancer Risk (per million)**	**% of Total Risk**
TAMT	OGV At Berth	0.4	1.9%	0.4	2.7%	0.4	3.2%
	OGV Harbor Movements	0.08	0.4%	0.08	0.5%	0.08	0.7%
	Tugs	0.03	0.2%	0.02	0.1%	0.02	0.2%
	CHE	0.1	0.6%	0.02	0.2%	-	-
	Rail Switching	0.002	0.01%	0.002	0.02%	0.002	0.02%
	Truck Activity at Terminal	0.0008	0.004%	0.0005	0.003%	-	-
	Truck Travel Offsite	0.08	0.4%	0.05	0.3%	-	-
NCMT	OGV At Berth	5.9	28.8%	0.7	4.9%	0.7	6.0%
	OGV Harbor Movements	1.2	5.9%	1.2	8.4%	1.2	10.1%
	Tugs	0.5	2.3%	0.3	1.9%	0.3	2.3%
	CHE	1.5	7.3%	1.5	10.4%	-	-
	Rail Switching	6.3	30.6%	6.3	43.8%	6.3	53.0%
	Truck Activity at Terminal	0.3	1.3%	0.2	1.1%	-	-
	Truck Travel Offsite	1.3	6.2%	0.8	5.3%	-	-
TAMT & NCMT	OGV Transit Outside Bay	0.5	2.3%	0.5	3.3%	0.5	4.0%
	Freight Rail	2.4	11.9%	2.4	17.0%	2.4	20.5%
Ferry	Ferry (Cabrillo)	0.02	0.1%	-	-	-	-
	Ferry (Silvergate)	0.01	0.04%	-	-	-	-
Total		**20.6**	**100%**	**14.4**	**100%**	**11.9**	**100%**

Table D-5 provides a detailed breakdown of the source contributions to the MEIR in Barrio Logan for each emissions scenario. Assuming implementation of short-term (2026) MCAS measures, the maximum cancer risk would decrease from 19.7 to 11.7, resulting in an approximately 40% reduction from the 2019 Baseline scenario. Then assuming implementation of long-term (2030) MCAS measures, the maximum cancer risk would decrease from 19.7 to 10.5, resulting in an approximately 46% reduction from the 2019 Baseline scenario.

TABLE D-5: RESIDENTIAL CANCER RISK SOURCE CONTRIBUTION FOR BARRIO LOGAN

		2019 Baseline		Forecasted 2026 MCAS		Forecasted 2030 MCAS	
Terminal	**Source Category**	**Cancer Risk (per million)**	**% of Total Risk**	**Cancer Risk (per million)**	**% of Total Risk**	**Cancer Risk (per million)**	**% of Total Risk**
TAMT	OGV At Berth	3.0	15.4%	3.1	26.7%	2.2	21.0%
	OGV Harbor Movements	0.4	2.2%	0.3	2.9%	0.2	2.3%
	Tugs	0.2	1.3%	0.1	1.0%	0.07	0.7%
	CHE	8.0	40.9%	0.9	7.9%	-	-
	Rail Switching	0.080	0.4%	0.05	0.4%	0.02	0.2%
	Truck Activity at Terminal	0.05	0.3%	0.02	0.2%	-	-
	Truck Travel Offsite	0.2	1.1%	0.5	4.3%	-	-
NCMT	OGV At Berth	0.7	3.4%	0.1	0.8%	0.1	1.2%
	OGV Harbor Movements	1.9	9.5%	1.9	16.4%	1.8	17.1%
	Tugs	0.8	4.0%	0.5	4.3%	0.5	4.3%
	CHE	0.01	0.1%	0.02	0.2%	-	-
	Rail Switching	0.3	1.5%	0.3	2.9%	0.4	4.2%
	Truck Activity at Terminal	0.003	0.01%	0.002	0.02%	-	-
	Truck Travel Offsite	0.5	2.5%	0.2	2.1%	-	-
TAMT & NCMT	OGV Transit Outside Bay	0.6	3.2%	0.6	5.0%	0.5	5.1%
	Freight Rail	2.5	12.5%	2.9	25.0%	4.6	43.9%
Ferry	Ferry (Cabrillo)	0.2	1.1%	-	-	-	-
	Ferry (Silvergate)	0.1	0.7%	-	-	-	-
Total		**19.7**	**100%**	**11.7**	**100%**	**10.5**	**100%**

Table D-6 provides a detailed breakdown of the source contributions to the MEIR in Downtown for each emissions scenario. With implementation of short-term (2026) MCAS measures, the maximum cancer risk would decrease from 18.9 to 16.6, resulting in an approximately 12% reduction from the 2019 Baseline scenario. Then assuming implementation of long-term (2030) MCAS measures, the maximum cancer risk would decrease from 18.9 to 16.4, resulting in an approximately 13% reduction from the 2019 Baseline scenario.

TABLE D-6: RESIDENTIAL CANCER RISK SOURCE CONTRIBUTION FOR DOWNTOWN

		2019 Baseline		Forecasted 2026 MCAS		Forecasted 2030 MCAS	
Terminal	**Source Category**	**Cancer Risk (per million)**	**% of Total Risk**	**Cancer Risk (per million)**	**% of Total Risk**	**Cancer Risk (per million)**	**% of Total Risk**
TAMT	OGV At Berth	0.7	4.0%	0.7	4.5%	0.7	4.6%
	OGV Harbor Movements	0.7	3.8%	0.7	4.3%	0.7	4.4%
	Tugs	0.5	2.7%	0.3	1.8%	0.3	1.9%
	CHE	0.2	1.3%	0.05	0.3%	-	-
	Rail Switching	0.007	0.04%	0.007	0.04%	0.007	0.04%
	Truck Activity at Terminal	0.002	0.009%	0.0010	0.006%	-	-
	Truck Travel Offsite	0.05	0.3%	0.03	0.2%	-	-
NCMT	OGV At Berth	0.5	2.4%	0.1	0.3%	0.1	0.3%
	OGV Harbor Movements	2.1	11.3%	2.1	12.9%	2.1	13.0%
	Tugs	1.0	5.3%	0.6	3.6%	0.6	3.6%
	CHE	0.01	0.04%	0.01	0.05%	-	-
	Rail Switching	0.2	1.1%	0.2	1.2%	0.2	1.2%
	Truck Activity at Terminal	0.001	0.01%	0.001	0.01%	-	-
	Truck Travel Offsite	0.1	0.8%	0.1	0.5%	-	-
TAMT & NCMT	OGV Transit Outside Bay	0.8	4.0%	0.8	4.6%	0.8	4.6%
	Freight Rail	10.9	57.6%	10.9	65.6%	10.9	66.3%
Ferry	Ferry (Cabrillo)	0.9	4.7%	-	-	-	-
	Ferry (Silvergate)	0.1	0.5%	-	-	-	-
Total		**18.9**	**100%**	**16.6**	**100%**	**16.4**	**100%**

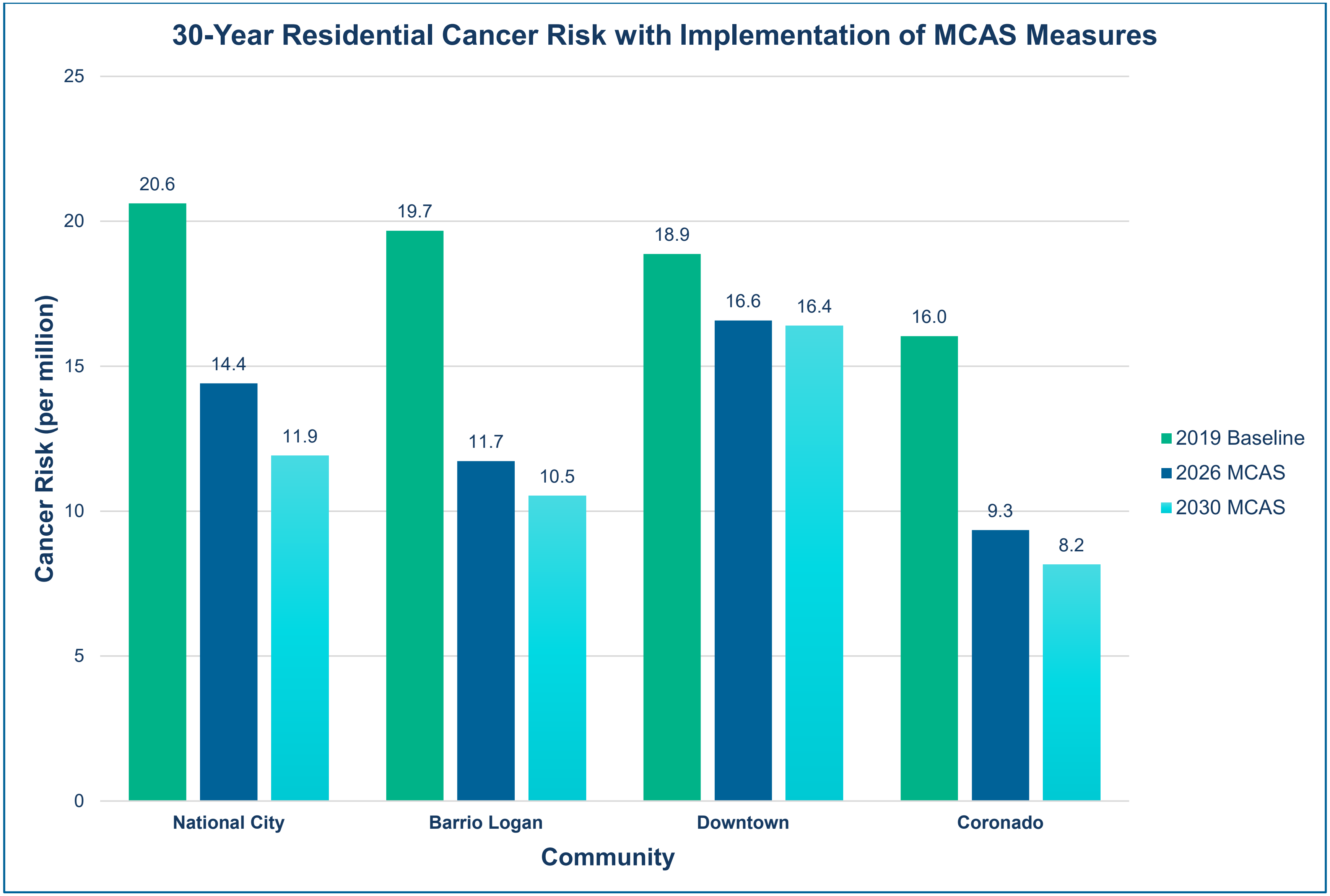
Table D-7 provides a detailed breakdown of the source contributions to the MEIR in Coronado for each emissions scenario. Assuming implementation of short-term (2026) MCAS measures, the maximum cancer risk would decrease from 16.0 to 9.3, resulting in an approximately 42% reduction from the 2019 Baseline scenario. Then assuming implementation of long-term (2030) MCAS measures, the maximum cancer risk would decrease from 16.0 to 8.2, resulting in an approximately 49% reduction from the 2019 Baseline scenario.

TABLE D-7: RESIDENTIAL CANCER RISK SOURCE CONTRIBUTION FOR CORONADO

		2019 Baseline		Forecasted 2026 MCAS		Forecasted 2030 MCAS	
Terminal	**Source Category**	**Cancer Risk (per million)**	**% of Total Risk**	**Cancer Risk (per million)**	**% of Total Risk**	**Cancer Risk (per million)**	**% of Total Risk**
TAMT	OGV At Berth	1.6	10.2%	1.6	17.6%	1.6	20.1%
	OGV Harbor Movements	0.7	4.5%	0.7	7.7%	0.7	8.9%
	Tugs	0.7	4.1%	0.4	4.2%	0.4	4.8%
	CHE	5.3	32.9%	1.1	11.3%	-	-
	Rail Switching	0.02	0.1%	0.02	0.2%	0.022	0.3%
	Truck Activity at Terminal	0.04	0.2%	0.02	0.2%	-	-
	Truck Travel Offsite	0.05	0.3%	0.03	0.3%	-	-
NCMT	OGV At Berth	0.6	3.7%	0.1	0.8%	0.1	0.9%
	OGV Harbor Movements	2.4	15.2%	2.4	26.0%	2.4	29.8%
	Tugs	1.5	9.1%	0.9	9.2%	0.9	10.6%
	CHE	0.01	0.1%	0.01	0.1%	-	-
	Rail Switching	0.3	1.7%	0.3	2.9%	0.3	3.3%
	Truck Activity at Terminal	0.002	0.01%	0.001	0.01%	-	-
	Truck Travel Offsite	0.1	0.6%	0.1	0.7%	-	-
TAMT & NCMT	OGV Transit Outside Bay	0.9	5.3%	0.9	9.1%	0.9	10.5%
	Freight Rail	0.9	5.6%	0.9	9.6%	0.9	11.0%
Ferry	Ferry (Cabrillo)	0.4	2.7%	-	-	-	-
	Ferry (Silvergate)	0.6	3.6%	-	-	-	-
Total		**16.0**	**100%**	**9.3**	**100%**	**8.2**	**100%**

Figure D-7 shows the trend in maximum cancer risk for residents assuming implementation of short-term and long-term MCAS measures.

FIGURE D-7: MAXIMUM RESIDENTIAL RISK WITH IMPLEMENTATION OF MCAS MEASURES



Schools

2019 Baseline School Cancer Risk

The cancer risk estimates were based on children attending school from pre-kindergarten at age 2 to 8th grade at age 13, for a total exposure duration of 12 years. The maximum cancer risk for children at schools under the 2019 Baseline scenario are presented in **Table D-8**. **Figure D-8** shows the source contribution to the maximum cancer risk. **Figure D-9** shows the cancer risk contours for the 2019 baseline school cancer risk.

TABLE D-8: 2019 BASELINE MAXIMUM SCHOOL CANCER RISK

Receptor Type	Maximum Cancer Risk (chances per million)
Children at Schools	2.0

FIGURE D-8: 2019 BASELINE SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM SCHOOL CANCER RISK

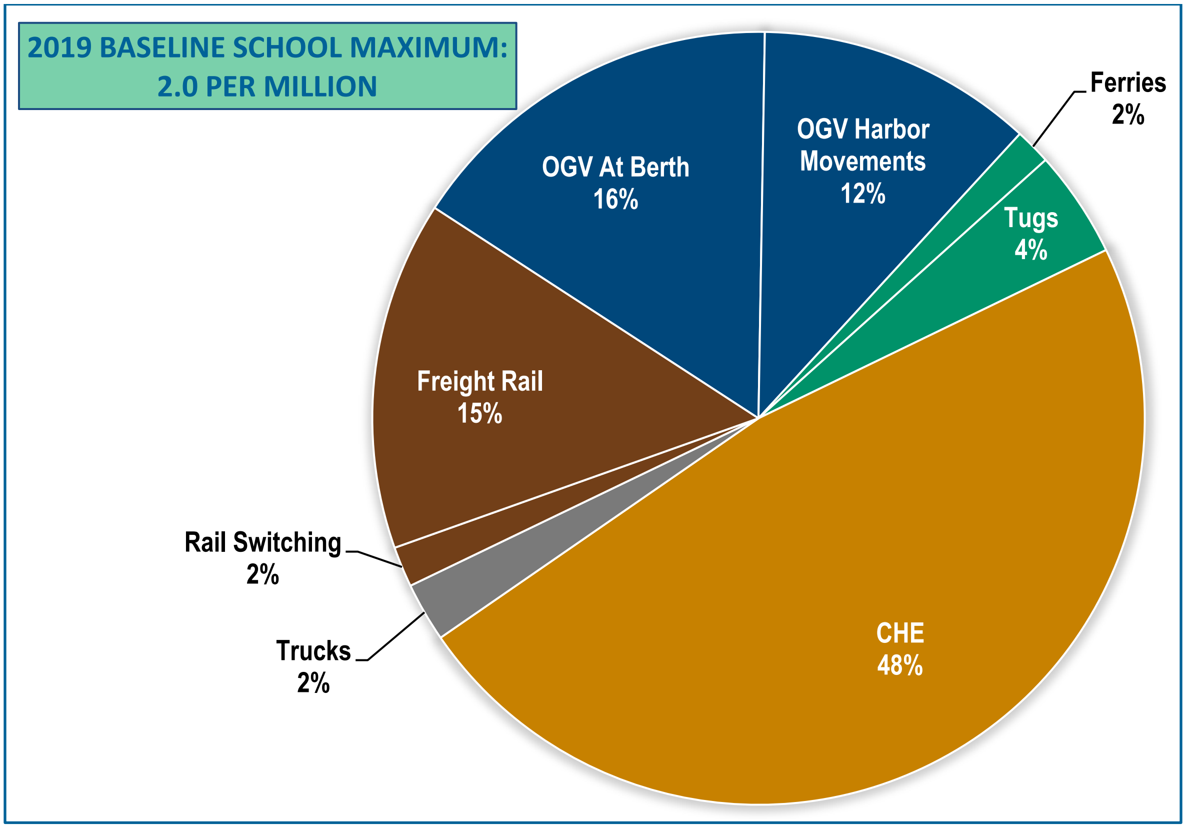
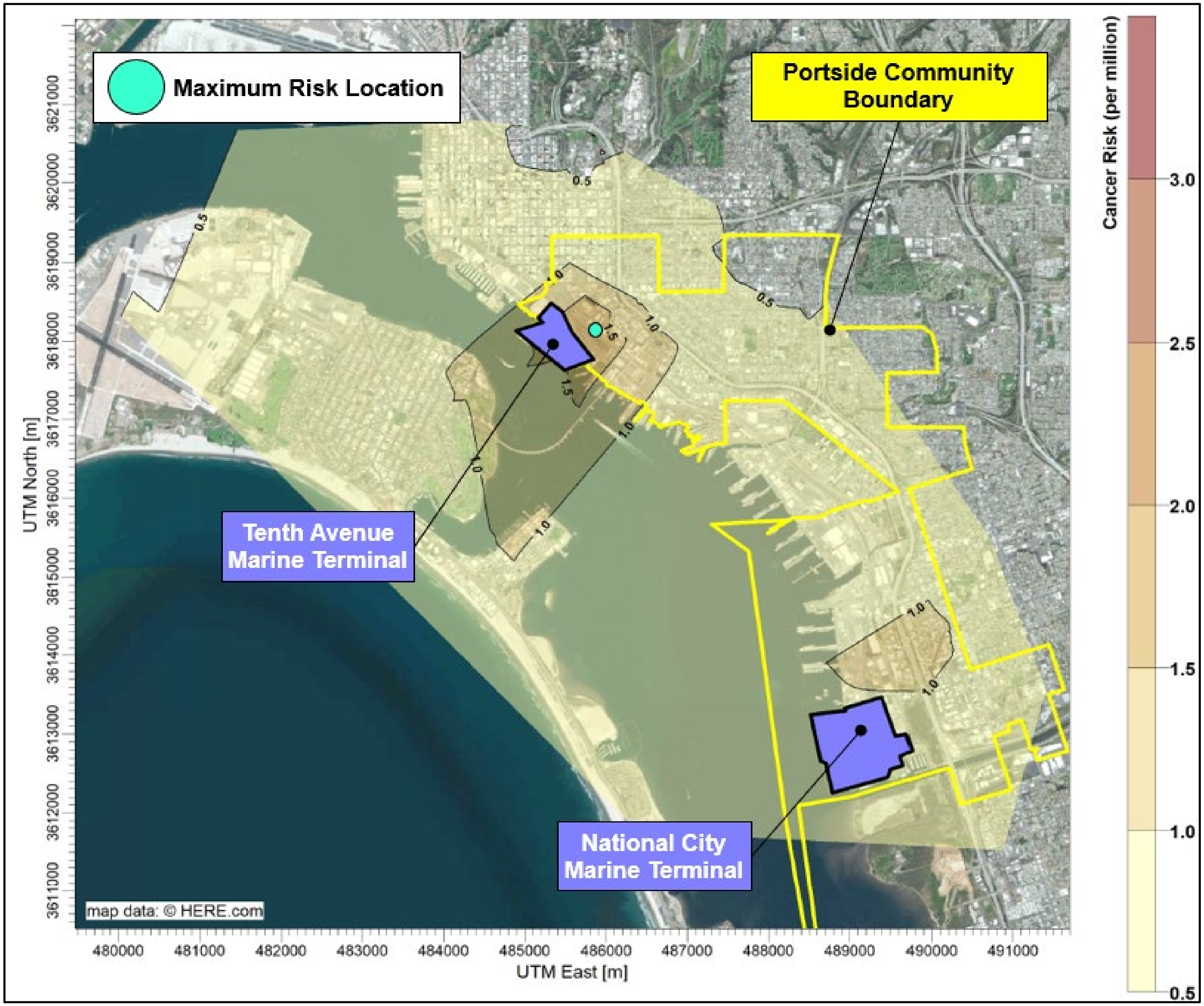


FIGURE D-9: 2019 BASELINE SCHOOL CANCER RISK CONTOUR MAP



2026 MCAS School Cancer Risk

Table D-9 presents the forecasted 2026 MCAS maximum school cancer risk, assuming implementation of the MCAS measures described previously. **Figure D-10** shows the source contribution to the maximum cancer risk. **Figure D-11** shows the cancer risk contours for the forecasted 2026 school cancer risk with implementation of short-term MCAS measures discussed above.

TABLE D-9: FORECASTED 2026 MCAS MAXIMUM SCHOOL CANCER RISK

Receptor Type	Maximum Cancer Risk (chances per million)
Children at Schools	1.1

FIGURE D-10: FORECASTED 2026 SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM SCHOOL CANCER RISK WITH SHORT-TERM MCAS MEASURES

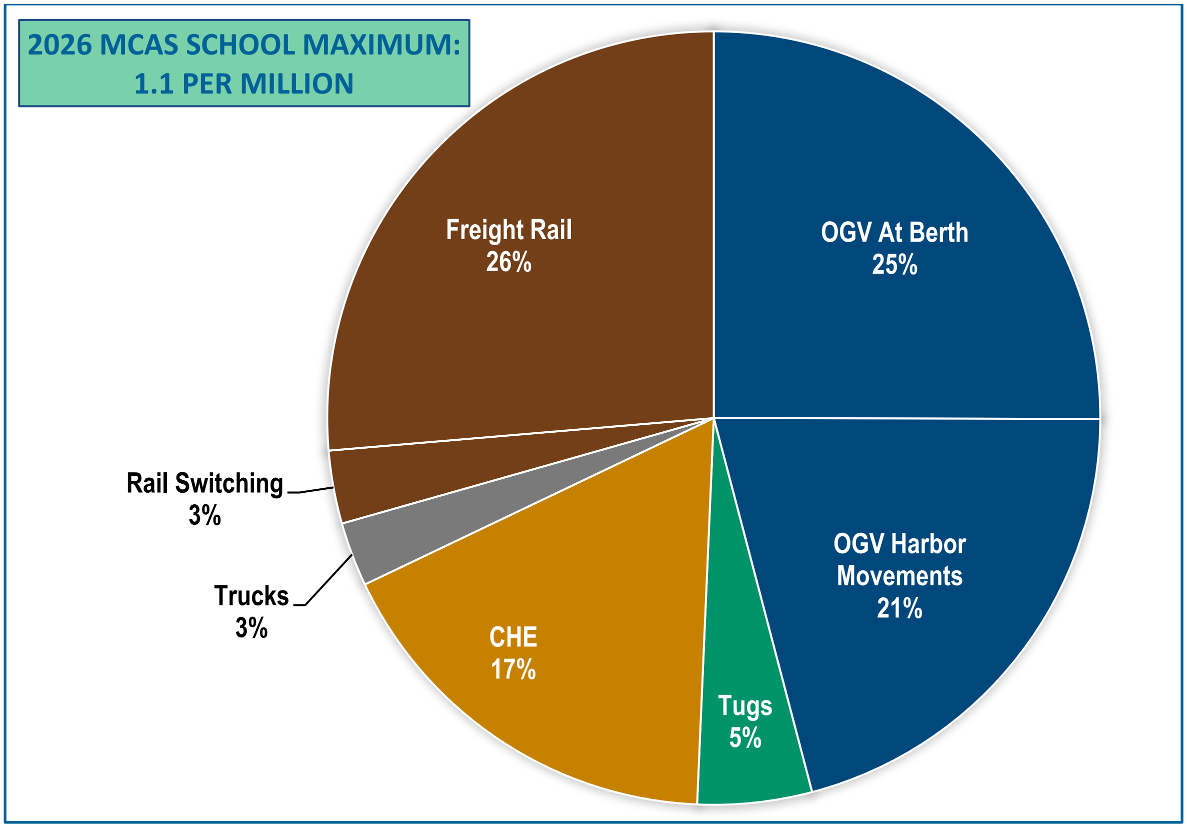
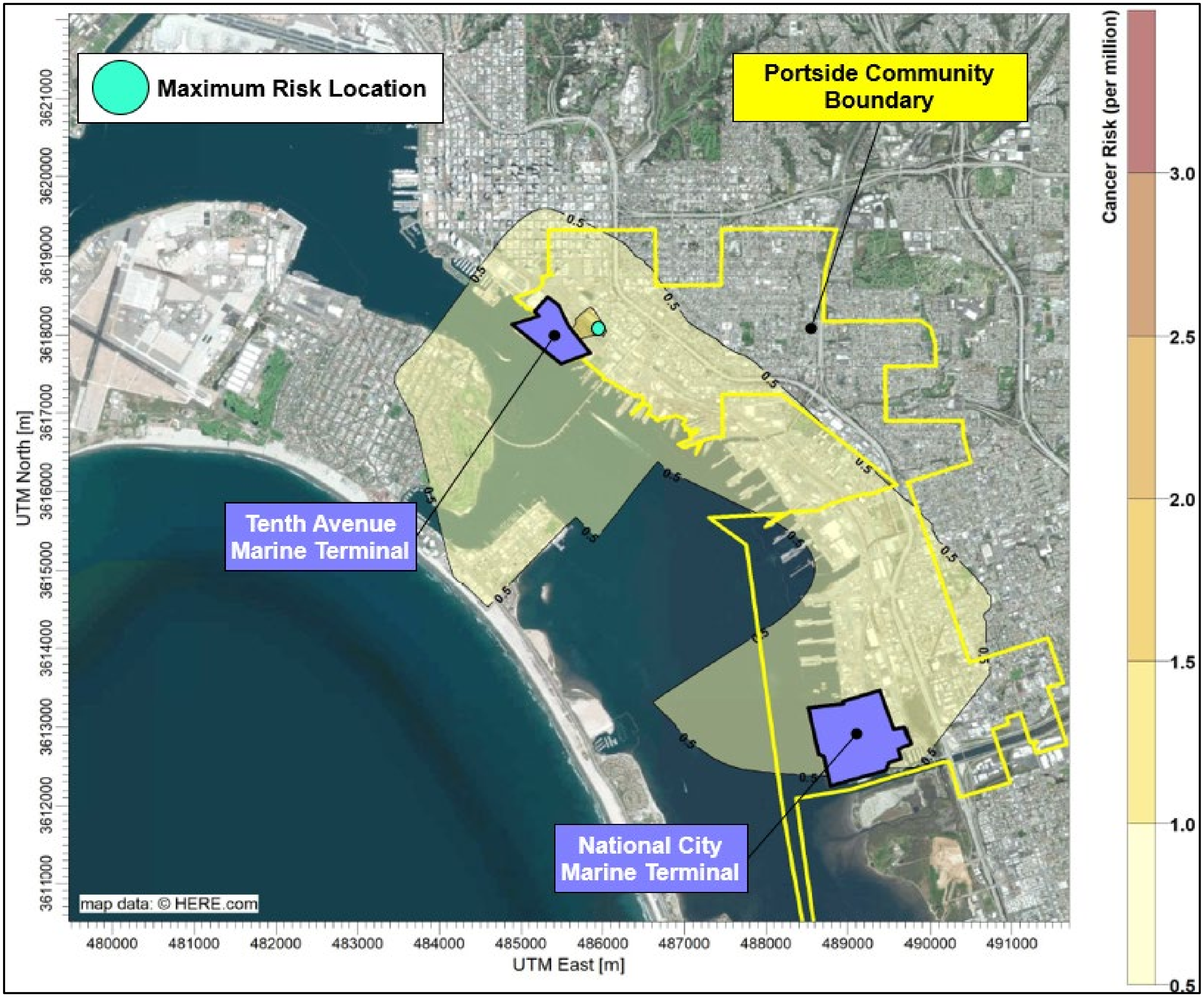


FIGURE D-11: FORECASTED 2026 MCAS SCHOOL CANCER RISK CONTOUR MAP WITH SHORT-TERM MCAS MEASURES



2030 MCAS School Cancer Risk

Table D-10 presents the forecasted 2030 MCAS maximum school cancer risk, assuming implementation of the MCAS measures described previously. **Figure D-12** shows the source contribution to the maximum cancer risk. **Figure D-13** shows the cancer risk contours for the forecasted 2030 school cancer risk with implementation of long-term MCAS measures discussed above.

TABLE D-10: FORECASTED 2030 MCAS MAXIMUM SCHOOL CANCER RISK

Receptor Type	Maximum Cancer Risk (chances per million)
Children at Schools	0.9

FIGURE D-12: FORECASTED 2030 SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM SCHOOL CANCER RISK WITH LONG-TERM MCAS MEASURES

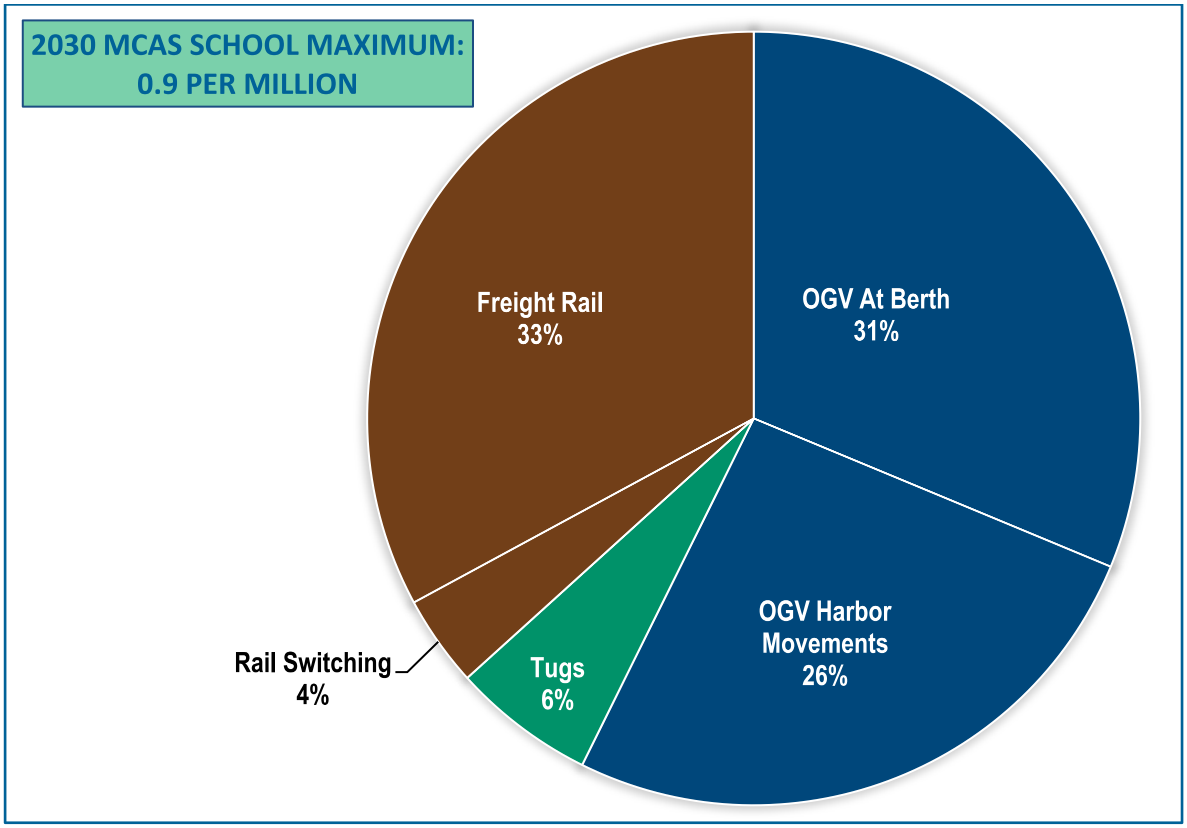
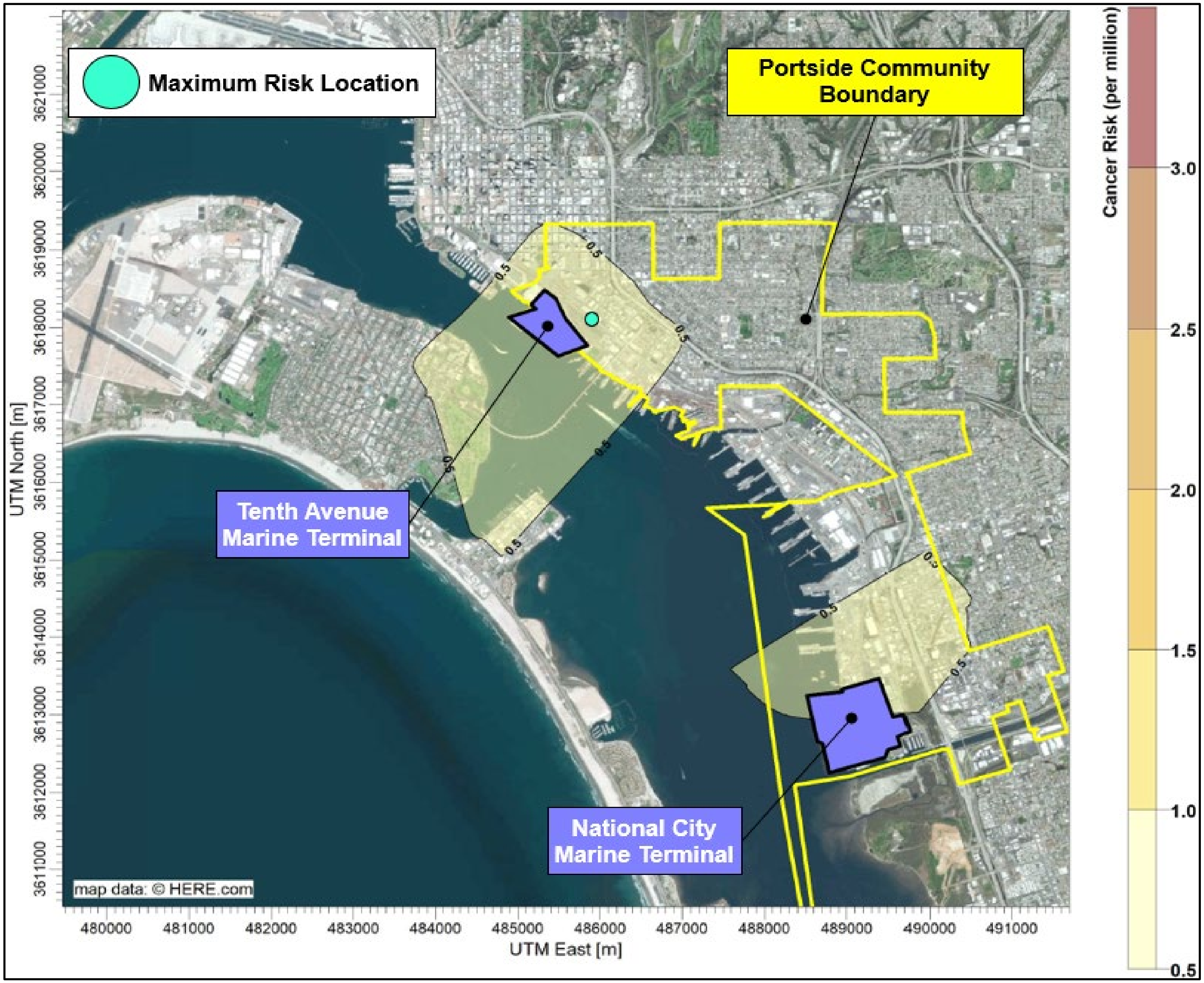


FIGURE D-13: FORECASTED 2030 MCAS SCHOOL CANCER RISK CONTOUR MAP WITH LONG-TERM MCAS MEASURES



Parks

2019 Baseline Park Cancer Risk

The cancer risk estimates were based on children attending parks from birth to age 9 for a total exposure duration of 9 years. The maximum cancer risk for children at parks under the 2019 Baseline scenario is presented in **Table D-11**. **Figure D-14** shows the source contribution to the maximum cancer risk. **Figure D-15** shows the cancer risk contours for the 2019 baseline park cancer risk.

TABLE D-11: 2019 BASELINE MAXIMUM PARK CANCER RISK

Receptor Type	Maximum Cancer Risk (chances per million)
Children at Parks	2.5

FIGURE D-14: 2019 BASELINE SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM PARK CANCER RISK

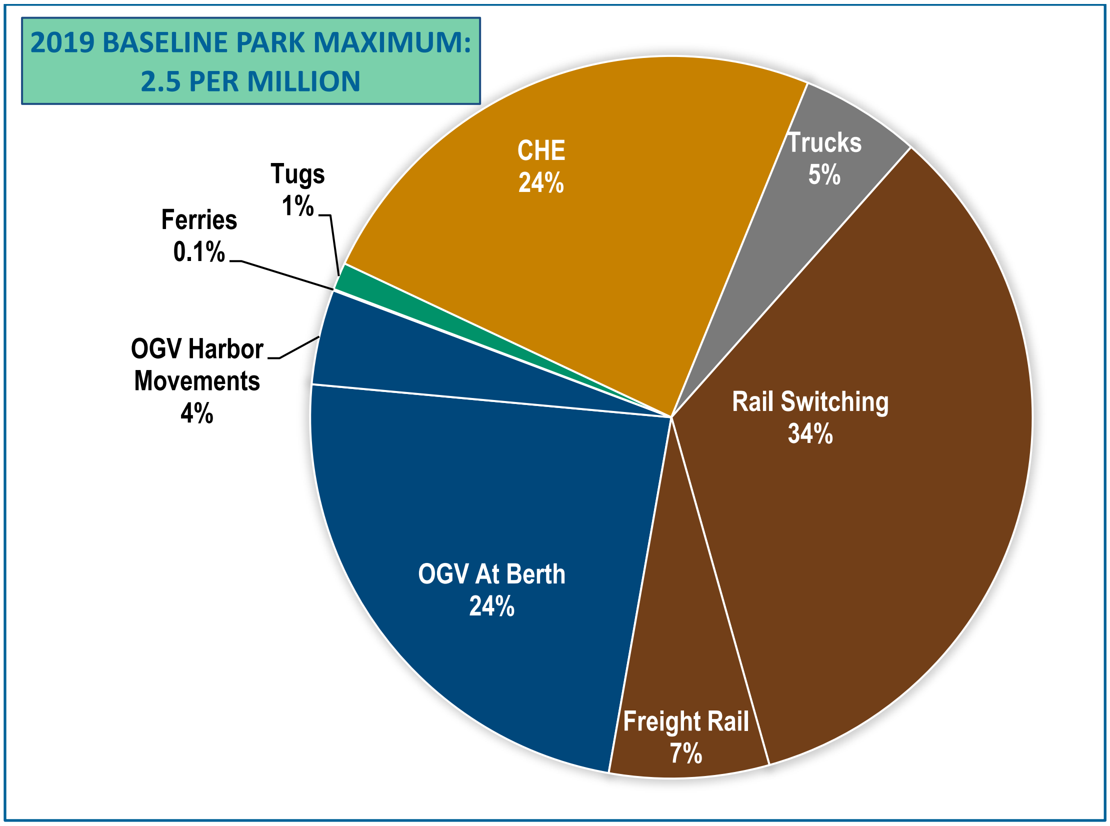
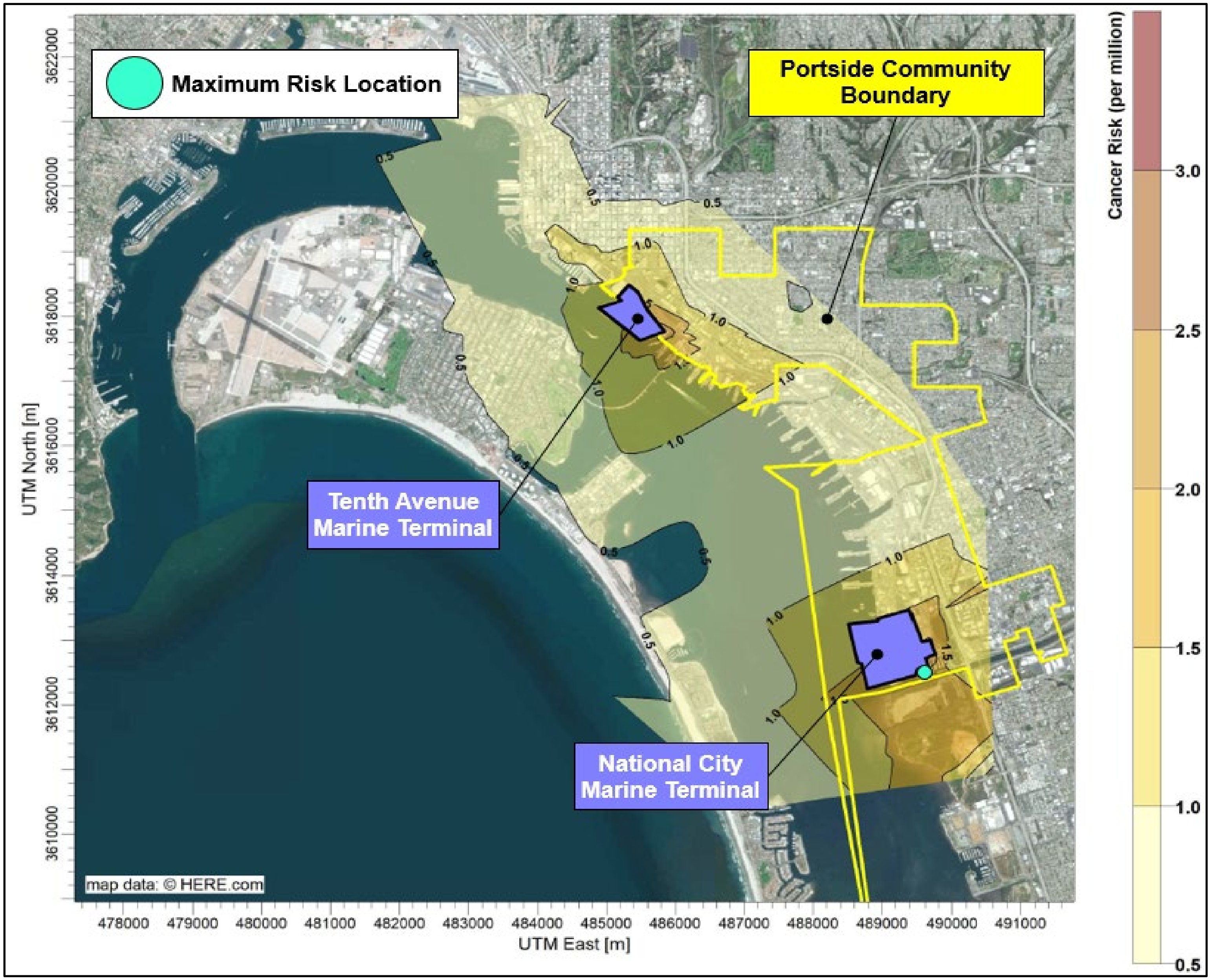


FIGURE D-15: 2019 BASELINE PARK CANCER RISK CONTOUR MAP



2026 MCAS Park Cancer Risk

Table D-12 presents the forecasted 2026 MCAS maximum park cancer risk, assuming implementation of the MCAS measures described previously. **Figure D-16** shows the source contribution to the maximum cancer risk. **Figure D-17** shows the cancer risk contours for the forecasted 2026 park cancer risk with implementation of short-term MCAS measures discussed above.

TABLE D-12: FORECASTED 2026 MCAS MAXIMUM PARK CANCER RISK

Receptor Type	Maximum Cancer Risk (chances per million)
Children at Parks	2.0

FIGURE D-16: FORECASTED 2026 SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM SCHOOL CANCER RISK WITH SHORT-TERM MCAS MEASURES

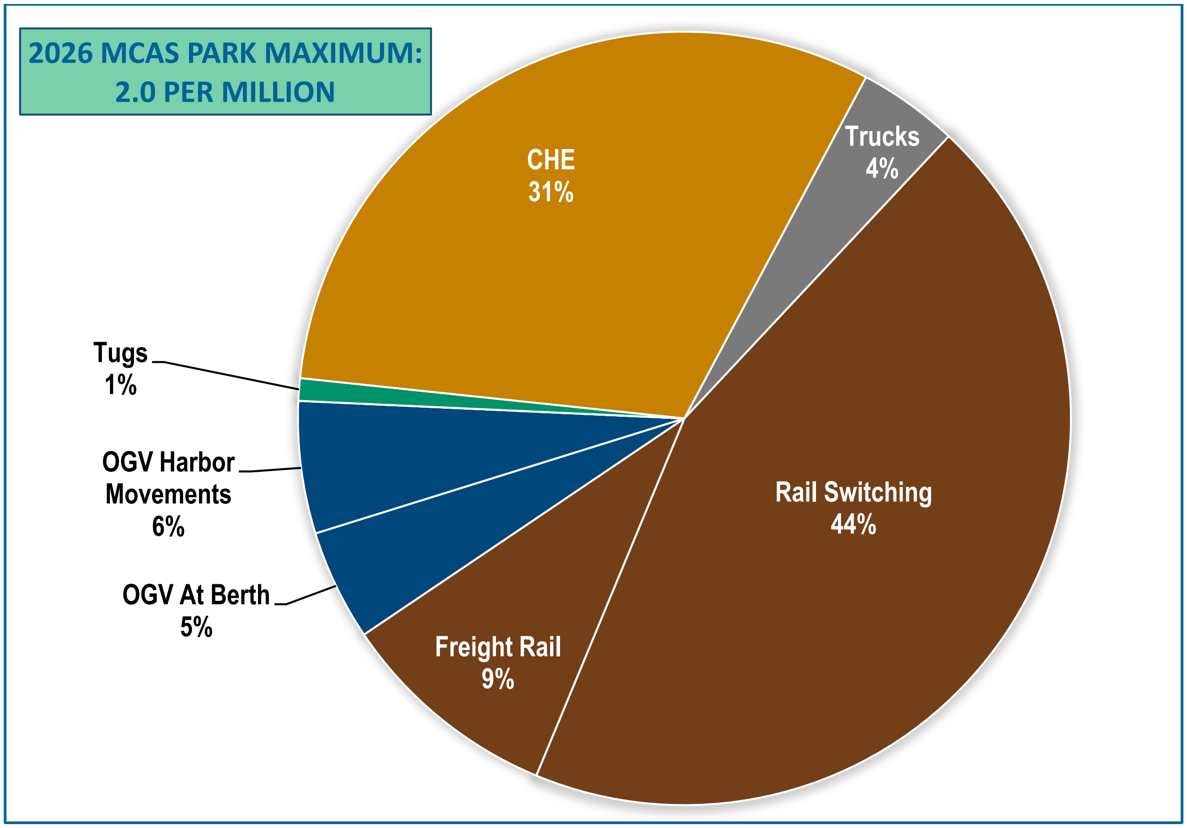
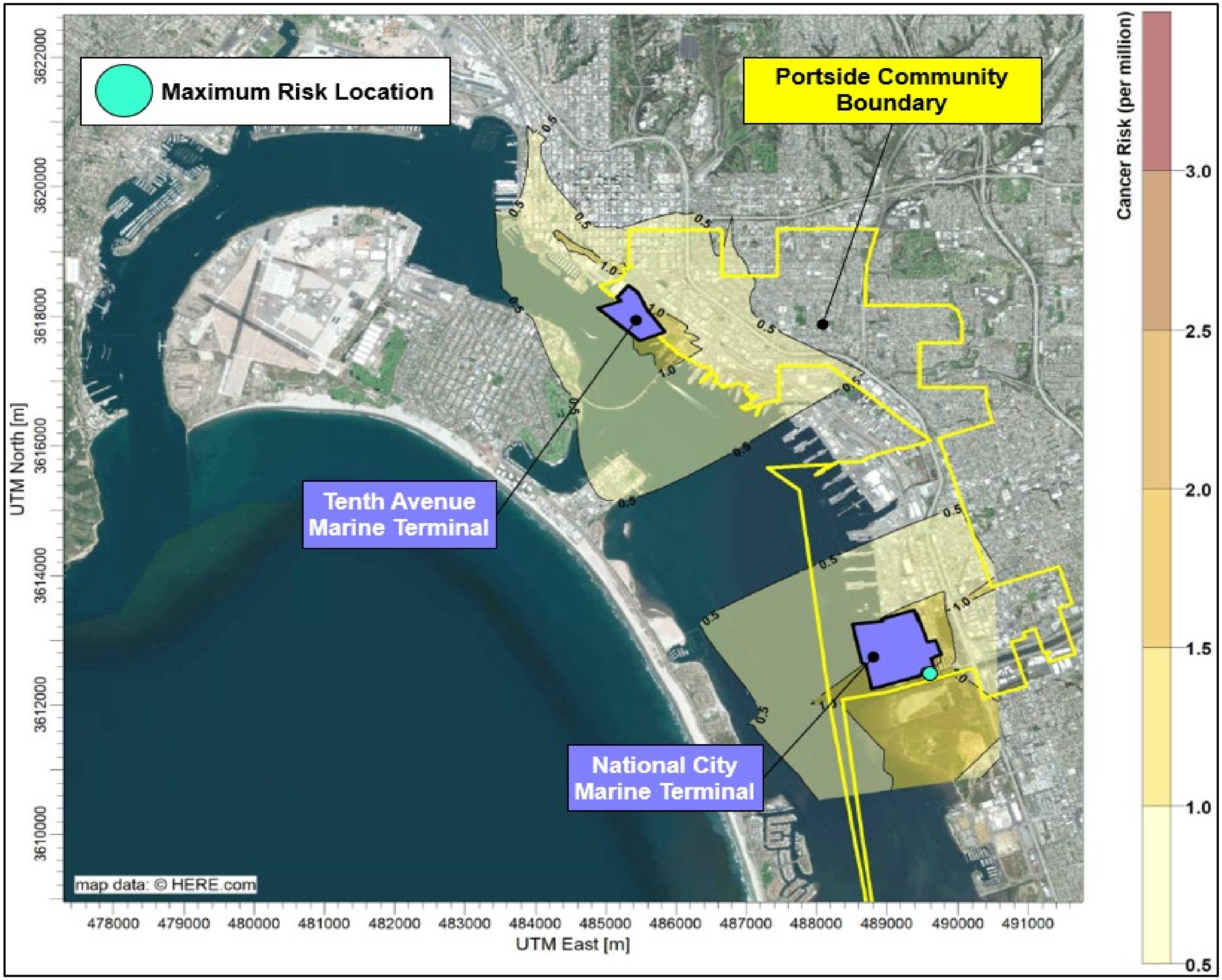


FIGURE D-17: FORECASTED 2026 MCAS PARK CANCER RISK CONTOUR MAP WITH SHORT-TERM MCAS MEASURES



2030 MCAS Park Cancer Risk

Table D-13 presents the forecasted 2030 MCAS maximum park cancer risk, assuming implementation of the MCAS measures described previously. **Figure D-18** shows the source contribution to the maximum cancer risk. **Figure D-19** shows the cancer risk contours for the forecasted 2030 park cancer risk with implementation of long-term MCAS measures discussed above.

TABLE D-13: FORECASTED 2030 MCAS MAXIMUM PARK CANCER RISK

Receptor Type	Maximum Cancer Risk (chances per million)
Children at Parks	1.3

FIGURE D-18: FORECASTED 2030 SOURCE CONTRIBUTION AS A PERCENTAGE TO MAXIMUM PARK CANCER RISK WITH LONG-TERM MCAS MEASURES

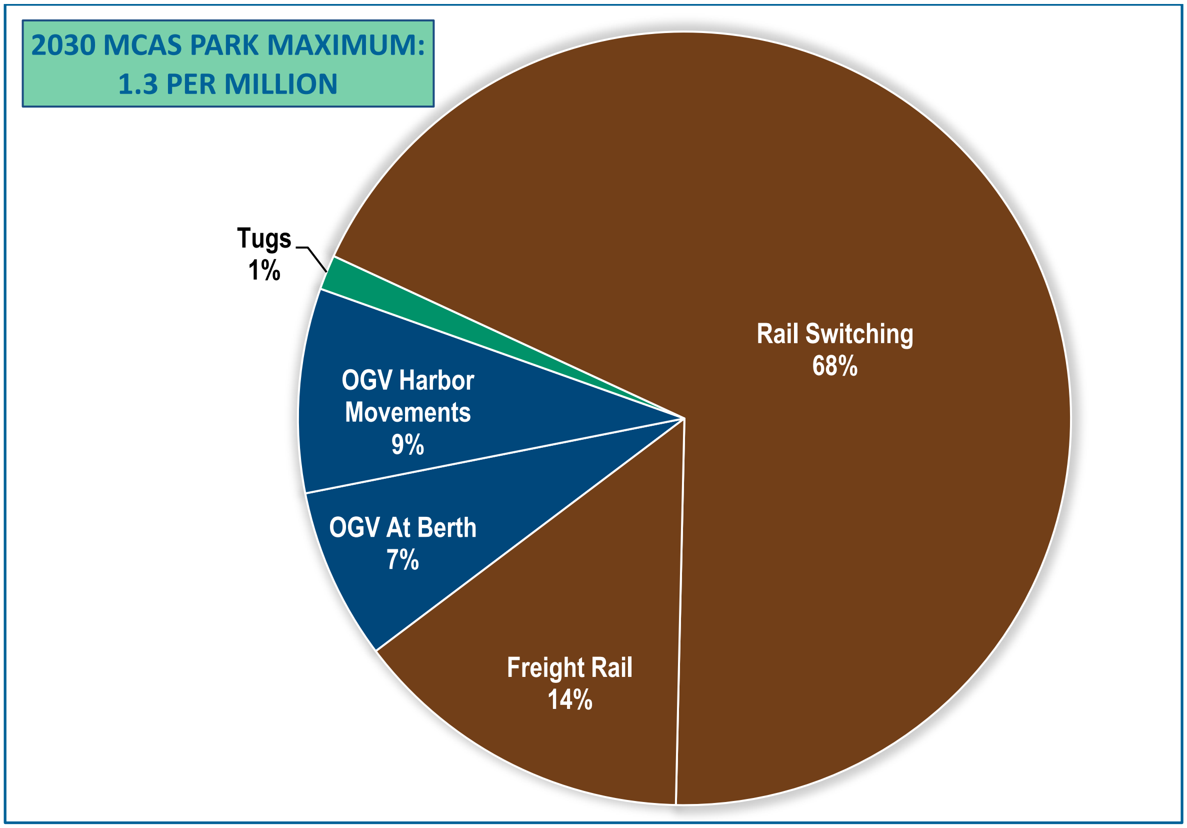


FIGURE D-19: FORECASTED 2030 MCAS PARK CANCER RISK CONTOUR MAP WITH LONG-TERM MCAS MEASURES

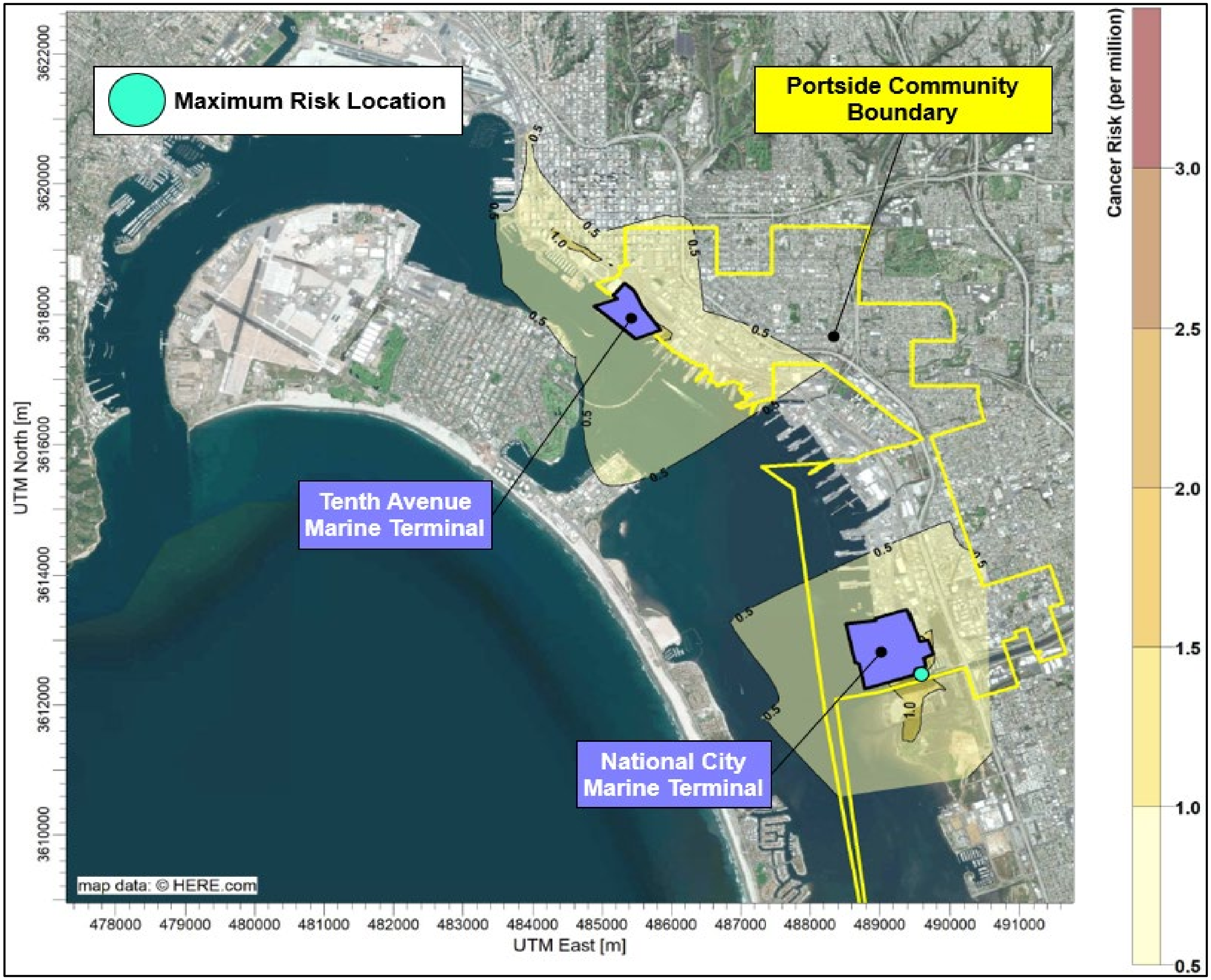
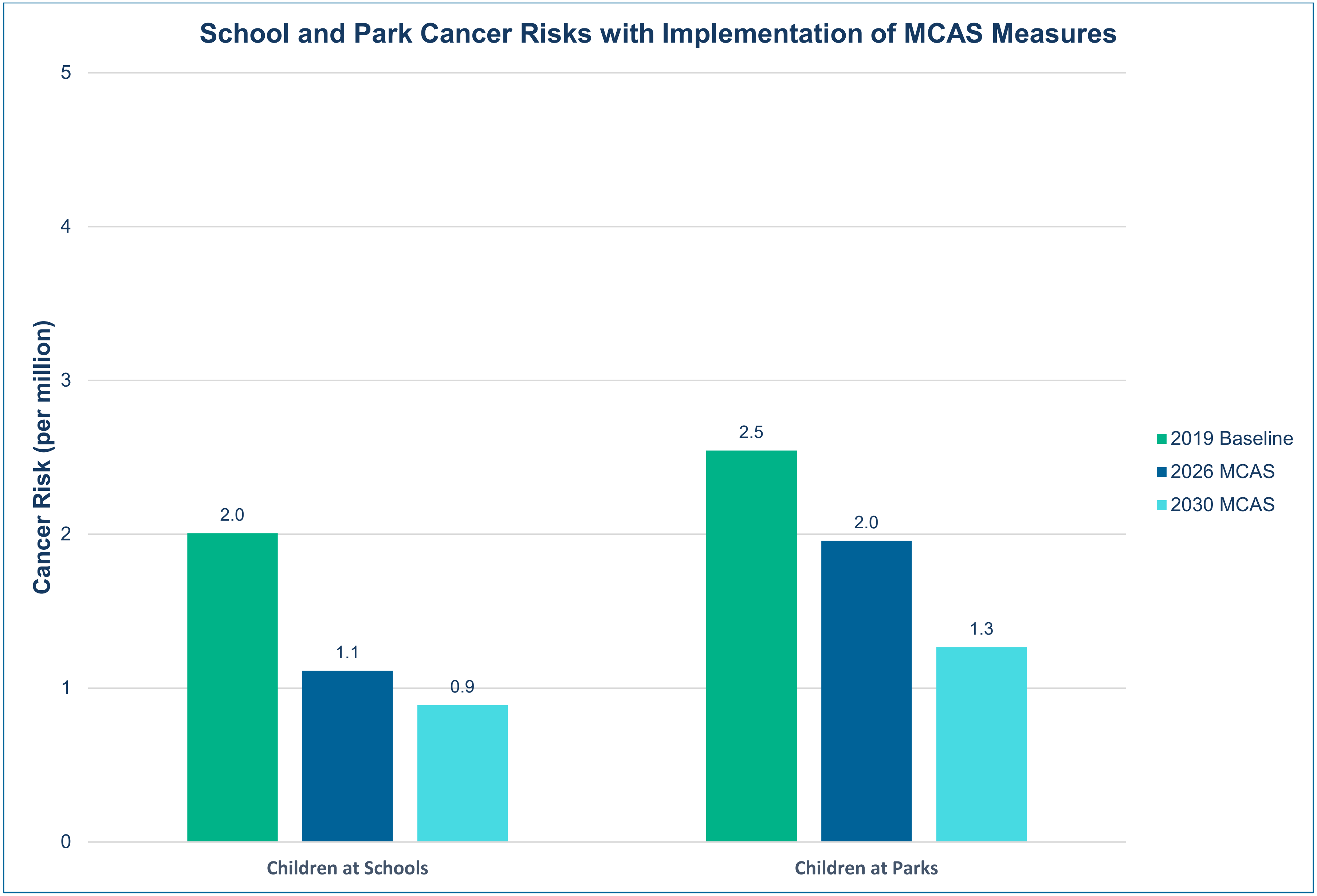


Figure D-20 shows the trend in maximum cancer risk for schools and parks assuming implementation of MCAS measures.

FIGURE D-20: MAXIMUM SCHOOL AND PARK CANCER RISK WITH IMPLEMENTATION OF MCAS MEASURES



Chronic (Non-Cancer) Risk

As discussed in Appendix C, chronic (non-cancer) risks were evaluated using the hazard quotient (HQ) approach. Chronic impacts were based on the average annual concentrations of DPM under each emissions scenario. OEHHA states that a hazard quotient value of 1.0 or less indicates that adverse health effects, such as incidence of cough, phlegm, chronic bronchitis, lung inflammation, and reductions in pulmonary function, are not expected to result from exposure to DPM emissions. The San Diego APCD further notes that if the HQ is below 1.0, then the estimated level of exposure is not likely to result in adverse health effects for anyone, including sensitive individuals such as children and the elderly.[26] **Table D-14** and **Table D-15** summarize maximum chronic (non-cancer) hazard quotients for residents and for children at schools and parks. All HQ values are significantly below 1.0; therefore, adverse health impacts are unlikely to occur.

TABLE D-14: MAXIMUM RESIDENTIAL CHRONIC HAZARD QUOTIENT BY COMMUNITY

	Chronic Hazard Quotient		
Community Area	**2019 Baseline**	**Forecasted 2026 MCAS**	**Forecasted 2030 MCAS**
Barrio Logan	0.005	0.003	0.003
Downtown	0.005	0.004	0.004
Coronado	0.004	0.003	0.002
National City	0.006	0.004	0.003

TABLE D-15: MAXIMUM SCHOOL AND PARK CHRONIC HAZARD QUOTIENT

	Chronic Hazard Quotient		
Receptor Type	**2019 Baseline**	**Forecasted 2026 MCAS**	**Forecasted 2030 MCAS**
Children at School	0.007	0.004	0.003
Children at Parks	0.011	0.008	0.005

[26] San Diego Air Pollution Control District. 2021. *2021 California Air Toxics "Hot Spots" Annual Report,* Background page 4. Available at: https://www.sdapcd.org/content/dam/sdapcd/documents/permits/air-toxics/2021-California-Air-Toxics-Hot-Spots-Annual-Report.pdf

Population-Weighted Cancer Risk

Table D-16 summarizes the population-weighted residential cancer risk results under the 2019 Baseline, with short-term (2026) MCAS measures and long-term (2030) MCAS measures. As discussed in Appendix C, the population-weighted risk analysis evaluated the potential cancer within the Portside Community based on census blocks rather than the maximum cancer risk at an individual residential location. **Figure D-21** shows the source contribution to the population-weighted residential cancer risk under each scenario.

TABLE D-16: 70-YEAR POPULATION-WEIGHTED RESIDENTIAL CANCER RISK

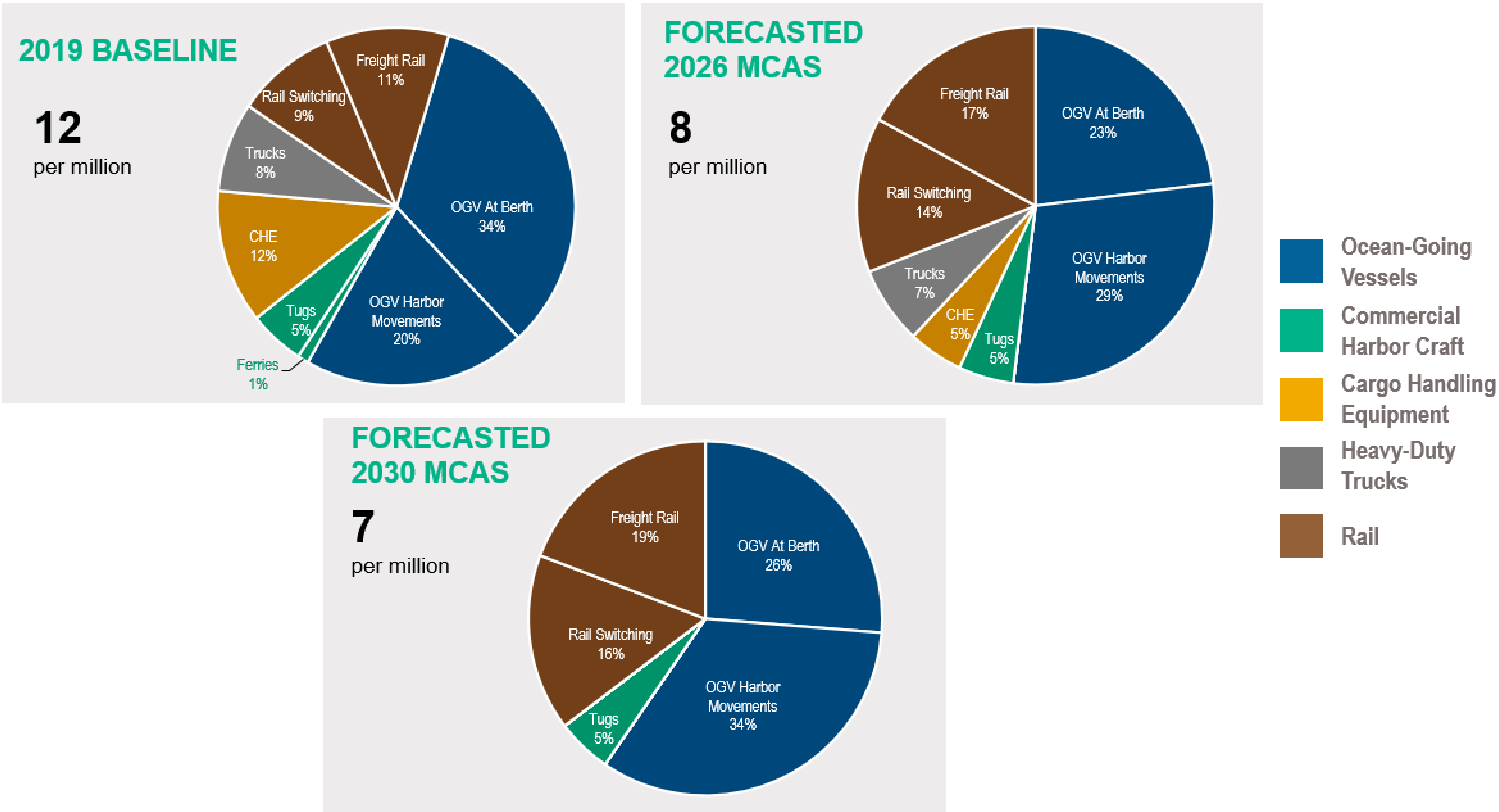
70-Year Population-Weighted Residential Cancer Risk		
2019 Baseline	**Forecasted 2026 MCAS**	**Forecasted 2030 MCAS**
12	8	7

In May 2022, CARB presented preliminary results for its *San Diego Regional & Portside Community Modeling*[27]*.* CARB's analysis evaluated cancer risk for areas within the Portside Community from exposure to DPM and other TACs including metals (e.g., chromium VI, lead) and volatile organic compounds (e.g., benzene, formaldehyde). CARB's analysis included TAC emissions from all major sources of emissions, including automobiles and trucks traveling on surface streets and freeways, permitted stationary and area sources, locomotives (freight and passenger rail), marine vessels, commercial harbor craft, and shipyards, as well as emissions from Mexico.

CARB's preliminary modeling resulted in a population-weighted cancer risk of approximately 700 per million for the Portside Community from exposure to DPM. As shown in **Table D-16**, the Port's highest population-weighted cancer risk of 12 per million from DPM exposure represents approximately 2% of CARB's population-weighted cancer risk.

[27] San Diego Air Pollution Control District, Portside Steering Committee Meetings:05/24/22 III. CARB SD Portside Risk Modeling. Available at: https://www.sdapcd.org/content/dam/sdapcd/documents/capp/meetings/portside-csc/052422/III.%20CARB%20SD%20Portside%20Risk%20Modeling_Eng.pdf.

FIGURE D-21: SOURCE CONTRIBUTION AS A PERCENTAGE TO POPULATION-WEIGHTED CANCER RISK RECEPTOR BY COMMUNITY FOR 2019 BASELINE AND WITH IMPLEMENTATION OF SHORT AND LONG-TERM MCAS MEASURES



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Appendix E Key Terms and Acronyms

Toxic Air Contaminants

Toxic air contaminants (TACs) are defined as air pollutants which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health.[28] CARB has identified over 200 TACs. Diesel Particulate Matter (DPM) was identified as a TAC in 1998 and is generally the most impactful TAC in urban areas. CARB estimates that about 70% of total known cancer risk related to air toxics in California is attributable to DPM.[29] More than 90% of DPM is less than 1 micron in diameter, and is attributed to adverse health effects, large part because of its small size. These health effects include cardiovascular and respiratory hospitalizations, and premature death. Note that while DPM contains a complex mixture of gases and solid particles, the potency factors developed and recommended by CARB and OEHHA are based on “whole diesel exhaust” (i.e., the sum of all of the gaseous and solid components). Thus, the DPM factors from OEHHA should be used as a surrogate for all TAC emissions from diesel-fueled compression-ignition internal combustion engines. Therefore, anticipated reductions in DPM emissions serve as a useful proxy for other TAC’s, particularly those associated with internal combustion engines.

Sensitive Receptors

Sensitive receptors are defined by CARB as members of the population that are most likely to be affected by air pollution: children younger than 14, the elderly older than 65, athletes, and people with cardiovascular and chronic respiratory diseases. Locations that may contain a high concentration of these sensitive population groups include residential areas, hospitals, daycare facilities, elder-care facilities, elementary schools, and parks. Most health studies indicate, and CARBs Air Quality and Land Use Handbook supports, that health effects are strongest within 1,000 feet of emission sources[30] with effects fading as the distance from emission sources increases. This HRA evaluates health impacts to residences, schools and parks because they may contain high concentrations of sensitive receptors within 1,000 feet of the marine terminals.

Cancer Risk

Cancer risk is defined as the probability of developing cancer if an individual is exposed continuously to a TAC(s) over an extended period of time. The duration of an individual’s exposure can vary depending on the scenario. For example, OEHHA recommends a 30-year exposure duration for residences. Since cancer risk is a probability, it is often expressed in chances per million people. For example, a cancer risk of one in one million means that in a population of one million people, not more than one additional person would be expected to develop cancer as the result of the exposure to the toxic air pollutant. For this HRA, when cancer risk is described or presented, the numerical value indicates the chances per million. For example, if the maximum cancer risk is 5, this indicates 5 chances per million. Additionally, the HRA evaluated cancer risk at individual receptor locations throughout the modeling grid, and identified the maximally exposed individual for each receptor type. For context, the maximum individual cancer risk threshold for stationary sources in San Diego APCD Rule 1210 is 10 in a million.

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[28] See OEHHA’s website, here: https://oehha.ca.gov/air/toxic-air-contaminants

[29] See CARB’s Diesel Exhaust and Health page, here: https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health

[30] See CARB’s Air Quality and Land Use Handbook, here: https://www.arb.ca.gov/ch/handbook.pdf

Chronic (Non-Cancer) Risk

For noncarcinogenic effects, dose-response data developed from animal or human studies are used to develop acute, 8-hour, and chronic noncancer Reference Exposure Levels (RELs). The acute, 8-hour and chronic RELs are defined as the concentration at which no adverse noncancer health effects are anticipated even in sensitive members of the general population, with infrequent one-hour exposures, repeated 8-hour exposures over a significant fraction of a lifetime, or continuous exposure over a significant fraction of a lifetime, respectively. The most sensitive health effect is chosen to develop the REL if the chemical affects multiple organ systems. Unlike cancer health effects, noncancer health effects are generally assumed to have thresholds for adverse effects. In other words, injury from a pollutant will not occur until exposure to that pollutant has reached or exceeded a certain concentration (i.e., threshold) and/or dose. The acute, 8-hour, and chronic RELs are air concentrations intended to be below the threshold for health effects for the general population.

Population-Weighted Cancer Risk

The OEHHA Guidelines recommends facilities with large emissions footprints such as ports, provide information on population-based health impacts since a large number of people may be exposed to the facility's emissions. Population-based risk is independent of individual risk and assumes that a population (not necessarily the same individuals) will live in the impacted zone over a 70-year period (OEHHA 2015). The population-based analysis incorporates census block and population data. Receptors are placed at the centroid of census blocks rather than individual receptors located at residential land uses. Population-weighted cancer risk is estimated by calculation the 70-year cancer risk for each census block, then the cancer risk of each census block is multiplied by the census block's population data, then these values are summed together and divided by the total population within the census blocks evaluated. To translate into chances per million, the resulting value is multiplied by one million. See Appendix C for further details.

Acronym	Description
A	Inhalation absorption factor
ACS	American Community Survey
AF	Adjustment Factor
AIS	Automatic Identification System
ASF	Age sensitivity factor
AT	Averaging time
Bay	San Diego Bay
BNSF	Burlington Northern Santa Fe Rail Company
CalEPA	California Environmental Protection Agency
CARB	California Air Resources Board
CCF	Cancer conversion factor
CF	Conversion factor
CHC	Commercial harbor craft
CHE	Cargo handling equipment
CPF	Cancer potency factor
CST	Cruise ship terminal
DBR	Daily breathing rate
DPM	diesel particulate matter
EF	Exposure frequency
EMFAC2021	Emission FACtor Model, version 2021
EPA	United States Environmental Protection Agency
FAH	Fraction of time at home
GIS	Geographic information systems
GLC	Ground level concentration
HI	Hazard index
HQ	Hazard quotient
HRA	Health risk assessment
I-15	Interstate Highway 15
I-5	Interstate Highway 5
MCAS	Maritime Clean Air Strategy

Acronym	Description
MEIR	Maximally exposed individual resident
MOU	memorandum of understanding
MSD	medium-speed diesel
NCMT	National City Marine Terminal
NED	National Elevation Dataset
nm	nautical miles
NOAA	National Oceanic and Atmospheric Administration
OEHHA	Office of Environmental Health Hazard Assessment
OGV	Ocean-going vessel
PM_{10}	particulate matter with a diameter of 10 microns or less
POLA	Port of Los Angeles
REL	Reference exposure level
RMP	Risk Management Policy
RoRo	Roll-on/Roll-off
San Diego APCD	San Diego County Air Pollution Control District
SSD	slow-speed diesel
TAC	toxic air contaminant
TAMT	Tenth Avenue Marine Terminal
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
VSR	Vessel Speed Reduction
ZE	Zero emission

Appendix F List of Preparers

Matthew McFalls, Senior Air Quality and Climate Change Manager

Ascent Environmental

Matthew is an experienced air quality professional with vast experience working on Port projects and performing and leading health risk assessments. Matthew has led air quality analyses for numerous projects at the Port of San Diego, including the Port Master Plan Update Environmental Impact Report (EIR), National City Bayfront Projects EIR, Fireworks EIR, National City Tank Farm EIR, Tenth Avenue Marine Terminal Redevelopment Plan EIR, Mitsubishi Cement Corporation EIR, and the San Diego Convention Center Phase III EIR. Matthew performed all of the emissions and HRA analysis tasks on the Tenth Avenue Marine Terminal Redevelopment Plan EIR and was ICF's lead author and lead technical specialist on the Maritime Clean Air Strategy (MCAS) as well as the 2016 Maritime Air Emissions Inventory. Matthew holds a Master of Science in Geography from the San Diego State University. Matthew was the Project Manager on this HRA.

Blake Barroso, Senior Technical Analyst

Environmental Review Partners, Inc

Blake is an experienced air quality professional with over five years of environmental consulting experience. Blake has experience conducting HRAs for a variety of projects in accordance with guidelines from the Office of Environmental Health Hazard Assessment (OEHHA). He is proficient with HRA modeling tools, which include air dispersion modeling software, AERMOD, and the suite of tools from the California Air Resources Board's (CARB) Hotspots Analysis and Reporting Program (HARP). Blake holds a Bachelor of Science degree in Environmental Science from California Lutheran University and a Master of Science degree in Civil Engineering from the University of Washington. He has also completed CARB's Intermediate training course on Health Risk Assessments. Blake was the lead analyst and modeler on this HRA.

Edward Carr, Technical Director Air Quality and Health Risk

ICF

Ed is a Technical Director of Air Quality Assessments at ICF. Ed is an expert modeler having completed multiple projects examining mobile source emissions contributions on air quality both for research studies and in regulatory support using a wide variety of emission and air quality models. During the past 15 years, Ed has conducted research and applications for project-level air quality analyses in more than a dozen cities that involved examination of a broad array of air pollutants, including particulate matter, air toxics, and diesel particulate matter. Ed performs research related to air quality modeling from mobile sources to better understand the formation of air pollutants at the micro to corridor scale and identify the sources that contribute to it. He has supported the Federal Highway Administration (FHWA), U.S. EPA, and National Cooperative Highway Research Program (NCHRP) in more than 20 studies over the past 30 years on mobile source emissions and near road exposure. Ed also led the air quality and health risk assessment for the San Pedro Waterfront Project at the Port of Los Angeles. Ed holds a Bachelor of Science in Meteorology from San Jose State University and a Master of Science in Atmospheric Science from the University of Washington, Seattle. Ed provided technical guidance and performed Quality Assurance/Quality Control on this HRA.

PORT of SAN DIEGO
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Updated Health Risk Assessment

Focusing on Diesel Particulate Matter at the District's Marine Cargo Terminals

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