

ATTACHMENT C

ANALYSES SUPPORTING THE PROPOSED 15-DAY CHANGES TO THE  
PROPOSED REGULATION

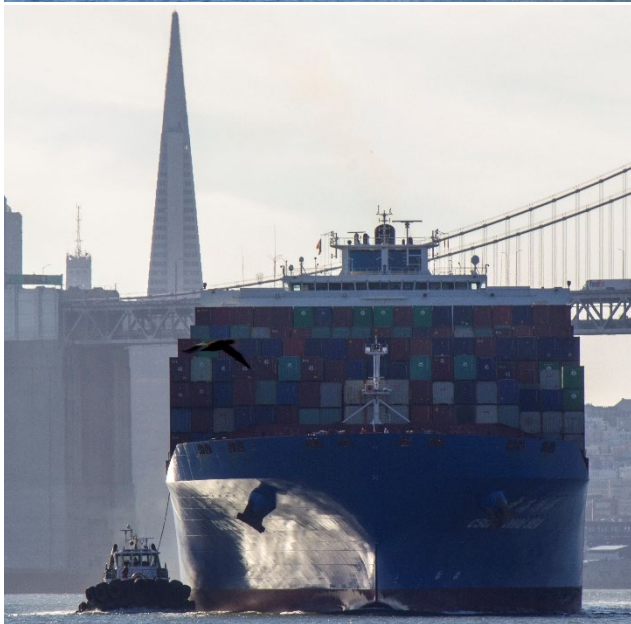
**UPDATES TO APPENDIX H: 2019 UPDATE TO INVENTORY FOR OCEAN-GOING  
VESSELS AT BERTH: METHODOLOGY AND RESULTS**

March 26, 2020

This attachment to the “Notice of Public Availability of Modified Text and Availability of Additional Documents and Information” related to Proposed At Berth Regulation is an update to Appendix H to the Initial Statement of Reasons (ISOR) supporting the Proposed Regulation released October 15, 2019. The tables and figures included in this attachment reflect the changes (15-day changes) to the Proposed At Berth Regulation and corrections to Appendix H. The information provided in this attachment also updates the emissions inventory information presented in Chapters V in the ISOR.

# Updates to Appendix H: 2019 Update to Inventory for Ocean-Going Vessels At Berth

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March 16, 2020

**1. Overview of suggested 15-day changes to the Proposed Regulation that impact emissions inventory and corrections to the Staff Report Appendix H.**

On October 15, 2019, California Air Resources (CARB) staff posted the Notice of Public Hearing and Proposed Control Measure for Ocean-Going Vessels at Berth Staff Report: Initial Statement of Reasons (ISOR). The ISOR included the Proposed Regulation Order (October 15, 2019, version) and Appendix H- 2019 Update to Inventory for Ocean-Going Vessels At Berth: Methodology and Results (Appendix H) that supports the October 15, 2019, version of the Proposed Regulation. CARB staff are proposing changes (15-day changes, dated March 16, 2020) to the Proposed Regulation. This document, Attachment C to the proposed 15-day changes, provides corrections to Appendix H and updates to the emissions inventory to reflect the 15-day changes. The corrections to Appendix H and updates from the 15-day changes do not include any updates or changes to inventory inputs or methodology. The table and figure numbers have been maintained from Appendix H and are labeled as “updated” to provide easier comparison with that document.

The proposed 15-day changes primarily impact the implementation dates for ro-ros and tankers and reflect increased emissions benefits due to earlier implementation of control requirements. The proposed implementation timeline in the 15-day changes is summarized in Table 22 (Updated).

Specifically, emissions control requirements for tankers would begin in 2025 at the Ports of Los Angeles and Long Beach (POLA, POLB) instead of 2027, with control requirements for the remainder of the tanker terminals statewide beginning in 2027 instead of 2029. Ro-ro vessel requirements begin in 2024 with an increase to regulated visits in 2025. The increase in regulated visits is due to a decrease in Terminal Incident Events (from 15 percent in 2024 to 5 percent in 2025).

**Table 22 (Updated): Implementation Timeline for the Proposed Regulation**

2021	2024	2025	2027
Container, Reefer, and Cruise			
	Ro-ro		
		Tankers - POLA/POLB* Terminals	
			Tankers – Remaining Statewide Terminals

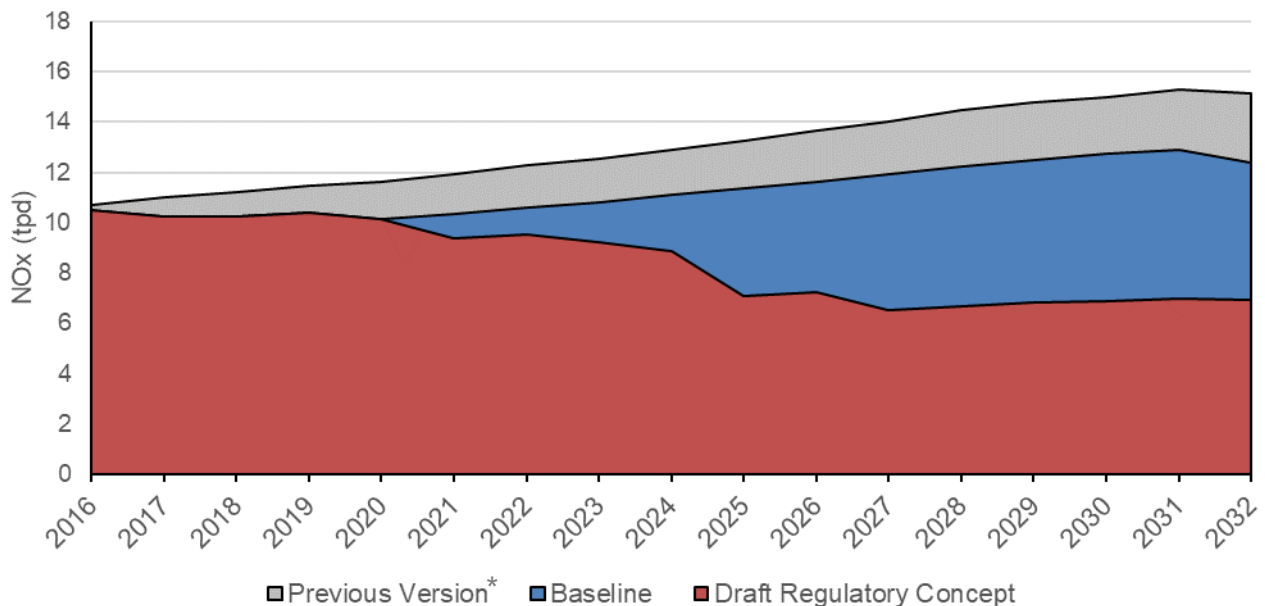
\* Port of Los Angeles (POLA), Port of Long Beach (POLB)

## 2. Summary of Estimated Emissions Benefits of the 15-Day Changes

The following charts show the emissions estimates in tons per day (tpd) for the 15-day changes version of the Proposed Regulation (identified as Draft Regulatory Concept in the charts) compared with the emissions estimates in tpd for the Baseline (Existing At Berth Regulation) and the Previous Version (2014 Emission Inventory baseline). At Berth emissions estimates for nitrogen oxides (NOx), particulate matter (PM) 2.5 and diesel PM (DPM) for the Existing At Berth Regulation are provided in Table 23a (Updated) and Table 23b (Updated). The emissions estimates for the 15-day changes version with the Proposed Regulation are provided in Table 24a (New) and Table 24b (New).

As shown in Figure 12 (Updated), statewide NOx emissions from at berth vessels are reduced in 2021 from container, cruise and refrigerated cargo vessels and 2024 from ro-ro vessels subject to the Proposed Regulation. Reductions also occur in 2025 and 2027 when implementation begins for tankers.

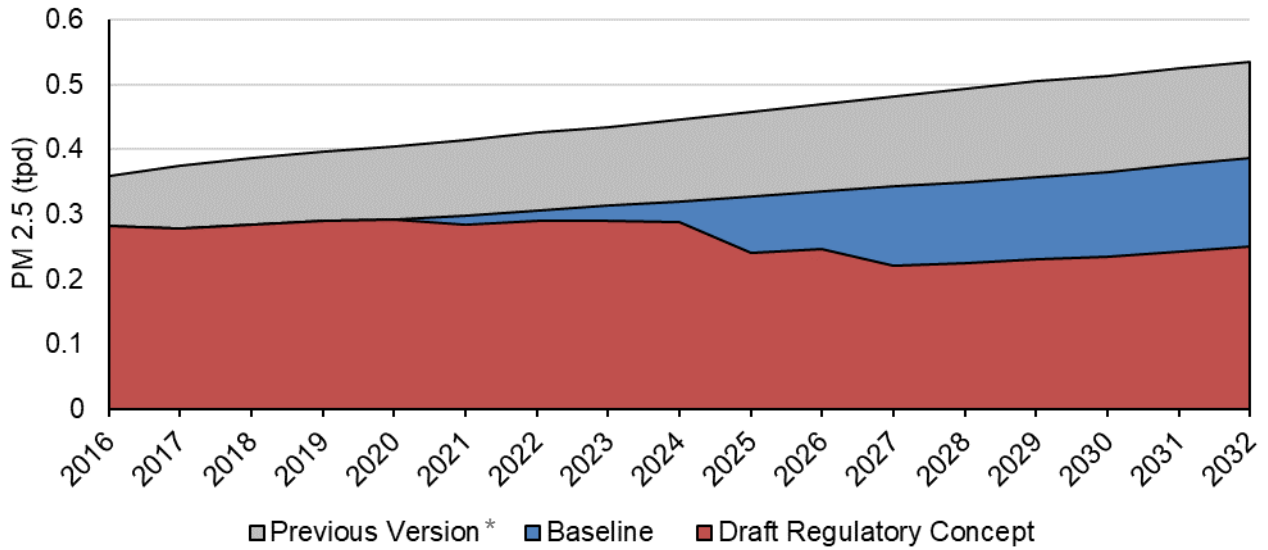
**Figure 12 (Updated): Statewide At Berth NOx Emissions**



\*Previous Version refers to 2014 Emissions Inventory Baseline (as discussed in ISOR Appendix H)

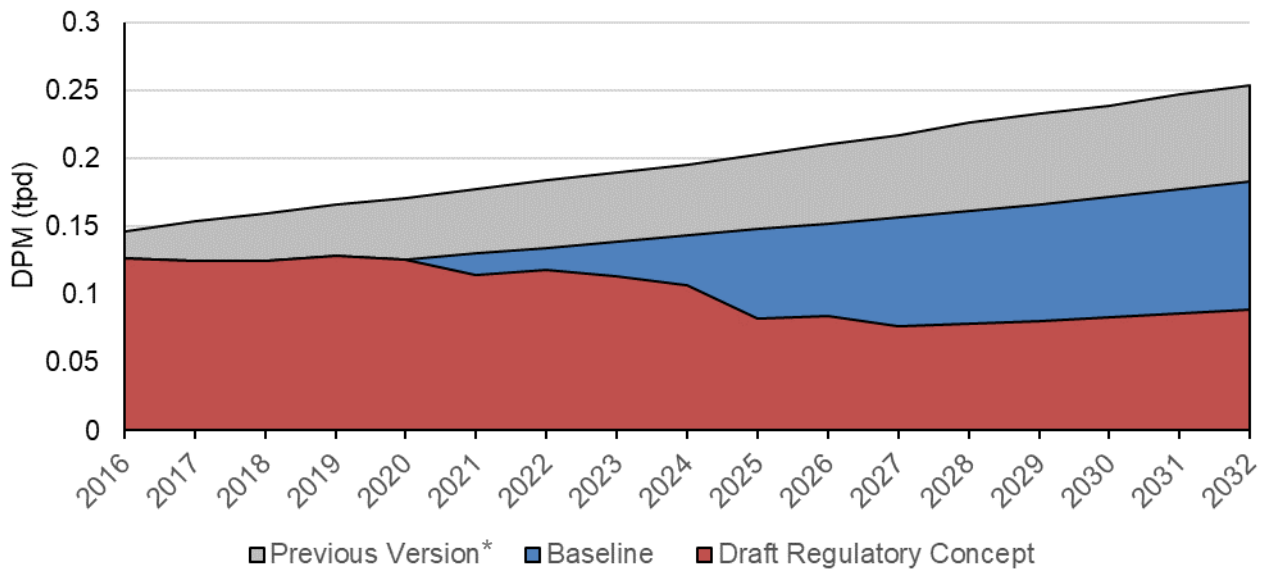
Similarly, statewide PM emissions from at berth vessels are shown for PM 2.5 in Figure 13 (Updated) and DPM in Figure 14 (Updated). The DPM emissions are those produced by diesel engines, and this excludes emissions from boilers.

**Figure 13 (Updated): Statewide At Berth PM 2.5 Emissions**



\*Previous Version refers to 2014 Emissions Inventory Baseline (as discussed in ISOR Appendix H)

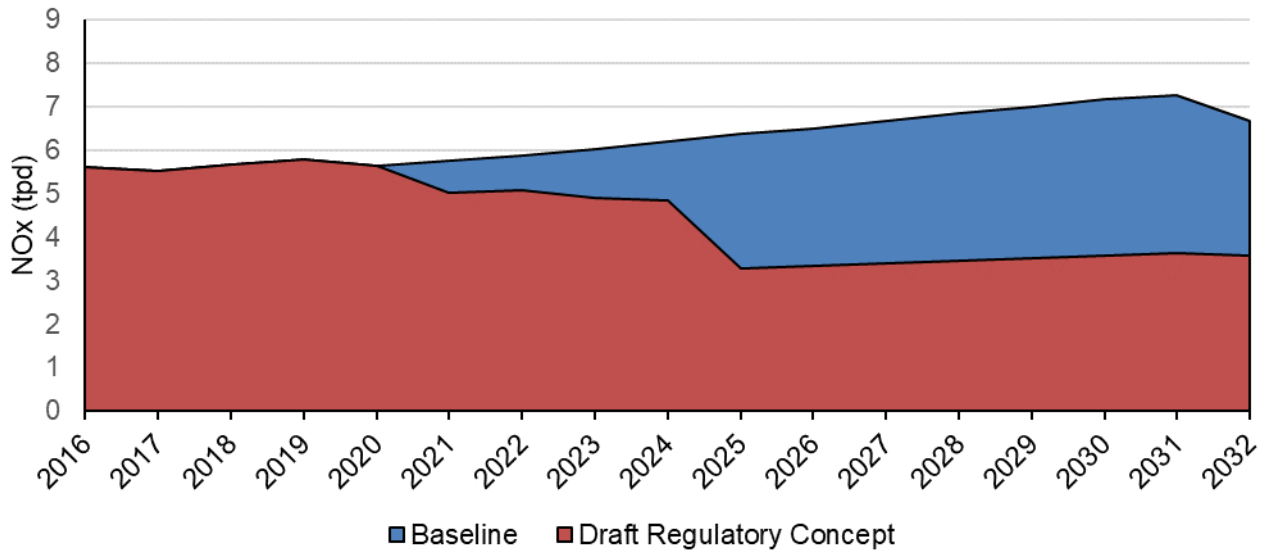
**Figure 14 (Updated): Statewide At Berth DPM Emissions**



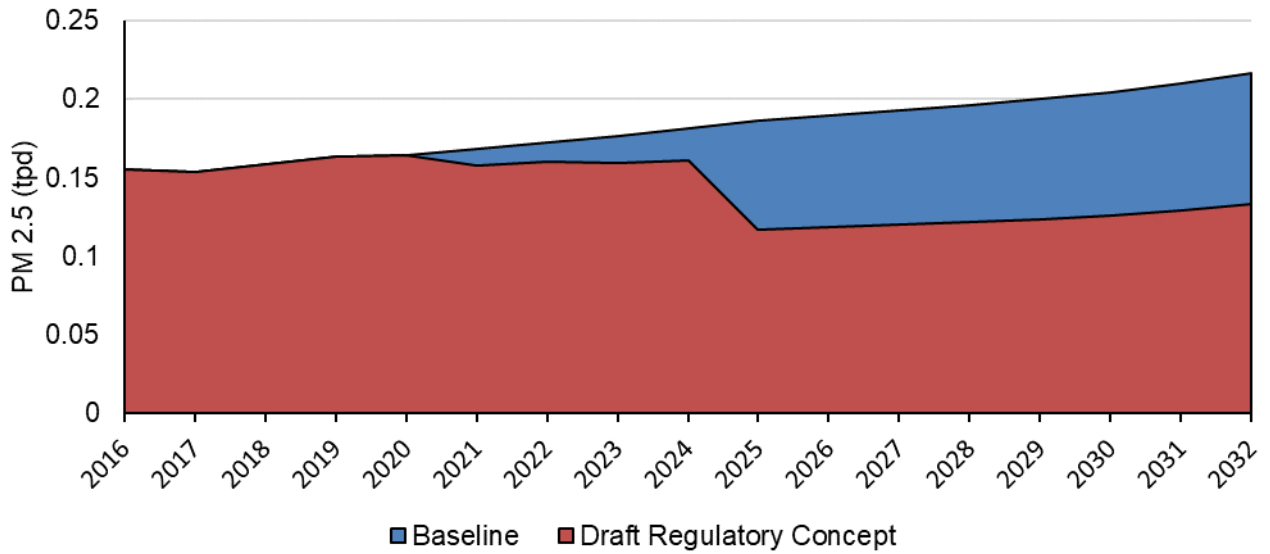
\*Previous Version refers to 2014 Emissions Inventory Baseline (as discussed in ISOR Appendix H)

Figure 15 (Updated) and Figure 16 (Updated) show the NO<sub>x</sub> and DPM emissions at POLA and POLB. Similarly, Figure 18 (Updated), Figure 19 (Updated) and Figure 20 (Updated) show the same information for the Port of Richmond Complex.

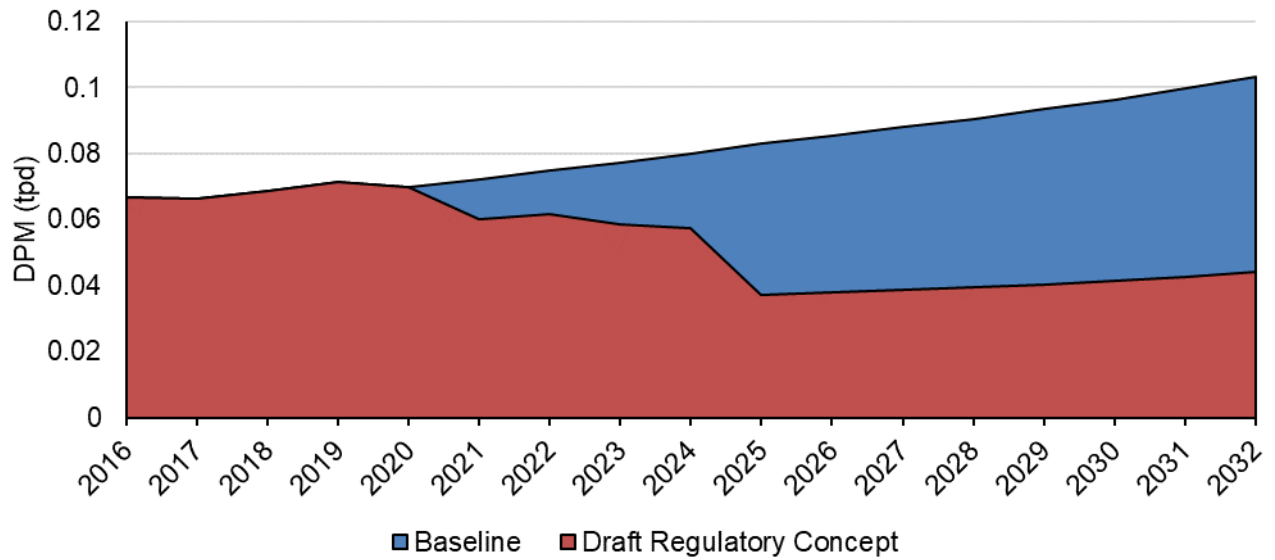
**Figure 15 (Updated): NOx Emissions Forecast At POLA and POLB**



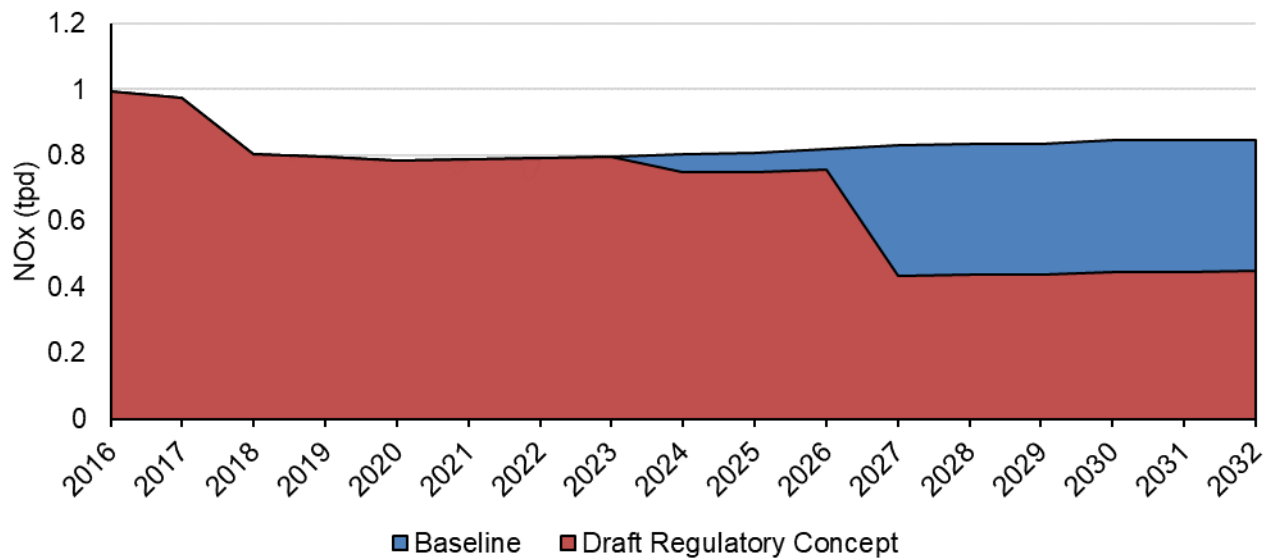
**Figure 16 (Updated): PM 2.5 Emission Forecast at POLA and POLB**



**Figure 17 (Updated): DPM Emission Forecast at POLA and POLB**

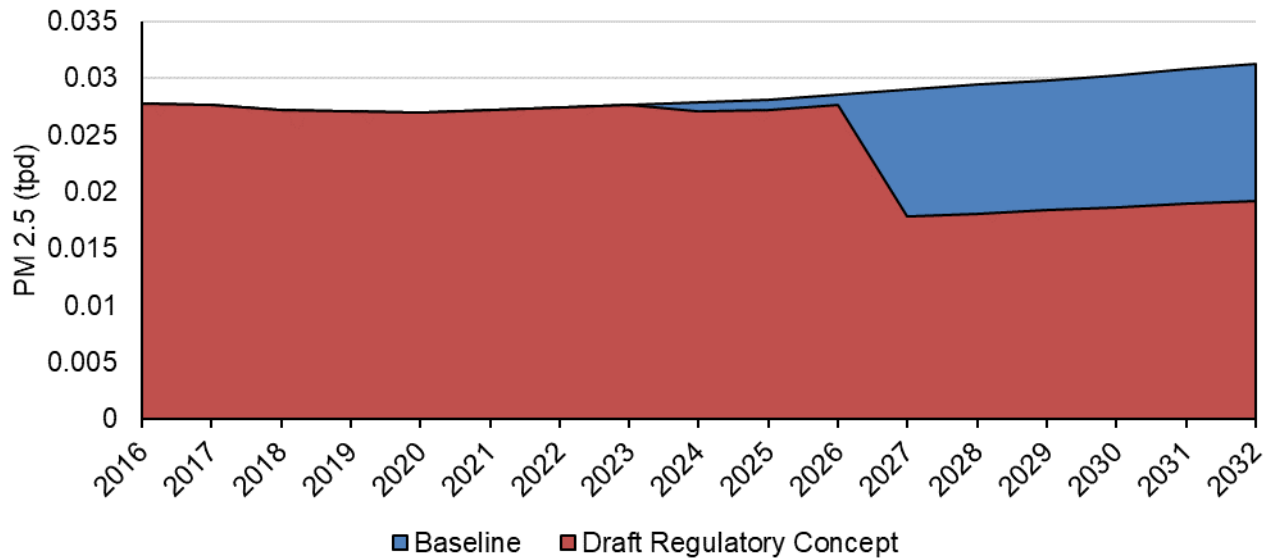


**Figure 18 (Updated): NOx Emission Forecast at the Port of Richmond Complex**

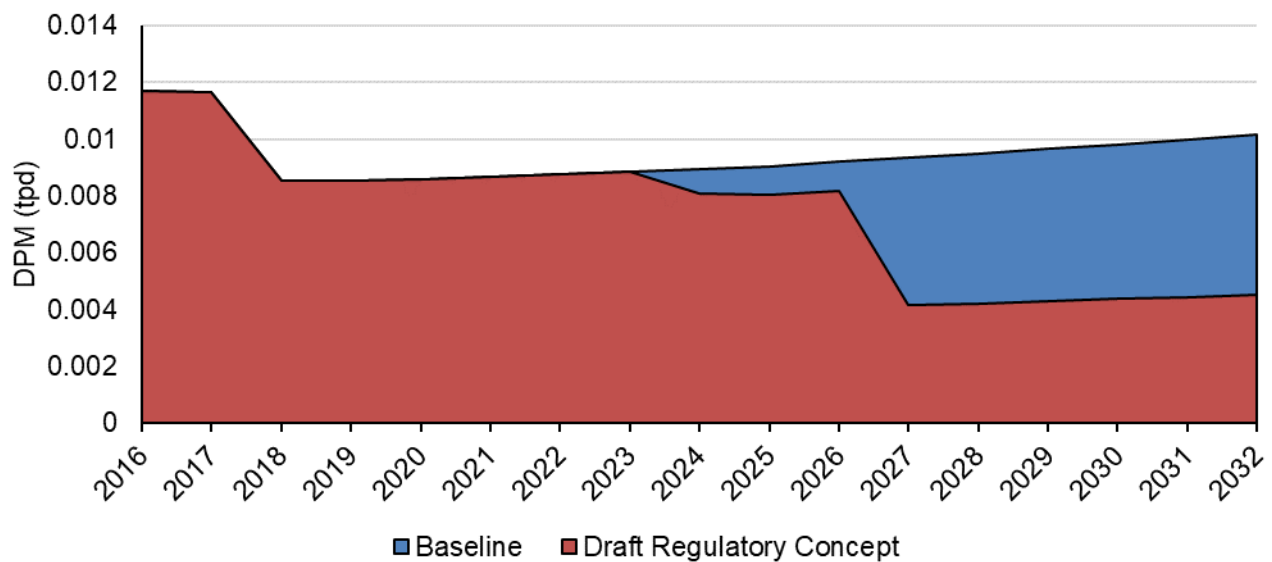




**Figure 19 (Updated): PM 2.5 Emission Forecast at the Port of Richmond Complex**



**Figure 20 (Updated): DPM Emission Forecast at the Port of Richmond Complex**



**3. Clarifications and Corrections to Appendix H to the Initial Statement of Reasons**

In Appendix H, Figures 12-20 incorrectly displayed emissions estimates for the Baseline and Draft Regulatory Concept. However, the baseline emissions estimates shown in Appendix H, Table 23 are correct. The tabulated baseline estimates have been included in this attachment (see Tables 23a and 23b (Updated) below) for ease of reference and emissions estimates for Richmond have been added to the table. In addition, Tables 25a and 25b (New) are included to provide corrected emissions estimates for the Draft Regulatory Concept in Appendix H (October 15, 2019, version of the Proposed

Regulation). Note that no updates have been made to the emissions methodology or data sources described in Appendix H.

In addition, Section 3.3. Effective Power (EP) has been corrected. A new table, Table 26 (New), has been added to clarify how the percentage of dead weight tonnage (DWT) of crude was determined for the suezmax vessels that visit Richmond. The strikeout/underline version is as follows:

For the Richmond area specifically, CARB also adjusted effective power for ~~Seawaymax~~ suezmax vessels based on data provided by Chevron Richmond Refinery illustrating unique operational characteristics of these vessels at the Richmond Complex. Chevron Richmond Refinery introduced two unique ~~Seawaymax~~ suezmax vessels into their operation in 2018. For these two vessels, the electrical generators that provide power to the pumps are coupled to steam turbines served by boilers, rather than auxiliary engines. Per the information provided by the Chevron Richmond Refinery, these two vessels account for 70 percent of their Richmond terminals crude deliveries. In the 2016 baseline data, ~~Seawaymax~~ suezmax visits account for ~~70~~77 percent of crude vessel capacity as can be seen in Table 26 (New). So based on this information, auxiliary engine effective power for ~~Seawaymax~~ suezmax vessels is set to zero during berth times. The effective power for boilers during this time is increased by the equivalent amount (based on the average effective power for ~~Seawaymax~~ suezmax auxiliary engines at Richmond, or 1,480 kilowatts (kW)), to reflect the increased load on the boilers providing electricity. This assumes equivalent efficiency for electricity generation between the auxiliary engines and the boiler-generator system. While we acknowledge that there are some differences in efficiency, data is lacking on boiler-generator system power generation efficiencies. Although this shift maintains the same overall power consumption, the main difference is the auxiliary engines produce DPM, while the boilers do not.<sup>1</sup>

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<sup>1</sup> Boilers produce particulate matter, but because the boilers do not have a compression ignition engine, these emissions are not treated as DPM.

**Table 23a (Updated): Statewide and Regional NOx, PM 2.5 and DPM At Berth Baseline Emissions Estimates (Existing At Berth Regulation)**

\*Note that the baseline emissions are the same in Appendix H and for the March 16, 2020 15-day changes emissions inventory

Calendar Year	Statewide			Bay Area			South Coast			Richmond		
	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)
2016	10.50	0.281	0.127	3.61	0.099	0.043	5.60	0.155	0.067	0.99	0.028	0.0117
2017	10.23	0.278	0.124	3.48	0.098	0.041	5.53	0.154	0.066	0.98	0.028	0.0117
2018	10.23	0.284	0.125	3.34	0.099	0.039	5.65	0.158	0.069	0.80	0.027	0.0085
2019	10.41	0.291	0.129	3.37	0.100	0.040	5.78	0.163	0.071	0.80	0.027	0.0086
2020	10.16	0.291	0.126	3.27	0.099	0.039	5.63	0.164	0.070	0.78	0.027	0.0086
2021	10.36	0.298	0.130	3.32	0.101	0.040	5.75	0.168	0.072	0.79	0.027	0.0087
2022	10.59	0.305	0.134	3.39	0.103	0.041	5.88	0.173	0.075	0.79	0.027	0.0088
2023	10.83	0.312	0.139	3.46	0.105	0.042	6.03	0.177	0.077	0.80	0.028	0.0088
2024	11.10	0.320	0.143	3.53	0.108	0.043	6.19	0.181	0.080	0.80	0.028	0.0089
2025	11.38	0.328	0.148	3.61	0.110	0.044	6.37	0.186	0.083	0.81	0.028	0.0090
2026	11.64	0.335	0.152	3.69	0.113	0.046	6.51	0.189	0.085	0.82	0.029	0.0092
2027	11.94	0.342	0.157	3.78	0.115	0.047	6.67	0.193	0.088	0.83	0.029	0.0093
2028	12.23	0.350	0.161	3.87	0.118	0.048	6.84	0.196	0.091	0.83	0.029	0.0095
2029	12.51	0.357	0.166	3.95	0.121	0.050	7.00	0.200	0.093	0.84	0.030	0.0096
2030	12.72	0.366	0.171	4.04	0.124	0.051	7.16	0.204	0.096	0.85	0.030	0.0098
2031	12.88	0.376	0.177	4.09	0.128	0.053	7.25	0.210	0.100	0.85	0.031	0.0100
2032	12.37	0.387	0.183	4.18	0.131	0.055	6.67	0.216	0.103	0.85	0.031	0.0102
2033	12.61	0.398	0.190	4.28	0.135	0.057	6.80	0.222	0.107	0.86	0.032	0.0103
2034	12.37	0.410	0.196	4.3	0.139	0.058	6.53	0.229	0.111	0.87	0.032	0.0105
2035	12.48	0.422	0.203	4.32	0.143	0.060	6.61	0.236	0.115	0.88	0.033	0.0107
2036	12.34	0.430	0.207	4.32	0.147	0.063	6.48	0.237	0.116	0.87	0.033	0.0109
2037	12.23	0.438	0.212	4.35	0.152	0.065	6.33	0.239	0.117	0.85	0.034	0.0111
2038	12.15	0.446	0.217	4.42	0.158	0.068	6.17	0.240	0.118	0.83	0.035	0.0114
2039	11.95	0.455	0.222	4.33	0.163	0.070	6.05	0.242	0.119	0.79	0.035	0.0116
2040	11.80	0.464	0.227	4.38	0.169	0.073	5.84	0.244	0.120	0.78	0.036	0.0118

**Table 23b: Statewide ROG, and GHG At Berth Baseline Emissions Estimates (Existing At Berth Regulation)**

Calendar Year	Statewide	
	ROG (tpd)	GHG (CO <sub>2</sub> eq)
2016	0.48	551,000
2017	0.47	546,000
2018	0.48	559,000
2019	0.50	571,000
2020	0.49	574,000
2021	0.50	588,000
2022	0.52	601,000
2023	0.53	614,000
2024	0.55	629,000
2025	0.56	643,000
2026	0.58	656,000
2027	0.59	669,000
2028	0.61	683,000
2029	0.62	697,000
2030	0.64	712,000
2031	0.66	732,000
2032	0.68	752,000
2033	0.70	773,000
2034	0.73	795,000
2035	0.75	818,000
2036	0.77	833,000
2037	0.78	848,000
2038	0.80	864,000
2039	0.82	880,000
2040	0.83	897,000

**Table 24a (New): Statewide and Regional NOx, PM 2.5 and DPM At Berth Emissions for the 15-Day Change  
Version of the Draft Regulatory Concepts (March 16, 2020 Version)**

Calendar Year	Statewide			Bay Area			South Coast			Richmond		
	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)
2016	10.50	0.281	0.127	3.61	0.099	0.043	5.6	0.155	0.067	0.99	0.028	0.0117
2017	10.23	0.278	0.124	3.48	0.098	0.041	5.53	0.154	0.066	0.98	0.028	0.0117
2018	10.23	0.284	0.125	3.34	0.099	0.039	5.65	0.158	0.069	0.80	0.027	0.0085
2019	10.41	0.291	0.129	3.37	0.100	0.040	5.78	0.163	0.071	0.80	0.027	0.0086
2020	10.16	0.291	0.126	3.27	0.099	0.039	5.63	0.164	0.070	0.78	0.027	0.0086
2021	9.38	0.284	0.115	3.09	0.098	0.036	5.01	0.157	0.060	0.79	0.027	0.0087
2022	9.54	0.290	0.118	3.15	0.100	0.037	5.09	0.160	0.062	0.79	0.027	0.0088
2023	9.24	0.289	0.113	3.02	0.099	0.035	4.91	0.160	0.059	0.80	0.028	0.0088
2024	8.88	0.287	0.107	2.95	0.099	0.034	4.84	0.161	0.058	0.75	0.027	0.0081
2025	7.10	0.241	0.083	2.76	0.098	0.031	3.29	0.116	0.037	0.75	0.027	0.0080
2026	7.24	0.245	0.085	2.82	0.100	0.032	3.35	0.118	0.038	0.76	0.028	0.0082
2027	6.53	0.220	0.077	2.05	0.073	0.023	3.40	0.120	0.039	0.43	0.018	0.0042
2028	6.67	0.225	0.079	2.11	0.075	0.024	3.46	0.121	0.039	0.44	0.018	0.0042
2029	6.81	0.230	0.081	2.16	0.077	0.024	3.53	0.123	0.040	0.44	0.018	0.0043
2030	6.87	0.235	0.083	2.21	0.079	0.025	3.58	0.125	0.041	0.44	0.019	0.0044
2031	6.97	0.242	0.086	2.25	0.082	0.026	3.63	0.129	0.043	0.45	0.019	0.0044
2032	6.94	0.250	0.089	2.30	0.084	0.027	3.57	0.133	0.044	0.45	0.019	0.0045
2033	7.08	0.257	0.092	2.36	0.087	0.028	3.65	0.138	0.046	0.45	0.020	0.0046
2034	7.08	0.265	0.095	2.40	0.089	0.029	3.61	0.142	0.047	0.46	0.020	0.0047
2035	7.16	0.274	0.098	2.42	0.092	0.030	3.67	0.147	0.049	0.47	0.020	0.0048
2036	7.12	0.280	0.101	2.45	0.095	0.031	3.60	0.148	0.049	0.47	0.021	0.0049
2037	7.11	0.285	0.104	2.50	0.099	0.032	3.54	0.149	0.050	0.46	0.021	0.0050
2038	7.10	0.292	0.106	2.55	0.102	0.034	3.47	0.150	0.051	0.45	0.021	0.0051
2039	7.02	0.298	0.110	2.52	0.106	0.035	3.41	0.151	0.051	0.44	0.022	0.0052
2040	7.01	0.305	0.113	2.57	0.110	0.036	3.34	0.152	0.052	0.44	0.022	0.0053

**Table 24b (New): Statewide ROG, and GHG At Berth Emissions for the 15-Day Change Version of the Draft Regulatory Concepts (March 16, 2020 Version)**

Calendar Year	Statewide	
	ROG (tpd)	GHG (CO <sub>2</sub> eq)
2016	0.48	551,000
2017	0.47	546,000
2018	0.48	559,000
2019	0.49	571,000
2020	0.49	574,000
2021	0.46	569,000
2022	0.47	580,000
2023	0.46	582,000
2024	0.44	596,000
2025	0.36	604,000
2026	0.36	614,000
2027	0.33	635,000
2028	0.34	646,000
2029	0.34	658,000
2030	0.35	670,000
2031	0.36	687,000
2032	0.38	704,000
2033	0.39	722,000
2034	0.40	740,000
2035	0.41	760,000
2036	0.42	773,000
2037	0.43	787,000
2038	0.45	802,000
2039	0.46	817,000
2040	0.47	832,000

**Table 25a (New): Corrections to Appendix H for Statewide and Regional NOx, PM 2.5 and DPM At Berth Emissions for the Draft Regulatory Concept (October 15, 2019 Version)**

Calendar Year	Statewide			Bay Area			South Coast			Richmond		
	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)	NOx (tpd)	PM 2.5 (tpd)	DPM (tpd)
2016	10.50	0.281	0.127	3.61	0.099	0.043	5.60	0.155	0.067	0.99	0.028	0.0117
2017	10.23	0.278	0.124	3.48	0.098	0.041	5.53	0.154	0.066	0.98	0.028	0.0117
2018	10.23	0.284	0.125	3.34	0.099	0.039	5.65	0.158	0.069	0.80	0.027	0.0085
2019	10.41	0.291	0.129	3.37	0.100	0.040	5.78	0.163	0.071	0.80	0.027	0.0086
2020	10.16	0.291	0.126	3.27	0.099	0.039	5.63	0.164	0.070	0.78	0.027	0.0086
2021	9.38	0.284	0.115	3.09	0.098	0.036	5.01	0.157	0.060	0.79	0.027	0.0087
2022	9.54	0.290	0.118	3.15	0.100	0.037	5.09	0.160	0.062	0.79	0.027	0.0088
2023	9.24	0.289	0.113	3.02	0.099	0.035	4.91	0.160	0.059	0.80	0.028	0.0088
2024	9.43	0.295	0.116	3.08	0.101	0.036	5.01	0.163	0.060	0.80	0.028	0.0089
2025	8.11	0.278	0.094	2.76	0.098	0.031	4.31	0.154	0.048	0.75	0.027	0.0080
2026	8.26	0.283	0.096	2.82	0.100	0.032	4.37	0.156	0.049	0.76	0.028	0.0082
2027	7.39	0.250	0.087	2.88	0.102	0.033	3.40	0.120	0.039	0.77	0.028	0.0083
2028	7.54	0.255	0.089	2.94	0.105	0.033	3.46	0.121	0.039	0.77	0.028	0.0084
2029	6.81	0.230	0.081	2.16	0.077	0.024	3.53	0.123	0.040	0.44	0.018	0.0043
2030	6.87	0.235	0.083	2.21	0.079	0.025	3.58	0.125	0.041	0.44	0.019	0.0044
2031	6.97	0.242	0.086	2.25	0.082	0.026	3.63	0.129	0.043	0.45	0.019	0.0044
2032	6.94	0.250	0.089	2.30	0.084	0.027	3.57	0.133	0.044	0.45	0.019	0.0045
2033	7.08	0.257	0.092	2.36	0.087	0.028	3.65	0.138	0.046	0.45	0.020	0.0046
2034	7.08	0.265	0.095	2.40	0.089	0.029	3.61	0.142	0.047	0.46	0.020	0.0047
2035	7.16	0.274	0.098	2.42	0.092	0.030	3.67	0.147	0.049	0.47	0.020	0.0048
2036	7.12	0.280	0.101	2.45	0.095	0.031	3.60	0.148	0.049	0.47	0.021	0.0049
2037	7.11	0.285	0.104	2.50	0.099	0.032	3.54	0.149	0.050	0.46	0.021	0.0050
2038	7.10	0.292	0.106	2.55	0.102	0.034	3.47	0.150	0.051	0.45	0.021	0.0051
2039	7.02	0.298	0.110	2.52	0.106	0.035	3.41	0.151	0.051	0.44	0.022	0.0052
2040	7.01	0.305	0.113	2.57	0.110	0.036	3.34	0.152	0.052	0.44	0.022	0.0053

**Table 25b (New): Corrections to Appendix H for Statewide ROG, and GHG At Berth Emissions for the Draft Regulatory Concept (October 15, 2019 Version)**

Calendar Year	Statewide	
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2016	0.48	551,000
2017	0.47	546,000
2018	0.48	559,000
2019	0.49	571,000
2020	0.49	574,000
2021	0.46	569,000
2022	0.47	580,000
2023	0.46	582,000
2024	0.47	594,000
2025	0.41	589,000
2026	0.42	599,000
2027	0.37	624,000
2028	0.38	635,000
2029	0.34	658,000
2030	0.35	670,000
2031	0.36	687,000
2032	0.38	704,000
2033	0.39	722,000
2034	0.40	740,000
2035	0.41	760,000
2036	0.42	773,000
2037	0.43	787,000
2038	0.45	802,000
2039	0.46	817,000
2040	0.47	832,000



**Table 26 (New) : Richmond Crude Tanker Total DWT of Visits**

<b>Tanker Subtype</b>	<b>Size Bin</b>	<b>Sum Of DWT</b>	<b>Percent of Total DWT</b>
Crude Oil Tanker	Panamax	559,825	2%
Crude Oil Tanker	Aframax	2,490,215	11%
Crude Oil Tanker	Suezmax	17,349,995	77%
Crude/Oil Products Tanker	Seawaymax	692,526	3%
Crude/Oil Products Tanker	Panamax	1,244,146	6%
Crude/Oil Products Tanker	Aframax	220,954	1%
	<b>Total</b>	<b>22,557,661</b>	