Blue Whales Blue Skies VSR Program - Air Emission Benefits Methodology

2023 Season

Background and Summary

The Blue Whales Blue Skies (BWBS) Vessel Speed Reduction (VSR) Program began as a trial in 2014 and it has been growing with each successful iteration. A summary table of the various program expansions is shown below, demonstrating the additional zones, extended request durations, and applicable vessels that have been invited to participate in the program.

Table 1: Summary of BWBS VSR Expansions

VSR Season	Duration	Basis	Speed Target	Vessel Applicability	Zones
2014	4 months	Transit	12 knots	Containerships & Auto Carriers	Santa Barbara (SB) Channel
2016	4.5 months	Transit	10-12 knots	---	Add south of Channel Islands
2017	4.5 months	Transit	10-12 knots	---	Add San Francisco (SF) lanes
2018	4.5 months	Fleet	10 knots	---	---
2019	6 months	Fleet	10 knots	---	---
2020	6 months	Fleet	10 knots	---	Add POLA/POLB zones (Southern California)
2021	6 months	Fleet	10 knots	---	---
2022	7.5 months	Fleet	10 knots	Add Bulk & General Cargo	Add Greater Farallones & Cordell Bank NMS (SF zones)
2023	7.5 months	Fleet	10 knots	Add Tankers	Add Monterey Bay NMS

Emission benefits for each VSR season are estimated by looking at the difference in emissions between each participating vessel at its baseline speed and the actual emissions based on the VSR compliant speed observed during the season. For the first few years of the program, containerships and auto carriers were invited to participate if the historic, baseline speed of the specific vessel within the Santa Barbara Channel or San Francisco Bay Area zones was high. At that time, limited funds were available for financial incentives, and so the focus of the program was on reducing the speed of the fastest ships in the region based on transit-specific data for the prior years.

However, with the expansion of the 2018 VSR program to include all vessel activities under an enrolled company, the time intensive process of determining emission reductions based on historical transit-specific speeds of each vessel was no longer practical. This document outlines the updated "fleet-based" methodology, which accounts for the normal operating speed of all vessels within a ship sector based on the 2016 and 2017 baseline "non-VSR speeds."

Baseline (Non-VSR) Speed Datasets

For the Santa Barbara Channel and San Francisco Bay Area regions, AIS (Automatic Identification System) data was obtained for vessel activities within each zone for calendar years 2016 and 2017. Vessel activities within the months of May through November were removed to prevent any bias from previous BWBS VSR programs and from the NOAA requests for all vessels 300 gross tons or larger to slow down to 10 knots or less.

In 2020, the BWBS program expanded to include the Port of Los Angeles (POLA) and Port of Long Beach (POLB) 40 nautical mile VSR zone in Southern California. Permission was obtained to analyze the 2016 and 2017 calendar year Marine Exchange (MarEx) vessel speeds, which are based on AIS data, to help establish BWBS baseline speeds in these zones. Since these Ports have existing VSR programs to slow down to 12 knots or less, and the programs have been in effect year-round since 2001 with a high level of cooperation, no months were excluded from the baseline speed calculations for this zone.

In 2022 and 2023, the BWBS program expanded to include the three National Marine Sanctuaries in the San Francisco Bay Area. For these zones, a similar AIS analysis was performed using 2017 calendar year data. Data in the months of May through November were removed for the Cordell Bank and Greater Farallones NMS to prevent any bias from the NOAA requests to slow down to 10 knots or less. The Monterey Bay NMS did not participate in the NOAA requests in 2017, and so no data was excluded from the analysis for the MBNMS zone.

Speed Correction Factors (SCFs)

Each dataset was used to estimate average speed correction factors of each vessel type in each zone, with containerships further classified by TEU (Twenty-foot Equivalent Unit) capacity. Using the IHS database (formerly known as Lloyd's Registry), each vessel type had its engine and operating specifications reviewed to determine an average maximum rated speed. These maximum rated speeds are shown in Table 2 below.

Table 2 – Average Max Rated Speed, by Vessel Type

Vessel Type	Vessel Size	Avg. Max Rated Speed (knots)
Auto & RoRo	All	19.8
Containership (small)	1,000 - 5,000 TEU	22.5
Containership (medium)	6,000 - 9,000 TEU	24.8
Containership (large)	10,000+ TEU	24.1
Bulk	All	15.0
General Cargo	All	16.0
Tanker	All	15.0

Speed Correction Factors are then calculated for each vessel type in each VSR zone to address the different operating speeds in each zone. SCFs were calculated for all ships in the 2016 and 2017 data sets based on Equation 1 below, and these SCFs were then averaged together. The calculated SCFs for each vessel type for the BWBS VSR zones are presented below in Tables 3 and 4, and the corresponding maps to demonstrate the zone boundaries are included in Appendix A and B at the end of this document.

Equation 1: Establishing Average SCF, by Vessel Type

$$(SCF)_{\text{avg vessel-zone}} = \frac{(\text{Non-VSR speed})_{\text{vessel-zone, in knots}}}{(\text{Maximum rated speed})_{\text{vessel, in knots}}}$$

Table 3: Southern California SCFs, by Vessel Type

Vessel Type	VSR Zone			
	Santa Barbara Channel	POLA/POLB Arrival (North & South)	POLA/POLB Departure & Inside 40 nm	Outside POLA/POLB 40 nm
Auto & RoRo	0.66	0.47	0.53	0.73
Containership (small)	0.63	0.47	0.50	0.69
Containership (medium)	0.62	0.43	0.47	0.59
Containership (large)	0.58	0.42	0.46	0.63
Bulk	0.82	0.73	0.75	0.82
General Cargo	0.76	0.70	0.74	0.80
Tanker	0.80	0.70	0.74	0.75

Table 4: Bay Area SCFs, by Vessel Type

Vessel Type	VSR Zone		
	SF Lane Arrival	SF Lane Departure	Expanded Sanctuaries (CB, GF, and MBNMS)
Auto & RoRo	0.57	0.77	0.73
Containership (small)	0.57	0.70	0.63
Containership (medium)	0.52	0.62	0.60
Containership (large)	0.52	0.62	0.59
Bulk	0.71	0.81	0.78
General Cargo	0.66	0.79	0.78
Tanker	0.71	0.75	0.79

In the San Francisco Bay Area and POLA/POLB IMO-designated lanes, SCFs were analyzed based on trip direction (arrival or departure) since vessels in these zones tend to travel at higher speeds after departing from the nearby port (as compared to the arrival leg near the port). Additional parameters for the inbound and outbound determinations are listed below:

- SCFs within the POLA/POLB 40 nautical mile VSR zone were averaged for the Northern route, while SCFs for the Southern route were averaged out to 25 nautical miles in order to stay consistent with the area that is included as part of the BWBS VSR Program.
- Due to the lack of IMO-approved shipping lanes for the POLA/POLB Western route, no adjustments were made to account for differences between inbound and outbound speeds on this route. All speed data for the Western route was comparable to and incorporated into the POLA/POLB departure routes.

- In 2023, vessels were requested to prioritize use of the western traffic lane of the San Francisco TSS (Traffic Separation Scheme). Due to this request and other routing behavior changes since 2017, the SCFs for the Northern, Western, and Southern IMO-designated lanes for the Bay Area were averaged together.
- The Santa Barbara Channel and remaining VSR zones are in open water and cover a greater distance, so vessel speed has not been observed to correlate to transit direction to nearby ports.

In summary, SCFs were averaged by vessel type, VSR zone, and in the case of the Bay Area and POLA/POLB IMO lanes, direction. Note that there are some zones, such as the SF Precautionary Area and the POLA/POLB Precautionary Area, in which the program records cooperation with the slow-speed requests, but speed correction factors and emission calculations are not performed because the BWBS program most likely did change ship behavior in these zones or the emission reductions would be negligible. For the ATBAs (Areas To Be Avoided), no emission benefits are calculated because the program requests the vessels to avoid these areas.

VSR Program Emissions Benefit Calculations

For a fleet that complied with the VSR program requirements, the program estimates the baseline speed for each participating vessel in each zone using the SCFs defined in the previous section. The baseline speeds are calculated using the following equation:

Equation 2: Determining Specific Vessel Baseline Speeds

$$(\text{Baseline Speed})_{\text{vessel-zone}} = (\text{Max Rated Speed})_{\text{vessel}} * (\text{SCF})_{\text{avg vessel-zone}}$$

The emissions for each specific ship are then calculated at both the baseline speed and the observed VSR speed for each transit during the season that complies with the VSR program requirements. Vessels often travel through multiple zones on each transit, and so the example below demonstrates a scenario with the various baseline and observed speeds for the entire trip.

Example: MSC Eleni

[IMO #9278143; Small Containership with a Max Rated Speed of 24.3 knots]

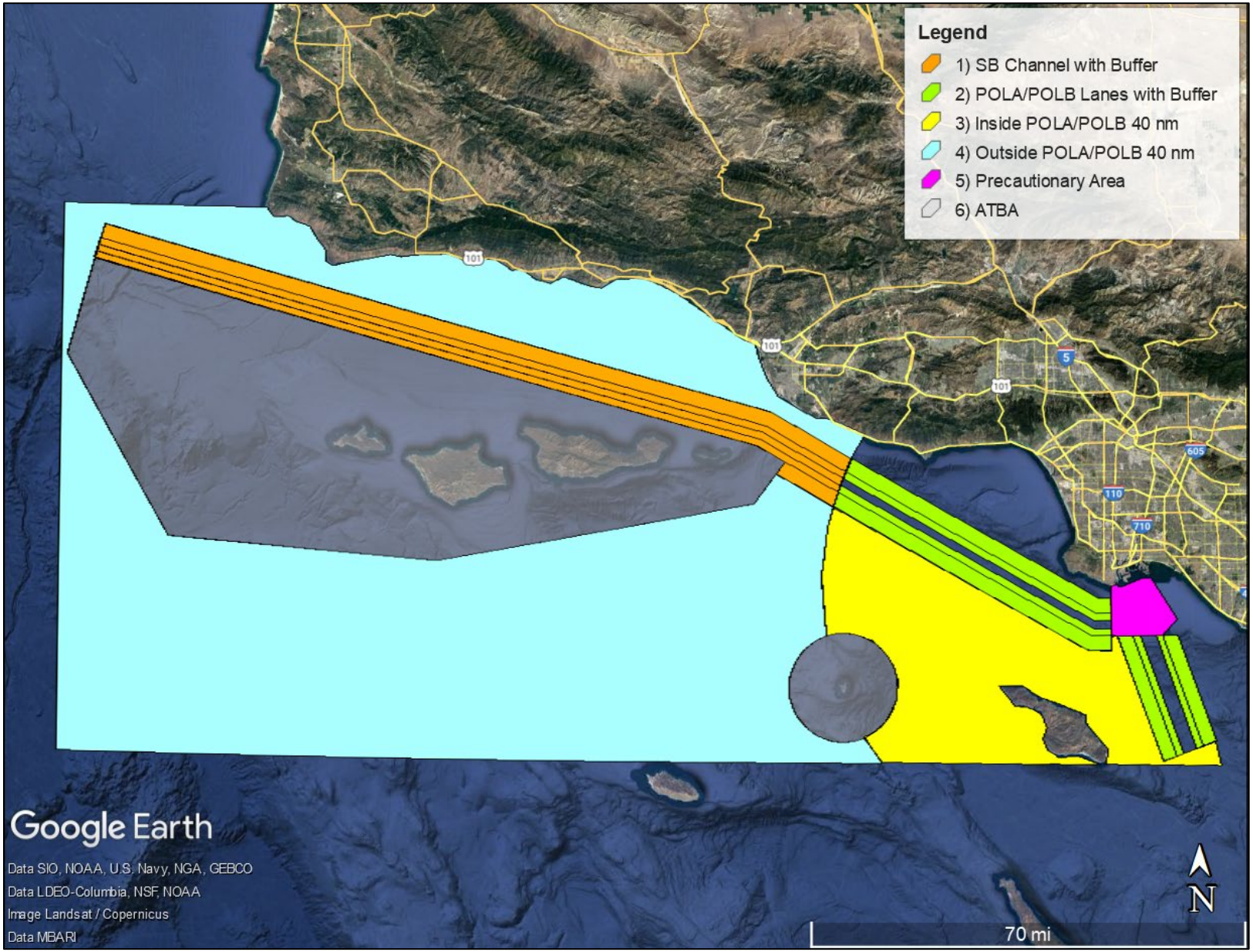
Transit Date	Zone	SCF	Baseline Speed	Observed Speed	Observed Transit Distance
8/4/2023	SB Channel	0.63	15.3 knots	9.8 knots	97.3 nm
8/4/2023	POLA Arrival	0.47	11.4 knots	9.4 knots	41.9 nm
8/5/2023	POLA Departure	0.50	12.1 knots	9.7 knots	42.0 nm
8/5/2023	SB Channel	0.63	15.3 knots	9.7 knots	97.1 nm

Since the AIS data for the VSR analysis is consolidated into segments, all segments with an observed speed of 12 knots or less will be attributed to the program calculations to account for any short-term vessel maneuvers that slightly exceeded the 10-knot target. Any activity from vessels that slowed down from their baseline speed – but did not achieve 12 knots – were excluded as these instances were most likely influenced by other factors outside the VSR

program. Additionally, segments where a vessel has been observed to be at anchor or loitering in a VSR zone have been removed.

Emission calculations are performed for Diesel Particulate Matter (DPM), Oxides of Nitrogen (NOx), Oxides of Sulfur (SOx), and Greenhouse Gases (GHGs - as carbon dioxide equivalent (CO_2E)). All emission calculations are performed by Starcrest Consulting using the same emission factors and adjustments used for the POLA/POLB emission inventory. For more information on the POLA/POLB emission inventory, please visit: www.portoflosangeles.org/environment/air-quality/air-emissions-inventory.

Appendix A: Southern California Methodology Map



Appendix B: Bay Area Methodology Map