

Boat Pump-Out BMP Expert Panel Report



A Presentation to the CBP Wastewater Workgroup
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Prepared by the Chesapeake Bay Program Partnership's Wastewater Treatment Workgroup

Background

In February, 2015, the Chesapeake Bay Program's (CBP) Wastewater Treatment Workgroup (WWTWG) was asked to consider Boat Pump-Out Facilities within No Discharge Zones (NDZ) as a BMP eligible for nutrient reduction credit within the Phase 6.0 Watershed Model. The proposal recommended the reductions be based upon direct monitoring of nitrogen and phosphorus removal at the pump-out facilities from Type I and II Marine Sanitation Devices (MSD) (treat and release systems), which would be reported to CBP by the jurisdictions on an annual basis. While the WWTWG was comfortable with the proposed approach of providing credit based upon directly monitored reductions, there were several outstanding regulatory and modeling issues that workgroup members felt required further evaluation. To evaluate the regulatory and modeling implications of the proposed BMP, the WWTWG has recommended the formation of a Boat Pump-Out and NDZ Expert Panel.

Expert Panel Scope of Work

The general scope of work for the Boat Pump-Out and NDZ Expert Panel will be to develop a report that evaluates, defines and configures the proposed Boat Pump-Out Facility in a No Discharge Zone BMP for nutrient reduction credit within the Chesapeake Bay Program's Phase 6.0 Watershed Model. The Expert Panel will evaluate the policy and regulatory implications of providing credit for the practice, and provide a recommended methodology for reporting and modeling the reductions.

The Expert Panel will work with the Wastewater Treatment Workgroup, Modeling Workgroup (MWG), and Watershed Technical Workgroup (WTWG) to develop their report.

Specifically, the Wastewater Treatment Workgroup recommends the following charges associated with tasks for the Boat Pump-Out and NDZ Expert Panel:



The main charge for the Panel :

To develop a report that evaluates, defines and configures the proposed Boat Pump-Out Facility BMP for nutrient reduction credit within the Chesapeake Bay Program's Phase 6.0 Watershed Model.

The Panel would evaluate the policy and regulatory implications of providing credit for the pump-out practice, and provide a recommended methodology for reporting and modeling the reductions.



CURRENT REGULATIONS

- **Clean Water Act – sections 312(a)**
 - **The CWA prohibits the discharge of untreated vessel waste within three nautical miles of the U.S. coast.**
 - **Under section 312 of the CWA, vessel sewage may be controlled through**
 - 1) **the establishment of No Discharge Zones (NDZs)**
 - 2) **regulating : Marine Sanitation Devices (MSDs).**



CURRENT REGULATIONS

- Clean Water Act – sections 312(a)

1. No Discharge Zones (NDZs)

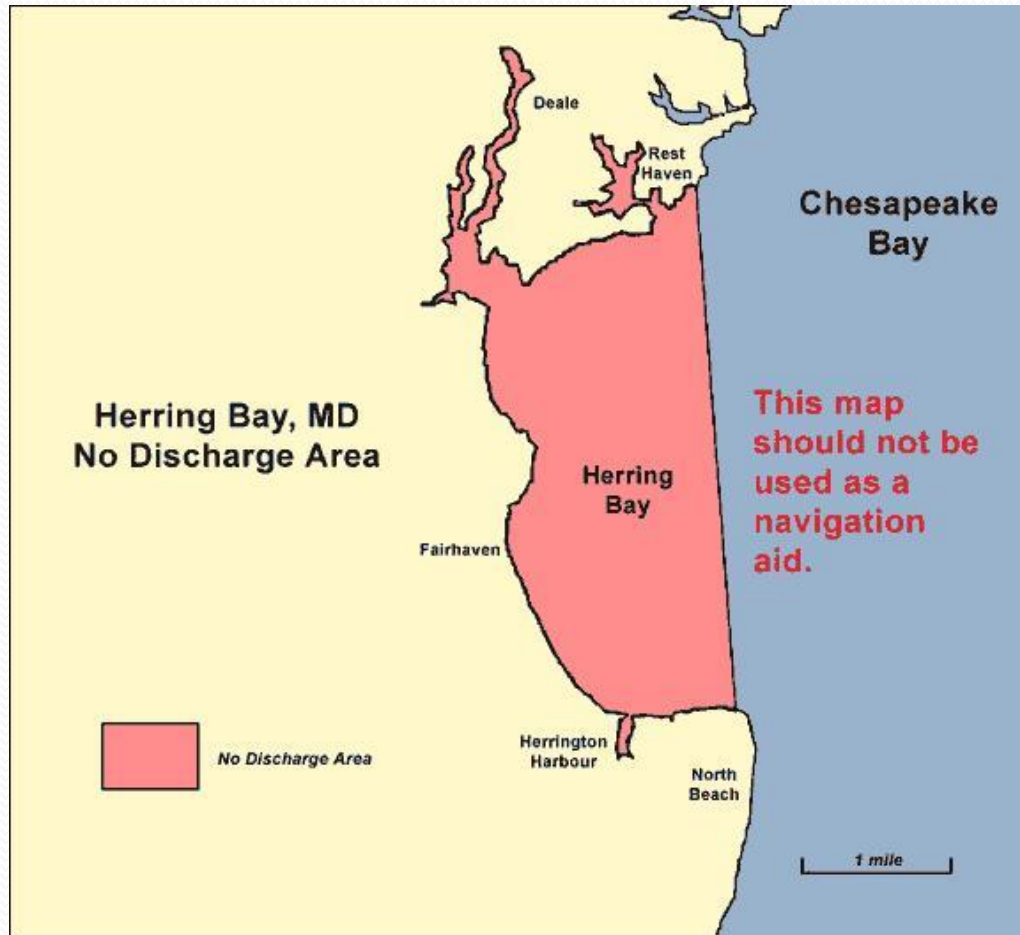
An NDZ is an area in which both treated and untreated sewage discharges from vessels are prohibited. Within NDZ boundaries, vessel operators are required to retain their sewage discharges onboard for disposal at sea (beyond three miles from shore) or onshore at a pump-out facility.

- How is an area designated as an NDZ under the CWA?
 - a) A state may initiate the process to establish an NDZ
 - b) The USEPA, upon application by the state, determines that the protection and enhancement of the water body requires establishment of an NDZ
- The U.S. Coast Guard and the state in which the NDZ has been designated may enforce the NDZ requirements.

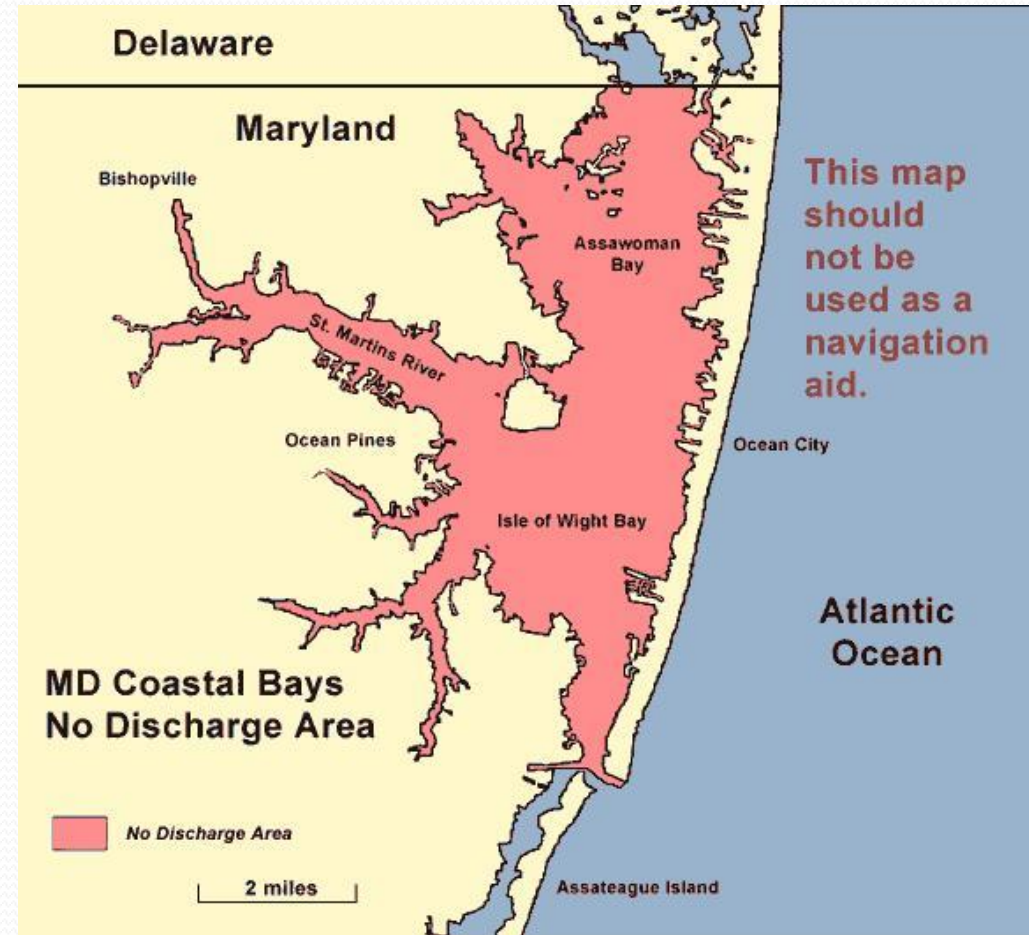


No-Discharge Zones in Maryland

Herring Bay

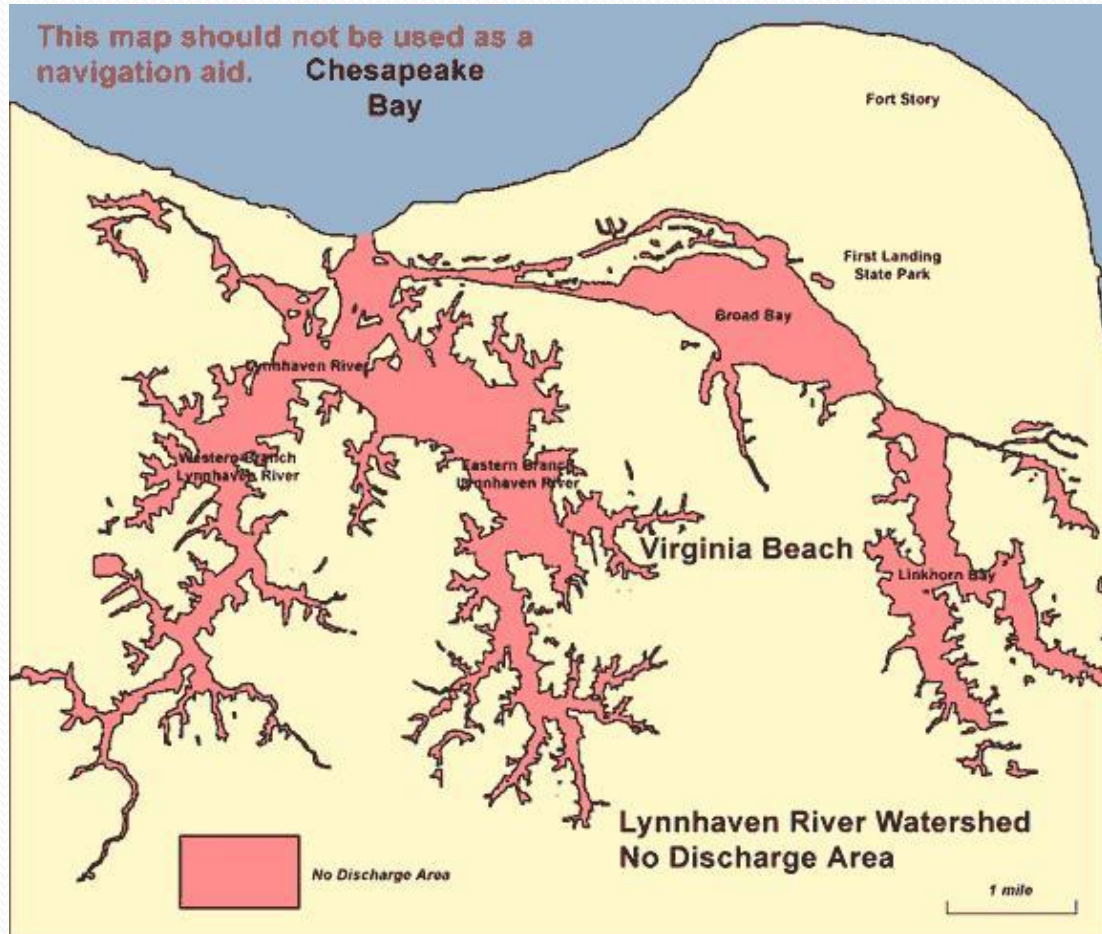


Northern Coastal Bays



No-Discharge Zones in Virginia within the Bay Watershed

Lynnhaven River



Broad Creek, Jackson Creek and Fishing Bay



CURRENT REGULATIONS

- **Clean Water Act – sections 312(a)**

- 2. Marine Sanitation Devices (MSDs)**

- For purposes of the CWA, an MSD is "any equipment for installation on board a vessel which is designed to receive, retain, treat, or discharge sewage, and any process to treat such sewage."
- USEPA and the U.S. Coast Guard jointly regulate MSDs
 - The USEPA has issued regulations setting performance standards for MSDs (40 CFR 140), which address **fecal coliform** and **total suspended solids**.
 - The Coast Guard has issued regulations (33 CFR 159) governing the design, construction, certification, installation and operation of MSDs, consistent with the USEPA's standards



Marine Sanitation Devices (MSDs)

	Type	Installation	Performance Standard	Nutrient Removal
Type I	Flow-through <u>treatment devices that commonly use maceration and disinfection</u> for the treatment of sewage	May be installed only on vessels less than or equal to 65 feet in length	Must produce an effluent with: <ul style="list-style-type: none"> No visible floating solids A fecal coliform bacterial count not greater than 1000 per 100 milliliters 	No nutrient removal
Type II	Flow-through <u>treatment devices that may employ biological treatment and disinfection</u> (some Type II MSDs may use maceration and disinfection)	May be installed on vessels of any length	Must produce an effluent with: <ul style="list-style-type: none"> A fecal coliform bacterial count not greater than 200 per 100 milliliters No more than 150 milligrams of total suspended solids per liter 	May have some nutrient removal depending on the system
Type III	Typically a <u>holding tank</u> where sewage is stored until it can be disposed of shore-side or at sea (beyond three miles from shore)	May be installed on vessels of any length	No performance standard; must "be designed to prevent the overboard discharge of treated or untreated sewage or any waste derived from sewage." 33 CFR 159.53(c).	100% nutrient removal if pumped out. If not pumped out, no nutrient removal



CURRENT REGULATIONS

- **MARPOL Annex IV**

The principal international instrument regulating sewage discharges from vessels is Annex IV to the "International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto ("MARPOL Annex IV").

The United States is not a party to MARPOL Annex IV, but ocean-going vessels operating in U.S. navigable waters which are registered in foreign countries may be subject to the MARPOL Annex IV requirements

Main points of MARPOL Annex IV

Distance from the nearest land	Discharge of sewage	Comparing with CWA
≤ 3 nautical miles	Prohibited for both treated and untreated	Equivalent to NDZ
> 3 and < 12 nautical miles	Allowed for treated by approved system	≤ 3 nautical miles
> 12 nautical miles	Allowed for untreated	> 3 nautical miles



CURRENT REGULATIONS

Clean Vessel Act

- Congress passed the Clean Vessel Act (CVA) in 1992
- The Act established a five-year federal pumpout grant program administered by the U.S. Fish & Wildlife Service.
- Reauthorized in 1998, Congress extended the pumpout grant program through 2003

Virginia Regulations:

- The Code of Virginia contains Regulations Governing the Discharge of Sewage and Other Wastes from Boats (Chapter 21) and Commonwealth of Virginia Sanitary Regulations for Marinas and Boat Moorings (Chapter 570).
- Three NDZs established: “Lynnhaven River”, “Broad Creek, Jackson Creek and Fishing Bay” and “Smith Mountain Lake”(outside of the watershed)



ADDITIONAL RESOURCES

Additional information related to MSDs, NDZ's, and regulations related to boat waste management. Some of these resources are from jurisdictions outside of the Chesapeake Bay area, but are still informative to the topic of vessel waste management.

- **Virginia Department of Health Marina Program**
- **Maryland DNR Report to Legislature on Marine Sanitation**
- **Maryland DNR - No Discharge Zones in Maryland's Waters**
- **Salem Sound Marine Sanitation Needs Assessment**



Literature Review

- Hänninen, S., & Sassi, J. (2009). *Estimated nutrient load from waste waters originating from ships in the Baltic Sea area-Updated 2009*.
- OSPAR. (2008). *OSPAR Commission, 2008: Nutrients in the Convention Area – Assessment of Implementation of PARCOM Recommendations 88/2 and 89/4*. Convention for the Protection of the Marine Environment of the North-East Atlantic.
- Baasel-Tillis, P., & Tucker-Carver, J. (1998). *Garbage and sewage disposal from recreational boats*. *Journal of Environmental Health*, 61(4), 8.
- Leon, L. M., & Warnken, J. (2008). *Copper and sewage inputs from recreational vessels at popular anchor sites in a semi-enclosed Bay (Qld, Australia): estimates of potential annual loads*. *Marine Pollution Bulletin*, 57(6), 838-845.
- GEERTZ-HANSEN, O. (2002). *Sanitary sewage from pleasure craft in the Baltic Sea*. Danish Environmental Protection Agency.
- Reid, et al., (2005). *Development of Emission Inventories of Recreational Boats and Commercial Marine Vessels for the Central States Regional Air Planning Association*. Presented at the 14th International Emission Inventory Conference “Transforming Emission Inventories – Meeting Future Challenges Today”.
- United States Coast Guard (USCG). (2012). *National Recreational Boating Survey*. Retrieved online.



Baseline Load Estimation

- Estimate is a function of 6 key factors:
 1. Number of boats operating in the Chesapeake Bay with the ability to use pump-out facilities
 2. Annual use days per vessel
 3. Duration of trip per use day
 4. Number of persons aboard per trip
 5. Nutrient output per person per day
 6. Pump-out utilization by recreational boaters
- Model record spans 1985-2015
 - Influenced by changes in regulations and practices
- Seasonal influence

Buchart-Horn, Inc. & Versar, Inc. (1992). *A Survey of the Quantity, Characteristics, and Potential Impacts of Boat Pumpout Waste Generated within the Chesapeake Bay Region of Maryland. A Marina Sewage Treatment Survey Project Conducted for the State of Maryland Department of the Environment.*



Number of Boats - Maryland

Boat Category	Range (years)	Count (years)
Type	1975 - 2015	41
Length	2003 - 2015	13
County of Registration	2011 - 2015	5

- Maryland boat registration data provided by Maryland Department of Natural Resources.
- The data were separated by county of registration as well as by length and type of boat registered.
- Missing data extrapolated to cover 1985-2015 time period.

County/City	Percentage of Total Registered Vessels
Anne Arundel	21.02%
Baltimore County	12.11%
Baltimore City	2.13%
Calvert	4.43%
Caroline	1.33%
Carroll	2.88%
Cecil	3.56%
Charles	3.32%
Dorchester	1.85%
Harford	5.42%
Howard	2.73%
Kent	1.74%
Montgomery	6.04%
Prince George's	3.57%
Queen Anne's	3.88%
Somerset	1.12%
St. Mary's	5.32%
Talbot	3.25%
Wicomico	2.17%
Worcester	3.01%
Total	90.9%



Boat Usage - Maryland

- United States Coast Guard (USCG). (2012). National Recreational Boating Survey.

Boat Type	Boating Days/Year	Hours/Day	Persons Onboard
Powerboat	14.1	6.1	2.6
Sailboat	12.8	8.0	2.4

Source	Type of Waste	Total Nitrogen		Total Phosphorus	
		Min. N (g/p/d)	Max. N(g/p/d)	Min. P (g/p/d)	Max P (g/p/d)
Kirschmann et al. (1995)	Liquid	6.85	11.78	1.92	2.74
	Solid	1.37	1.92	0.82	1.37
	Total	8.22	13.7	2.74	4.11
Hänninen, S., & Sassi, J. (2009)	Total	12	15	3	5
Assumed for Baseline Estimate	Total	13		4	



Baseline Estimate Example

Nitrogen Load from Power boats:

$$162,185 \frac{\text{registered boats}}{\text{year}} * 14.1 \frac{\text{boating days}}{\text{registered boat}} * 0.38 \text{ prorate factor} * 2.6 \text{ persons onboard}$$
$$= 2.27 \text{ million} \frac{\text{person - days}}{\text{year}} * 13 \frac{\text{g N}}{\text{person - day}} * \frac{1 \text{ ton}}{907,185 \text{ g}} = 32.5 \frac{\text{tons N}}{\text{year}}$$

Nitrogen Load from Sail Boats:

$$10,818 \frac{\text{registered boats}}{\text{year}} * 12.8 \frac{\text{boating days}}{\text{registered boat}} * 0.50 \text{ prorate factor} * 2.4 \text{ persons onboard}$$
$$= 0.166 \text{ million} \frac{\text{person - days}}{\text{year}} * 13 \frac{\text{g N}}{\text{person - day}} * \frac{1 \text{ ton}}{907,185 \text{ g}} = 2.4 \frac{\text{tons N}}{\text{year}}$$

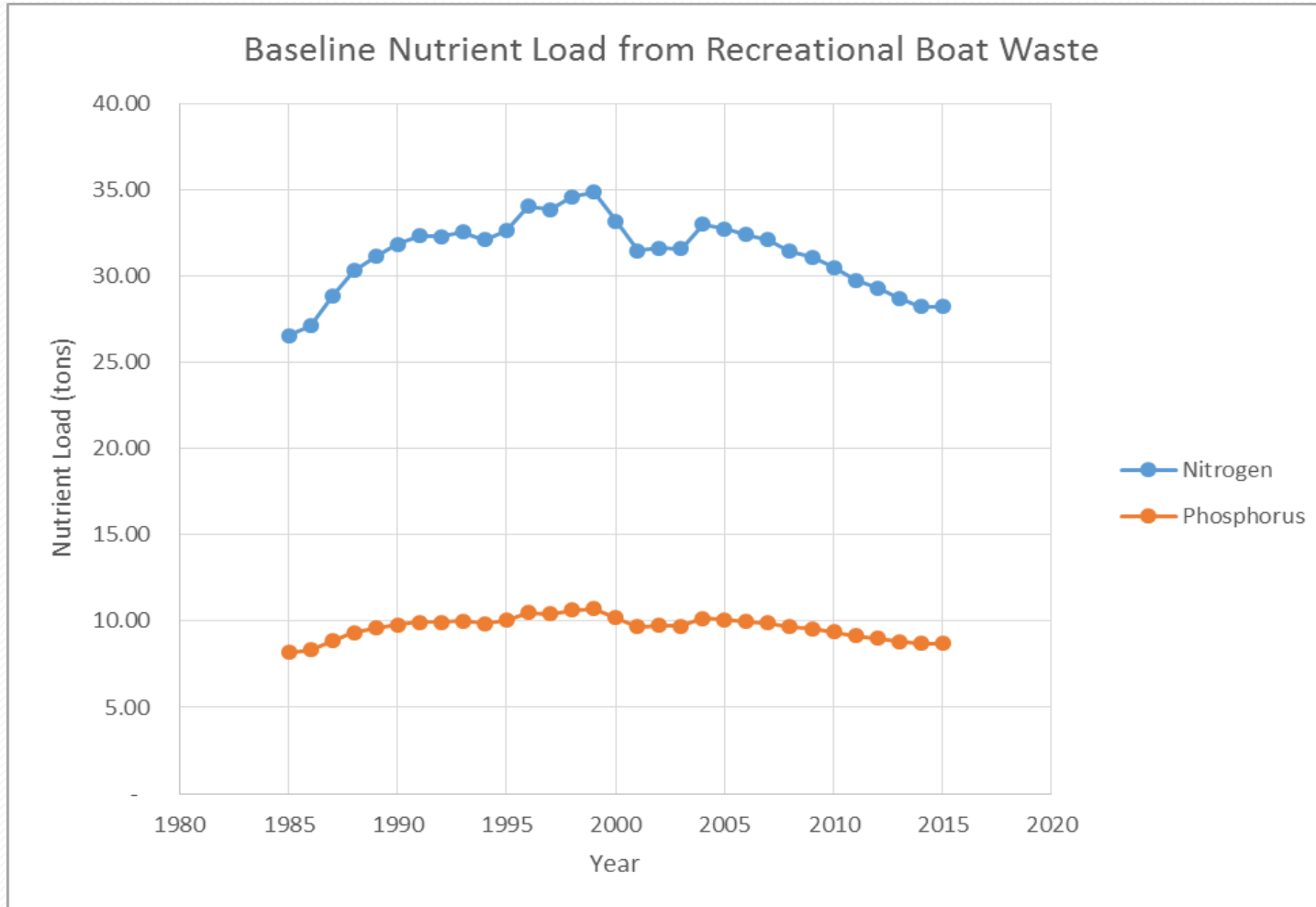
Total Nitrogen Load for 1999:

$$32.5 \frac{\text{tons}}{\text{year}} \text{ N} + 2.4 \frac{\text{tons}}{\text{year}} \text{ N} = 34.9 \frac{\text{tons}}{\text{year}} \text{ N}$$



Baseline Estimates - Maryland

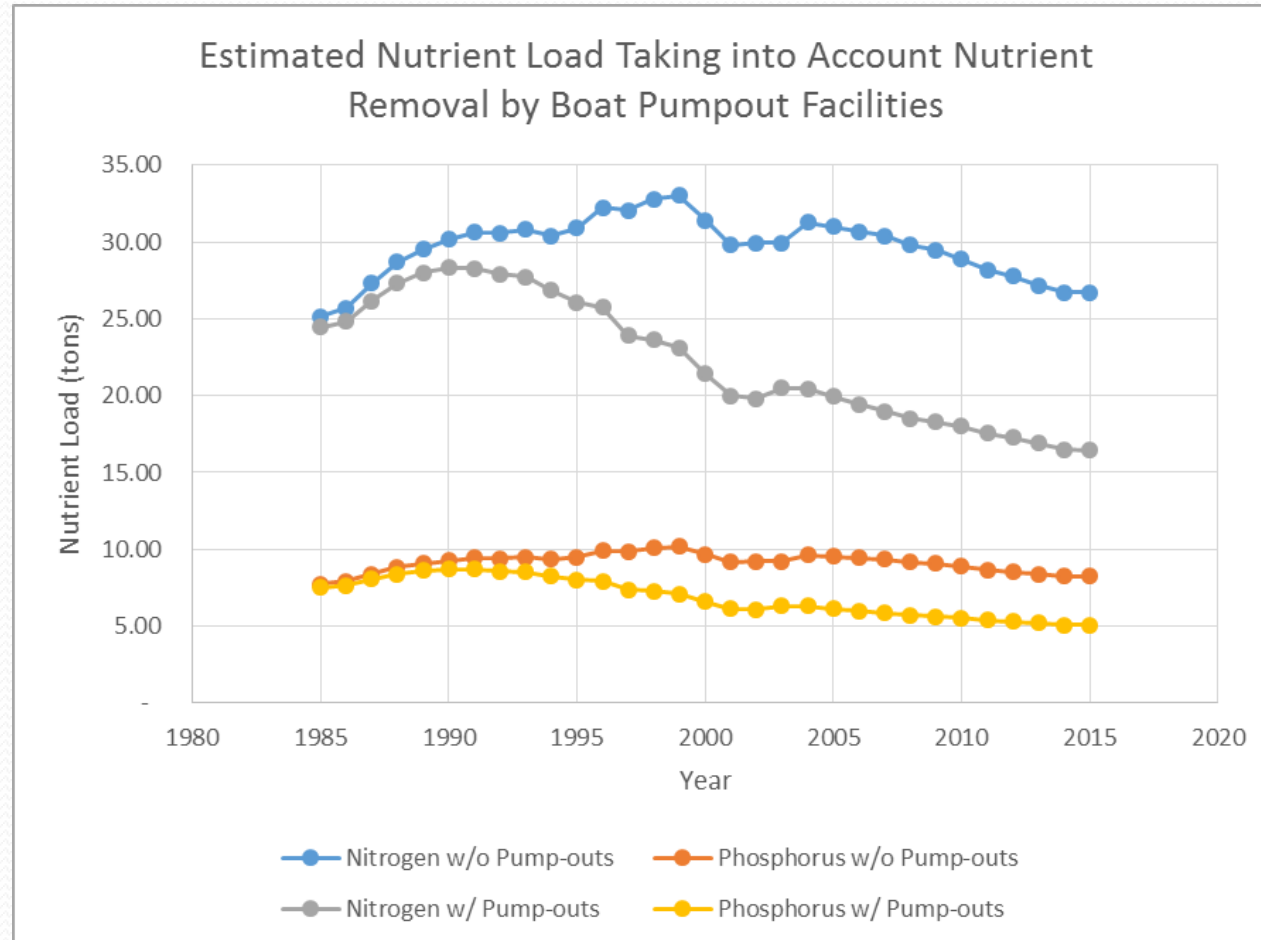
(Reid, S. et al., 2005)



Month	% of Total Annual Boat Usage
January	3.0%
February	3.0%
March	8.5%
April	8.5%
May	8.5%
June	14.5%
July	14.5%
August	14.5%
September	7.5%
October	7.5%
November	7.5%
December	2.5%



Effect of Pump-Outs - Maryland



- 30.8% of boats 16'-21' and 88% of boats >22' have ability to use pump-out facilities (Buchart-Horn, Inc. and Versar, Inc., 1992; and MD DNR, 2000a).
- Pump-out utilization estimated by creating a timeline of the total number of pump-out facilities in the state and the date they were installed, assuming that each had an equal effect on increasing utilization up to 95% (MD DNR, 2000; and O'Neill, D. and Morrow, D., 2014).



Number of Boats - Virginia

- Virginia boat registration data provided by Virginia Department of Game and Inland Fisheries (DGIF).
- The data were separated by county of registration as well as by length and type of boat registered.
- Missing data extrapolated to cover 1985-2015 time period.
- Maryland trends used where data were limited.
- 66.5 percent of vessels registered in counties within 50 miles of Bay.

Boat Category	Range (years)	Count (years)
Type	2015	1
Length	2015	1
County of Registration	1997 – 2015	19
Total Registrations	1960 – 2015	56



Baseline Estimate Example

Nitrogen Load from Power boats:

$$132,536 \frac{\text{registered boats}}{\text{year}} * 14.1 \frac{\text{boating days}}{\text{registered boat}} * 0.38 \text{ prorate factor} * 2.6 \text{ persons onboard}$$
$$= 1.85 \text{ million} \frac{\text{person} - \text{days}}{\text{year}} * 13 \frac{\text{g N}}{\text{person} - \text{day}} * \frac{1 \text{ ton}}{907,185 \text{ g}} = 26.5 \frac{\text{tons N}}{\text{year}}$$

Nitrogen Load from Sail Boats:

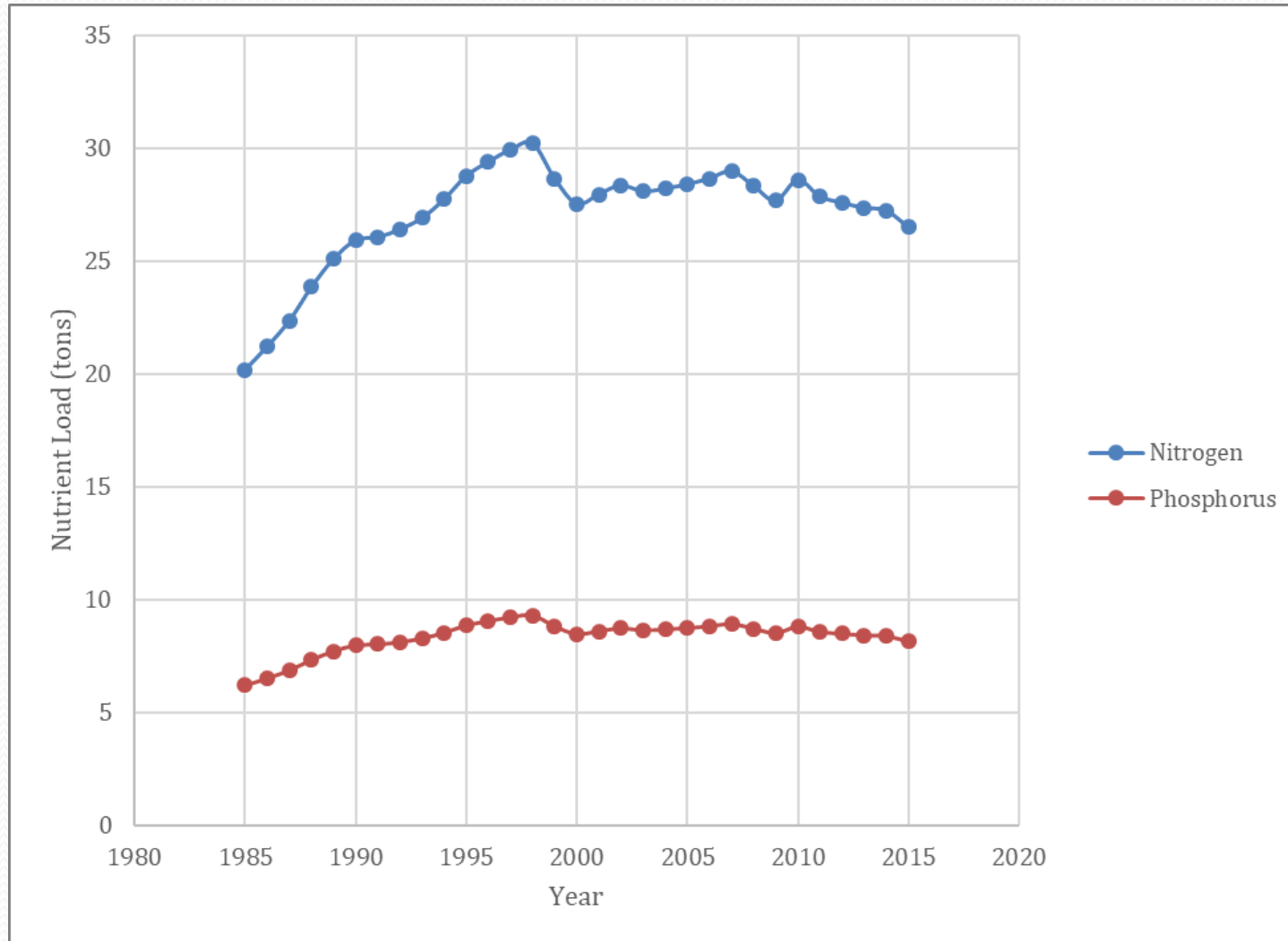
$$9,619 \frac{\text{registered boats}}{\text{year}} * 12.8 \frac{\text{boating days}}{\text{registered boat}} * 0.50 \text{ prorate factor} * 2.4 \text{ persons onboard}$$
$$= 0.148 \text{ million} \frac{\text{person} - \text{days}}{\text{year}} * 13 \frac{\text{g N}}{\text{person} - \text{day}} * \frac{1 \text{ ton}}{907,185 \text{ g}} = 2.1 \frac{\text{tons N}}{\text{year}}$$

Total Nitrogen Load for 1999:

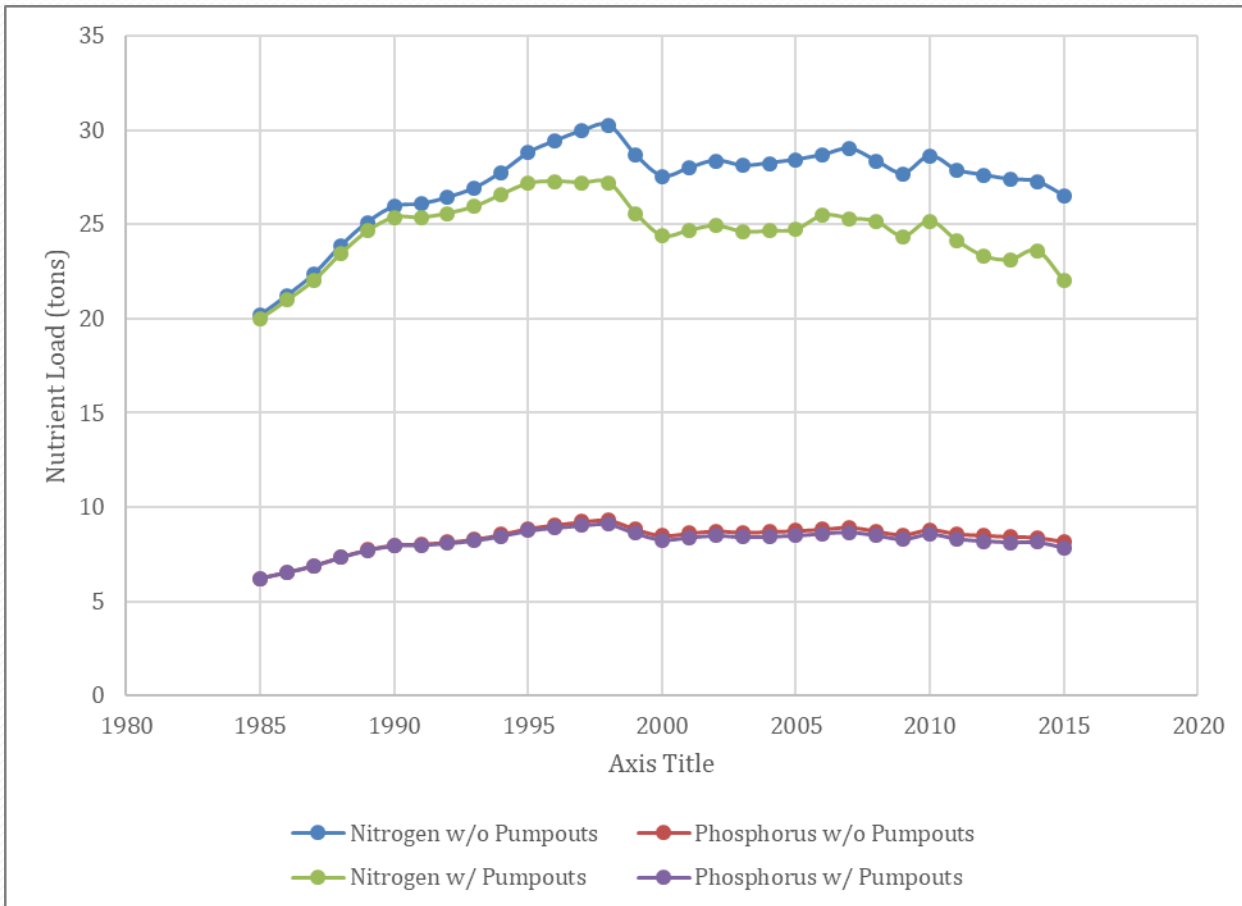
$$26.5 \frac{\text{tons}}{\text{year}} \text{N} + 2.1 \frac{\text{tons}}{\text{year}} \text{N} = 28.6 \frac{\text{tons}}{\text{year}} \text{N}$$



Baseline Estimates - Virginia



Effect of Pump-Outs – Virginia



- Sewage and associated nutrient removal by boat pump-outs was estimated using methods similar to those used by the City of Virginia Beach in a memorandum delivered to the Virginia Department of Conservation & Recreation.
- 58 percent of boats 26’-40’ and all boats greater than 40’ have the ability to use pump-out facilities.
- Pump-out utilization was estimated using Maryland data.
- Annual pump-out volumes were assessed on the basis of 21 peak weekends per year from early May to late September and a peak occupancy rate of 40% for weekends during the peak boating season.
- The volume of wastewater removed per pump-out is based on data and records kept by the Hampton Roads Sanitation District (HRSD).
- The nutrient content of boat wastewater was based on the Lynnhaven River Boat Wastewater Sampling Program report prepared for the City of Virginia Beach (KCI Lewis White & Associates, 2008).

3,516 vessels that can use pumpouts * 81% pumpout utilization rate * 40% weekend peak occupancy rate

$$\begin{aligned}
 &= 1,139 \frac{\text{vessels}}{\text{weekend}} * 19 \frac{\text{gal}}{\text{vessel}} * 21 \frac{\text{weekend}}{\text{year}} \\
 &= 454,563 \frac{\text{gal}}{\text{year}} * 0.01387 \frac{\text{lb N}}{\text{gal}} * \frac{\text{ton}}{2,000 \text{ lb}} = 3.15 \frac{\text{ton N removed}}{\text{year}}
 \end{aligned}$$



Recommendations

- Add VA and MD estimates as loads in model
 - Direct dischargers into Bay tidal waters: DE? D.C.?
- Add boat pump-out as programmatic BMP
 - Recognize and incentivize improved practices
 - Minimize burdens (e.g., to marina operators)
- Allow flexibility in programs and verification
 - Direct metering is gold standard (see VA Beach proposal for Lynnhaven River NDZ pump-out program)
 - Marine facility survey
 - Estimates versus baseline as in VA and MD

