Chesapeake Bay Marine Vessel Nutrient Discharges

Modeling Quarterly Review

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Outline

- Background
- Data
- Future Direction

Background: What is the problem?

Discharges from marine vessels generate waste (nitrogen and phosphorus) and impacts to aquaculture, shellfish, and public beaches.

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Untreated or poorly treated waste could be discharged into the Chesapeake Bay and its tributaries

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Stakeholders, e.g., VA DEQ, and Anne Arundel County, would like to remove these pollutants for credited BMPs which reduce nutrient inputs, protect shellfish, and address human health concerns.

Background - Marine Sanitation Devices (MSDs)

- “..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." 33 U.S.C. 1322(a)(5).

Type I	Treatment devices that commonly use maceration and disinfection 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: • No visible floating solids • A fecal coliform bacterial count not greater than 1000 per 100 milliliters	No nutrient removal
Type II	Treatment devices that employ biological treatment and disinfection (some Type II MSDs may use maceration and disinfection)	May be installed on vessels of any length (more often on commercial vessels)	Must produce an effluent with: • A fecal coliform bacterial count not greater than 200 per 100 milliliters • No more than 150 milligrams of total suspended solids per liter	Some nutrient removal
Type III	Typically a holding tank 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

Background - What happens with waste on boats?

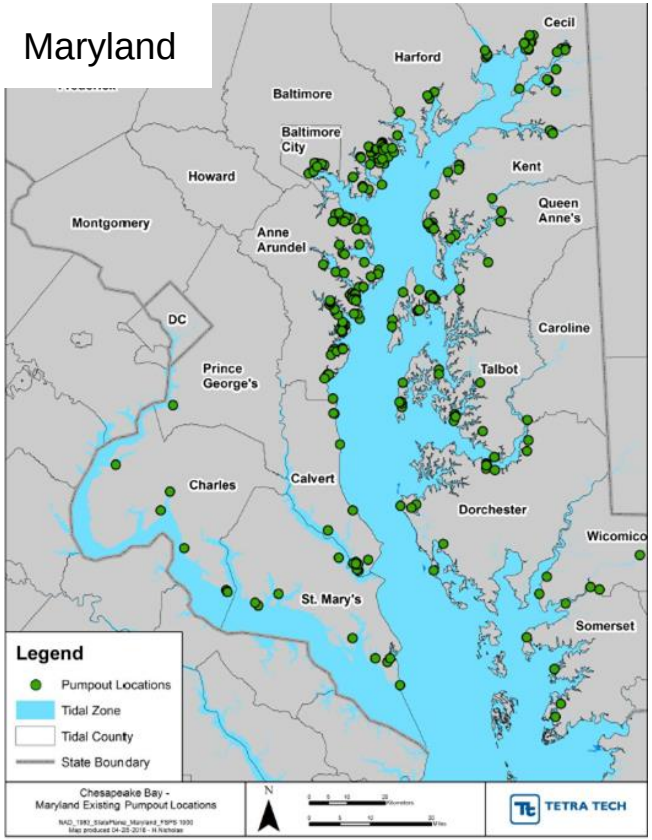
- EPA/USCG regulated via Clean Water Act.
- No Discharge Zones (NDZs) where NO dumping can occur.
  - Must hold on the boat

Table 2. Summary of Clean Water Act and MARPOL Annex IV sewage discharge requirements

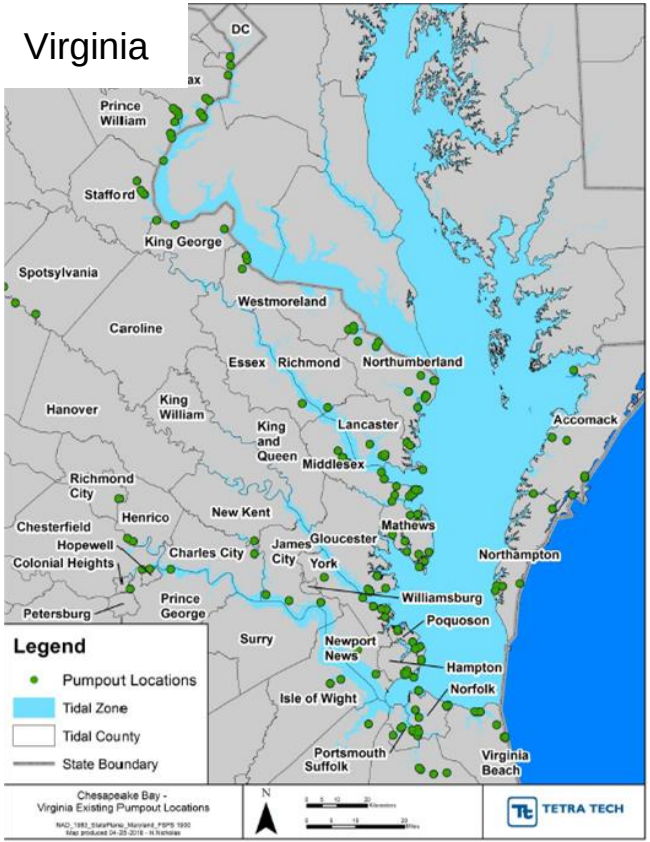
Distance from the nearest land	Clean Water Act Section 312(a)	MARPOL Annex IV
Less than 3 nautical miles	Allows discharge of treated sewage (except in NDZs)	Prohibits discharge of both treated and untreated sewage
Between 3 and 12 nautical miles	Allows discharge of treated and untreated sewage	Allows discharge of sewage treated by approved system
Greater than 12 nautical miles		Allows for discharge of treated and untreated sewage

Background: Boat Pump-Out stations

Maryland



Virginia



Background summary

1. Recreational Boats registered in MD and VA create human waste
2. Dumping untreated waste is illegal but happens
3. It is necessary to quantify a baseline representing how much untreated sewage is being discharged to tidal waters
4. **Our focus is on demonstrating the removal of illegally dumped untreated sewage from recreational vessels can be credited as a BMP which reduces nutrient inputs, protects shellfish, and addresses human health concerns**

Data: Tetratech Baseline Load Estimation

- Base load estimate was calculated using 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

- CBP model data ranges from 1985-2015

Buchart-Horn, Inc. and Versar, Inc. (1992) in the “Survey of the Quantity, Characteristics, and Potential Impacts of Boat Pump Out Waste Generated within the Chesapeake Bay Region of Maryland” that was conducted for the State of Maryland Department of the Environment

Data- Determining number of Boats MD

- Data from MD DNR
  - County of registration
  - Boat length
  - Boat registration type (sail vs power)
- Extrapolation where necessary

Table 4. Maryland Boat Registration Data Availability

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

Table 5. County Distribution of Boat Registrations for Maryland

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%

Data- Determining Number of Boats VA

- Data on boat length and type were provided by Virginia Department of Inland Fisheries.
  - 2015 ONLY
- Data are separated by county, length and boat type.
- Maryland trends were used for extrapolation where data was scarce.

Table 11. Virginia Boat Registration Data Availability

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

Data- Determining Boat Usage

- National Recreational Boating Survey. United States Coast Guard (USCG, 2012).
- United States Southern region annual number of person-days spent boating in the Chesapeake Bay by Maryland boaters.

Table 6. USCG Southern Region Boat Usage Statistics

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

Table 7. Nutrient Content of Human Excreta

Source	Type of Waste	Min. N (g/p/d)	Max. N (g/p/d)	Min. P (g/p/d)	Max. P (g/p/d)
Kirscmann 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	

Data- Baseline Estimates

- Average Boat Discharge of Nitrogen and Phosphorus
- Apply monthly proportion of boat use for a monthly estimate

Table 8. Range and Mean of Boat Discharge Nutrient Load Estimates for Maryland, 1985-2015

Nutrient	Min (lbs.)	Max (lbs.)	Mean (lbs.)
Nitrogen	53,200	69,800	62,600
Phosphorus	16,340	21,460	19,260

Table 12. Range and Mean of Boat Discharge Nutrient Load Estimates for Virginia, 1985-2015

Nutrient	Min (lbs.)	Max (lbs.)	Mean (lbs.)
Nitrogen	40,400	60,400	54,220
Phosphorus	12,420	18,600	16,680

Table 9. Proportion of Annual Boat Usage by Month

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%

Data- Maryland Baseline N and P Estimates

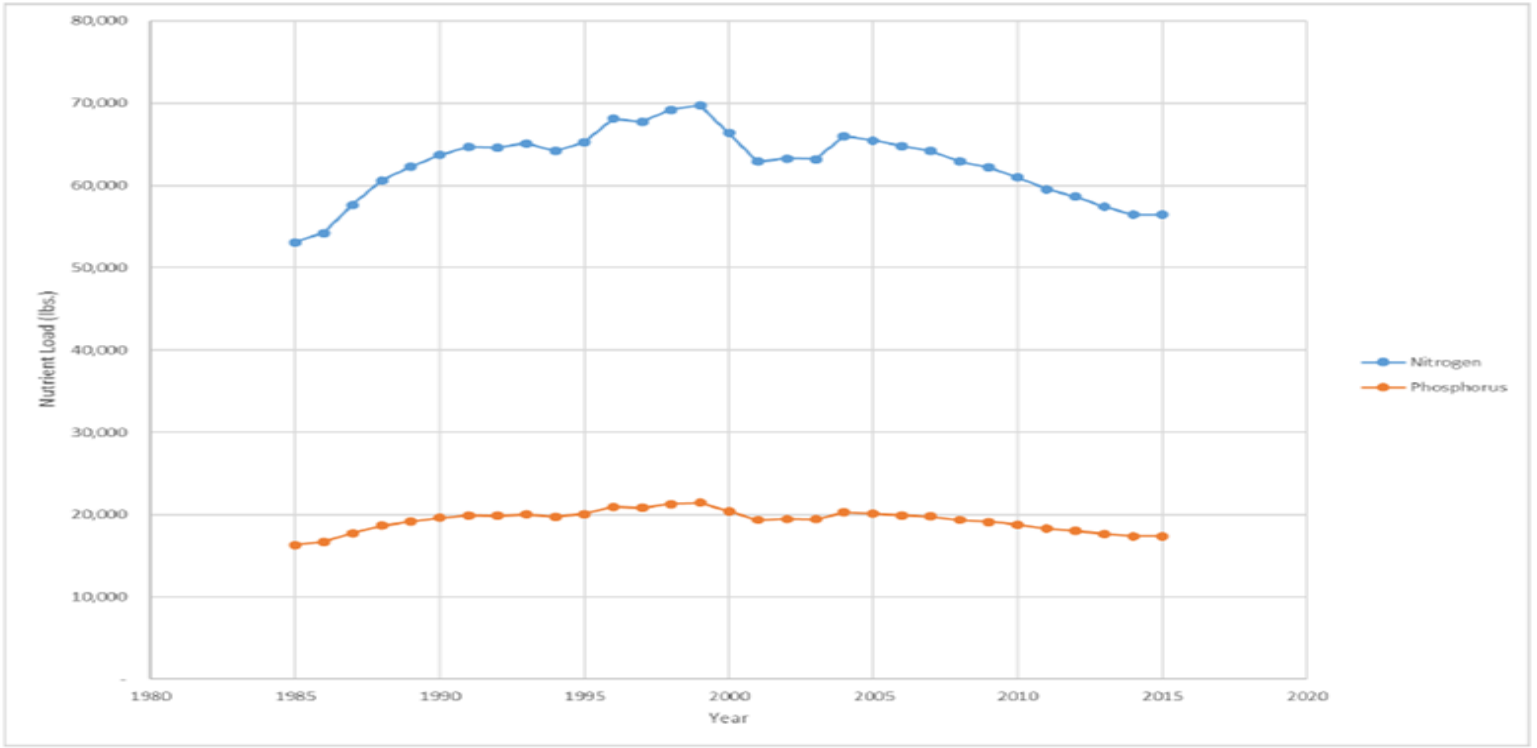


Figure 1. Boat Discharge Nutrient Load Estimates for Maryland, 1985-2015

Data- Virginia Baseline N and P Estimates

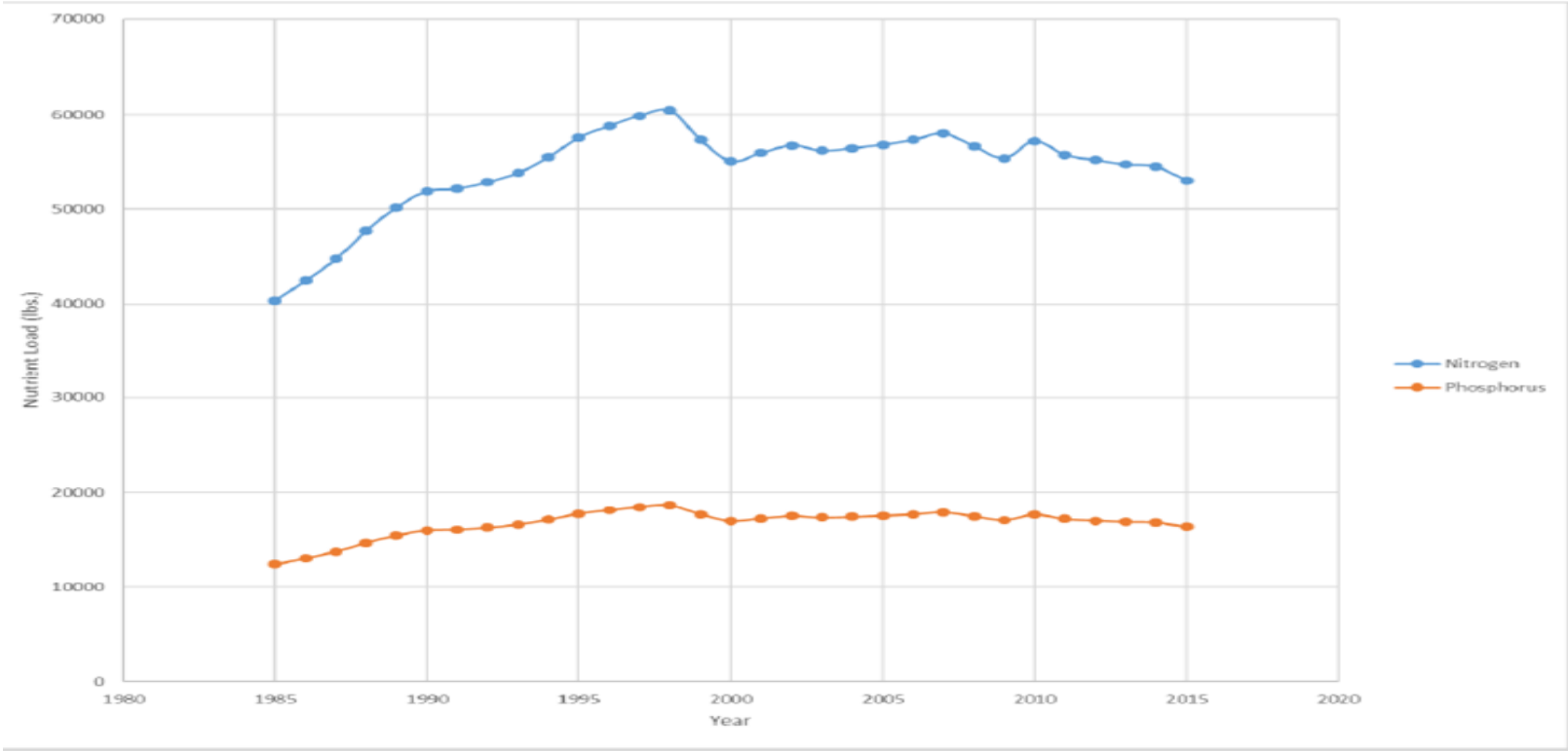


Figure 3. Boat Discharge Nutrient Load Estimates for Virginia, 1985-2015

Data- MD Pump-Out

- 30.8% of boats 16’-21’ and 88% of boats 22’ and greater have the ability to use pump-out facilities (Buchart-Horn,Inc. and Versar, Inc., 1992; and MD DNR, 2000a).
- Removal was determined by the prorated annual person days * Nitrogen per person like the baseline estimates

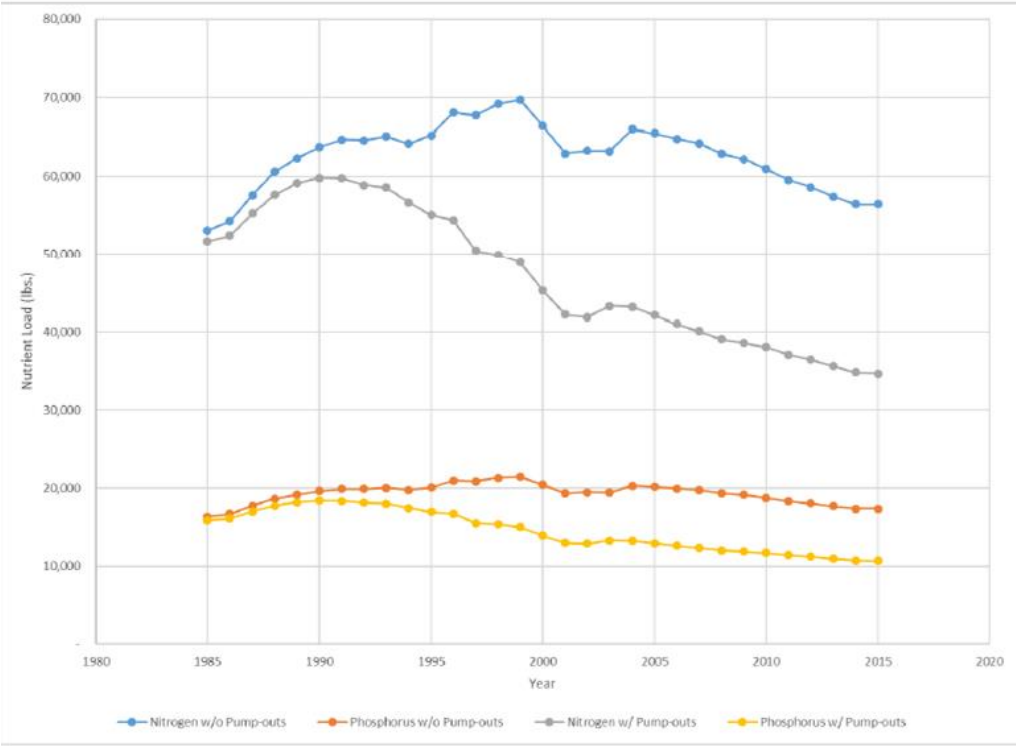


Figure 2. Estimated Nutrient Load Taking into Account Nutrient Removal by Boat Pumpout Facilities, Maryland 1985-2015

Table 10. Annual Estimate of Nutrients Removed by Boat Pump-Out Facilities in Maryland

Parameter	Min	Max	Mean
Nitrogen (lbs.)	1,440	24,140	15,440
Phosphorus (lbs.)	440	7,420	4,760
% Reduction	3%	35%	25%

Data- VA Pump-Out

- 58% of boats 26’-40’ and all boats greater than 40’ can use pump-out facilities.
- Annual pump out volumes were assessed on a 21 week peak period between early May to late September and a peak occupancy rate of 40% for weekends.
- Volume of wastewater removed per pump-out based on data from the Hampton Roads Sanitation District.
- Nutrient content of boat wastewater was based on the Lynnhaven River Boat Wastewater Sampling Program report.

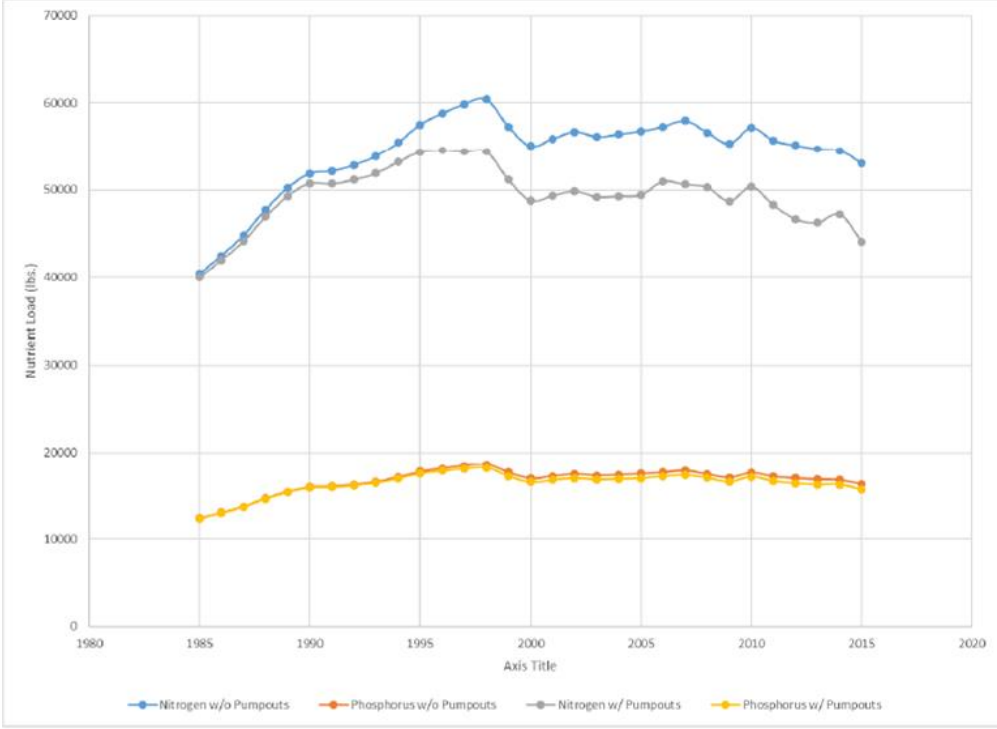


Figure 4. Estimated Nutrient Load Taking into Account Nutrient Removal by Boat Pumpout Facilities, Virginia 1985-2015

Table 13. Annual Estimate of Nutrients Removed by Boat Pump-Out Facilities in Virginia

Parameter	Min	Max	Mean
Nitrogen (lbs.)	400	8,980	4,940
Phosphorus (lbs.)	20	640	340
Nitrogen % Reduction	1.0%	14.9%	9.1%
Phosphorus % reduction	0.2%	3.4%	2.1%

Incorporation into Chesapeake Bay Program Models

- Need a starting point incorporating boat waste
- Likely to use in Phase 7
- Communication with CAST team
  - As shoreline loads
- Currently working to gather information for a technical appendix
  - Need to account for commercial and military vessels
  - Vessels registered in other states

Questions?