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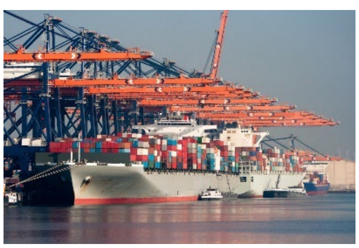

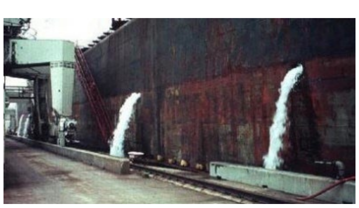

Economic Analysis of the EPA Final Rulemaking for *Vessel Incidental Discharge National Standards of Performance*

September 2024

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U.S. Environmental Protection Agency
Office of Water
Office of Wetlands, Oceans & Watersheds
1200 Pennsylvania Avenue, NW
Washington, DC 20460

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Table of Contents

Executive Summary .... **ix**

1 Background **1**

1.1 Scope of the Final Rule 1

1.1.1 Waters 1

1.1.2 Vessels 2

1.1.3 Incidental Discharges 2

1.1.4 Emergency and Safety Concerns 3

1.1.5 Effective Date 3

1.2 Summary of the Final Rule 3

1.3 Report Organization 5

2 Need For the Final Rule **6**

2.1 History, Previous Rulemakings, Amendments, Revisions, Clarifications 6

2.1.1 Clean Water Act 6

2.1.2 Additional U.S. and International Authorities 8

2.2 Environmental Concerns Addressed by the final Rule 9

2.3 Market Failure Addressed by the Final Rule 12

2.4 Statutory Authority 12

3 Profile of Vessels Subject to the Final Rule **14**

3.1 U.S.-Flagged Vessels 14

3.1.1 Large U.S.-Flagged Vessels 15

3.1.2 Small U.S.-Flagged Vessels 16

3.2 Foreign-Flagged Vessels 20

3.3 Great Lakes Fleet 22

3.4 Summary of Projected Vessel Universe 29

4 Economic Impact and Cost Analysis **30**

4.1 Introduction 30

4.2 Cost Methodology 30

4.3 Rule Provisions Dictated by VIDA 32

4.3.1 Changes to Ballast Water Management Systems 32

4.3.2 Exclusions for Small Vessels and Fishing Vessels 47

4.4 Rule Provisions Unchanged from VGP 50
4.4.1 Environmentally Acceptable Lubricants for Equipment That Extends Overboard (40 CFR 139.6) 50
4.5 Other Rule Provisions Including Changes from VGP 53
4.5.1 Graywater Systems (40 CFR 139.21) 53
4.5.2 Macrofouling (40 CFR 139.28) 60
4.5.3 Other Rule Provisions Total Compliance Costs 62
4.5.4 Ballast Water Management for Lakers 63
4.5.5 Desalination and Purification Systems (40 CFR 139.16) 72
4.5.6 Exhaust Gas Recirculation (EGR) Systems (40 CFR 139.18) 72
4.5.7 Fire Protection Equipment (40 CFR 139.19) 72
4.5.8 Hulls and Associated Niche Area Management (40 CFR 139.22) 73
4.6 Administrative Cost 75
4.6.1 Relief from Exclusion of Small Vessels and Fishing Vessels 75
4.6.2 Transitioning from VGP to VIDA 75
4.6.3 State Petitions 76
4.7 Total Cost of the Final Rule 77
4.8 Limitations and Uncertainties 78
5 Benefits Analysis 80
5.1 Ballast Water, Biofouling, and Invasive Species 80
5.1.1 Aquatic Nuisance Species Impacts 80
5.1.2 Benefits of Enhanced Ballast Water and Biofouling Management Practices 84
5.2 Other Pollutants 87
5.2.1 Impacts from Other Pollutants 88
5.2.2 Benefits of Reducing Pollutant Discharges 91
5.2.3 Benefits from Deregulation of Small Vessels and Fishing Vessels 92
6 Comparison of Costs and Benefits 95
7 Economic Impacts of the Final Rule 97
7.1 Introduction 97
7.1.1 Rule Provisions Dictated by VIDA or Unchanged from VGP 97
7.1.2 Other Rule Provisions, including Changes from VGP 97

7.2 Economic Achievability of the Final Rule 100
8 Statutory and Administrative Requirements 101
8.1 Introduction 101
8.2 Executive Orders 12866, 13563 and 14094 101
8.3 Regulatory Flexibility Act 102
8.3.1 Discharge Standards 102
8.3.2 Lakers 105
8.3.3 The EPA's Determination under RFA 105
8.4 E.O. 13990, Protecting Public Health and the Environment and Restoring Science To Tackle the Climate Crisis 105
8.4.1 Background 105
8.4.2 Social Cost of Greenhouse gas emmisions Estimation 107
References 110
Appendix A Summary of Rule Cost: 3 and 7 Percent Discount Rate 123
Appendix B Capital and Operation and Maintenance Cost of a Newly Constructed Laker 125
Capital Costs 125
Annual operation and maintenance (O&M) costs 127
Sailing Day O&M Cost 127
Port Day O&M Cost 128
Estimated Annual O&M cost per vessel 129

List of Tables

Table ES-1: Total Annualized Costs of the Final Rule, by Provision ($2022) at a 2% Discount Rate x

Table 3-1. U.S.-Flagged Large Vessel Population, 2009 and 2016 15

Table 3-2. Projected U.S.-Flagged Large Vessel Population, 2022 16

Table 3-3. U.S.-Flagged Small Vessel Population, 2009[a] 17

Table 3-4. U.S.-Flagged Small Vessel Count by Industry, 2009 18

Table 3-5. Projected U.S.-Flagged Small Vessel Population, 2022 19

Table 3-6. Projected Foreign-Flagged Vessel Population, 2022 21

Table 3-7. Lakers by International Classification of Ships by Type 23

Table 3-8. List of Laker Vessels 24

Table 3-9. U.S. Laker Operators and Owners by Total Number of Vessels Owned 27

Table 3-10. List of Laker Owners/Operators 28

Table 3-11. Projected Universe of Vessels Covered by VIDA, 2022 29

Table 4-1. Ballast Water Exchange Volumes by Vessel Type 33

Table 4-2. Ballast Water Exchange Costs 33

Table 4-3. Average Unit Cost for BWE or Saltwater Flushing by Vessel Type 34

Table 4-4. Percentage of U.S.-Flagged Vessels and Foreign-Flagged, U.S.-Owned Vessels Voyaging Between U.S and Foreign Ports 35

Table 4-5. Estimated Costs for Saltwater Flushing for Coastal Vessels ($2022) 35

Table 4-6. Estimated Fuel Cost for Saltwater Flushing of Empty Tanks When Voyaging Between Atlantic and Gulf of Mexico Ports ($2022) 36

Table 4-7. Coastal Voyages into the Saint Lawrence Seaway System and Great Lakes, 2018 39

Table 4-8. Estimated Costs for Coastal Vessels Entering the SLSS or the Great Lakes to Conduct BWE or Saltwater Flushing ($2022) 39

Table 4-9. Estimated Fuel Costs for Pacific Coast Voyages to 50 nm Off-Shore to Conduct BWE and Flushing ($2022) 41

Table 4-10. Anticipated BWE or Saltwater Flushing Volumes and Costs for Hawaiian Inter-Island Voyages ($2022) 42

Table 4-11. Estimated Overseas and Coastal Voyages to Pacific Region Ports with Low Salinity Ballast Water or Discharging into Low Salinity Water, 2018 45

Table 4-12. Estimated Cost for U.S.-Flagged Vessels to Conduct BWE with Low Salinity Ballast Water or Discharging into Low Salinity Water, (2022$) 46

Table 4-13. Estimated Incremental Vessel Costs to Comply with the Ballast Water Requirements ($2022) 47

Table 4-14. Estimated Unit Costs of Non-Ballast Water Discharge Requirements for Excluded Vessels (2022$) 49

Table 4-15. Estimated Change in Annual Costs (Cost Savings) for Vessels Due to VIDA Exclusions, (2022$) 50

Table 4-16. Lubricant Consumption Rate by Vessel Class 51

Table 4-17. Environmentally Acceptable Lubricants Cost Estimate, (2022$) 52

Table 4-18. New Build Vessels of 400 Gross Tonnage and Above with 15 or Greater Berths subject to the Graywater Standard 55

Table 4-19. Graywater Incremental Costs per Vessel for New Builds of 400 Gross Tonnage and Above with 15 or Greater Berths, (2022$) at a 2% Discount Rate 56

Table 4-20. Graywater Estimated Total Annualized Costs for New Build Vessels of 400 Gross Tonnage and Above with 15 or Greater Berths, (2022$) at a 2% Discount Rate 56

Table 4-21. Estimated Daily Graywater and Sewage Generation Rates for Ferries Covered under 40 CFR 139.21(e)(4) 57

Table 4-22. Estimated Capital Cost for Ferries Covered under 40 CFR 139.21(e)(4) to Install Advanced Type II MSD to Treat Both Graywater and Sewage (2022$) at a 2% Discount Rate 57

Table 4-23. Incremental Capital Cost to Install an Advanced Type II MSD Versus a Typical Type II MSD on Ferries Covered under 40 CFR 139.21(e)(4) (2022$) at a 2% Discount Rate 58

Table 4-24. Estimated Incremental Annual Cost for Ferries Covered under 40 CFR 139.21(e)(4) to Operate and Maintain an Advanced Type II MSD to Treat Both Graywater and Blackwater (2022$) 58

Table 4-25. Graywater Incremental Per Vessel Costs for Ferries Covered under 40 CFR 139.21(e)(4) (2022$) at a 2% Discount Rate 58

Table 4-26. Number of Ferries Covered under 40 CFR 139.21(e)(4) Generating Graywater 59

Table 4-27. Graywater Total Cost Estimate for Ferries Covered under 40 CFR 139.21(e)(4) (2022$) at a 2% Discount Rate 59

Table 4-28. Estimated Capital and Annual Costs for Vessels to Install and Operate a MGPS (2022$) at a 2% Discount Rate 62

Table 4-29. Estimated Cumulative Cost of Other Rule Provisions (2022$) at a 2% Discount Rate 63

Table 4-30. Characteristics of Two Newly Built Lakers 64

Table 4-31. Ballast Water Management System Capital Cost Estimates, (2022$) 65

Table 4-32. Annualized Ballast Water Management System Capital Cost Estimates, (2022$) at a 2% Discount Rate 65

Table 4-33. Ballast Water Management System Annual O&M Costs, (2022$) 65
Table 4-34. Total Annualized Cost of Procuring, Operating, and Maintaining Ballast Water Management Systems - UV + Filtration and Chemical Addition, (2022$) at a 2% Discount Rate 66
Table 4-35. Total Annualized Cost of the Equipment Standard for New Lakers, (2022$) at a 2% Discount Rate 66
Table 4-36. Characteristics of a Converted Laker 69
Table 4-37. Ballast Water Management System Capital Costs for Converted Lakers 69
Table 4-38. Total Annualized Cost of Procuring, Operating, and Maintaining Ballast Water Management Systems for Converted Lakers 69
Table 4-39. Total Annualized Cost of the Equipment Standard for Converted Lakers, (2022$) at a 2% Discount Rate 70
Table 4-40. Total Annualized Cost of the Equipment Standard for Lakers, (2022$) at a 2% Discount Rate 72
Table 4-41. Total Annual Cost of State Petitions under VIDA (2022$).. 76
Table 4-42. Total Annualized Cost of the Final Rule, by Rule Provision, ($2022) at a 2% Discount Rate77
Table 4-43: Description of Analysis Limitations and Uncertainties.. 78
Table 5-1. Pollutants Found in Vessel Discharges 87
Table 5-2. Impairment Status of the Top 20 Ports by Annual Vessel Calls 91
Table 5-3. Overview of Benefits from Reducing Pollutants Found in Vessel Discharges 92
Table 5-4. Pollutants in Discharges from Small Vessels 92
Table 6-1. Cost and Benefits, by provision ($2022) 95
Table 7-1. Annualized Cost of BWMS as a Percent of the Annualized Cost of a New Laker (2022$, Commercial Rate of Capital at 7 Percent) 98
Table 7-2. Annualized Cost of the BWMS as a Percent of the Annual Cost of a Converted Laker (2022$, Commercial Rate of Capital at 7 Percent) 99
Table 8-1. Small Businesses by Industry Sector, 2023 102
Table 8-2. Cost Impact Thresholds for Small Businesses in Smallest Size Categories at 1% and 3% of Annual Revenue, 2022$ 104
Table A-0-1. Total Annualized Costs of the Final Rule, by Provision, (2022$) at a 3% Discount Rate.. 123
Table A-0-2. Total Annualized Costs of the Final Rule, by Provision, (2022$) at a 7% Discount Rate.. 124
Table B-0-1. Capital Cost Estimate for Bulk Carriers 125
Table B-0-2. Estimated Capital Cost for Newly Built Lakers 126
Table B-0-3. Daily Sailing O&M Cost Based on Published Fuel Use 128

Table B-0-4. Daily Port O&M Cost Based on Published Fuel Use 129

Table B-0-5. Estimated Annual O&M Cost Per Vessel.. 130

Acronyms

AAGR	Average Annual Growth Rate
AFFF	Aqueous Film-Forming Foam
ANS	Aquatic Nuisance Species
AR	Annual Report
BWE	Ballast Water Exchange
COTP	Captain of the Port
CPI	Consumer Price Index
CWA	Clean Water Act
EA	Economic Analysis
eNOI	Electronic Notice of Intent
EEZ	Exclusive Economic Zone
FTVEC	Foreign Traffic Vessel Entrances and Clearances database
GDP-IPD	Gross Domestic Product- Implicit Price Deflator
GRT	Gross Register Tonnage
ICST	International Classification of Ships by Type
ITC	International Tonnage Certificate
MISLE	Marine Information for Safety and Law Enforcement database
MGPS	Marine Growth Prevention System
MSD	Marine Sanitation Device
NAICS	North American Industry Classification System
NANPCA	Nonindigenous Aquatic Nuisance Prevention and Control Act
NBIC	National Ballast Information Clearinghouse
nm	nautical miles
NOBOB	No Ballast on Board
NPDES	National Pollutant Discharge Elimination System
PARI	Permit Authorization and Record of Inspection
SBA	Small Business Administration
SLSS	Saint Lawrence Seaway System
sVGP	Small Vessel General Permit
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
VGP	Vessel General Permit
VIDA	Vessel Incidental Discharge Act
WTLUS	Waterborne Transportation Lines of the United States

Executive Summary

On December 4, 2018, the President signed into law the Vessel Incidental Discharge Act (VIDA). This legislation amends section 312 of the Clean Water Act (CWA) and establishes a new section 312(p) under which the EPA and the U.S. Coast Guard (USCG) are to regulate incidental discharges from vessels. The new section 312(p) calls for the EPA to set Federal standards for discharges from vessels using the existing National Pollutant Discharge Elimination System (NPDES) Vessel General Permit (VGP) requirements as a starting point. Subsequently, the USCG is to establish implementing regulations for those standards, including but not limited to establishing inspection, monitoring, reporting, and recordkeeping requirements.

The VIDA also contains other provisions related to controlling incidental discharges from vessels, including specific ballast water requirements, procedures for establishing emergency best management practices, petitions by state governors for review of standards including for enhanced Great Lakes requirements, and state petitions for no-discharge zones. In addition, the law repeals the NPDES Small Vessel General Permit (sVGP) and excludes small vessels and fishing vessels from federal incidental discharge requirements, except for ballast water.

This economic analysis (EA) presents the estimated costs and benefits associated with the EPA's final rulemaking to address its new responsibilities as assigned under the VIDA. The EA uses as the analytic baseline the vessel discharge requirements in the VGP and sVGP in place immediately prior to passage of the VIDA legislation. The analysis also considers other international, federal, state, and local regulations and guidelines and industry standards covering vessel discharges. This analysis does not cover impacts from VIDA on requirements for inspections, monitoring, reporting, and recordkeeping because the VIDA in CWA section 312(p)(5) assigned the United States Coast Guard (USCG) responsibility for developing implementing regulations that, with few exceptions, are to be no less stringent than the VGP with respect to inspections, monitoring, reporting, and recordkeeping as necessary to ensure, monitor, and enforce compliance with the EPA discharge standards. As such, the EPA determined it is appropriate for the USCG to evaluate any potential change in impacts for these types of VGP requirements as part of the USCG regulatory development process required under CWA section 312(p)(5).

The EPA estimates 69,000 U.S.-flagged and 16,000 foreign-flagged vessels will need to comply with the new discharge standards in the EPA's final rulemaking. In addition to its assessment of the cost impacts specifically to the 69,000 U.S.-flagged vessels, the EPA also examined the cost impacts to the approximately 600 foreign-flagged vessels that are U.S.-owned.

Overall, the cost impacts of the EPA's final rulemaking are estimated to be limited since the principal effect of the VIDA is to transfer authority for establishing discharge standards from the NPDES permitting program to the new CWA section 312(p) program. In total, the EPA projects U.S.-flagged and U.S.-owned vessels will experience a net savings of $11.3 million annually as a result of the VIDA and the EPA's final rulemaking (see Table ES-1). This regulatory relief is mainly due to the VIDA excluding small vessels and fishing vessels from incidental discharge standards, except for ballast water, which more than offsets the relatively minor annual cost increases ($4.976 million) arising from the EPA's final standards. The analysis included consideration of the cost impacts associated with the final rulemaking in three categories:

1. Rule revisions dictated by the VIDA. This includes (a) specific, new ballast water requirements for vessels nationally as well as regionally, and (b) exclusions of small vessels and fishing vessels from discharge standards, except for ballast water.
2. Rule revisions unchanged from the VGP, including the requirement to use environmentally acceptable lubricants.
3. Other Rule revisions including changes from the VGP. This includes (a) two new discharge requirements under the VIDA for graywater systems (b) a new discharge requirement for biofouling prevention for seawater piping systems, and (c) a requirement for new or converted vessels that operate only on the Great Lakes (referred to as New Lakers) to install, operate, and maintain a ballast water management system (BWMS) that has been type-approved by the USCG.

Table ES-7-1: Total Annualized Costs of the Final Rule, by Provision ($2022) at a 2% Discount Rate

Rule Provisions	Annualized Cost
Rule Provisions Dictated by VIDA	
Changes to BWMS	$5,479,000
Overseas and coastal vessels	*$3,268,000*
St. Lawrence Seaway	*$165,000*
Pacific Region	*$1,640,000*
Pacific Region, low salinity BW	*$406,000*
Exclusions for Small Vessels and Fishing Vessels	($27,410,000)
State Petitions	$6,000
Subtotal	**($21,925,000)**
Rule Provisions Unchanged from VGP	
Environmentally Acceptable Lubricants	$5,690,000
Subtotal	**$5,690,000**
Other Rule Provisions, including Changes from VGP	
Graywater Systems	$2,399,000
New Build Vessels 400 GT or more Carrying 15 or more passengers and overnight accommodations	*$2,280,000*
New Build Ferries Carrying 250 or more passengers	*$119,000*
MGPS to prevent macrofouling	$295,000
BWMSs for New Lakers	$2,282,000
New Builds	$1,373,000
Conversions	$909,000
Subtotal	$4,976,000
Total Annualized Cost:	**($11,259,000)**

The analysis also included consideration of the potential impacts of the final rule on states and small entities, the impacts of which are projected to be minor.

The EPA also assessed the environmental benefits associated with the VIDA and the corresponding regulations. While the EPA anticipates the final rule will reduce discharges of pollutants from vessels, the Agency does not expect the final rule to change environmental conditions significantly as compared to those realized by the VGP because the existing VGP requirements are largely being adopted as the new discharge standards. The EPA notes the VIDA's repeal of the sVGP along with the statutory exclusions for small vessels and fishing vessels could potentially lead to a reduction in environmental benefits to the extent affected vessels no longer adhere to practices previously required under the sVGP. In particular, the EA examines possible losses in benefits from elimination of sVGP discharge management requirements for bilgewater, graywater, and anti-fouling hull coatings.

Finally, as required by the CWA, the EPA has determined the final rule is economically achievable. In addition, the final rule imposes no significant impact on a substantial number of small entities.

1 BACKGROUND

On December 4, 2018, the President signed into law the Vessel Incidental Discharge Act (VIDA). This legislation amends section 312 of the Clean Water Act (CWA) and establishes a new section 312(p) under which the EPA and the U.S. Coast Guard (USCG) are to regulate incidental discharges from vessels. The new section 312(p) calls for the EPA to set national standards for discharges from vessels using the existing National Pollutant Discharge Elimination System (NPDES) Vessel General Permit (VGP) requirements as a starting point. Subsequently, the USCG is to establish implementing regulations for those standards, including establishing inspection, monitoring, reporting, sampling and recordkeeping requirements. The VIDA requires the EPA to finalize the CWA section 312(p) Federal standards and the USCG thereafter to promulgate the implementing regulations to ensure, monitor, and enforce compliance with the new EPA national discharge standards.

The VIDA also contains other provisions related to controlling incidental discharges from vessels, including specific ballast water requirements, procedures for establishing emergency best management practices, petitions by state governors for review of standards including for enhanced Great Lakes requirements, and state petitions for no-discharge zones. In addition, the law repeals the NPDES Small Vessel General Permit (sVGP) and excludes small vessels and fishing vessels from federal incidental discharge requirements, except for ballast water.

This economic analysis presents the estimated costs and benefits associated with:

1. Rule revisions dictated by the VIDA. This includes (a) specific, new ballast water requirements for vessels nationally as well as regionally, and (b) exclusions of small vessels and fishing vessels from discharge standards, except for ballast water.
2. Rule revisions unchanged from VGP.
3. Other Rule revisions including changes from VGP. This includes (a) two new discharge requirements under the VIDA for graywater systems (b) a new discharge requirement for biofouling prevention for seawater piping systems, and (c) a requirement for new or converted vessels that operate only on the Great Lakes (referred to as New Lakers) to install, operate, and maintain a ballast water management system (BWMS) that has been type– approved by the USCG.

1.1 SCOPE OF THE FINAL RULE

1.1.1 WATERS

The final rule applies to incidental discharges from non-military, non-recreational vessels operating in the waters of the United States or the waters of the contiguous zone. 33 U.S.C. 1322(p)(8)(B). Sections 502(7), 502(8), and 502(9) of the CWA define the terms "navigable waters," "territorial seas," and "contiguous zone," respectively. The term "navigable waters" means the waters of the United States including inland waters and the territorial seas, where the United States includes the 50 states, the District of Columbia, the Commonwealth of Puerto Rico, the U.S. Virgin Islands, Guam, American Samoa, the

Commonwealth of the Northern Mariana Islands, and the Trust Territories of the Pacific Islands. The term "territorial seas" means the belt of seas that extends three miles seaward from the line of ordinary low water along the portion of the coast in direct contact with the open sea and the line marking the seaward limit of inland waters. The term "contiguous zone" means the entire zone established or to be established by the United States under Article 24 of the Convention of the Territorial Sea and the Contiguous Zone, which extends 12 nm under this Convention.

1.1.2 VESSELS

The final rule applies to discharges incidental to the normal operation of a vessel as set forth in CWA section 312(p)(2). The final rule does not apply to discharges incidental to the normal operation of a vessel of the Armed Forces subject to CWA section 312(n); a recreational vessel subject to CWA section 312(o); a small vessel less than 79 feet in length or a fishing vessel, except the rule applies to any discharge of ballast water from a small vessel or fishing vessel; or a floating craft that is permanently moored to a pier, including a floating casino, hotel, restaurant, or bar. The types of vessels covered under the final rule include, but are not limited to, public vessels of the United States, commercial fishing vessels (for ballast water only), passenger vessels (e.g., cruise ships and ferries), barges, tugs and tows, offshore supply vessels, mobile offshore drilling units, tankers, bulk carriers, cargo ships, container ships, and research vessels. The domestic and international vessel population that is subject to the national standards of performance includes approximately 85,000 vessels. The final rule also does not apply to a narrow category of ballast water discharges that Congress believed do not pose a risk of spreading or introducing ANS (33 U.S.C. 1322(p)(2)(B)(ii); VIDA Senate Report, at 10), or to any discharges that result from (or contain material derived from) an activity other than the normal operation of a vessel (33 U.S.C. 1322(p)(2)(B)(iii)). Unless otherwise provided by CWA section 312(p), any incidental discharges excluded from regulation in the VIDA remain subject to the pre-enactment status quo (e.g., State law, NPDES permitting, etc.). VIDA Senate Report, at 10.

The national standards of performance apply equally to new and existing vessels except in such cases where the final rule expressly distinguishes between such vessels as authorized by CWA section 312(p)(4)(C)(ii).

1.1.3 INCIDENTAL DISCHARGES

The final rule establishes general as well as specific national standards of performance for discharges incidental to the normal operation of a vessel described in CWA section 312(p)(2). The general standards apply to all vessels and all incidental discharges. The specific standards apply to specific discharges incidental to the normal operation of the following types of vessel equipment and systems: ballast tanks, bilges, boilers, cathodic protection, chain lockers, decks, desalination and purification systems, elevator pits, exhaust gas emission control systems, fire protection equipment, gas turbines, graywater systems, hulls and associated niche areas, inert gas systems, motor gasoline and compensating systems, non-oily machinery, pools and spas, refrigerators and air conditioners, seawater piping, and sonar domes.

1.1.4 EMERGENCY AND SAFETY CONCERNS

The VIDA recognizes safety of life at sea and other emergency situations not resulting from the negligence or malfeasance of the vessel owner, operator, master, or person in charge may arise, and the prevention of loss of life or serious injury may require operations that would not otherwise be consistent with these standards. Therefore, it is reasonably likely no person would be found to be in violation of the final rule under the affirmative defense described in CWA section 312(p)(8)(C).

1.1.5 EFFECTIVE DATE

The effective date of this rule is 30 days after publication in the Federal Register. However, the national standards of performance become effective beginning on the date upon which the regulations promulgated by the Secretary pursuant to CWA section 312(p)(5) governing the implementation, compliance, and enforcement of the national standards of performance become final, effective, and enforceable. Per CWA section 312(p)(3)(C), as of that date, the requirements of the VGP and all regulations promulgated by the Secretary pursuant to Section 1101 of the Nonindigenous Aquatic Nuisance Prevention and Control Act (NANPCA, 16 U.S.C. § 4711) (as in effect on December 3, 2018), including the regulations contained in subparts C and D of part 151 of title 33, Code of Federal Regulations, and 46 CFR 162.060 (as in effect on December 3, 2018), shall be deemed repealed and have no force or effect. Similarly, as of that same date, any CWA section 401 certification requirement in Part 6 of the 2013 VGP, shall be deemed repealed and have no force or effect.

1.2 SUMMARY OF THE FINAL RULE

The final rule establishes both general and specific discharge standards of performance for approximately 85,000 international and domestic non-military, non-recreational vessels operating in the waters of the United States or the waters of the contiguous zone. The types of vessels covered under the final rule include but are not limited to public vessels of the United States, fishing vessels (for ballast water only), passenger vessels such as cruise ships and ferries, barges, tugs and tows, offshore supply vessels, mobile offshore drilling units, tankers, bulk carriers, cargo ships, container ships, and research vessels. While most provisions are intended to apply to a wide range of vessels, the VIDA specified fishing vessels would only be subject to ballast water provisions. 33 U.S.C.1322(p)(2)(B)(i)(III). The requirements are based on best available technology economically achievable, best conventional pollutant control technology, and best practicable technology currently available, including the use of best management practices (BMPs), to prevent or reduce the discharge of pollutants into the waters of the United States or the waters of the contiguous zone.

The general discharge standards of performance apply to all vessels and incidental discharges covered by the rule, as appropriate, and are organized into three categories: (1) General Operation and Maintenance, (2) Biofouling Management, and (3) Oil Management. The general discharge standards of performance are preventative in nature and require BMPs to minimize the introduction of pollutants into the discharges, as well as the volume of discharges.

The specific discharge standards of performance establish requirements for discharges incidental to the normal operation of a vessel from the following 20 distinct pieces of equipment and systems: ballast tanks; bilges; boilers; cathodic protection; chain lockers; decks; desalination and purification systems; elevator pits; exhaust gas emission control systems; fire protection equipment; gas turbines; graywater systems; hulls and associated niche areas; inert gas systems; motor gasoline and compensating systems; non-oily machinery; pools and spas; refrigeration and air conditioning; seawater piping; and sonar domes.

Pursuant to CWA section 312(p), the final discharge standards of performance are at least as stringent as the VGP, with some exceptions discussed below. The final standards, however, do not incorporate the VGP requirements verbatim. The EPA is promulgating changes to the VGP requirements to transition the permit requirements into national technology-based standards of performance, improve clarity, and enhance enforceability and implementation. In some cases, this results in the EPA consolidating or renaming the VGP requirements to comport with the VIDA. The similarities and differences between the requirements in the final discharge standards of performance and the requirements in the VGP can be sorted into three distinct groups.

The first group consists of 13 discharge standards that are substantially the same as the requirements of the VGP: boilers; cathodic protection; chain lockers; decks; elevator pits; fire protection equipment; gas turbines; inert gas systems; motor gasoline and compensating systems; non-oily machinery; pools and spas; refrigeration and air conditioning; and sonar domes. These 13 discharge standards encompass the intent and stringency of the VGP but include other changes to conform the requirements to the VIDA (e.g., extent of regulated waters, consistency across discharge standards, enforceability and legal precision, minor clarifications).

The second group consists of two discharge standards that are consistent but slightly modified from the VGP to expand controls or provide greater language clarifications: bilges and desalination and purification systems.

The third group consists of five discharge standards that contain the greatest modifications from the VGP: ballast tanks, exhaust gas emission control systems, graywater systems, hulls and associated niche areas, and seawater piping. In addition, the final rule modifies slightly the requirements as they apply in federally-protected waters for five discharges: chain lockers, decks, hulls and associated niche areas, pools and spas, and seawater piping. These modifications address specific VIDA requirements as well as incorporate new information that has become available since the issuance of the VGP.

CWA section 312(p) also directs the EPA to establish additional discharge requirements for vessels operating in certain bodies of water, to include: the Great Lakes, the Pacific Region, and waters subject to Federal protection, in whole or in part, for conservation purposes (federally-protected waters). The final rule establishes place-based requirements to further prevent or reduce the discharge of pollutants into these waterbodies that may contain unique ecosystems, support distinctive species of aquatic flora and fauna, contend with more sensitive water quality issues, or otherwise require greater protection. In the case of vessels operating exclusively on the Great Lakes the EPA has established technology standards for new vessels (New Lakers).

Finally, as required under CWA section 312(p), the final rule contains specific procedural requirements for states to petition the EPA to establish different discharge standards, issue emergency orders, or establish a complete prohibition of one or more discharges into specified state waters (no-discharge zones).

1.3 REPORT ORGANIZATION

This economic analysis presents the EPA's analysis of the benefits of the regulatory options, assessment of the total social costs, and comparison of the social costs and monetized benefits.

The analysis is organized as follows:

- Chapter 2 provides an overview of the history, necessity, and authority of the Final Rule as well as the outreach, consultations, and engagement efforts with the public.
- Chapter 3 highlights the 2013 VGP vessel baselines for U.S.- and Foreign-Flagged Vessel and summarizes the projected vessel universe. It also includes a profile of Lakers subject to the rule.
- Chapter 4 discusses the economic impact and cost analysis of the final rule. This section analyzes the impacts of different parts of the rule: provisions dictated directly by the VIDA, provisions unchanged from the VGP, and provisions changed made from the VGP.
- Chapter 5 describes the EPA's benefits analysis of impacts associated with ballast water, biofouling, invasive species, and reducing other pollutant discharging.
- Chapter 6 provides a comparison of the costs and benefits of the final rule.
- Chapter 7 describes the analysis demonstrating that the final rule requirements are economically achievable.
- Chapter 8 summarizes the statutory and administrative requirements of the rule.
- The final section of this EA provides a list of references.

Several appendices provide additional details on selected aspects of analyses described in the main text of the report.

- Appendix A summarizes the costs at 3 and 7 percent discount rates, to facilitate comparison with the proposed rule, which followed OMB's 2003 Circular A-4.
- Appendix B summarizes the capital and the operation and maintenance costs for newly constructed Lakers at several cost levels including annual, sailing day, and port day.

2 NEED FOR THE FINAL RULE

This section provides the statutory and economic rationales for choosing a regulatory approach to establish national standards of performance for marine pollution control devices for discharges incidental to the normal operation of primarily non-military and non-recreational vessels. The EPA's statutory requirements, regulatory actions, and agency initiatives impacting vessel incidental discharges are discussed.

2.1 HISTORY, PREVIOUS RULEMAKINGS, AMENDMENTS, REVISIONS, CLARIFICATIONS

2.1.1 CLEAN WATER ACT

The CWA's regulatory regime to control vessel discharges has changed over time. The first sentence of the CWA states, "[t]he objective of [the Act] is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters." (33 U.S.C. 1251(a)). CWA section 301(a) provides that "the discharge of any pollutant by any person shall be unlawful" unless the discharge is in compliance with certain other sections of the Act (33 U.S.C. 1311(a)). Among its provisions, the CWA authorizes the EPA and other federal agencies to address the discharge of pollutants from vessels. As such, the EPA established regulations to address vessel discharges authorized under CWA section 311 (addressing oil), section 312 (addressing sewage and discharges incidental to the normal operation of a vessel of the Armed Forces), and section 402 (pursuant to which the EPA established the VGP).

From 1972 to 2005, the EPA vessel regulations were primarily limited to addressing the discharge of oil and sewage under CWA sections 311 and 312, respectively. In December of 2003, a long-standing exclusion of discharges incidental to the normal operation of vessels from the CWA section 402 NPDES permitting program became the subject of a lawsuit in the U.S. District Court for the Northern District of California (Nw. Envtl. Advocates v. EPA, No. C-03-05760-SI, 2005 WL 756614). The lawsuit arose from the EPA's September 2003 denial of a January 1999 rulemaking petition submitted to the EPA by parties concerned about the effects of ballast water discharges. Prior to the lawsuit, the EPA, through a 1973 regulation, had excluded discharges incidental to the normal operation of vessels from the CWA section 402 permitting program. See 38 FR 13528, May 22, 1973. The petition asked the Agency to repeal its regulation at 40 CFR 122.3(a) that excludes certain discharges incidental to the normal operation of vessels from the requirement to obtain an NPDES permit. The petition asserted vessels are "point sources" requiring NPDES permits for discharges to U.S. waters; that the EPA lacks authority to exclude point source discharges from vessels from the NPDES program; that ballast water must be regulated under the NPDES program because it contains invasive plant and animal species as well as other materials of concern (e.g., oil, chipped paint, sediment, and toxins in ballast water sediment); and enactment of CWA section 312(n) (the Uniform National Discharge Standards) in 1996 demonstrated Congress's rejection of the exclusion.

In March 2005, the court determined the exclusion exceeded the Agency's authority under the CWA and subsequently declared in 2006 that "[t]he blanket exemption for discharges incidental to the normal operation of a vessel, contained in 40 CFR § 122.3(a), shall be vacated as of September 30, 2008." Nw. Envtl. Advocates v. EPA, C 03-05760 SI, 2006 WL 2669042, at *15 (N.D. Cal. Sept. 18, 2006), aff'd 537 F.3d 1006 (9th Cir. 2008). Shortly thereafter, Congress enacted two pieces of legislation to exempt discharges incidental to the normal operation of certain types of vessels from the requirement to obtain a permit. The first of these, the Clean Boating Act of 2008 (Public Law 110-288, July 28, 2008), amended the CWA to provide discharges incidental to the normal operation of recreational vessels are not subject to NPDES permitting, and created a new regulatory regime to be implemented by the EPA and the USCG under a new CWA section 312(o). The second piece of legislation provided for a temporary moratorium on NPDES permitting for discharges, excluding ballast water, subject to the 40 CFR 122.3(a) exclusion from commercial fishing vessels (as defined in 46 U.S.C. § 2101 and regardless of size) and those other non-recreational vessels less than 79 feet in length. S. 3298, Pub. L. 110-299 (July 31, 2008).

In response to the court decision and the legislation, the EPA issued the first VGP in December 2008 for discharges incidental to the normal operation of non-recreational, non-military vessels 79 feet in length and above (see 73 FR 79473, December 29, 2008). Additionally, in September 2014, the EPA issued the sVGP for discharges from non-recreational, non-military vessels less than 79 feet in length (see 79 FR 53702, September 10, 2014). Upon expiration of the 2008 permit, the EPA issued the second VGP in 2013 (see 78 FR 21938, April 12, 2013).

After the EPA issuance of the VGP under the CWA and the USCG promulgation of regulations under the NANPCA, the vessel community expressed concerns regarding the lack of uniformity, duplication, and confusion associated with the vessel regulatory regime (see Errata to S. Rep. No. 115-89 (2019) [hereinafter "VIDA Senate Report"], at 3–5 (discussing these and similar concerns), available at https://www.congress.gov/115/crpt/srpt89/CRPT-115srpt89-ERRATA.pdf). In response, members of Congress introduced various pieces of legislation to modify and clarify the regulation and management of ballast water and other incidental vessel discharges. In December 2018, President Trump signed into law the Frank LoBiondo Coast Guard Authorization Act of 2018, which included the VIDA. Pub. L. No. 115-282, tit. IX (2018) (codified primarily at 33 U.S.C. 1322(p)).

The VIDA restructures the way the EPA and the USCG regulate incidental vessel discharges from non-military, non-recreational vessels and amended CWA section 312 to include a new subsection (p) titled, "Uniform National Standards for Discharges Incidental to Normal Operation of Vessels." CWA section 312(p), among other things, repeals the EPA's 2014 sVGP effectively immediately and requires the EPA and the USCG to develop new regulations to replace the existing EPA VGP and USCG vessel discharge requirements. The VIDA also specifies, effective immediately upon enactment of the VIDA, neither EPA nor NPDES-authorized states may require, or in any way modify, a permit under the NPDES program for any discharge incidental to the normal operation of a vessel from a small vessel (less than 79 feet in length) or fishing vessel (of any size).

Specifically, CWA section 312(p)(4) directs the Administrator, with concurrence of the Secretary and in consultation with interested Governors, to promulgate national standards of performance for marine pollution control devices for each type of discharge incidental to the normal operation of non-recreational and non-military vessels. CWA section 312(p)(5) also directs the Secretary to develop corresponding implementing regulations to govern the implementation, compliance, and enforcement of the national standards of performance. Additionally, CWA section 312(p) generally preempts states from establishing more stringent discharge standards once the USCG implementing regulations required under CWA section 312(p)(5)(A)-(C) are final, effective, and enforceable. The VIDA, however, includes several exceptions to this expressed preemption (33 U.S.C. 1322(p)(9)(A)(ii)–(v); VIDA Senate Report, at 15 (discussing these exceptions)), a savings clause (33 U.S.C. 1322(p)(9)(A)(vi)), and provisions for states working directly with the EPA and/or the USCG to pursue additional requirements, including the establishment of no-discharge zones for one or more incidental discharges (33 U.S.C. 1322(p)(10)(D)). The VIDA also establishes several programs to address invasive species, including the establishment of the "Great Lakes and Lake Champlain Invasive Species Program" research and development program and the "Coastal Aquatic Invasive Species Mitigation Grant Program."

2.1.2 ADDITIONAL U.S. AND INTERNATIONAL AUTHORITIES

During the development of the final rule, the EPA reviewed other U.S. laws and international authorities that address discharges incidental to the normal operation of a vessel. As expressly provided in the VIDA, this final rule will not affect the requirements for vessels established under any other provision of Federal law (33 U.S.C. 1322(p)(9)(B)), These include:

- The International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). MARPOL is primarily implemented in the United States by the Act to Prevent Pollution from Ships (APPS), 33 U.S.C. 1901 et seq. The USCG is the lead agency for APPS implementation and issued implementing regulations primarily found at 33 CFR part 151. Those requirements already apply to many of the vessels covered by the final rule.
- The Oil Pollution Act of 1990 and the associated USCG implementing regulations at 33 CFR parts 155 and 157 also address oil and oily mixture discharges from vessels. The final rule is consistent with the existing requirements for fuel and oil established under the Oil Pollution Act and APPS and does not otherwise affect the requirements for vessels established under these Acts.
- CWA section 311, the Oil and Hazardous Substances Liability Act. CWA section 311, states that it is a policy of the United States that there should be no discharges of oil or hazardous substances into the waters of the United States, adjoining shorelines, and certain specified areas, except where permitted under Federal regulations (e.g., the NPDES program). As such, the Act prohibits the discharge of oil or hazardous substances into these areas in such quantities as may be harmful. The final rule prohibits the discharge of oil, including oily mixtures, in such quantities as may be harmful.
- The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) regulates the distribution, sale, and use of pesticides. The final rule reiterates the VGP requirement that any registered pesticide must be used in accordance with its FIFRA label for all activities that result in a discharge into the waters of the United States or the waters of the contiguous zone. The final rule does not negate the requirements under FIFRA and its implementing regulations to use registered pesticides consistent with the product's labeling. In fact, the discharge of pesticides used in violation of certain FIFRA requirements incorporated into this rule is also a violation of these standards, and therefore a violation of the CWA (e.g., exceeding hull coating application rates).
- The National Marine Sanctuaries Act (NMSA) authorizes the designation and management of National Marine Sanctuaries to protect marine resources with conservation, education, historical,

scientific, and other special qualities. Consistent with the VGP, the final rule establishes additional restrictions and requirements for certain discharges for vessels that operate in and around National Marine Sanctuaries.

2.2 ENVIRONMENTAL CONCERNS ADDRESSED BY THE FINAL RULE

Discharges incidental to the normal operation of vessels can have significant adverse impacts on aquatic ecosystems and other potential impacts such as to human health through contamination of food from aquaculture/shellfish harvesting areas through the addition of pollutants (e.g., metals, nutrients, bacteria, viruses, ANS).[1] The adverse environmental impacts vary considerably based on the type and number of vessels, the size and location of the port or marina, and the condition of the receiving waters. These adverse impacts are more likely to occur when there are significant numbers of vessels operating in receiving waters with limited circulation or if the receiving waters are already impaired. As a result of this variation, protecting U.S. waters from vessel-related activities poses unique challenges for local, state, and federal governments. Targeted reduction of certain discharges or constituents of concern can significantly benefit receiving waters.

The information below provides an overview of the environmental impacts associated with the pollutants addressed in this final rule: ANS, nutrients, pathogens (including Escherichia coli and fecal coliform), oil and grease, metals, toxic and nonconventional pollutants with toxic effects, and other nonconventional and conventional pollutants.

2.2.1.1 AQUATIC NUISANCE SPECIES (ANS)

ANS, which can include invasive plants, animals, and pathogens, are a persistent problem in U.S. coastal and inland waters. The VIDA specifically includes ANS in the category of nonconventional pollutants to be regulated through the application of best available technology and best practicable technology (33 U.S.C. 1322(p)(4)(B)(i)).

ANS may be incidentally discharged or released from a vessel's operations through a variety of vessel systems and equipment, including, but not limited to, ballast water, sediment from ballast tanks, vessel hulls and appendages, seawater piping, chain lockers, and anchor chains. ANS pose severe threats to aquatic ecosystems, including outcompeting native species, damaging habitat, changing food webs, and altering the chemical and physical aquatic environment. Furthermore, ANS can have profound and wide-ranging socioeconomic impacts, such as damage to recreational and commercial fisheries, infrastructure, and water-based recreation and tourism. Once established, it is extremely challenging and costly to remove ANS and remediate the impacts. It has become even more critical to control discharges of ANS from vessel systems and equipment with the increase in vessel traffic due to globalization and increased trade.

[1] The VIDA requires the EPA to establish technology-based standards, which do not consider the effects on receiving water quality. Information regarding environmental impacts of these discharges and associated pollutants were not considered in the development of national standards of performance representing best available technology economically achievable, as established in this rule.

2.2.1.2 NUTRIENTS

Nutrients, including nitrogen, phosphorus, and other micro-nutrients, are constituents of incidental discharges from vessels. Though often associated with discharges from sewage treatment facilities and other sources such as runoff from agricultural and urban stormwater sources, nutrients are also discharged from vessel sources such as runoff from deck cleaning, graywater, and bilgewater.

Increased nutrient discharges from anthropogenic sources are a major source of water quality degradation throughout the United States (U.S. Geological Survey, 1999). Generally, nutrient over-enrichment of waterbodies adversely impacts biological diversity, fisheries, and coral reef and seagrass ecosystems (National Research Council, 2000). One of the most notable effects of nutrient over-enrichment is the excess proliferation of plant life and ensuing eutrophication. A eutrophic system has reduced levels of dissolved oxygen, increased turbidity, and changes in the composition of aquatic flora and fauna. Such conditions also fuel harmful algal blooms, which can have significant adverse impacts on human health as well as aquatic life (National Research Council, 2000; Woods Hole Oceanographic Institute, 2007).

2.2.1.3 PATHOGENS

Pathogens are another constituent that can be found in discharges from vessels, particularly in graywater and ballast water discharges. Discharges of pathogens into waterbodies can adversely impact local ecosystems, fisheries, and human health. Pathogens found in untreated graywater are similar to, and in some cases may have a higher concentration than, domestic sewage entering land-based wastewater treatment plants (U.S. EPA, 2008a). Specific pathogens of concern found in graywater include Salmonella spp., Escherichia coli, enteroviruses, hepatitis, and pathogenic protists (National Research Council, 1993). Pathogen discharges have also been associated with ballasting operations, including Escherichia coli, intestinal enterococci, Vibrio cholerae, Clostridium perfringens, Salmonella spp., Cryptosporidium spp., Giardia spp., and a variety of viruses (Knight et al., 1999; Reynolds et al., 1999; Zo et al., 1999). Pathogens can potentially even be transported in unfilled ballast water tanks (Johengen et al, 2005). Under the VIDA, bacterial and viral pathogens can qualify as "aquatic nuisance species." 33 U.S.C. 1312(p)(1)(A), (Q), (R) (defining the related terms "aquatic nuisance species," "nonindigenous species," and "organism").

2.2.1.4 OIL AND GREASE

Vessels can discharge a variety of oils during normal operations, including lubricating oils, hydraulic oils, and vegetable or organic oils. A significant portion of the lubricants discharged from a vessel during these normal operations directly enters the marine environment. Some types of oil and grease can be highly toxic and carcinogenic, and have been shown to alter the immune system, reproductive abilities, and liver functions of many aquatic organisms (Ober, 2010). Broadly, the toxicity of oil and grease to aquatic life is due to reduced oxygen transport potential and an inability of organisms to metabolize and excrete them once ingested, absorbed, or inhaled.

The magnitude of impact of oils differs depending on the chemical composition, method of exposure, concentration, and environmental conditions (e.g., weather, salinity, temperature). It can therefore be difficult to identify one single parameter responsible for negatively impacting aquatic life.

Aromatic hydrocarbon compounds, commonly present in fuels, lubricants, and additives, are consistently associated with acute toxicity and harmful effects in aquatic biota (Dupuis and Ucan-Marin, 2015). Impacts are observed in both developing and adult organisms, and include reduced growth, enlarged livers, fin erosion, reproduction impairment, and modifications to heartbeat and respiration rates (Dupuis and Ucan-Marin, 2015). Laboratory experiments have shown that fish embryos exposed to hydrocarbons exemplify symptoms collectively referred to as blue sac disease (BSD). Symptoms of BSD range from reduced growth and spinal abnormalities, to hemorrhages and mortality (Dupuis and Ucan-Marin, 2015). Oils can also taint organisms that are consumed by humans, resulting in economic impacts to fisheries and potential human health effects.

In establishing the final rule, the EPA considered the availability of environmentally acceptable lubricants (EALs). Production of EALs focuses on using chemicals with oxygen atoms, which, unlike hydrocarbons, makes them water soluble. The solubility of EALs increases their biodegradability, thereby decreasing their accumulation in aquatic environments. The solubility of EALs also makes it easier for aquatic life to metabolize and excrete these chemicals (U.S. EPA, 2011). Overall, EALs reduce bioaccumulation potential and toxic effects to aquatic life.

2.2.1.5 METALS

Vessel discharges can contain metal constituents from a variety of onboard sources, including graywater, bilgewater, exhaust gas emission control systems, and fire main systems. While some metals, including copper, nickel, and zinc, are known to be essential to organism function when present at certain levels, many others, including thallium and arsenic, are non-essential and/or are known to have only adverse impacts. Even essential metals may harm organism function in sufficiently elevated concentrations. Some metals may also bioaccumulate in the tissues of aquatic organisms, intensifying toxic effects. Through a process called biomagnification, concentrations of some metals can increase up the food chain, leading to elevated levels in commercially harvested fish species (Malik and Maurya, 2014).

Vessel hulls and appendages are frequently coated in metal-based biocides to prevent biofouling. The most widely used metal in biocides is copper. While it is an essential nutrient, copper can be both acutely and chronically toxic to fish, aquatic invertebrates, and aquatic plants at higher concentrations. Elevated concentrations of copper can adversely impact survivorship, growth, and reproduction of aquatic organisms (U.S. EPA, 2023). Excess copper can also inhibit photosynthesis and interfere with enzyme function in a variety of plants (Chen et. al., 2022).

2.2.1.6 OTHER POLLUTANTS

Vessel discharges can contain a variety of other toxic, conventional, and nonconventional pollutants. This rule is intended to prevent and control the discharge of certain pollutants that have been identified in the various discharges. For example, graywater can contain phthalates phenols, and chlorine (U.S. EPA, 2008a). These compounds can cause a variety of adverse impacts on aquatic organisms and human health. Phthalates are known to interfere with reproductive health, liver, and kidney function in both animals and humans. (Sekizawa et al., 2003; DiGangi et al., 2002). Chlorine can cause respiratory problems, hemorrhaging, and acute mortality to aquatic organisms, even at relatively low concentrations (U.S. EPA, 2008a).

Vessel discharges may also contain certain biocides used in vessel coatings, which can be harmful to aquatic organisms. For example, cybutryne, also commonly known as Irgarol 1051, is a biocide that functions by inhibiting the electron transport mechanism in algae, thus inhibiting growth. Numerous studies indicate cybutryne is both acutely and chronically toxic to a range of marine organisms (Carbery et al, 2006; Van Wezel and Van Vlaardingen, 2004).

Some vessel discharges are more acidic or basic than the receiving waters, which can have a localized effect on pH (Alaska Department of Environmental Conservation, 2007). For example, exhaust gas emission control systems remove sulfur dioxide in exhaust gas and dissolve it in washwater, where it is then ionized and produces an acidic washwater. Research has shown that even minor changes in ambient pH can have profound effects, such as developmental defects, reduced larval survivorship, and decreased calcification of corals and shellfish (Oyen et al., 1991; Zaniboni-Filho et al., 2009; Marubini and Atkinson, 1999).

2.3 MARKET FAILURE ADDRESSED BY THE FINAL RULE

As discussed above, discharges incidental to the normal operation of vessels can have significant adverse impacts on aquatic ecosystems and other potential impacts such as to human health. However, the owners and operators of vessels do not fully bear the environmental impacts associated with these discharges. At the same time, controlling these incidental discharges requires equipment and changes to operating procedures that would result in additional operating costs to the vessel owners and operators. Therefore, absent the requirements of this final rule, vessel operators face an economic disincentive to take the necessary actions to manage incidental discharges. The rule will correct this market failure by requiring vessel owners and operators to internalize the cost of controlling incidental discharges by requiring these firms to implement control technologies and practices.

2.4 STATUTORY AUTHORITY

The EPA promulgates this rule under CWA sections 301, 304, 307, 308, 312, and 501 as amended by the Vessel Incidental Discharge Act. 33 U.S.C. §§ 1311, 1314, 1317, 1318, 1322, and 1361. This final rule fulfills the EPA’s obligation under CWA section 312(p) to establish technology-based national standards of performance for discharges incidental to the normal operation of primarily non-military, non-recreational vessels 79 feet in length and above. This final rule also fulfills the EPA’s consent decree obligation to sign (and promptly thereafter transmit to the Office of Federal Register) a decision taking final action following notice and comment rulemaking with regard to the EPA’s October 26, 2020, proposed rule pertaining to Federal standards of performance for marine pollution control devices for discharges incidental to the normal operation of a vessel under CWA section 312(p)(4)(A)(i), 33 U.S.C. §§ 1322(p)(4)(A)(i) (Vessel Incidental Discharge National Standards of Performance, 85 Fed. Reg. 67818-01 (proposed Oct. 26, 2020)).” (Consent Decree, *Center for Biological Diversity, et al. v. Regan, et al.*, Case No. 4:23-cv-535 (N.D. Cal. Dec. 13, 2023).

This economic analysis is conducted pursuant to Executive Orders 12866, 13563 and 14094, as this rule is deemed significant. This economic analysis also demonstrates the economic achievability of the final performance standards and technology standards, pursuant to the CWA.

3 PROFILE OF VESSELS SUBJECT TO THE FINAL RULE

3.1 U.S.-FLAGGED VESSELS

For U.S.-flagged vessels[2], the analysis started with data on the universe of vessels originally collected to support previous VGP and sVGP analyses. The analysis then extrapolated those counts to 2022 based on industry growth rates. For large vessels, 79 feet in length or greater, the EPA used two years of data from two primary data sources to estimate the population of vessels: (1) the Marine Information for Safety and Law Enforcement (MISLE) database compiled by the USCG (USCG, 2009 and USCG, 2016), and (2) the Waterborne Transportation Lines of the United States (WTLUS) data file compiled by the Waterborne Commerce Statistics Center of the U.S. Army Corps of Engineers (USACE) Navigation Data Center (NDC) (USACE, 2009 and USACE, 2016). For small vessels, the EPA used one year of MISLE data (USCG, 2009) to estimate the population.

The MISLE database provided a wide range of information regarding vessel and facility characteristics, accidents, marine pollution incidents, and other information pertinent to USCG operations. The database covers a wide range of vessels (e.g., recreational vessels, commercial fishing vessels, freight barges, tank barges, tank ships, passenger vessels, utility vessels) and provides data on various characteristics for each individual vessel. These data include: identification number(s); vessel category (e.g., class, type, subtype, service); size (e.g., tonnage, length, breadth, depth); area of operation (e.g., hailing port, route type); passenger and crew capacity; propulsion (i.e., method, engine type, and horsepower); construction material and design (e.g., hull material, design type, hull configuration/shape); and year built or age.

The WTLUS data file is a three-volume annual product that provides both an inventory of vessel companies, along with their U.S.-flagged vessels operating in the transportation of freight and passengers, and a national summary of all vessels. The database lists the vessel companies in alphabetical order and provides each vessel's name and number; Coast Guard number; net tonnage; Vessel Type, Construction, and Characteristics (VTCC) code and International Classification of Ships by Type (ICST) code; register and overall length and breadth; loaded and light draft; horsepower; carrying capacity in short tons or units of cargo and number of passengers; height of fixed superstructures; cargo handling equipment; operating headquarters; and year built or rebuilt.

EPA jurisdiction under the VGP extends out to three nautical miles whereas USCG jurisdiction extends out to 12 nautical miles; however, under the VIDA both the EPA and the USCG jurisdiction extends out to 12 nautical miles. The EPA's assessment of vessels covered under the VGP did not attempt to adjust the tallies of vessels derived from the MISLE and WTLUS databases to account for differences in EPA and USCG jurisdiction. That approach potentially over-estimated the burden vessels incurred for VGP compliance in the analytical baseline because EPA jurisdiction was more limited than USCG jurisdiction.

[2] The number and type of Lakers, a subset of the universe of vessels, is discussed in Section 3.3.

3.1.1 LARGE U.S.-FLAGGED VESSELS

To estimate the population of large, U.S.-flagged vessels, the EPA created two databases by combining the MISLE and WTLUS data files, with the first based on 2009 data and the second based on 2016 data. The combined databases allowed the Agency to obtain a comprehensive estimate of the vessel population for each year and to minimize the number of missing data fields for any given vessel. The primary Vessel Identification Number (VIN) was used to combine information across the databases. The EPA used the MISLE data as the base of the population and supplemented it with additional vessel observations and attributes available in WTLUS. Vessel type could not be determined for a relatively small percent of large vessels (i.e., less than 3 percent in 2016). These vessels were assigned to a vessel type based on relative shares of vessel types. Using this methodology, the Agency estimated as shown in Table 3-1 the number of large U.S.-flagged vessels subject to the VGP was 58,600 in 2009 and 63,600 by 2016.

Table 3-1. U.S.-Flagged Large Vessel Population, 2009 and 2016

Vessel Type	2009[a]		2016[b]	
	Total Vessels Count[c]	Percentage of Vessels	Total Vessels Count[c]	Percentage of Vessels
Commercial Fishing	2,326	4.0%	2,159	3.4%
Freight Barge	39,760	67.8%	45,773	72.0%
Freight Ship	812	1.4%	756	1.2%
Passenger Vessel	1,970	3.4%	2,042	3.2%
Tank Barge	7,144	12.2%	7,834	12.3%
Tank Ship	332	0.6%	207	0.3%
Utility Vessel	6,258	10.7%	4,818	7.6%
Total	**58,602**	**100%**	**63,589**	**100%**

[a] *Source: Estimated from USCG, MISLE database, 2009 and USACE, WTLUS, 2009.*
[b] *Source: Estimated from USCG, MISLE database, 2016 and USACE, WTLUS, 2016.*
[c] *Includes vessels greater than or equal to 79 feet with status noted as "active," "unknown," "laid up" or without status. Excludes vessels identified as duplicate records. Vessels with type unspecified were assigned to a vessel type based on relative shares of vessel types.*

This analysis used the vessel population groupings as defined in MISLE and WTLUS categorizations:

- *Commercial Fishing*. Includes fish processing, fish catching, and other fishing vessels. For analytical purposes, the projection assumed large commercial fishing vessels all have ballast water.
- *Freight Barge*. Includes open and covered hopper barges, car floats, flat/deck barges, pontoon barges, open and covered dry cargo barges, container barges, lash barges, and convertible barges.
- *Freight Ship*. Includes general cargo freighters, break bulk carriers, roll-on/roll-off (RO-RO) carriers, container ships, partial container ships, refrigerated ships (reefer), and vehicle carriers.
- *Passenger Vessel*. Includes cruise ships, combination passenger and cargo ships, ferries, railroad car ferries, excursion and sightseeing vessels, and passenger barges. Note certain standards apply only to non-cruise passenger vessels, and in those cases the cost calculations are adjusted to reflect that subset of vessels.

- *Tank Ship*. Includes petroleum, chemical, and liquid gas carriers, and liquid bulk tankers.
- *Tank Barge*. Includes liquid cargo barges that are single hull, double hull, double sided only, and double bottom only.
- *Utility Vessel*. Includes crew boats, mobile offshore drilling units, offshore supply vessels, industrial vessels, oil recovery vessels, research vessels, school ships, push boats, and tug/towing vessels.

Freight barges and tank barges together accounted for 80 percent of large U.S.-flagged vessels in 2009 and increased in both absolute numbers and relative to other vessel types to account for 84.3 percent of the vessel population by 2016. Conversely, large commercial fishing vessels, freight ships, tank ships and utility vessels all decreased in both absolute and relative terms over the same period, while the total number of large passenger vessels increased modestly.

To extrapolate vessel counts for large U.S.-flagged vessels to 2022, the EPA calculated the average annual growth rate (AAGR) from 2009 to 2016 for each vessel type and then multiplied the 2016 vessel counts by one plus the type-specific AAGR over six years.[3] These results are presented in Table 3-2.

Table 3-2. Projected U.S.-Flagged Large Vessel Population, 2022

Vessel Type	Average Annual Growth Rate, 2009 - 2016[a]	Projected Total Large Vessels, 2022[b]
Commercial Fishing	-1.06%	2,025
Freight Barge	2.03%	51,646
Freight Ship	-1.01%	711
Passenger Vessel	0.52%	2,106
Tank Barge	1.33%	8,478
Tank Ship	-6.54%	138
Utility Vessel	-3.67%	3,851
Total	**1.32%[c]**	**68,955**

[a] *EPA calculation from vessel counts by type in Table 3-1*
[b] *EPA calculation multiplying 2016 vessel counts in Table 3-11 by AAGR over 6 years.*
[c] *Calculated as the AAGR over all vessel types listed, weighted by the relative number of vessels in each type category.*

3.1.2 SMALL U.S.-FLAGGED VESSELS

To estimate the number of small U.S.-flagged vessels, the EPA examined comparable figures generated in connection with issuing the 2014 sVGP (EPA, 2014). The sVGP figures rely principally on 2009 MISLE data, which has two sources of uncertainty that affect counts of small vessels. First, although approximately 115,000 vessels were clearly small based on vessel length recorded in the MISLE database, no length is recorded for an additional 22,600 vessels. If these vessels were also less than 79

[3] AAGR is the average annual growth rate over a multi-year period, and is calculated as:

$$AAGR = \left(\frac{Vessel\ count\ at\ period\ end}{Vessel\ count\ at\ period\ start}\right)^{\frac{1}{years\ in\ period}} - 1$$

feet in length, then the small vessel count would total almost 137,600 (19.6 percent higher). Therefore, the EPA presents small vessel counts as a range with a lower bound excluding all vessels of unknown length and an upper bound including all vessels of unknown length.

Second, no service type was listed for a significant number of vessels. Records for over 15,000 vessels 79-feet long or less did not specify type, while another 12,400 with unknown length also did not specify type. Using the same methodology as for large vessels, the EPA distributed vessels with unknown type across all type categories based on the relative share of small vessels with known type, with one exception. Communications with the USCG Fishing Vessel Safety Program suggested that the small commercial fishing vessel count was reasonably accurate, and therefore the analysis did not distribute any vessels with unknown type to that particular category.[4]

Table 3-3 presents the range computed using this methodology to estimate the population of affected small vessels. Compared to the large vessel estimates, freight and tank barges combined comprise a relatively small percentage of the small vessel universe (about 6 percent to 11 percent). Conversely, commercial fishing and passenger vessels compose approximately 74 percent to 82 percent of small U.S.-flagged vessels.

Table 3-3. U.S.-Flagged Small Vessel Population, 2009[a]

Vessel Type	Lower Bound[b]		Upper Bound[c]	
	Total Vessels Count	Percentage of Vessels	Total Vessels Count	Percentage of Vessels
Commercial Fishing	67,178	58.4%	67,713	49.2%
Freight Barge	6,250	5.4%	13,180	9.6%
Freight Ship	844	0.7%	1,263	0.9%
Passenger Vessel	27,199	23.7%	34,451	25.0%
Public Vessel, unclassified	98	0.1%	1,023	0.7%
Tank Barge	418	0.4%	1,518	1.1%
Tank Ship	71	0.1%	294	0.2%
Utility Vessel	12,938	11.3%	18,142	13.2%
Total	**114,996**	**100%**	**137,583**	**100%**

Source: Estimated from USCG, MISLE database, 2009. Includes vessels with status noted as "active," "unknown," "laid up," or without status. Vessels with type unspecified were assigned to a vessel type based on relative shares of vessel types (excluding commercial fishing vessels).

[a] The 2014 sVGP presented the 2009 MISLE counts as the best estimate of 2014 vessel counts. Because vessel counts are now projected an additional eight years out to 2022, it is analytically preferable to project those counts from the 2009 starting point instead of from 2014.

[b] Includes only vessels less than 79 feet; excludes vessels with length unknown.

[c] Includes vessels less than 79 feet and vessels with length unknown.

[4] The MISLE classification also depends on the information provided directly by the vessel owner or operator on the application for documentation or renewal (*Source:* Personal communication with Jack Kemerer, Fishing Vessel Safety Program, May 26, 2009).

To extrapolate vessel counts for small vessels to 2022, the EPA calculated growth rates for maritime industries and applied those growth rates to the 2009 vessel counts. The EPA matched MISLE data on vessel ownership with sources such as the Dun & Bradstreet (2006), ReferenceUSA (2006), or Manta.com business databases to determine business categories of the vessel owners. Using this method, the EPA identified business categories for almost 60 percent of vessels for the upper bound estimate of small vessel counts, but nearly 60,000 vessels remained for which no business category was indicated. To adjust the tallies for this deficiency in categorization, the EPA assigned those vessels where no business category was indicated to the other business categories based on the pattern of distribution exhibited for the vessels with known business categories. As was the case for vessels with unspecified type, the EPA did not assign vessels with unknown codes to the small commercial fishing vessel category. The results of this process are presented in Table 3-4 below.

Table 3-4. U.S.-Flagged Small Vessel Count by Industry, 2009

Industry Sector	Business Category (NAICS[a] code)	Small Vessel Count[b]	Percent	Adjusted Small Vessel Count	Percent
Water Transportation Industry and Related Sectors					
Deep Sea, Coastal, & Great Lakes Water Transp.	4831	133	0.1%	944	0.7%
Inland Water Transportation	4832	7,317	5.3%	51,927	37.7%
Scenic and Sightseeing Transp., Water	4872	1,437	1.0%	10,198	7.4%
Support Activities for Water Transportation	4883	606	0.4%	4,301	3.1%
Fishing					
Fishing	1141	67,713	49.2%	67,713	49.2%
Mining Industry					
Support activities for mining	2131	592	0.4%	592	0.4%
Other mining	2111 & 2123	15	0.0%	15	0.0%
Other Industries	48-49[c]	1,894	1.4%	1,894	1.4%
Vessels with no assigned code	NA	57,876	42.1%	NA	NA
Total		137,583	100%	137,583	100%

[a] *NAICS codes are the "North American Industry Classification System" codes established by the Office of Management and Budget for classifying business establishments.*
[b] *Upper bound estimate of small vessels counts, 2009. See Table 3-3.*
[c] *NAICS 48-49: Transportation and Warehousing.*

For consistency with the large vessel extrapolation approach, the EPA then used national economic data for these NAICS sectors for the same years, 2009 and 2016, from U.S. Census County Business Patterns (CBP) data (Census, 2009 and 2016) to estimate the AAGR for industries identified in the table above, as a proxy for the AAGR for vessels in these sectors. CBP provided estimates of establishments, employment, and payroll by industry and year. Much like the trucking, rail, and air transportation industries, a given number of establishments can support a range of vessels. The number of vessels in operation can increase or decrease significantly without affecting the number of establishments owned. Conversely, increasing or decreasing the number of vessels operated requires hiring additional employees or laying them off to operate the vessels, and, to a lesser extent, support those vessels' operations. Thus, the EPA used employment growth by industry as the best proxy for estimating growth in the number of vessels.

Applying the estimated industry-specific AAGR to the estimated number of vessels attributed to that industry, this time beginning in 2009, the EPA estimated the population of small U.S.-owned vessels is projected to increase to 159,000 by 2022 as shown in Table 3-5. Across all vessel sectors, the total number of vessels grew by an average rate of 1.07 percent per year, which is somewhat smaller than the 1.32 percent average AAGR for large vessels.

Table 3-5. Projected U.S.-Flagged Small Vessel Population, 2022

Industry Sector	Average Compound Annual Growth Rate (2009-2016)	Projected Total Small Vessels, 2022
Water Transportation Industry and Related Sectors		
Deep Sea, Coastal, and Great Lakes Water Transportation	-1.76%	749
Inland Water Transportation	1.55%	63,433
Scenic and Sightseeing Transportation, Water	4.60%	18,303
Support Activities for Water Transportation	1.24%	5,049
Fishing		
Fishing	0.01%	67,782
Mining Industry		
Support activities for mining	-0.18%	579
Other mining	0.85%	17
Other Industries	2.56%	2,632
Total:	**1.07%**[b]	**158,540**
Estimated Number of Small Vessels that Discharge Ballast Water		
Total:		16

[a] *EPA used the weighted average AAGR for the construction industry and the administrative, support, waste management, and remediation services industry NAICS codes (56 and 23) as the growth rate for "other" industries.*

[b] *Calculated as the AAGR over all industries listed, weighted by the relative number of vessels assigned to each industry.*

The EPA estimated the subset of small vessels that will still be required to abide by ballast water discharge requirements because the VIDA stipulates small vessels with ballast water must meet the same ballast water discharge requirements as large vessels. The EPA used data from the 2013 VGP electronic reporting system annual reports submitted between 2014 and 2023 to identify the number of domestic vessels reporting ballast water discharges by vessel size. The EPA found from 2014 to 2023, an average of 16 domestic vessels per year that were smaller than 79 feet in length discharged ballast water in U.S. waters Conversely, more than 158,000 small vessels no longer need to comply with CWA requirements because of the VIDA exclusions.

3.2 FOREIGN-FLAGGED VESSELS

The Foreign Traffic Vessel Entrances and Clearances (FTVEC) database provides information on foreign vessels entering or clearing U.S. Customs. The data are compiled by the U.S. Army Corps of Engineers from information originally collected by the U.S. Customs and Border Protection. They include entrance/clearance characteristics such as the date a vessel made entry into or cleared the U.S. Customs port or waterway, vessel characteristics such as the name, type by rig or ICST code, flag of registry, last (for entrances) or next (for clearances) port of call, net and gross register tonnage, and draft in feet. The database includes both foreign-flagged and U.S.-flagged vessels, but only foreign-flagged vessels were used to estimate the foreign vessel population for this analysis.

Note although all foreign-flagged vessels were included in the universe of vessels potentially affected by the rule (i.e., they must comply with the VIDA when operating in U.S. waters), the EPA was not able to fully analyze the costs for those vessels, but where possible, attempted to include those costs. The EPA did not have comprehensive data relating to existing incidental discharge regulations in other countries that foreign-flagged and foreign-owned vessels already may be subject to and so was unable to estimate with reasonable precision the additional implementation costs that this rule would result in for those vessels (as noted in Table 4-43). While EPA does not have the foregoing data, EPA notes that, related to the requirements of the A-4 Circular, the EPA has determined that impacts of the Laker equipment standard would have negligible impacts to foreign-flagged and foreign-owned vessels due to existing ballast water regulations in Canada. Canadian vessels would likely be in compliance with the requirements of this rule. Additionally, the requirement that vessels use EALs is an existing requirement from the 2013 VGP and does not represent a change from the baseline; its inclusion in this EA was to rectify an omission of the administrative record of the VGP.

To estimate the population of large, foreign-flagged vessels, the EPA compiled six years of FTVEC clearance data into two databases, the first being a three-year aggregate of foreign-flagged vessels from 2008 to 2010 and the second ranging from 2015 to 2017. These three-year aggregate databases helped the Agency estimate the population of unique foreign vessels likely to visit a U.S. port in one year. The EPA used multiple years of data because of the potential for ebbs and flows in population numbers from year-to-year given the inconsistent visits of some foreign-flagged vessels (e.g., tramp freighters) to U.S. ports. This approach allowed the EPA to account for all foreign-flagged vessels that could feasibly clear U.S. ports. Duplicates in the compiled databases were removed based on matching vessel name, ICST code, flag registration, and gross register tonnage. Using this methodology, the Agency estimated the overall population of unique foreign-flagged vessels, regardless of size, was 14,342 from 2008 to 2010 and 15,336 from 2015 to 2017.

Because the FTVEC database does not include vessel length data, the Agency in its 2010 Study of Discharges Incidental to the Normal Operation of Commercial Fishing Vessels and Other Non-Recreational Vessels Less than 79 Feet (EPA, 2010b) derived a relationship between gross register tonnage (GRT) and vessel length to determine which vessels should be considered large. That analysis found a 79-foot-long vessel is roughly equivalent to 150 GRT, with the caveat there are segments of vessel categories such as small passenger ships where this relationship does not always hold true. The EPA also used this equivalency ratio to partition small from large foreign vessels. The EPA distributed vessels with unspecified type among the seven vessel types in proportion to the existing distribution of vessels with known type.

The EPA then calculated the AAGR for each vessel type over the timeframe in this analysis[5] and used it to extrapolate the 2017 population of unique vessels forward to 2022. This calculation yielded an estimated total population for 2022 of 16,048 unique foreign-flagged large vessels and 167 small vessels.

To estimate the subset of foreign-flagged vessels that are U.S.-owned, the EPA examined characteristics of vessels with VGP coverage as documented in the EPA's VGP eNOI System. The VGP eNOI system is the Agency's database for submitting and tracking Notices of Intent for coverage under the NPDES VGP. The Agency was able to determine the relative ratio of foreign-owned to U.S.-owned vessels by vessel type, and then apply this ratio to the total numbers of foreign-flagged vessels to generate estimated counts of foreign-flagged, U.S.-owned vessels as shown in Table 3-6 below.

Table 3-6. Projected Foreign-Flagged Vessel Population, 2022

	Large Foreign-Flagged Vessels[b]				**Small Foreign-Flagged Vessels[b]**			
Vessel Type	**AAGR, 2008-10, 2015-17[a]**	**Foreign Owned**	**U.S. Owned**	***Total***	**AAGR, 2008-10, 2015-17[a]**	**Foreign Owned**	**U.S. Owned**	***Total***
Commercial Fishing	-18.8%	5	0	*5*	-27.5%	1	0	*1*
Freight Barge & Tank Barge[c]	-5.0%	87	25	*112*	14.0%	24	6	*30*
	-12.5%	7	2	*9*				
Freight Ship	1.2%	10,879	146	*11,026*	-1.7%	15	0	*15*
Passenger Vessel	0.0%	92	122	*214*	48.6%	102	131	*233*
Tank Ship	1.4%	4,230	56	*4,286*	-9.4%	1	0	*1*

[5] For analytical purposes, tank barges and freight barges were combined for small vessels because the small foreign-flagged tank barge count was zero for the 2008 to 2010 period. AAGR is undefined when the starting value is zero.

Utility Vessel	-1.5%	282	114	*396*	-4.1%	36	14	*50*
Total	**1.01%[c]**	**15,583**	**465**	***16,048***	**1.11%[c]**	**179**	**151**	***330***

[a] Source: Estimated from USACE, FTVEC databases, 2008, 2009, 2010 and 2015, 2016, 2017.

[b] EPA calculation multiplying 2016 vessel counts by type-specific AAGR over 3 years.

[c] Small freight and tank barges cannot be separately calculated.

[d] Calculated as the average AAGR over all vessel types listed, weighted by the relative number of vessels in each type category.

The EPA coordinated with the USCG to explore the possibility of using the MISLE database to generate actual counts of foreign-flagged, U.S.-owned vessels. However, the USCG indicated to the EPA that the MISLE may not reflect where the parent company is located or the financial relationship between that parent company and the company in MISLE (USCG, 2020). As such, the EPA elected instead to estimate the numbers of foreign-flagged, U.S.-owned vessels using the VGP eNOI data.

For purposes of the analysis, the EPA assumed all small foreign-flagged vessels have the potential to discharge ballast water.

3.3 GREAT LAKES FLEET

The U.S. Laker fleet subject to the final rule consists of 63 vessels. These include vessels defined as 3,000 gross tons ITC (1,600 GRT if ITC is not assigned) and above and operating exclusively upstream of the waters of the St. Lawrence River west of a rhumb line drawn from Cap de Rosiers to West Point, Anticosti Island, and west of a line along 63° W. longitude from Anticosti Island to the north shore of the St. Lawrence River. U.S. Lakers primarily transport domestic dry-bulk cargo such as ore, limestone, cement, salt, and gravel. This fleet operates under Section 27 of the Merchant Marine Act of 1920, known as the Jones Act which requires all waterborne shipping between points in the U.S. to be carried by vessels built in the U.S., owned by U.S. citizens, and crewed with U.S. citizen mariners. The equipment standard in this final rule would apply to both U.S. and Canadian vessels that operate exclusively in the Great Lakes. However, this economic analysis only included U.S. Lakers. Canadian Lakers are required to install, operate, and maintain a BWMS according to 2021 Canadian regulations (Canada Gazette, Part 11, Volume 155, Number 13, SOR/2021-120, June 4, 2021). Therefore, the EPA's equipment standard would not result in any additional cost to these vessels.

3.3.1.1 DATA COLLECTION, FILTERING, AND VALIDATION

Data on the number of vessels operating on the Great Lakes and their owners/operators were gathered from the U.S. Army Corps of Engineers (USACE) Waterborne Commerce Statistics Center (WCSC) Vessels Characteristics database (USACE, 2023). The WCSC Vessels Characteristics database contains data on all U.S. vessels operating in the Waterborne Transportation Lines of the United States (WTLUS) including the Great Lakes System, the Mississippi River System and Gulf Intracoastal Waterway, and the Atlantic, Gulf, and Pacific Coasts. The data are collected annually on a calendar year basis, by authority of Title 33, Navigation & Navigable Waters (33 USC § 555). The latest data available on vessels and their operating companies was from the year 2020, which were used to create an inventory of all U.S. Lakers.

The WCSC Vessels Characteristics dataset includes variables for vessel name, operating company name, USCG vessel number, net registered tons (NRT), year built, year rebuilt (described as major conversions in this analysis) be consistent with 33 CFR 151.2005), operating state, operating WTLUS region, and other vessel characteristics. To narrow the population to only vessels that would be covered by the equipment standard, the data were filtered using WTLUS region, state, and NRT. The region and state were narrowed to the Great Lakes System and the eight states located along the Great Lakes (i.e., Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, and Wisconsin). Filtering on geography resulted in 590 vessels operating within the transportation lines of the Great Lakes. A further filter for NRT was used to limit the data to include only vessels greater than or equal to 1,777 NRT.[6] These two filters resulted in 66 vessels from the WCSC data that met the Laker definition above. Since, the WCSC Vessels Characteristics data only go through 2020, manual searches of each vessel were conducted using the Port State Information eXchange (PSIX) system. The EPA looked up each vessel by their USCG number to determine their operating states. The PSIX system contains weekly uploaded data on vessel specific information derived from the USCG Marine Information Safety and Law Enforcement System (MISLE). The EPA also looked up company names to assess their current fleet and further exclude decommissioned vessels and include new vessels. The validation process resulted in the exclusion of four vessels due to these vessels being decommissioned or scrapped post-2020 as well as the inclusion of one new vessel built in 2022. A final inventory of 63 vessels was produced. These 63 ships are operated by 16 operators.

3.3.1.2 GREAT LAKES FLEET

Table 3-7 contains a summary of the basic physical characteristics of the 63 U.S. Lakers comprising the Great Lakes fleet. These Lakers fall into six different International Classification of Ship Types (ICST) with the majority being bulk carriers. For each ICST, Table 3-7 provides the number of vessels, average net registered tonnage, total capacity (deadweight tons), average capacity (deadweight tons), average length and breadth (feet), average age, and age range.

Table 3-7. Lakers by International Classification of Ships by Type

ICST Type	Vessels	Net Registered Tonnage	Total capacity (tons)	Avg. capacity (tons)	Avg. Length (feet)	Avg. Breadth (feet)	Average Age (years)	Age Range (years)
Covered dry cargo barge	10	138,555	328,369	32,837	661	74	41	3 - 78
Dry Cargo Deck barge	2	5,046	6,650	3,325	287	53	60	37 - 82

[6] The WCSC data reported capacity in terms of Net Registered Tons (NRT) and not Gross Registered Tons (GRT). Therefore, NRT was used as a screening criterion. GRT can be approximated from NRT using the following equation: GRT = NRT /0.9. Therefore, an NRT value of 1,440 was used to filter vessels that would not be subject to the equipment standard (U.S. Coast Guard, 2009).

Liquid Tank Barge (Double Hull)	8	27,592	62,560	7,820	339	56	43	14 - 68
Open dry cargo barge	2	14,121	32,700	16,350	499	71	69	66 - 71
Other bulk carrier	40	622,916	1,617,687	40,442	760	82	56	1 - 117
Other Carriers (Specialized)	1	2,033	185	185	394	60	70	70

A list of the 63 vessels is provided in Table 3-8, including information about ICST classification description, engine power (horsepower), length (feet), net register tonnage, capacity (tons), year built, year converted (if applicable), and operator listed in WCSC. The median age of a U.S. Laker is over 50 years old with the oldest U.S. Laker in operation built in 1909. A total of 17 of the 63 vessels (10 of the 40 bulk carriers) have undergone major conversions, with the most recent conversion occurring in 2019. The newest vessel in the fleet commenced operation in 2022. There have been nine vessel completions over the last 20 years (six new builds and three major conversions).

Table 3-8. List of Laker Vessels

Vessel Name	ICST Desc	HP	Length (ft)	NRT	Capacity (tons)[a]	Year Built	Year Converted[b]	Operator
American Century	Other Bulk Carrier	14,000	1,000	33,534	71,300	1981		American Steamship Co
American Courage	Other Bulk Carrier	7,000	635	8,105	24,100	1979		American Steamship Co
American Integrity	Other Bulk Carrier	14,400	990	33,263	68,540	1978		American Steamship Co
American Mariner	Other Bulk Carrier	7,000	716	11,245	41,800	1980		American Steamship Co
American Spirit	Other Bulk Carrier	16,000	991	29,412	70,896	1978		American Steamship Co
Burns Harbor	Other Bulk Carrier	14,000	990	33,263	90,600	1980		American Steamship Co
H Lee White	Other Bulk Carrier	7,000	690	10,348	39,800	1974		American Steamship Co
Indiana Harbor	Other Bulk Carrier	14,000	990	33,534	62,161	1979		American Steamship Co
John J Boland	Other Bulk Carrier	7,000	666	9,712	38,000	1973		American Steamship Co
Sam Laud	Other Bulk Carrier	7,000	615	8,036	27,200	1975		American Steamship Co
Walter J McCarthy Jr	Other Bulk Carrier	14,000	990	33,534	90,600	1977		American Steamship Co
A - 390	Liquid Tank Barge (Dbl Hull)		310	2,346	5,400	1982		Andrie, Inc

A - 397	Liquid Tank Barge (Dbl Hull)		270	2,928	5,500	1962		Andrie, Inc
A - 410	Liquid Tank Barge (Dbl Hull)		335	3,793	5,700	1955	1978	Andrie, Inc
Endeavour	Liquid Tank Barge (Dbl Hull)		339	2,459	4,040	2009		Andrie, Inc
Great Lakes	Liquid Tank Barge (Dbl Hull)		397	5,024	10,150	1982		Better Way Logistics LLC
Menominee	Open Dry Cargo Barge		602	9,097	22,000	1952	2006	Grand River Navigation
Maumee	Covered Dry Cargo Barge		673	9,336	25,500	1953	2008	Grand River Navigation
Joseph L Block	Other Bulk Carrier	7,000	728	12,524	37,572	1976		Central Marine Logistics, Inc
Str Edward L Ryerson	Other Bulk Carrier	9,000	714	7,637	27,500	1960		Central Marine Logistics, Inc
Str Wilfred Sykes	Other Bulk Carrier	7,000	661	7,148	24,640	1949		Central Marine Logistics, Inc
Warner Provider	Liquid Tank Barge (Dbl Hull)		264	1,698	3,110	1962		Fuel Boat Holdings LLC
Calumet	Other Bulk Carrier	5,400	612	5,700	21,056	1973		Grand River Navigation
Manitowoc	Other Bulk Carrier	5,400	612	5,700	21,056	1973		Grand River Navigation
Ashtabula	Covered Dry Cargo Barge		610	14,337	42,800	1982		Grand River Navigation
Great Lakes Trader	Covered Dry Cargo Barge		710	15,823	38,500	2000		Van Enkevort
Alpena	Other Bulk Carrier	4,000	503	5,452	15,221	1942	1991	Inland Lakes Management
J A W Iglehart	Other Bulk Carrier	4,000	486	6,028	12,320	1936	1964	Inland Lakes Management
Paul H Townsend	Other Bulk Carrier	2,200	432	2,825	8,636	1945	1958	Inland Lakes Management
Pere Marquette 41	Dry Cargo Deck Barge		389	3,413	5,700	1941	1998	Interlake Steamship Co
Herbert C Jackson	Other Bulk Carrier	6,300	670	7,370	27,776	1959	1975	Interlake Steamship Co
Hon James L Oberstar	Other Bulk Carrier	8,500	786	11,079	34,720	1959	1981	Interlake Steamship Co
James R Barker	Other Bulk Carrier	16,000	991	29,629	70,896	1976		Interlake Steamship Co
John Sherwin	Other Bulk Carrier	8,500	786	12,405	35,280	1958	1973	Interlake Steamship Co
Kaye E Barker	Other Bulk Carrier	7,000	749	8,940	29,008	1952	1981	Interlake Steamship Co
Lee A Tregurtha	Other Bulk Carrier	7,000	812	11,428	32,816	1942	1978	Interlake Steamship Co

Mesabi Miner	Other Bulk Carrier	16,000	991	29,629	70,896	1977		Interlake Steamship Co
Paul R Tregurtha	Other Bulk Carrier	16,000	1,000	32,580	76,160	1981		Interlake Steamship Co
Stewart J Cort	Other Bulk Carrier	14,400	989	29,918	58,000	1971		Interlake Steamship Co
Pathfinder	Covered Dry Cargo Barge		581	10,577	26,700	1952	1998	Interlake Steamship Co
Arthur M. Anderson	Other Bulk Carrier	7,000	750	9,372	28,400	1952	1981/1982	Great Lakes Fleet
Cason J Callaway	Other Bulk Carrier	7,000	750	9,332	28,400	1952		Great Lakes Fleet
Edgar B Speer	Other Bulk Carrier	19,260	990	28,553	66,000	1980		Great Lakes Fleet
Edwin H Gott	Other Bulk Carrier	19,500	990	30,690	66,000	1979		Great Lakes Fleet
Great Republic	Other Bulk Carrier	7,000	625	11,106	28,600	1981		Great Lakes Fleet
John G Munson	Other Bulk Carrier	7,000	752	11,330	28,600	1952		Great Lakes Fleet
Philip R Clarke	Other Bulk Carrier	7,000	750	9,372	28,400	1952		Great Lakes Fleet
Roger Blough	Other Bulk Carrier	15,000	833	14,114	49,200	1972		Great Lakes Fleet
Presque Isle	Covered Dry Cargo Barge		975	22,259	55,600	1973		Great Lakes Fleet
Derrick No 109	Dry Cargo Deck Barge		185	1,633	950	1986		King Co The, Inc
Innovation	Other Bulk Carrier		441	7,990	17,310	2006		Andrie, Inc
Integrity	Covered Dry Cargo Barge		441	7,990	17,557	1996		Andrie, Inc
Badger	Other Carriers (Specialized)	7,000	394	2,033	185	1953		Lake Michigan Carferry
Mckee Sons	Covered Dry Cargo Barge		579	10,800	22,700	1945	1996	Lake Service Shipping Company
Commander	Open Dry Cargo Barge		396	5,024	10,700	1957	1990[c]	Port City Marine Services
Erie Trader	Covered Dry Cargo Barge		710	16,552	37,600	2012		Van Enkevort
Spartan Ii	Liquid Tank Barge (Dbl Hull)		407	3,124	10,000	1980		Andrie, Inc
St Mary's Challenger	Other Bulk Carrier	3,000	530	5,384	10,250	1906	2014	Port City Marine Services
Margaret	Liquid Tank Barge (Dbl Hull)		391	6,220	18,660	2005		US Oil A Division Of US Venture, Inc
J H Thompson	Covered Dry Cargo Barge		620	14,356	23,000	1989		Van Enkevort
Michigan Trader	Covered Dry Cargo Barge		710	16,525	37,512	2020		Van Enkevort

St Mary's Conquest	Other Bulk Carrier		419	3,363	8,600	1937	1989	Vcna Prairie, Inc
Mark W Barker	Other Bulk Carrier	8,000	639	12,332	26,000	2022		Interlake Steamship Co

[a] Source: USCG Maritime Information Exchange (cgmix.uscg.mil/PSIX/PSIXSearch.aspx), except Mark W. Barker (http://www.interlake-steamship.com/our-fleet/mark-w-barker), Innovation and Integrity (https://greatlakesships.wordpress.com), and Erie Trader (Know Your Ships, 2017. Field Guide to boats on the Great Lakes and St. Lawrence Seaway).
[b] The WCSC data uses the term rebuilt. For purposes of this analysis, it is assumed that the year rebuilt is consistent with year converted.
[c] The rebuilt date for the Commander is listed as 1990 in the WCSC database. There is press information which describes the rebuilt date being converted to a cement-hauling barge in 2019 (Boomgaard, 2019). However, this analysis kept the 1990 rebuilt date since WCSC is the primary source of information.

3.3.1.3 OWNERS AND OPERATORS

3.3.1.3.1 Company Details

The 63 U.S. Lakers in the dataset are operated by 16 different operators. To understand the ownership and size of companies in the industry, the EPA queried Experian's Business Target IQ portal (Experian, 2023) as well as searched other public records, such as company, industry, news, and government online sources, to collect data on employment and any potential parent company relationships.[7] Ten of the sixteen operators are subsidiaries of larger shipping or construction companies. For the purposes of this analysis, the EPA will refer to the top entities in corporate structure as "owners", and to the entities directly linked to individual vessels as "operators." In total, the fleet is owned by 13 firms.

Three owners: American Industrial Partners, Interlake Maritime Services, and Chaz Kurtz account for 38 vessels. Six owners operate a single U.S. Laker. After accounting for subsidiaries, the EPA found 9 of the 13 vessel-owning companies own 5 or fewer vessels. A summary of the total number of U.S. Lakers by owner and parent company can be found in Table 3-9. The U.S. Laker owners and operators are listed in Table 3-10.

Table 3-9. U.S. Laker Operators and Owners by Total Number of Vessels Owned

Number of Vessels Owned	Number of Operators	Number of Owners
1 to 2	8	5
3 to 5	4	4
6 to 8	1	1
More than 8	3	3

[7] Although the EPA used a variety of sources to profile these firms, such as public datasets, business directories, online data sources, and phone interviews, detailed financial information for these privately held companies is confidential and not available for the purposes of this analysis.

3.3.1.3.2 Small Business Status

Cargo operations on the Great Lakes are classified under NAICS 483113 (Coastal and Great Lakes Freight Transportation). The Small Business Administration (SBA) has established a small business threshold of 800 employees for this industry (SBA, 2023). The SBA threshold applies to the highest U.S. based level of an organization's corporate structure.

To determine the small business status of the operators in our database, the EPA cross-validated between three different sources: Experian, the federal System for Award Management (SAM) (GSA, 2023), and where necessary, made phone or email information requests. While the EPA was not able to collect reliable information about the exact number of employees of each owner/operator, the EPA was nonetheless able to determine if a firm should be considered "small" or "large" for the purposes of this economic impact analysis.

Nine of the 13 U.S. Laker owners are small businesses according to the SBA's small business criteria, while 4 are large firms. Slightly over half (35) of the 63 vessels are owned by small entities. The small business status of owner/operator entities is summarized in Table 3-10.

Table 3-10. List of Laker Owners/Operators

Owner/Operator	Ships	Employees of Owner/ Operator	Owner	Employees of Owner	Data Source on Employment	SBA Size Category of Owner
American Steamship Co.	11	50	American Industrial Partners	50,001	Experian	Large
Grand River Navigation	5	10				
Interlake Steamship Co	12	28	Interlake Maritime Services	>800	Email from company	Large
Lake Michigan Carferry	1	35				
Keylakes, Inc.	9	7	Chaz Kurz, Inc.	480	Experian/ Phone interview	Small
Andrie, Inc.	7	99	NA	NA	Experian/ SAM.gov	Small
Inland Lakes Management	3	15	NA	NA	Experian	Small
Van Enkevort	4	<800	NA	NA	Phone Interview	Small
Central Marine Logistics, Inc.	3	10	NA	NA	Experian/ SAM.gov	Small
Better Way Logistics LLC	1	4	NA	NA	Experian/ SAM.gov	Small
Fuel Boat Holdings LLC	1	3	Warner Petroleum Corp	<800	Experian/ Phone interview	Small
The King Co.	1	30	NA	NA	Experian/ SAM.gov	Small
Lake Service Shipping Company	1	3	Sand Products Corporation	<800	Email from company	Small
Port City Marine Services	2	3				
U.S. Oil	1	7	U.S. Venture Inc.	2,500	Experian	Large
Vcna Prairie, Inc.	1	24	VCNA	1,800	Experian/	Large

					Website	
NA = information not applicable *Owner = parent company*						

3.4 SUMMARY OF PROJECTED VESSEL UNIVERSE

Based on the analysis described in the preceding sections, the EPA projects as shown in Table 3-11 below that 85,349 vessels globally are covered by the final rule. Of these entities, 68,971 are U.S.-flagged vessels and 616 are foreign-flagged, U.S.-owned vessels that could experience compliance costs as projected in the cost analysis presented in this EA. Not all vessels tabulated in this chapter are estimated to incur costs under each specific component of the VIDA. Some vessels may accrue cost savings if they no longer need to meet a particular standard.

Table 3-11. Projected Universe of Vessels Covered by VIDA, 2022

Vessel Type (Large Vessels, except as noted)	U.S.-Flagged Vessels	Foreign-Flagged Vessels		Total	Percentage of Vessels
		Foreign-Owned	U.S.-Owned[a]		
Commercial Fishing	2,025	5	0	2,030	2.6%
Freight Barge	51,646	87	25	51,758	60.64%
Tank Barge	8,478	7	2	8,488	9.94%
Freight Ship	711	10,879	146	11,737	13.75%
Passenger Vessel	2,106	92	122	2,320	2.72%
Tank Ship	138	4,230	56	4,424	5.18%
Utility Vessel	3,851	282	114	4,246	4.98%
Large Vessels, Total	*68,955*	*15,583*	*465*	*85,003*	*99.6%*
Small Vessels with Ballast Water	*16*	*179*	*151*	*346*	*0.4%*
TOTAL VESSELS	***68,971***	***15,762***	***616***	***85,349***	***100.0%***

[a] *Note that compliance costs for foreign-flagged vessels are only presented for the portion of vessels that are U.S.-owned.*

4 ECONOMIC IMPACT AND COST ANALYSIS

4.1 INTRODUCTION

In Chapter 4, the EPA presents a cost analysis to estimate the total annual incremental costs for affected vessels to comply with the VIDA and the EPA's final rule. The content of this chapter includes compliance cost estimates, discharge standards, ballast water management, administrative cost estimates, and related information specific to Lakers relevant to the final rule. The EPA also discusses the approach and process used to derive these estimates.

This chapter has eight main sections including this introductory section. Section 4.2 describes the methodology used to identify the number of affected vessels, and the estimated annual incremental compliance costs for vessels to comply with the VIDA and final rule. Section 4.3 estimates the costs due to rule provisions dictated by the VIDA. Section 4.4 estimates the costs for rule provisions unchanged from VGP. Section 4.5 covers other rule provisions, including changes from VGP. Section 4.6 provides the estimated administrative costs for states due to the VIDA provisions for state petitions to the EPA for more stringent discharge requirements. Section 4.7 presents the total costs of compliance with this Final Rule. Section 4.8 summarizes the limitations and uncertainties encountered during the economic analysis. The analysis used two separate discount rates depending on the perspective from costs are analyzed. When analyzing costs from society's perspective (e.g. total costs to the economy), the analysis uses a rate of 2 percent. When analyzing costs from the perspective of a private entity (e.g. costs an entity would incur to own and operate a vessel) for purposes of an economic achievability test, the analysis uses a rate of 7 percent. The former rate reflects society's willingness to trade current for future consumption, and the latter reflects the rate at which financing is available to affected entities.

4.2 COST METHODOLOGY

While both domestic and foreign-flagged vessels operating in U.S. waters are covered by the VGP and the VIDA and are included in the vessel universe estimate, the EPA's cost analysis assessed cost impacts to only U.S.-flagged vessels and the subset of foreign-flagged vessels that are U.S.-owned. For brevity's sake, this EA refers to U.S.-flagged and foreign-flagged, U.S.-owned vessels for the remainder of the analysis collectively as "U.S.-owned vessels."

After identifying the universe of potentially affected vessels, the analysis then established the regulatory baseline against which the impacts of the VIDA are measured. Consistent with OMB's Circular A-4 (2023), the Agency determined the most appropriate baseline for the cost analysis are the vessel discharge requirements that existed immediately prior to passage of the VIDA legislation – the without-statute baseline. This includes the VGP, the sVGP, and other requirements governing vessel operations such as USCG regulations and international requirements under MARPOL (i.e., the International Convention for the Prevention of Pollution from Ships).

The Agency then estimated an average annual incremental "unit" cost per vessel (or per firm) for the standard. For example, if the standard requires vessels equipped with AFFF firefighting systems to use a nonfluorinated foam for training purposes (but not for actual fire suppression), the EPA did not assign the complete cost of a new system to the vessel. Instead, the Agency calculated only the incremental cost of switching foams: the difference in the cost per gallon of each type of foam replaced on a one-to-one basis along with the cost of any modifications to the system associated with use of a different foam.

The majority of the unit cost estimates were derived largely from communications (e.g., phone calls, emails) with industry. Additional cost inputs such as estimates for incremental capital and maintenance expenditures are derived from information received from manufacturers and field experts both in connection with the analysis the EPA originally conducted for the 2013 VGP as well as in more recent communications. These communications are documented as part of the 2013 VGP issuance and in the docket for the EPA's rulemaking for the VIDA standards, as appropriate. Annual per-vessel unit costs for meeting the various standards were based on the cost of meeting the requirement in a single instance. The Agency multiplied these unit costs of compliance by the number of times each year the activity needs to be performed.

Finally, the Agency scaled the estimated annual incremental compliance costs for a single vessel to project the annual incremental industry-wide costs of adopting that standard. To compute this estimate, the EPA multiplied the average compliance costs per vessel by the number of vessels to which the standard applies and then summed the projected costs across all vessel types.

The cost analysis supporting the EPA's final rulemaking reflects the following important considerations and assumptions:

- For the analytic baseline, the Agency assumed all vessels are in full compliance with all current federal and state regulations. Consequently, the estimated costs for complying with the final standards represent the incremental costs vessel owners experience as a result of needing to comply with the new standards rather than the current VGP and sVGP requirements.

- When the EPA conducted an economic analysis for the 2013 VGP, that analytic baseline accounted for other considerations that affected the cost impacts to vessel owners, such as the existence of industry standards and practices, international treaties, and onboard equipment and other resources necessary to comply with the discharge standards. For example, several international treaties in place establish guidelines, such as for exhaust gas emission control systems and bilgewater, that are generally already practiced by the maritime industry. To the extent the new standards replicate those international obligations, the analysis assumed vessel owners will not incur any additional cost burden as a direct result of the new standards.

- The EPA did not assess cost impacts from changes in inspection, monitoring, reporting, and recordkeeping that vessel owners will experience as part of the transition from the VGP to the new requirements established pursuant to the VIDA. Consistent with the new CWA section 312(p)(5) established under the VIDA, the USCG is required to promulgate inspection, monitoring, reporting, and recordkeeping requirements within two years of the EPA's issuance of final discharge standards under CWA section 312(p)(4). These USCG requirements as specified in CWA section 312(p)(5)(A)(ii) must, with few exceptions, be at least as stringent as the VGP. Consequently, the EPA determined that it is appropriate for the USCG to evaluate the net cost impact from any changes in these requirements as part of the USCG VIDA rulemaking.

4.3 RULE PROVISIONS DICTATED BY VIDA

The following subsections present the estimated incremental compliance costs associated with VIDA-related requirements.

4.3.1 CHANGES TO BALLAST WATER MANAGEMENT SYSTEMS

Legislative changes mandated directly in the VIDA will give rise to incremental costs to vessel owners and operators for ballast water management. Under the VIDA, vessel owners could potentially incur incremental ballast water management costs through the following four provisions mandated directly in the legislation:

- §312(p)(6)(B) requiring overseas and coastal vessels to conduct a saltwater flush of any empty ballast tanks;
- §312(p)(10)(A) requiring vessels entering the St. Lawrence Seaway through the mouth of the St. Lawrence River to conduct ballast water exchange (BWE) or flushing;
- §312(p)(10)(C)(ii) establishing Pacific Region BWE requirements; and
- §312(p)(10)(C)(iii) establishing Pacific Region BWE requirements for low salinity ballast water.

Other VIDA ballast water provisions were incorporated from the 2013 VGP and the existing USCG regulations and therefore do not impose additional requirements or costs on vessels.

The EPA used a common costing methodology to estimate incremental compliance costs for each of the VIDA's four newly mandated BWE and flushing provisions. First, the EPA estimated a common unit cost for BWE, which was applied to all vessels expected to incur incremental costs under each provision listed above either directly or as applied to saltwater flushing. However, under each provision, the number, types, and sizes of vessels expected to be affected will vary. Therefore, the EPA first presents the method used to estimate the unit cost of BWE, then in the four sections following, presents estimates of the number and type of vessels likely to be affected by each VIDA provision.

4.3.1.1 UNIT COST OF BALLAST WATER EXCHANGE AND SALTWATER FLUSHING

The cost of BWE is primarily determined by the volume of ballast water that must be pumped, measured in cubic meters (m^3) and the ballasting rate (i.e., speed with which ballast water is pumped), measured as cubic meters per hour (m^3/hr). Both ballast water capacity and ballasting rate are largely correlated with vessel size. Larger vessels require greater ballast capacity to maintain safety when conditions require ballasting, and larger ballast tanks typically use larger, more powerful pumps to ensure ballasting can be performed in a reasonable period.

The EPA used data from the NBIC and the literature to estimate ballast water volumes and ballasting rates by vessel type as described below. The EPA assumed vessels either conduct flow-through or empty-refill of ballast tanks. For the flow-through method, the vessel flushes the tanks with 3 volumes of open-ocean water, while the empty-refill method requires the vessel to empty and then refill the tanks twice. Therefore, the EPA assumed the volume of open-ocean water is 2.5 times the volume of ballast water being carried by the vessel (USCG, 2012). Using the average vessel ballast capacities calculated from the literature (ABS, 2014) and an average factor of 2.5 times the total ballast capacity, the volume of exchange water by vessel type was calculated as shown in Table 4-1.

Table 4-1. Ballast Water Exchange Volumes by Vessel Type

Vessel Type	Average Ballast Capacity (m^3) (A)	Average Ballasting Rate (m^3/hr) (B)	Ballast Exchange Factor (C)	Ballast Water Exchange Volume per Vessel (m^3) (D=A*C)
Bulk Carriers[a]	31,250	1,625	2.5	78,125
Tankers	55,300	3,505	2.5	138,250
General Cargo[b]	9,750	450	2.5	24,375
Other Vessels[c]	7,000	425	2.5	17,500

Source: ABS (American Bureau of Shipping). (2014). Ballast Water Treatment Advisory.
[a] Includes vessels that are classified both as bulk carriers and as other vessel types.
[b] Includes container ships and ro-ro ships
[c] Includes passenger vessels and reefers.

To calculate saltwater flushing volumes, the EPA used NBIC data to estimate the volume of flush water (m^3) per ballast tank capacity (m^3) used on coastal vessel voyages. The EPA found unit flush water volumes are 0.28 m^3/m^3 of ballast capacity for bulk carriers, 0.30 m^3/m^3 of ballast capacity for tankers, and 0.37 m^3/m^3 of ballast capacity on general cargo ships. The EPA applied the average of the flush volumes for the three known vessel types (0.31 m^3/m^3) to the "other vessels" category.

Assuming the cost for both BWE and flushing ballast tanks is similar since both require electric power, equipment maintenance, and labor, the EPA used USCG's 2012 Regulatory Analysis and Final Regulatory Flexibility Analysis costs for vessels to conduct BWE (USCG, 2012). The USCG BWE costs were then inflated to 2022 dollars, using the GDP implicit price deflator (USBEA, 2022) as shown in Table 4-2.

Table 4-2. Ballast Water Exchange Costs

Ballast System Capacity (m^3/hr)	Electric Power Cost ($/$m^3$)	Maintenance Cost ($/$m^3$)	Labor Cost ($/$m^3$)	Total Cost (2007$/$m^3$)	Total Cost (2022$/$m^3$)
250	$0.01	$0.03	0.022	$0.062	$0.08
750	$0.01	$0.02	0.01	$0.037	$0.05
2000	$0.01	$0.01	0.003	$0.026	$0.04
5000	$0.01	$0.01	0.001	$0.021	$0.03

Source: Table B-3, USCG, 2012

The EPA regressed estimated unit ballast water exchange costs against ballasting capacity as shown in Table 4-2 to develop an equation that could be used to estimate the cost for BWE or saltwater flushing of empty ballast tanks on bulk carriers, tankers, general cargo ships, and other vessels. Combining the ballast system capacities of the various vessel types, the EPA calculated the unit cost of adding a cubic meter of saltwater to ballast tanks for BWE or flushing as shown in Table 4-3.

Table 4-3. Average Unit Cost for BWE or Saltwater Flushing by Vessel Type

Vessel Type	BWE or Saltwater Flushing Unit Cost (2022$) $/m3 saltwater added
Bulk Carriers[a]	$0.04
Tankers	$0.03
General Cargo[b]	$0.07
Other Vessels[c]	$0.07

[a] *Includes combination vessels.*

[b] *Includes container ships and ro-ro ships.*

[c] *Includes passenger vessels and reefers.*

4.3.1.2 COSTS FOR FLUSHING EMPTY BALLAST TANKS OF COASTAL VESSELS (§312(P)(6)(B))

Under CWA section 312(p)(6)(B), vessels that have empty ballast tanks and are on voyages originating in the Exclusive Economic Zone (EEZ) and are bound for a U.S. port or a destination subject to U.S. jurisdiction (i.e., a coastal voyage) must conduct saltwater flushing of empty tanks not less than 50 nm from any shore unless:

- The unpumpable residual waters and sediments of an empty ballast tank were subject to treatment through a type-approved ballast water management system (BWMS);
- The flushing as mandated would compromise the safety of the vessel;
- Design limitations of the vessel prevent BWE or a saltwater flush from being conducted; or
- The vessel is operating exclusively within the internal waters of the United States or Canada.

This new provision requiring coastal vessels along the Atlantic Coast and the Gulf Coast to conduct saltwater flushing of empty ballast tanks will result in incremental costs to the industry.

To estimate the incremental costs associated with requiring vessels on U.S. coastal voyages to conduct saltwater flushing of empty ballast tanks, the EPA first estimated the percentage of affected vessels. For all voyages between U.S. ports (including between coastal and Great Lakes ports), the EPA assumed all vessels were U.S.-flagged as a result of the Jones Act.[8] The EPA used the NPDES permitting database to estimate the percentage of vessels transiting between Canadian and Mexican coast to U.S ports and for vessels entering Pacific coast ports from overseas. The EPA found that fewer than five percent of all bulkers, tankers and cargo vessels are U.S.-flagged, while more than 95 percent of other vessels, including utility, barges, fishing, and passenger vessels, are U.S.-flagged as shown in Table 4-4.

[8] The Jones Act typically refers to the combination of the Merchant Marine Act of 1920 and the Passenger Service Act. These two Acts together control U.S. maritime commerce and require all goods and passengers transported by water between U.S. ports to be carried on U.S.-flagged vessels.

Table 4-4. Percentage of U.S.-Flagged Vessels and Foreign-Flagged, U.S.-Owned Vessels Voyaging Between U.S and Foreign Ports

Vessel Type	Percent of U.S.-Flagged Vessels	Percent of Foreign-Flagged, U.S.-Owned Vessels
Bulk Carriers[a]	0.5	1.2
Tankers	1.3	1.3
General Cargo[b]	3.1	1.7
Other Vessels[c]	97.1	30.2

Source: EPA VGP 2018 eNOI database
[a] *Includes combination vessels.*
[b] *Includes container ships and ro-ro ships.*
[c] *Includes passenger vessels and reefers.*

The EPA then obtained data on all 2018 U.S. coastal voyages from NBIC and eliminated all arrivals in Great Lakes ports and the Pacific region to avoid double counting of costs associated with sections 312(p)(10)(A) and 312(p)(10)(C). The EPA also eliminated Pacific nearshore vessel voyages as flushing requirements for these vessels were already included in the 2013 VGP (i.e., no incremental costs). Finally, the origin and arrival ports on each voyage were examined to eliminate those that did not travel between at least one Captain of the Port (COTP) zone.

Because NBIC data does not include information on no ballast on board (NOBOB) coastal voyages that would require flushing, the EPA performed a literature search to determine if any studies outside the Great Lakes region had estimated the number of NOBOB coastal voyages in U.S. waters. Drake et al. (2005) examined the number of vessels entering the Chesapeake Bay from August 2002 to May 2004 and determined that only 14 percent of vessels arrive with NOBOB. Based on this study, the EPA assumed that 14 percent of voyages reporting to NBIC for all vessel categories were NOBOB vessels that would be required to conduct flushing of empty ballast tanks.

At the unit cost for saltwater flushing presented in Table 4-3, the estimated annual costs (2022$) for coastal vessels to conduct saltwater flushing is as shown in Table 4-5.

Table 4-5. Estimated Costs for Saltwater Flushing for Coastal Vessels ($2022)

Vessel Type	Coastal Voyages Assumed to have NOBOB[d,e]	Vessel Ballast Water Volume by Vessel Type (m^3)[f]	Saltwater Flushing Volume (m^3/m^3)[g]	Estimated Annual Cost for Coastal Vessels to Conduct Saltwater Flushing[d,e,f]
Bulk Carrier[a]	**174**	31,250	0.28	$62,000
Tanker	**528**	55,300	0.37	$280,000
General Cargo[b]	**114**	9,750	0.30	$21,000
Other Vessels[c]	**222**	7,000	0.31	$32,000
Total:	**1,038**			$395,000

Source: National Ballast Water Information Clearinghouse *[a] Includes combination vessels.*

[b] Includes container ships and ro-ro ships.

[c] Includes passenger vessels and reefers.

[d] Excludes vessels operating between ports in the Great Lakes and St. Lawrence Seaway.

[e] Excludes coastal vessels entering the Great Lakes through the St. Lawrence Seaway through the mouth of the St. Lawrence River and voyages by vessels to Pacific region ports.

[f] Average ballast water volumes for various vessel types from ABS (2014).

[g] Saltwater flush volume estimated from NBIC.

Note: Numbers may not add due to rounding.

In addition to the estimated incremental costs of actual BWE, vessels on coastal voyages could incur incremental fuel costs to undertake BWE. The 2013 VGP did not require a vessel, except those entering the Great Lakes or federally-protected waters, to deviate from its route to conduct BWE or flushing at least 50 nm from any shore. However, under the VIDA, coastal vessels would have to venture to 50 nm from shore to conduct saltwater BWE or flushing if their normal voyage pattern would not meet this distance, imposing additional fuel costs on the vessel.

The EPA examined Marine Traffic[9] voyage density maps for the Atlantic and Gulf coasts to determine if vessels will need to deviate from their usual route to voyage beyond 50 nm from shore to meet the new BWE requirements. The distances from shore for typical voyage distance were then calculated using latitude and longitude data from the coastal voyage density maps and Google Earth measurement software. For the Atlantic coast, the average coastal vessel voyage is approximately 30 nm from shore and in the Gulf of Mexico, predominant routes from Corpus Christi to Houston and from New Orleans to Lake Charles averages 17 miles from shore. For voyages having arrival and destination ports on the Atlantic coast, vessels would need to deviate 40 nm (round trip) from their intended route to conduct flushing 50 nm from shore. For coastal voyages in the Gulf of Mexico, vessels would need to deviate approximately 67 nm (round trip) from their intended route to conduct flushing. Based on typical fuel costs, the resulting incremental compliance burden for these voyages is as shown in Table 4-6 below.

Table 4-6. Estimated Fuel Cost for Saltwater Flushing of Empty Tanks When Voyaging Between Atlantic and Gulf of Mexico Ports ($2022)

Vessel Type	Coastal Voyages with NOBOB[d] (A)	Round Trip Distance per Voyage (nm) (B)	Total Travel Distance for All Voyages (nm) (C)	Fuel Use Rate (mtons/nm) (D)	Fuel Cost ($/mtons) (E)	Total Annual Fuel Cost for U.S.-Flagged Vessels to Conduct Saltwater Flushing (F=C*D*E)
Atlantic Coast						
Bulk Carrier[a]	62	40	2,500	0.1	$504	$122,000
Tanker	104	40	4,200	0.1	$504	$206,000

[9] https://www.marinetraffic.com/en/ais/home/centerx:-159.3/centery:21.7/zoom:9

General Cargo[b]	71	40	2,800	0.1	$504	$137,000
Other Vessels[c]	138	40	5,500	0.1	$504	$269,000
					Subtotal:	**$734,000**
Gulf of Mexico						
Bulk Carrier[a]	112	66	7,400	0.1	$504	$362,000
Tanker	424	66	28,000	0.1	$504	$1,371,000
General Cargo[b]	42	66	2,800	0.1	$504	$137,000
Other Vessels[c]	84	66	5,500	0.1	$504	$269,000
					Subtotal:	**$2,139,000**
					Total:	**$2,873,000**

Source: National Ballast Water Information Clearinghouse

[a] *Includes combination vessels.*

[b] *Includes container ships and ro-ro ships.*

[c] *Includes passenger vessels and reefers.*

[d] *Includes vessels voyaging from Canadian ports on the Atlantic coast to U.S. ports on the Atlantic coasts.*

4.3.1.3 BWE OR FLUSHING VESSELS ENTERING THE ST. LAWRENCE SEAWAY THROUGH THE MOUTH OF THE ST. LAWRENCE RIVER (§312(P)(10)(A))

The 2013 VGP required all vessels utilizing a ballast water treatment system to conduct BWE as well or saltwater flushing (as applicable) in addition to treating their ballast water under the following circumstances:

- If the vessel operated outside the EEZ and more than 200 nm from any shore, then entered the Great Lakes via the Saint Lawrence Seaway System (SLSS), and
- If the vessel had taken on ballast water with a salinity of less than 18 parts per thousand from a coastal, estuarine, or freshwater ecosystem within the previous 30 days.

The VIDA extends this requirement to international vessels from outside the EEZ originating from higher salinity ports.

In 2014 and 2015, a total of 81 unique vessels on 131 voyages arrived at U.S. Great Lakes ports from overseas ports, 82 percent of which departed from European ports. Due to limited data on the salinity of the origination ports, it is difficult to estimate the affected universe from higher salinity ports that will be required to do BWE plus treatment under the VIDA. These vessels already conduct BWE plus treatment to comply with the 2013 VGP and consequently would not incur incremental costs as a result of the VIDA for this group of vessels.

However, coastal vessels entering the Great Lakes through the SLSS are expected to incur added costs as a result of the VIDA. The VIDA requires vessels whose voyage originated within the EEZ to conduct BWE or flushing of empty tanks at least 50 nm from any shore before entering the mouth of the Saint Lawrence River at Anticosti Island. Prior to the VIDA, vessels on such coastal voyages could enter the SLSS and Great Lakes with unmanaged ballast water thus creating a potential stepping-stone for the transfer of ANS into the Great Lakes.

To estimate the incremental costs for this category of coastal vessels to conduct BWE or saltwater flushing, the EPA paired NBIC data for SLSS and Great Lakes port arrivals with U.S. and Canadian Atlantic coast port departure data (NBIC, 2019). The EPA distinguished vessels carrying ballast water from those that reported no ballast water activity. For vessels with ballast water on board (BOB), the EPA assumes none will seal their tanks and therefore need to conduct BWE or flushing. For vessels that reported no ballast water activity, the EPA assumed that all vessels reporting no ballast activity will load and discharge ballast water in either the Saint Lawrence Seaway or Great Lakes and will therefore be required to conduct saltwater flushing.

Table 4-7 presents the total number of U.S.-flagged vessels entering ports on the SLSS and Great Lakes on voyages that originated from Atlantic coastal ports in the U.S. and Canada, as well as those that discharged ballast water and those that reported no ballast water activity. Table 4-7 does not include voyages by Canadian-flagged coastal vessels to Canadian ports in the SLSS or the Great Lakes.

Table 4-7. Coastal Voyages into the Saint Lawrence Seaway System and Great Lakes, 2018

Vessel Type	Estimated Total Coastal Voyages into the SLSS and Great Lakes in 2018[a] (A)	Estimated Coastal Voyages into the SLSS and Great Lakes with BOB (B)	Estimated Coastal Voyages into the SLSS and Great Lakes with NOBOB (C=A-B)
Bulk Carrier[b]	44	38	6
Tanker	6	5	1
General Cargo[c]	0	0	0
Other Vessels[d]	23	20	3

Source: National Ballast Water Information Clearinghouse
[a] *Excludes voyages between Canadian coastal ports and Canadian ports in the SSLS or Great Lakes.*
[b] *Includes combination vessels.*
[c] *Includes container ships and ro-ro ships.*
[d] *Includes passenger vessels and reefers.*

Using the BWE and flushing volumes by vessel type and the unit costs for BWE or flushing, the EPA estimated the annual costs (2022$) for U.S.-flagged coastal vessels entering the SLSS and the Great Lakes as shown in Table 4-8.

Table 4-8. Estimated Costs for Coastal Vessels Entering the SLSS or the Great Lakes to Conduct BWE or Saltwater Flushing ($2022)

Vessel Type	Estimated BWE Volume for Vessels Entering the SLSS and Great Lakes in 2018 (m^3) (A)	Estimated Saltwater Flush Volume for Vessels Entering the SLSS and Great Lakes in 2018 (m^3) (B)	BWE and Saltwater Flushing Unit Cost ($/$m^3$ saltwater added) (C)	Estimated Annual Cost for Coastal Vessels Entering the SLSS and Great Lakes to Conduct BWE or Saltwater Flushing (D=(A+B)*C)
Bulk Carrier[a]	2,956,000	53,500	$0.04	$123,000
Tanker	713,000	13,700	$0.03	$19,000
General Cargo[b]	0	0	$0.07	$0
Other Vessels[c]	346,000	7,100	$0.07	$23,000
Total BWE and Flushing Cost:				**$165,000**

Source: National Ballast Water Information Clearinghouse
[a] *Includes combination vessels.*
[b] *Includes container ships and ro-ro ships.*
[c] *Includes passenger vessels and reefers.*

The EPA reviewed the Marine Traffic vessel density maps and determined that vessels originating in U.S. ports on the Atlantic must cross open ocean more than 50 nm from shore to traverse Nova Scotia before entering the SLSS. Thus, such vessels are expected to incur no incremental fuel costs for BWE or flushing. However, vessels on voyages originating in Nova Scotia or Newfoundland may enter the SLSS without traveling more than 50 nm from shore. Because NBIC does not include information on voyages that begin at ports in Nova Scotia or Newfoundland, incremental fuel costs for these vessels could not be estimated.

4.3.1.4 PACIFIC REGION REQUIREMENTS (§ 312(P)(10)(C))

Under the VIDA, vessels must now conduct BWE or flushing at least 50 nm from shore. The EPA projects that this requirement will impose incremental costs on affected vessels.

This represents a change from what was required in the 2013 VGP for Pacific Region voyages:

- Vessels were not required to deviate from their voyage or delay the voyage to conduct BWE or saltwater flushing in the Pacific Region.
- Vessels in the Pacific Region were exempt from conducting BWE if the vessel was not engaged in an international voyage and did not traverse more than one USCG COTP zone.

In addition, because all the Hawaiian Islands are in a single COTP zone, the 2013 VGP did not require vessels on inter-island voyages to conduct BWE or flushing. Under the VIDA, BWE and flushing is required for vessels moving between ports or places of destination in different counties of the State of Hawaii. Because each of the Hawaiian Islands is a different county, inter-island voyages will now be required to conduct BWE or flushing in waters that are more than 10 nm from shore and at least 200 meters deep. Therefore, the EPA anticipates that vessels will incur incremental BWE or flushing costs.

To estimate incremental fuel costs for Pacific Region vessels to voyage 50 nm from shore to conduct BWE or flushing, the EPA used Marine Traffic voyage density maps as presented in Table 4-9 to estimate the current distance from shore that coastal vessels typically travel.

Vessels on such voyages will need to travel approximately an additional 44 nm (round trip) to conduct BWE or flushing at least 50 nm from shore. Applying the same fuel burn rate and price used in Table 4-6, the EPA estimated the incremental annual fuel cost for coastal vessels to comply with this VIDA provision as shown in Table 4-9 using the GDP implicit price deflator cited earlier; bunker oil price was $504/mt in 2022$.

Table 4-9. Estimated Fuel Costs for Pacific Coast Voyages to 50 nm Off-Shore to Conduct BWE and Flushing ($2022)

Vessel Type	U.S.-Flagged Pacific Coastal Voyages[a,b] (A)	Round Trip Distance per Voyage (nm)[c] (B)	Total Travel Distance for All Voyages (nm) (C)	Fuel Use Rate (mtons/nm) (D)	Fuel Cost ($/mtons) (E)	Estimated Annual Fuel Cost for Vessels to Conduct BWE and Saltwater Flushing (F=C*D*E)
Bulk Carrier[d]	179	44	8,000	0.1	$504	$392,000
Tanker	285	44	12,600	0.1	$504	$617,000
General Cargo[d]	61	44	2,700	0.1	$504	$132,000
Other Vessels[f]	192	44	8,500	0.1	$504	$416,000
					Total:	**$1,557,000**

Source: National Ballast Water Information Clearinghouse, Bialystocki and Konovessis (2016), Ship and Bunker (2019), Marine Traffic and Google Earth
[a] *Voyages to U.S. ports on the Pacific Coast that cross at least one COTP zone.*
[b] *Voyages to U.S. ports on the Pacific Coast from Canadian and Mexican ports on the Pacific Coast estimated based on the percentage of U.S.-flagged vessel voyages in the VGP eNOI dataset for 2018.*
[c] *Average round trip distance based on density map information from Marine Traffic.*
[d] *Includes combination vessels.*
[e] *Includes container ships and ro-ro ships.*
[f] *Includes passenger vessels and reefers.*

To estimate the incremental costs to voyages between the Hawaiian Islands, the State of Hawaii Department of Land and Natural Resources in cooperation with Pacific Cooperative Studies Unit provided information on the number and types of vessels on inter-island voyages within the Hawaiian archipelago. For vessels that carried ballast water, the EPA assumed vessels will conduct BWE. For vessels that reported no ballast water activity, the EPA assumed the vessels had empty tanks and will conduct saltwater flushing. The EPA used the previously calculated ballast water capacity, flushing volumes, and unit costs by vessel type to calculate incremental costs.

Table 4-10 presents resulting estimated costs for BWE or saltwater flushing volumes for U.S.-flagged vessels on Hawaiian inter-island voyages.

Table 4-10. Anticipated BWE or Saltwater Flushing Volumes and Costs for Hawaiian Inter-Island Voyages ($2022)

Vessel Type	Total U.S.-Flagged Hawaiian Island Voyages in 2018[a]	Hawaiian Island Voyages with BOB[a]	Hawaiian Island Voyages with NOBOB[a]	Estimated Total Ballast Water Exchange Volume (m3)	Total Saltwater Flushing Volume (m^3)	BWE and Saltwater Flushing Unit Cost ($/$m^3$)	Estimated Annual Cost for BWE or Saltwater Flushing
Bulk Carrier[b]	0	0	0	0	0	$0.04	$0
Tanker	0	0	0	0	0	$0.03	$0
General Cargo[c]	53	52	1	1,268,000	1,600	$0.07	$83,000
Other Vessels[d]	0	0	0	0	0	$0.07	$0
Total							**$83,000**

[a] *Hawaii Department of Land and Natural Resources.*
[b] *Includes combination vessels.*
[c] *Includes container ships and roll-on roll off vessels.*
[d] *Other vessels include passenger vessels, utility vessels, cable layers, research vessels, etc.*

Using information from Marine Traffic and Google Earth, the EPA found that vessels are expected to travel at least 10 nm from shore when traveling between the Hawaiian Islands. In addition, the water is much deeper than 200 meters on these routes. Therefore, the EPA estimated that no vessels on Hawaiian inter-island voyages will incur any incremental fuel costs under the VIDA.

CWA section 312(p)(10)(C) also provides exemptions for BWE and flushing for vessels located in the following areas:

- Vessels voyaging between or to a port or place of destination in the State of Washington, if the ballast water to be discharged originated solely from waters located between parallel 46 degrees north latitude (including the internal waters of the Columbia River), and the internal waters of Canada south of parallel 50 degrees north latitude (including the waters of the Strait of Georgia and the Strait of Juan de Fuca);
- Vessels voyaging between ports or places of destination in the State of California within the San Francisco Bay area east of the Golden Gate Bridge (including the Port of Stockton and the Port of Sacramento), if the ballast water to be discharged originated solely from ports or places within that area;
- Vessels voyaging between the Port of Los Angeles, the Port of Long Beach, and the El Segundo offshore marine oil terminal, if the ballast water to be discharged originated solely from the Port of Los Angeles, the Port of Long Beach, or the El Segundo offshore marine oil terminal; and
- Vessels voyaging between a port or place of destination in the State of Alaska within a single Captain of the Port Zone;

- ➢ Vessels voyaging between ports or places of destination in the State of Oregon, if the ballast water to be discharged originated solely from waters located between parallel 40 degrees north latitude and parallel 50 degrees north latitude.

Review of the current state ballast water regulations found that these exemptions included in the VIDA for California, Oregon, and Washington are already in place. According to California Code of Regulations, Title 2, section 2280(b) vessels voyaging between ports east of the Golden Gate Bridge in the San Francisco Bay area, including the Ports of Stockton and Sacramento, and the Ports of Los Angeles, Long Beach and the El Segundo marine terminal are construed as the same California port or place and the provisions of Article 4.6 do not apply.[10]

In Washington, the Common Waters exemption codified under WAC-220-650-070(4) states "The requirements of this section [Open Sea Exchange] do not apply to a vessel discharging ballast water or sediments that originated solely within the water of Washington State, the Columbia River system, or the internal waters of British Columbia south of latitude fifty degrees north, including the waters of the Straits of Georgia and Juan de Fuca." In Oregon, ballast water requirements apply to all vessels carrying ballast water from a voyage into the waters of the state, except a vessel that discharges ballast water that originated solely from waters located between the parallel 40 degrees north latitude and the parallel 50 degrees north latitude on the west coast of North America (see 2017 Oregon Revised Statutes (ORS) 783.630(e)). Since these exemptions were already in place in California, Oregon, and Washington prior to the VIDA, no cost savings can be attributed to the VIDA.

4.3.1.5 PACIFIC REGION REQUIREMENTS – LOW SALINITY WATER (§ 312(P)(10)(C))

Under the Pacific Region requirements of the VIDA, a commercial vessel that transports ballast water sourced from waters with a measured salinity of less than 18 parts per thousand (ppt) and voyages to a Pacific Region port or place of destination with a measured salinity of less than 18 ppt will be required to conduct a complete ballast water exchange:

- ➢ Not less than 50 nautical miles from shore, if the ballast water was sourced from a Pacific Region port or place of destination; or
- ➢ More than 200 nautical miles from shore if the ballast water was not sourced from a Pacific Region port or place of destination.

However, vessels are exempt from conducting BWE when ballasting or de-ballasting in water with salinity less than 18 ppt if the vessel's USCG-approved BWMS can achieve the following performance standards:

- ➢ Less than 1 living organism or organism rendered nonviable per 10 cubic meters for organisms larger than 50 micrometers (µm) in dimension;

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[10] California Code of Regulations, Article 4.6 requires all vessels entering California waters to meet discharge requirements by one of the following methods: 1) Discharging treated ballast water to meet State Lands Commission numeric limits; 2) Transfer of the ship's ballast water to a third party; i.e., an onshore facility or another ship; or 3) not discharging ballast water into California waters.

- Less than 1 living organism or organism rendered nonviable per 10 milliliters for organisms between 10 and 50 µm in dimension;
- Less than 1 colony-forming unit of toxicogenic Vibrio cholera (serotypes O1 and O139) per 100 milliliters or less than 1 colony-forming unit of that microbe per gram of wet weight of zoological samples;
- Less than 126 colony-forming units of escherichia coli (E. coli) per 100 milliliters;
- Less than 33 colony-forming units of intestinal enterococci per 100 milliliters

Because no USCG-approved BWMS has been demonstrated to achieve these standards, all vessels ballasting or de-ballasting in waters having less than 18 ppt salinity will be required to conduct BWE.

To estimate the incremental costs associated with low salinity ballast water requirements for U.S.-flagged vessels, the EPA estimated the total number of Pacific coastal voyages and voyages to Pacific coast ports from overseas in 2018 based on the NBIC dataset. All voyages between U.S. Pacific coast ports were assumed to be by U.S.-flagged vessels due to the Jones Act, while the overseas voyages to Pacific coast ports were estimated using the percentages shown above. Hawaiian inter-island voyages and voyages from ports in Canada and Mexico were excluded from the analysis to avoid double-counting.

Based on Drake et al. (2005), the EPA assumed that 14 percent of coastal arrivals had no ballast water while 86 carried ballast water. The EPA then used information from the Great Lakes Seaway Ballast Water Working Group (BWWG) to estimate out of the vessels with ballast on board, how many either sourced their ballast in waters having less than 18 ppt salinity or will discharge in locations having less than 18 ppt salinity. According to BWWG, 50 ballast tanks out of 166 ballast tanks (30 percent) were issued letters of retention before entering the Great Lakes for having low salinity ballast water (BWWG, 2018). Therefore, the EPA assumed that 30 percent of voyages to Pacific Coast ports source ballast water in areas having less than 18 ppt salinity or discharge in waters having less than 18 ppt salinity. Table 4-11 presents the estimated number of voyages as of 2018 by vessel type that will need to conduct BWE to comply with low salinity ballast water requirements.

Table 4-11. Estimated Overseas and Coastal Voyages to Pacific Region Ports with Low Salinity Ballast Water or Discharging into Low Salinity Water, 2018

Vessel Type	U.S.-Flagged and Foreign-Flagged U.S. Owned Pacific Coastal Voyages[b]	U.S.-Flagged Overseas Voyages to Pacific Coast Ports[a]	Foreign-Flagged U.S. Owned Overseas Voyages to Pacific Coast Ports[a]	Estimated Voyages to Pacific Ports with BOB[c]	Voyages to Pacific Coast Ports with Low Salinity Ballast or Discharging into Low Salinity Waters[d]
Bulk Carrier[e]	179	6	15	172	52
Tanker	285	3	3	249	75
General Cargo[f]	61	3	2	56	17
Other Vessels[g]	192	227	71	421	126

Source: National Ballast Water Information Clearinghouse

[a] *Excludes coastal voyages between Canada and Mexico to the United States.*

[b] *Excludes voyages between Hawaiian Counties.*

[c] *Assumes 86 percent of U.S.-flagged and foreign-flagged U.S.-owned overseas and coastal voyages have ballast on board.*

[d] *Assumes 30 percent of U.S.-flagged and foreign-flagged U.S.-owned overseas and coastal voyages having ballast on board was sourced in or will discharge into water having less than 18 ppt salinity.*

[e] *Includes combination vessels.*

[f] *Includes container ships and ro-ro ships.*

[g] *Includes passenger vessels and reefers.*

The EPA then used its standard exchange volume and unit cost values to estimate the incremental cost of BWE as shown in Table 4-12.

Table 4-12. Estimated Cost for U.S.-Flagged Vessels to Conduct BWE with Low Salinity Ballast Water or Discharging into Low Salinity Water, (2022$)

Vessel Type	Voyages to Pacific Coast Ports with Low Salinity Ballast or Discharging into Low Salinity Waters	Estimated Ballast Water Exchange Volume (m^3)[a]	Estimated Annual Cost for BWE	Pacific Coastal Voyages with Low Salinity Ballast or Discharging into Low Salinity Waters[d]	Total Travel Distance for Coastal Voyages (nm)	Estimated Annual Fuel Cost for Vessels to Conduct BWE
Bulk Carrier[c]	52	3,722,000	$152,000	46	2,100	$103,000
Tanker	75	10,220,000	$267,000	73	3,300	$162,000
General Cargo[d]	17	400,000	$26,000	16	700	$34,000
Other Vessels[e]	126	1,890,000	$125,000	50	2,200	$108,000
		Total:	**$570,000**			**$406,000**

Source: National Ballast Water Information Clearinghouse
[a] Exchange volume per vessel is 2.5 times the vessel's ballast volume.
[b] Includes combination vessels.
[c] Includes container ships and ro-ro ships.
[d] Includes passenger vessels and reefers.

Vessels voyaging between Pacific coastal ports with low salinity ballast water or planning to discharge into low salinity receiving water will need to voyage at least 50 nm from shore to conduct BWE. The EPA estimated as laid out in Table 4-12 the typical distances from shore and the associated round trips for undertaking BWE as specified in the standard. Using the fuel burn rate and price documented above, the EPA then estimated the incremental fuel cost for Pacific coast vessels to voyage to 50 nm from shore to conduct BWE due to low salinity water restrictions as shown in the table.

4.3.1.6 COST SUMMARY FOR BALLAST WATER REQUIREMENTS

Estimated incremental costs for U.S.-flagged vessels to comply with the statutorily-mandated ballast water requirements in the VIDA and contained in the final rule will vary depending on voyage patterns and whether the vessel is carrying ballast water and if that vessel is operating with any empty ballast tanks. Average voyage distances from shore estimated based on density maps available in Marine Traffic have a wide range that could significantly impact the estimated fuel cost for vessels to travel 50 nm from shore to conduct BWE or flushing. In addition, incremental fuel use by vessels will vary depending on vessel type, draft, speed and engine efficiency, which will subsequently impact fuel costs. Lastly, the EPA assumed vessel owners will not incur capital expenditures to upgrade shipboard systems for BWE or flushing. If owners or operators need to make physical changes to their vessels to comply with the VIDA, then additional capital costs will be incurred.

Table 4-13 summarizes the estimated incremental costs for U.S.-flagged vessels to comply with the four statutorily-mandated requirements in the VIDA. See Section 8.4.2 for an estimate of the disbenefits from incremental greenhouse gases emissions associated with the additional fuel usage for flushing of empty ballast tanks.

Table 4-13. Estimated Incremental Vessel Costs to Comply with the Ballast Water Requirements ($2022)

VIDA Section	Estimated Annual Compliance Cost
Atlantic and Gulf of Mexico Coastal Voyages	
BWE and/or Flushing	$395,000
Fuel Costs	$2,873,000
SLSS and Great Lakes – BWE and/or Flushing	$165,000
Hawaiian Inter-Island – BWE and/or Flushing	$83,000
Pacific Region	
BWE and/or Flushing	$570,000
Fuel Costs	$406,000
Total Annual Cost:	**$4,500,000**

4.3.1.7 EXEMPTION OF EXISTING GREAT LAKES VESSELS FROM BALLAST WATER NUMERIC DISCHARGE STANDARDS (40 CFR 139.10(D)(3))

The 2013 VGP required Lakers[11] built on or after January 1, 2009, and other vessels operating in the Great Lakes to meet ballast water numeric discharge standards, but exempted existing Lakers built before that date. The EPA estimated zero incremental compliance costs (or savings) since existing Lakers and other vessels operating exclusively on the Great Lakes were all able to obtain USCG extensions to the compliance date (that the EPA accepts as a condition of its 2013 Enforcement Response Policy). This is because the EPA estimated zero incremental compliance costs for any vessels operating exclusively on the Great Lakes based on the Agency's decision to exempt this class of vessels from having to meet the numeric discharge standards.

4.3.2 EXCLUSIONS FOR SMALL VESSELS AND FISHING VESSELS

The VIDA repealed the Small Vessel General Permit (sVGP) and exempted both small vessels and commercial fishing vessels of any size from future regulation of incidental discharges, with the exception of discharges of ballast water. The result of these exclusions is that any small vessel with ballast water and any commercial fishing vessel with ballast water will now be required to adhere to ballast water discharge requirements as laid out for larger vessels. Specifically, these vessels will have to comply with the VGP (ballast water requirements only, CWA section 312(p)(2)(B)(i)(III)), and they will have to comply with the VIDA ballast water requirements once the USCG Guard finalizes their VIDA implementing regulations.

[11] The 2013 VGP defines "Laker" to mean bulk carrier vessels that operate exclusively in Lake Ontario, Lake Erie, Lake Huron (including Lake Saint Clair), Lake Michigan, Lake Superior, and the connecting channels (Saint Mary's River, Saint Clair River, Detroit River, Niagara River, and Saint Lawrence River to the Canadian border), including all other bodies of water within the drainage basin of such lakes and connecting channels).

For purposes of estimating costs, there are then two subsets of vessels that are expected to benefit from regulatory relief afforded by the VIDA's exclusions:

- Small vessels, including small commercial fishing vessels, that no longer need to comply with the sVGP or other NPDES requirements for non-ballast water incidental discharges, and
- Large commercial fishing vessels that no longer need to comply with the VGP or other NPDES requirements for non-ballast water incidental discharges.

Constructing an estimate of the potential cost impacts—which in this case are cost savings—proceeded in three steps. First, the EPA estimated the universe of small vessels and large commercial fishing vessels likely to benefit from the exclusions. The second step was to estimate the pre-VIDA costs for those vessels to comply with non-ballast water discharge requirements. Third, the EPA combined these estimates to calculate the total cost savings experienced by small vessels and large commercial fishing vessels as a result of the VIDA exclusions.

Using the figures in Table 3-5 and Table 3-6, the EPA estimated that 158,540 small U.S.-flagged and 151 small foreign-flagged, U.S.-owned vessels—a combined total of 158,691 vessels—will benefit from the VIDA exclusions for small vessels. Then using the figures in Table 3-11, the EPA estimated that as of 2022 there were 2,025 U.S.-owned large commercial fishing vessels that would benefit from the VIDA exclusions for commercial fishing vessels.

To estimate costs for complying with non-ballast water requirements, the EPA examined the existing permitting requirements in force under the sVGP at the time the VIDA was signed. For purposes of the analysis presented here, the EPA assumed that all affected vessels, both small vessels and large commercial fishing vessels, experienced the same per vessel costs for complying with non-ballast water requirements. This approach does not account for differences in how each of the categories of vessels was covered under the VGP as opposed to the sVGP and how prior statutory moratoriums impacted regulation of the vessels; these nuances are beyond the scope of this analysis. To the extent that the larger fishing vessels may have experienced a larger compliance burden because they were regulated under the VGP rather than the sVGP, the EPA may have underestimated the cost savings resulting from the VIDA exclusions.

To estimate current costs for affected vessels to comply with non-ballast water discharges, the EPA used incremental unit costs for discharge requirements presented in the 2014 sVGP analysis and inflated these costs to 2022$ using the GDP implicit price deflator.

In applying the 2014 sVGP costs, the EPA:

- Assumed fuel air separator system costs do not apply to the "average vessel" costs, given that fewer than one percent of all vessels incur these costs.
- Assumed hull maintenance costs will be incurred and those were included in the "average" vessel costs (the effect of these is minimal).
- Assumed all small vessels will be subject to the same non-ballast water discharge requirements. Note that some cost categories, such as hull maintenance inspection, apply only to certain vessel types.

- Applied average costs when a range of costs exists. This is a simplification because some of the cost ranges are driven by vessel characteristics.[12]

Table 4-14 presents the EPA's unit cost estimates of non-ballast water costs for complying with the sVGP.

Table 4-14. Estimated Unit Costs of Non-Ballast Water Discharge Requirements for Excluded Vessels (2022$)

Cost Categories for Final 2014 sVGP	Low End Incremental Cost	High End Incremental Cost	Average Incremental Cost
Fuel management - oil absorbent material[a]	$2.57	$44.05	$23.31
Engine and oil control	$20.45	$49.47	$34.96
Engine and oil control – lubricants	$2.06	$2.06	$2.06
Solid and liquid waste management	$15.88	$80.25	$48.07
Deck washdown, deck runoff, cleaning	$0.00	$0.00	$0.00
Hull maintenance - purchase tarp	$ 1.17	$2.78	$1.98
Hull maintenance – inspection	$32.84	$43.17	$38.00
Graywater	$0.00	$0.00	$0.00
Overboard cooling water	$0.00	$0.00	$0.00
Fish hold effluent		not estimated	
Total:			**$148.36**

Source: 2014 sVGP Final EA, 2022$ dollars calculated using A191RD3A086NBEA. Annual hull inspection unit costs calculated from a quarterly inspection at $6.71 for fishing vessels and $8.82 for non-fishing vessels (2014$) as the low- and high- end incremental costs, respectively.

[a] Assumes that vessels will comply with fuel management requirements by using oil absorbent material during fueling rather than installing a fuel-air separator system.

Excluded vessels are expected to experience a reduction in paperwork burden because they will no longer be required to adhere to NPDES permit reporting or recordkeeping requirements under the VIDA. The EPA estimated the unit savings attributable to the paperwork burden reduction as the cost that would have been incurred to maintain a PARI had the sVGP requirements continued to exist. (A PARI is the "Permit Authorization and Record of Inspection" that vessels update annually to indicate commitment to comply with NPDES requirements under the VGP or sVGP.) Note that for purposes of this analysis, the EPA

[12] For example, estimated fuel management costs ranged from $2 to $36 per vessel in 2014$. For the purpose of this analysis, the EPA used either the mid-level cost (when available) or an average of the high- and low-end costs.

assumed that even those large commercial fishing vessels that obtained coverage under the VGP would have also elected to maintain a PARI rather than submit a Notice of Intent. To the extent that these vessels may have been subject to more extensive discharge requirements under the VGP, this assumption could lead to a low-end estimate of total cost savings.

For the cost analysis accompanying the 2014 sVGP, the EPA estimated unit costs for PARIs at $16.86 (2010$) annually (EPA, 2014). Inflated to 2022 dollars, this figure was adjusted to a unit cost of $22.19.

Based on the number of excluded vessels and the unit costs for complying with discharge requirements and maintaining PARIs, the Agency estimates as shown in Table 4-15 below that excluded vessels will experience total annual cost savings of more than $27.4 million due to the VIDA's narrowing of the scope of regulated vessels. The Agency notes that vessels may continue implementing the practices called for under the NPDES permitting regime voluntarily, but it is beyond the scope of this analysis to project such decisions on the part of the vessel owners.

Table 4-15. Estimated Change in Annual Costs (Cost Savings) for Vessels Due to VIDA Exclusions, (2022$)

Vessel Type	Number of Vessels	Per Vessel Change in Annual Compliance Costs	Total Change in Annual Compliance Costs
Non-Ballast Water Discharge Requirements			
Small vessels	158,691	-$148.36	-$23,543,000
Large commercial fishing vessels	2,025	-$148.36	-$300,000
Subtotal	*160,717*		*-$23,843,000*
Paperwork Requirements			
Small vessels	158,691	-$22.19	-$3,522,000
Large commercial fishing vessels	2,025	-$22.19	-$45,000
Subtotal	*160,717*		*-$3,567,000*
Total, all excluded vessels:	**162,742**		**-$27,410,000**

NOTE: Numbers may not add due to rounding.

4.4 RULE PROVISIONS UNCHANGED FROM VGP

4.4.1 ENVIRONMENTALLY ACCEPTABLE LUBRICANTS FOR EQUIPMENT THAT EXTENDS OVERBOARD (40 CFR 139.6)

The final standard for oil-to-sea interfaces clarifies the scope of this discharge category includes discharge of lubricants from equipment that extends overboard, and vessels must therefore use EALs in equipment that extends overboard as well as equipment with oil-to-sea interfaces below the waterline. This is a clarification of the scope of the 2013 VGP rather than a new requirement under the VIDA.

However, the economic analysis accompanying issuance of the 2013 VGP did not include a cost estimate for EAL use specifically for equipment that extends overboard. To rectify this omission, this analysis revisits the 2013 EAL cost estimates and projects costs for vessels switching from conventional lubricants to EALs for those categories of on-deck equipment likely to have portions that extend overboard.

On-deck equipment from which discharges of lubricants to marine waters may occur includes machinery such as hose handling cranes, hydraulic system provision cranes, hydraulic cranes, and hydraulic stern ramps. When vessels are in transit, this equipment is often not operational, and any lubricant losses are typically captured during deck washdown and treated as part of deck washdown wastewater. However, when components of on-deck machinery such as booms or jibs, trolleys, cables, hoist gear, or derrick arms are in use and extend over the side of vessel, discharges can occur when lubricants drip down and fall directly into surrounding waters.

To estimate the universe of affected vessels with such discharges, the EPA identified four types of equipment with on-deck equipment that extends overboard with oil-to-sea interfaces:

- Hose handling cranes,
- Hydraulic system prov cranes,
- Hydraulic cranes, and
- Hydraulic stern ramps.

The EPA excluded submerged equipment that was already covered in the 2013 VGP analysis as well as equipment that operates entirely on-deck with no direct oil-to-sea interface.

Etkin (2010) estimated lubricating oil consumption per port visit for each type of on-deck machinery by vessel class. For the sixty vessel sub-classes considered, on-deck lubricant use for these four types of machinery ranges from zero to 11.63 liters per visit per ship, with the highest use rate by container ships.

The EPA mapped Etkin's vessel sub-categories to the six vessel categories used throughout the VGP analyses (excluding commercial fishing vessels with no ballast water because the VIDA exempted these from regulation) (EPA, 2008c; EPA, 2013), and averaged the consumption across all relevant vessel sub-categories to estimate the average consumption for each vessel class. The Agency then converted Etkin's per visit lubricant usage to annual per vessel usage by assuming each vessel spends one day in port for every three days at sea, consistent with the assumptions made in the 2013 VGP (EPA, 2013). These lubricant consumption rates by vessel class are presented below in Table 4-16.

Table 4-16. Lubricant Consumption Rate by Vessel Class

Vessel Type	Days in port per year*	Consumption per vessel (l / port day)	Consumption per vessel (l / year)	Consumption per vessel (gallons/year)
Freight Barge	91.3	0.4	40	10
Freight Ship	91.3	4.3	389	103
Passenger Vessel	91.3	1.6	147	39
Tank Barge	91.3	1.8	160	42
Tank Ship	91.3	0.7	61	16
Utility Vessel	91.3	1.0	94	25

Source: Etkin (2010)
** Assumes that vessels are at port every 4th day.*

In addition to estimating the consumption rate per vessel and the number of vessels operating, calculating the incremental industry costs for additional use of EALs requires: 1) an estimate of the cost difference of EALs compared with traditional lubricants, and 2) a baseline estimate of the percentage of vessels where this requirement represents a change from current practices. Although substantial changes have occurred in the water transportation industry since the 2013 VGP, the EPA has determined the estimates used in the 2013 VGP economic analysis remain the most robust and precise estimates currently available.

To estimate the additional cost of replacing standard oil lubrication with environmentally acceptable lubricants, the EPA inflated the estimated cost differences calculated for the 2013 VGP (EPA, 2013)[13] to 2022 dollars using the GDP implicit price deflator[14]. This exercise yielded a low-end estimate of $5.10 per gallon of lubricant and a high-end estimate of $10.49 per gallon.

Again, following the methods of the 2013 VGP economic analysis, the EPA assumed between 48 percent and 73 percent of vessels will switch from their current practices to use EALs in over deck equipment that extends overboard as a result of the scope of this discharge category. This difference was calculated based on the number of new and current vessels in the vessel universe, and the assumption that between 2.5 and 10 percent of vessels already use EALs.

Using the same approach in the 2013 VGP economic analysis, but using updated EAL costs and vessel counts, the Agency then estimated that U.S.-owned vessels will incur annual compliance costs as presented in Table 4-17 to switch to EALs in equipment that extends overboard.

Table 4-17. Environmentally Acceptable Lubricants Cost Estimate, (2022$)

Vessel Type	Vessel Count[a]	% Vessels where Practice is Applicable[b]	Annual Cost per Vessel	Total Annual Cost
		Low End (Average incremental cost of $5.10 / gallon)		
Freight Barge	51,671	48%	$51	$1,264,000
Freight Ship	857	48%	$525	$179,000
Passenger Vessel	2,228	48%	$199	$201,000
Tank Barge	8,480	48%	$214	$872,000
Tank Ship	194	48%	$82	$5,000
Utility Vessel	3,964	48%	$128	$236,000
Total:	**67,395**			**$2,757,000**
		High End (Average incremental cost of $10.49 / gallon)		
Freight Barge	51,671	73%	$105	$3,955,000

[13] The 2013 VGP EA estimated a low cost of replacement of $4 per gallon, and a high-end cost of replacement of $8 per gallon.

[14] GDP implicit price deflator A191RD3A086NBEA, Annual Not Seasonally adjusted, Index 2017=100.

Freight Ship	857	73%	$1,080	$561,000
Passenger Vessel	2,228	73%	$409	$629,000
Tank Barge	8,480	73%	$441	$2,727,000
Tank Ship	194	73%	$168	$17,000
Utility Vessel	3,964	73%	$262	$737,000
	Total: 67,395			**$8,626,000**
Average Annual Incremental Cost				**$5,690,000**

Source: Etkin (2010)

[a] *Existing and new vessels, assuming that vessels are replaced at the rate of 1/30th of the population each year.*

[b] *Fraction represents the combination of assumptions on the fraction of new and existing vessels that adopt the practice in the baseline and those anticipated to use EALs under the 2013 VGP.*

4.5 OTHER RULE PROVISIONS INCLUDING CHANGES FROM VGP

4.5.1 GRAYWATER SYSTEMS (40 CFR 139.21)

The EPA is finalizing two requirements for graywater systems that the Agency anticipates will result in incremental compliance costs:

- New build vessels of 400 gross tonnage and above that are certificated to carry 15 or more persons and provide overnight accommodations to those persons must treat their discharge.
- New build ferries authorized by the USCG to carry 250 or more passengers must treat their discharge.

4.5.1.1 NEW BUILD VESSELS OF 400 GROSS TONNAGE AND ABOVE THAT ARE CERTIFICATED TO CARRY 15 OR MORE PERSONS AND PROVIDE OVERNIGHT ACCOMMODATIONS TO THE PERSONS MUST TREAT THEIR DISCHARGE (40 CFR 139.21(E)(1))

The final standard revises the 2013 VGP requirements for new build vessels of 400 gross tonnage and above to require the discharge of graywater meet the numeric discharge standards in section 139.21(f) from those new build vessels of 400 gross tonnage and above that are certificated to carry 15 or more persons and provide overnight accommodations to those persons. To comply with this standard, vessels either need to be constructed with sufficient storage capacity to hold all graywater generated while operating in waters subject to the final rule or install a treatment system. To maximize operational flexibility regarding discharge or storage of graywater and to construct an economic estimate of the highest potential costs incurred, the EPA assumed vessels subject to this rule will install and operate a graywater treatment system to allow discharge.

Achieving the minimum level of effluent quality specified in section 139.21(f) requires vessels to install an advanced Type II marine sanitation device (MSD). The EPA assumed such devices would include biological treatment, membrane separation for solids removal, and final UV light disinfection. Since advanced Type II MSDs treating graywater require a secondary source of organic carbon for the biological portion to function as intended, the EPA assumed that new build vessels will treat a combined sewage and graywater waste stream in the advanced Type II MSD. The EPA's analysis of the MISLE database assumes a typical cargo/container ship, bulk carrier or tanker has a crew and passenger count of 26. Applying the sewage and graywater generation rates developed in the Cruise Ship Discharge Assessment Report (EPA, 2008) together with the crew occupancy assumption generates an estimate that these vessels likely generate between 1,500 and 2,000 gallons per day (gpd) of combined graywater and sewage.

To estimate the cost to purchase and install an advanced Type II MSDs on vessels such as cargo/container ships, bulk carriers or tankers, the EPA contacted a vendor to obtain costs for a marine biological treatment system that treats combined sewage from toilets and urinals and graywater from washbasins, sinks, galley, laundry and showers. According to the system vendor, the cost for a system capable of treating approximately 1,800 gpd of combined sewage and graywater is approximately $145,000 (2022$) (EVAC North America, 2019)[15]. Assuming the installed cost for this equipment is approximately 3.5 times the prior budgetary estimate (EPA, 2011), the total installed cost for this advanced Type II MSD is $508,000 (2022$). These costs are a rough estimate, since actual piping configurations, available space, and existing vessel control systems may have a significant impact on actual costs for a specific vessel.

The cost relevant to this analysis is the incremental cost of the advanced Type II MSD over and above the cost of a traditional Type II MSD that new build vessels would install in the absence of the new requirement, which is the difference in cost between the advanced Type II MSD that treats both graywater and sewage and the traditional Type II MSD that treats only sewage. Therefore, the EPA obtained an estimate from a system vendor for a traditional electrolytic Type II MSD capable of treating sewage generated by a crew of 26. With a quoted price of approximately $86,000 (2022$) (EVAC North America, 2019)[16], and assuming total cost (purchase of system and installation) are 3.5 times the equipment's purchase price (direct plus indirect costs), then the installed cost for a traditional Type II MSD capable of treating sewage from vessels with a crew and passenger count of 26 is $302,000 (2022$).

The EPA then subtracted the installed capital cost of the traditional Type II MSD from the installed capital cost for the advanced Type II MSD. Thus, the incremental capital cost to install an advanced Type II MSD rather than a traditional Type II MSD on new build vessels of 400 gross tonnage and above is estimated to be $206,000 (2022$).

The EPA estimated the annual operating and maintenance (O&M) cost for labor, consumables and parts associated with an advanced Type II MSD using information provided to the EPA by the Cruise Lines International Association (CLIA, 2010). According to the data provided by CLIA, annual O&M costs are approximately 4 percent of installed equipment cost. For an advanced Type II MSD, the EPA estimated the annual cost to treat graywater and sewage onboard a vessel of 400 gross tonnage and above is $20,000 per year (4 percent of $508,000 capital cost; 2022$). This assumes vessels will operate the advanced Type

[15] The quoted price of the system was $128,000 in 2019$ and was extrapolated to 2022$ using A191RD3A086NBEA.

[16] The quoted price of the system was $76,000 in 2019$ and was extrapolated to 2022$ using A191RD3A086NBEA.

II MSD continuously to avoid operational problems that result if biological treatment systems were only operated in waters subject to the final rule. Applying the same assumptions, the EPA estimated annual O&M costs to be approximately $12,000 per year (4 percent of $302,000 capital cost; 2022$) for a traditional electrolytic Type II MSD. Subtracting the annual O&M cost for a traditional Type II MSD from the O&M cost for an advanced Type II MSD resulted in an annual incremental O&M cost of $8,000 per year (2022$) for new build vessels of 400 gross tonnage and above.

To estimate the number of vessels that have a gross tonnage of 400 and above, the EPA calculated the share of each vessel type that was 400 gross tonnage and above based on previous vessel estimates from the 2013 VGP (EPA, 2013) and multiplied that value by the 2022 projected number of large U.S.-owned (U.S.-flagged and foreign-flagged, U.S.-owned) vessels in for each respective vessel type. To calculate the number of vessels, the EPA then multiplied the estimated number of vessels that have a gross tonnage of 400 or above by the calculated percentage of vessels 400 gross tonnage and above that also have 15 or greater berths from recent eNOI data. The EPA estimated 1.3 percent of freight and tank barges carry either crew or passengers (EPA, 2017) and therefore may generate graywater, while 100 percent of all other vessel types are expected to generate graywater.

As the graywater standard applies only to new vessels, the EPA needed a way to estimate the number of new vessels based on the number of existing vessels. The EPA assumed vessels have an expected service life of 30 years, the ages of existing vessels are uniformly distributed, and therefore 1/30th of the stock of existing vessels will be built each year as replacements. This number was then adjusted by applying the AAGR from Table 3-2. Table 4-18 presents estimates for the number of new builds of 400 gross tonnage and above with 15 or greater berths by vessel type that are subject to the graywater standard. The figures presented for passenger vessels exclude cruise ships because cruise ships are covered under separate final standards. The estimate also excludes commercial fishing vessels because these are specifically excluded in the VIDA from regulation under the CWA section 312(p) standards other than those covering ballast water.

Table 4-18. New Build Vessels of 400 Gross Tonnage and Above with 15 or Greater Berths subject to the Graywater Standard

Vessel Type	Number of Vessels	Fraction Generating Graywater	Number of Vessels Generating Graywater	AAGR	New Build Vessels[a]
Freight Barges	96	1.3%	1	2.0%	0
Freight Ships	35	100.0%	35	-1.0%	2
Passenger Vessels (non-cruise)	1,359	100.0%	1,359	0.5%	131
Tank Barges	0	1.3%	0	1.3%	0
Tank Ships	170	100.0%	170	-6.5%	0
Utility Vessels	606	100.0%	606	-3.7%	0
Total	***2,265***		***2,171***		***133***

Sources: Table 3-11; EPA 2017; Table 3-2; eNOI Reported Number of US Owned or US Flagged Vessels 400 GT or greater with 15 or greater berths as of April 2024.

[a] New builds are calculated by multiplying the vessels generating graywater subject to the standard by the replacement rate of 1/30 and adding the number of vessels added due to AAGR. This value is then multiplied by 2.5 to represent the mid-point of a five-year period and multiplied by the crewed new vessel rate. Based on the 2013 VGP, the crewed new vessel rate is assumed to be 25 percent for utility vessels and 100 percent for all other vessel types. Only positive numbers were retained to exclude negative new builds.

To estimate the incremental cost of maintaining a graywater treatment system for these vessels, the EPA amortized incremental capital costs over a thirty-year period at a two percent discount rate and added the incremental cost associated with annual operations and maintenance (O&M). Incremental costs for new build vessels of 400 gross tonnage and above are shown in Table 4-19. Total costs for these new build vessels are shown in Table 4-20.

Table 4-19. Graywater Incremental Costs per Vessel for New Builds of 400 Gross Tonnage and Above with 15 or Greater Berths, (2022$) at a 2% Discount Rate

Incremental Capital Cost	Incremental Annualized Capital Cost[a]	Incremental Annual O&M Cost	Total Annualized Incremental Cost per Vessel
$206,400	$9,200	$8,000	$17,200

[a] This value was amortized over the 30-year expected life of treatment system.

Table 4-20. Graywater Estimated Total Annualized Costs for New Build Vessels of 400 Gross Tonnage and Above with 15 or Greater Berths, (2022$) at a 2% Discount Rate

Total New Builds	Capital Cost	Annualized Capital Cost	Annual O&M Cost	Total Annualized Graywater Cost
133	$27,400,000	$1,220,000	$1,060,000	$2,280,000

4.5.1.2 NEW BUILD FERRIES AUTHORIZED BY THE USCG TO CARRY 250 OR MORE PASSENGERS MUST TREAT THEIR DISCHARGE (40 CFR 139.21(E)(4))

The final standard revises the 2013 VGP graywater requirements and states new build ferries that carry 250 or more passengers must now treat their graywater discharge. To comply with this standard, ferries in this size class either need to be constructed with sufficient storage capacity to hold all graywater generated while operating in waters subject to the final rule or install a treatment system. For purposes of the cost analysis, the EPA assumed affected ferries would be built with an advanced Type II MSD for graywater treatment, and the treatment system would be operated continuously, regardless of vessel location. The analysis also assumed costs to ferries with passenger capacity greater than 500 were either captured in the cost analysis in the preceding section or those costs had already been accounted for in the 2013 VGP analysis of graywater costs incurred by cruise ships.

To construct its cost analysis for the VIDA graywater requirements for new build ferries, the Agency combined information on per vessel capital and operating costs with data on the number of affected ferries.

As a first step, the Agency estimated the incremental capital and operating costs associated with an advanced Type II MSD. Since biologically-based advanced Type II MSDs treating graywater require an additional carbon source, the EPA assumed systems on new ferries will treat combined graywater and sewage. Using information from the EPA's Cruise Ship Discharge Assessment Report (EPA, 2008), the Agency started by estimating graywater and sewage generation rates for vessels in the size class in question. The cost analysis as described in the tables below applies the generation rates for passenger vessels with a capacity for 351 to 499 passengers and crew as a conservative proxy for the new build ferries with passenger capacity of 250 passengers or more. The results of this approach are presented in Table 4-21.

Table 4-21. Estimated Daily Graywater and Sewage Generation Rates for Ferries Covered under 40 CFR 139.21(e)(4)

Passenger Capacity	Graywater Volume (gal/day)	Sewage Volume (gal/day)	Combined Graywater and Sewage Volume (gal/day)
351-499	30,150	3,780	33,930

The EPA then used system sizing information provided by CLIA in 2010 (EPA, 2010) to develop installed capital costs for the relevant subcategory of ferries to treat graywater and sewage using an advanced Type II MSD. According to CLIA, the average installed capital cost for an advanced Type II MSD onboard a large cruise ship treating both graywater and sewage is approximately $3,860,300 (2022$). Since large cruise ships are expected to generate, on average, 191,000 gallons per day of combined graywater and sewage (EPA, 2008), the unit capital cost for treatment using an advanced Type II MSD is approximately $20.21 (2022$) per gallon per day ($3,860,300 divided by 191,000 gallons per day). The EPA combined this unit capital cost with the anticipated graywater and sewage generation rates shown in Table 4-21 to estimate the installed capital costs shown in Table 4-22.

Table 4-22. Estimated Capital Cost for Ferries Covered under 40 CFR 139.21(e)(4) to Install Advanced Type II MSD to Treat Both Graywater and Sewage (2022$) at a 2% Discount Rate

Combined Graywater and Sewage Volume (gal/day) (A)	Unit Capital Cost ($/gal/day) (B)	Installed Capital Cost for an Advanced Type II MSD (C=A+B)
33,930	$20.21	$686,000

To estimate the incremental cost to upgrade the treatment system from a typical Type II MSD to an advanced Type II MSD, the EPA calculated the difference in costs between a typical electrolytic Type II MSD and an advanced Type II MSD using a membrane bioreactor (MBR). According to one vendor, an advanced Type II MSD using an MBR costs approximately $128,000 while a typical electrolytic Type II MSD costs approximately $76,000 (2019$), resulting in a difference of 41 percent for the same size unit (EVAC North America, 2019). The EPA extrapolated the costs to 2022$ and applied this 41 percent difference to the installed capital cost for an advanced Type II MSD to approximate the installed capital cost for a traditional electrolytic Type II MSD. Subtracting the installed capital cost for a traditional Type II MSD from an advanced Type II MSD resulted in the estimated incremental capital cost as presented in Table 4-23.

Table 4-23. Incremental Capital Cost to Install an Advanced Type II MSD Versus a Typical Type II MSD on Ferries Covered under 40 CFR 139.21(e)(4) (2022$) at a 2% Discount Rate

Estimated Installed Capital Cost for an Advanced Type II MSD (A)	Estimated Installed Capital Cost for a Traditional Type II MSD (B)	Incremental Capital Cost for Installation of an Advanced Type II MSD (C=A-B)
$686,000	$405,000	$281,000

The EPA also used information from CLIA (EPA, 2010) to estimate the incremental annual O&M cost for an advanced Type II MSD versus a traditional Type II MSD. Based on information provided by CLIA, annual O&M costs for a Type II MSD comprise approximately 4 percent of installed capital costs. The EPA applied this rate to the installed costs in Table 4-23 to predict annual O&M cost for specified sizes of traditional and advanced Type II MSDs. Subtracting the annual O&M cost for a traditional Type II MSD from an advanced Type II MSD results in the incremental O&M cost for affected ferries to operate an advanced Type II MSD as shown in Table 4-24.

Table 4-24. Estimated Incremental Annual Cost for Ferries Covered under 40 CFR 139.21(e)(4) to Operate and Maintain an Advanced Type II MSD to Treat Both Graywater and Blackwater (2022$)

Annual O&M Cost for an Advanced Type II MSD (A)	Annual O&M Cost for a Traditional Type II MSD[a] (B)	Incremental Annual O&M Cost to Operate an Advanced Type II MSD (C=A-B)
$27,200	$16,100	$11,100

[a] *Annual O&M cost is equal to 4% of the installed capital cost (EPA, 2010).*

To estimate the combined incremental per vessel cost of graywater treatment systems for new build ferries, the EPA followed a similar process as the one used for the vessels of 400 gross tonnage and above with greater than 15 berths. The resulting estimates are detailed in Table 4-25.

Table 4-25. Graywater Incremental Per Vessel Costs for Ferries Covered under 40 CFR 139.21(e)(4) (2022$) at a 2% Discount Rate

Incremental Capital Cost	Incremental Annualized Capital Cost[a] (A)	Incremental Annual O&M Cost (B)	Total Annualized Incremental Cost per Vessel (C=A+B)

$281,000	$12,600	$11,200	$23,700

Table 4-26 presents the estimated number of affected ferries. For its EA supporting the 2020 VIDA proposed rulemaking, the EPA had presented an estimate of 20 new ferries annually for the size category in question based on data from MISLE. During the comment period for the proposed rule, the EPA received input from the Passenger Vessel Association, the national association representing the interests of the U.S. passenger vessel industry, indicating that this estimate was too high. Specifically, the association stated in their comments that the number of new passenger vessels has ranged over the past 20 years from 2 to 5 new build vessels annually. The Agency compared this information with data in the VGP eNOI database on the number of ferries by construction year with passenger capacity between 250 and 500. These data confirmed the commenter's information in that they showed that for the period 2010-2019, the number of new build ferries in the relevant size class ranged from zero to three. This finding led the Agency to revise its estimate of affected ferries downward to conform with the commenter's high-end figure of five new ferries annually for the size class.

Table 4-26. Number of Ferries Covered under 40 CFR 139.21(e)(4) Generating Graywater

Passenger Capacity	Annual New Build Ferries[a]
250-499	5

Source: VGP eNOI database; public comment EPA-HQ-OW-2019-0482-0730-A1 as recorded in the docket for the VIDA rulemaking

[a] This figure does not account for the number of ferries operating in Alaska, which under CWA section 312(p)(9)(A)(v) will continue to be covered by state-specific requirements for graywater.

Multiplying the figures for incremental per vessel costs for new build ferries in Table 4-25 by the number of affected ferries as detailed in Table 4-26 resulted in total incremental costs for affected ferries as presented in Table 4-27.

Table 4-27. Graywater Total Cost Estimate for Ferries Covered under 40 CFR 139.21(e)(4) (2022$) at a 2% Discount Rate

Passenger Capacity	Number of New Builds	Capital Cost	Annualized Capital Cost (A)	Annual O&M Cost (B)	Total Annualized Graywater Cost[b] (C=A+B)
250-499	5	$1,406,000	$63,000	$56,000	$119,000

4.5.1.3 GRAYWATER STANDARDS WITH NO CHANGE IN COMPLIANCE COSTS

The EPA finalized several new requirements for graywater discharges that the Agency assumes for purposes of this analysis will not add any additional compliance burden:

- Vessels with available storage capacity must treat their discharge or, if unable to treat, discharge greater than three nm from shore for vessels that voyage at least three nm from shore, or greater than one nm for vessels that voyage outside of one nm but not outside three nm from shore.

- Any passenger vessel with overnight accommodations for 500 or more passengers, as well as any passenger vessel with overnight accommodations for 100-499 passengers (unless constructed before December 19, 2008, and not voyaging beyond one nm from shore), must treat graywater discharges within 12 nm rather than three nm.

4.5.1.3.1 Vessels with Available Storage Capacity Must Treat their Discharge or, if Unable to Treat, Discharge Greater Than Three nm (or One nm, as Appropriate) from Shore (40 CFR 139.21(d))

This new standard applies only to vessels that are already equipped with either a graywater treatment system or a holding tank with available capacity and voyage at least one nm from shore. As such, the EPA does not anticipate any incremental costs to comply with this requirement.

4.5.1.3.2 Passenger Vessels with Overnight Accommodations for 100 or More Passengers Must Treat their Discharge (40 CFR 139.21(e)(2)-(3))

The 2013 VGP prohibits cruise ships certified to carry 100 or more passengers from discharging untreated graywater within three nm from shore, except for 100 to 499 passenger cruise ships constructed before December 19, 2008, that do not voyage beyond one nm from shore. The final rule, which revises reference to these vessels from "cruise ships" to "passenger vessels with overnight accommodations" for consistency with USCG terminology, extends this requirement for discharge without treatment from three nm to 12 nm. Common practice for these vessels is to either treat their discharge or hold their graywater for discharge outside U.S. waters. Assuming a vessel speed of 20 knots, traveling from 12 nm to three nm, and again from three nm to 12 nm, would add an additional 0.9 hours of graywater holding time. According to responses to the EPA's 2004 cruise ship survey, graywater holding capacity ranges from five to 90 hours, with an average of 56 hours (EPA, 2008c). Therefore, this additional 0.9 hours of holding time represents less than 2 percent of available holding capacity on average. In addition, many of these vessels already treat their graywater discharges, presumably particularly those with relatively short holding capacities. For these reasons, the EPA assumed for this analysis passenger vessels with overnight accommodations will not incur incremental costs to comply with this new standard.

4.5.2 MACROFOULING (40 CFR 139.28)

4.5.2.1 SEAWATER PIPING SYSTEMS THAT ACCUMULATE MACROFOULING MUST BE FITTED WITH MARINE GROWTH PREVENTION SYSTEMS (40 CFR 139.28(C))

The EPA is finalizing a new standard that requires seawater piping systems that accumulate macrofouling to be fitted with marine growth prevention systems (MGPS); the 2013 VGP does not require biofouling prevention for seawater piping systems. However, the VGP did include reactive biofouling management measures for seawater piping, such as requiring vessel owners/operators to remove fouling organisms from seawater piping on a regular basis. The VGP also required a drydock inspection report noting that the sea chest and other surface and niche areas of the vessel have been inspected for attached living organisms, and those organisms have been removed or neutralized.

The EPA differentiates biofouling into microscopic fouling (microfouling) and macroscopic fouling (macrofouling). Microfouling is biofouling caused by bacteria, fungi, microalgae, protozoans, and other microscopic organisms that creates a biofilm, also called a slime layer. Microfouling is a precursor to macrofouling. Macrofouling is biofouling caused by the attachment and subsequent growth of visible plants and animals. Macrofouling includes large, distinct multicellular individual or colonial organisms visible to the human eye such as barnacles, tubeworms, mussels, fronds/filaments of algae, bryozoans, sea squirts, and other large attached, encrusting, or mobile organisms. The final standard specifies that acceptable MGPS must be selected to address the level, frequency, and type of biofouling, as well as the design, location, and area in which the system will be used. The EPA lists a variety of acceptable technologies and practices such as electrolytic, ultrasonic, ultraviolet, or electrochlorination systems; anti-fouling coatings; and/or cupro-nickel piping; and/or glass-reinforced / filament-wound epoxy-based composite piping. The EPA notes that these requirements are generally consistent with the 2023 Guidelines for the Control and Management of Ships' Biofouling to Minimize the Transfer of Invasive Aquatic Species (MEPC.378(80)).

Information collected by the California State Lands Commission indicates that many vessels already have MGPS devices installed (50.1 percent to 65.7 percent of vessels operating in California, on average, between 2008 and 2011) (Scianni et al., 2013). Scianni et al. provide no additional information regarding the remaining vessels operating in California. Some of these remaining vessels likely use alternative macrofouling prevention methods, such as anti-fouling coating or cupro-nickel piping to prevent macrofouling of seawater piping system, while others may not experience macrofouling and do not require MGPS.

In the absence of available data, the EPA assumed based on engineering judgement that 5 percent of seagoing vessels will require installation of MGPS to comply with the new standard and that zero non-seagoing vessels will require MGPS to control seawater piping biofouling. Based on an analysis of National Ballast Information Clearinghouse (NBIC) data on vessel voyages between U.S. ports in 2014 and 2015, the EPA estimated that 80 percent of all vessels are seagoing (EPA, 2020b). The EPA estimated installed capital costs of $6,500 for a single MGPS installed in a steel sea chest straining having a typical flow of 900 gallons per minute (gpm) on a vessel with 440 volt, 60 hertz electrical power (Allied Marine Services, 2019), and assumed that each seagoing vessel has two sea chests that each require MGPS (Frey, et al., 2014). Since the sacrificial anodes associated with the MGPS eventually become expended, vessels may need to replace the anodes as often as every five years during the vessel's scheduled dry-docking. The EPA was unable to determine the cost of anode replacement, so the analysis assumed conservatively the entire system rather than just the anodes will need to be replaced every five years.

Table 4-28 presents the estimated cost for seagoing vessels to install and maintain their MGPS in their sea chest strainers to prevent biofouling. Capital costs for all vessels needing MGPS are annualized to reflect both maintenance and replacement costs. This estimate does not include commercial fishing vessels because these are specifically excluded in the VIDA from regulation under the CWA section 312(p) standards other than those covering ballast water.

Table 4-28. Estimated Capital and Annual Costs for Vessels to Install and Operate a MGPS (2022$) at a 2% Discount Rate

Vessel Type	Vessel Count	Percentage Vessels with Seawater Piping Systems[a]	Vessels Needing MGPS[b],[c]	Average Expected Vessel Life Remaining[d]	MGPS Cost per Vessel	MGPS Capital Cost, All Vessels	Total Annualized MGPS Cost[e]
Freight Barge	51,671	1%	21	20	$13,000	$273,000	$57,900
Freight Ship	857	89%	31	22	$13,000	$403,000	$85,500
Passenger Vessels	2,228	19%	17	16	$13,000	$221,000	$46,900
Tank Barge	8,480	1%	3	25	$13,000	$39,000	$8,300
Tank Ship	194	77%	6	25	$13,000	$78,000	$16,500
Utility Vessels	3,964	18%	29	24	$13,000	$377,000	$80,000
Totals:	**67,395**		**107**			**$1,391,000**	**$295,100**

[a] Percentage of vessels having seawater piping systems based on information reported in VGP annual reports for 2014-2018.
[b] Approximately 80 percent of vessels are seagoing according to VGP annual reports from 2014 and 2015.
[c] Assumes 5 percent of vessels do not currently have a MGPS.
[d] Assumes vessels on average have five years of life remaining.
[e] To calculate Total Annualized MGPS Cost per year, the EPA amortized the cost of a single system over five years using a discount rate of two percent. (Annualizing $13,000 over five years at a two percent discount rate results in an average annualized cost of $2,700 per year; multiplying $2,700 per year by the number of vessels requiring MGPS results in Total Annualized MGPS Cost per year.)

4.5.2.2 REACTIVE MEASURES FOR MACROFOULING OF SEAWATER PIPING (40 CFR 139.28(C)(3))

The final rule requires the use of reactive measures to manage macrofouling of seawater piping. Specifically, if macrofouling is identified in seawater piping systems despite preventative measures, then the final rule requires the regular use of reactive measures such as freshwater flushing or chemical dosing. The 2013 VGP includes a similar requirement that vessel owners remove fouling organisms from seawater piping on a regular basis to prevent substantial fouling of the seawater piping. For these reasons, the EPA assumed this new requirement will result in zero incremental cost.

4.5.3 OTHER RULE PROVISIONS TOTAL COMPLIANCE COSTS

Incremental costs to regulated entities from the standards being finalized as a result of the VIDA are estimated to total approximately $2.7 million per year as shown in Table 4-29. This annualized figure includes both annually recurring costs and annualized capital or one-time costs.

Table 4-29. Estimated Cumulative Cost of Other Rule Provisions (2022$) at a 2% Discount Rate

Cost Category	Incremental Capital or One-Time Costs (A)	Average Annualized Capital or One-Time Costs[b] ($/yr) (B)	Annually Recurring Costs ($/yr) (C)	Average Annualized Total Costs ($/yr) (B+C)
Graywater Treatment[a]				
New Builds ≥400 GT, 15+ berths, and certificated for overnight	$27,400,000	$1,220,000	$1,060,000	$2,280,000
New Build Ferries ≥250 Passengers	$1,406,000	$63,000	$56,000	$118,500
Seawater Piping Marine Growth Prevention Systems[a]	$1,391,000	$295,100	-	$295,100
Total	**$30,197,000**	**$1,578,100**	**$1,116,000**	**$2,694,100**

[a] *Capital costs are annualized at a two percent discount rate over the 30-year expected life of the vessel. In this case, Annually Recurring Costs include both the annualized initial investment as well as future replacement for the system.*

4.5.4 BALLAST WATER MANAGEMENT FOR LAKERS

The regulatory definition of a new Laker includes any newly constructed Laker (referred to here as New Laker, for brevity) and any existing Laker that undergoes a "major conversion" as that term is defined in 40 CFR 139.2. The EPA estimates costs separately for these two types of New Lakers.

4.5.4.1 COSTS ASSOCIATED WITH NEW LAKERS

The EPA developed estimates of the capital and operation and maintenance (O&M) costs of BWMSs on New Lakers using the methodologies in the 2012 USCG cost report (USCG, 2012). Details of the EPA's calculations are provided in Appendix B and summarized in this chapter. Specifically, the EPA estimated the capital and O&M costs of BWMSs if they were installed on two recently built Lakers, the Mark W. Barker, a bulk carrier with a capacity of 26,000 tons and the Erie Trader, a covered dry cargo barge with a capacity of 37,600 tons. The EPA selected these recently built vessels to represent future Lakers. The EPA did not intend for these vessels to represent the entire fleet of Lakers. Although it cannot be predicted which vessels will be newly built each year in the future, the EPA assumed that future vessels may be more similar to newly built Lakers than other vessels in the fleet which may have different costs.

For each vessel, the EPA configured two different USCG type-approved BWMS technologies: a) filtration plus ultraviolet (UV) radiation and b) filtration plus chemical addition. These two technologies were compatible with the characteristics of the two newly built U.S. Lakers (Table 4-30). The EPA assumed that a New Laker would be built with coated tanks to accommodate the use of a chemical-addition BWMS similar to the construction of the Mark W. Barker.

Table 4-30. Characteristics of Two Newly Built Lakers

	Year Built	Length	Manifold Ballast System	Number of Ballast Tanks	Number of Ballast Pumps	Ballast pump capacity (m^3/hr)	Vessel Ballasting Capacity (m^3/hr)	Coated Ballast Tanks
Mark W. Barker	2022	639	Yes	16	2	1,500	3,000	Yes
Erie Trader	2012	710	Yes	16	2	3,180	6,359	No

4.5.4.1.1 Capital Costs

To determine BWMS capital costs for newly constructed Lakers, the EPA relied on USCG reported costs (USCG, 2012). The capacity of the USCG type-approved BWMS selected for a Laker must be compatible with the ballasting rate of the ballast pumps and the total ballasting capacity of the vessel. Typically, vessel operators install a higher capacity BWMS than would otherwise be necessary to account for slowing of the system from higher sediment loads on the filter during cargo operations.

- Mark W. Barker – The EPA used cost estimates for 2 BWMSs (one for each ballast pump) each with capacities of 2,000 m^3/hr to meet the ballast capacity of the Mark W. Barker (3,000 m^3/hr).
- Erie Trader – The EPA used cost estimates for 2 BWMSs (one for each ballast pump) each with capacities of 5,000 m^3/hr to meet the ballast capacity of the Erie Trader (6,359 m^3/hr).

Capital costs include the acquisition cost of the BWMS including costs for designing the system, license fees, regulatory approvals, cost to purchase equipment, and costs for developing a specification suitable for installation of the unit on the desired vessel. The EPA assumed installation cost is negligible given that the installation would occur at the same time as new construction and the required space, interface connections for the ballast, and the electrical power systems can be efficiently included in the design. For future Lakers, the EPA did not estimate costs for lost cargo capacity or increased loading or transit time. The EPA assumed these considerations would be factored into the decision process of the vessel operator in constructing a New Laker that complies with the regulation. The BWMS acquisition cost estimates were multiplied by two to account for the purchase of two BWMSs and updated from January 2012 to January 2022 dollars using the GDP implicit price deflator[17] (Table 4-31).

[17] https://fred.stlouisfed.org/series/GDPDEF

Table 4-31. Ballast Water Management System Capital Cost Estimates, (2022$)

Vessel	UV + Filtration	Chemical Addition + Filtration
Mark W. Barker	$1,676,000	$683,000
Erie Trader	$2,863,000	$993,000

BWMSs have a 25-year useful life, on average (King et al, 2012). Therefore, the EPA calculated the annualized capital cost over 25 years for each of the two Lakers.[18] Table 4-32 shows the annualized costs for UV Radiation + Filtration and Chemical Addition + Filtration.[19]

Table 4-32. Annualized Ballast Water Management System Capital Cost Estimates, (2022$) at a 2% Discount Rate

Vessel	UV Radiation+ Filtration	Chemical Addition + Filtration
Mark W. Barker	$86,000	$35,000
Erie Trader	$147,000	$51,000

4.5.4.1.2 Operation and Maintenance Costs

Operation and maintenance (O&M) costs for BWMS include labor, energy, and materials (chemicals, UV lamps, etc.) as well as maintenance and repair. The EPA used the USCG methodology (USCG, 2012) to estimate the cost to operate and maintain a BWMS including the O&M cost factors expressed as direct operation and maintenance and replacement costs per cubic meter of ballast water treated.

An important input for estimating the annual BWMS O&M costs is the amount of ballast water discharged per arrival and number of U.S. arrivals per year for a vessel. This information was gathered from data reported to the National Ballast Information Clearinghouse (NBIC) by the Mark W. Barker (2022) and the Erie Trader (2018 – 2022).

The estimated BWMS annual O&M costs for each of the two vessels, were inflated from 2012 to 2022 dollars using the GDP implicit price deflator (Table 4-33). For each BWMS technology, the EPA added the annualized capital cost and the annualized O&M cost to calculate the total annualized cost of procuring, operating, and maintaining the BWMS for each ship (Table 4-34).

Table 4-33. Ballast Water Management System Annual O&M Costs, (2022$)

Vessel	UV + Filtration	Chemical Addition

[18] See equation (3) in Chapter 6 on "Discounting Future Benefits and Costs" of the EPA's *Guidelines for Preparing Economic Analyses* (U.S. EPA, 2016) for more on the annualization formula used throughout this analysis.

[19] Given the 25-year useful life of a BWMS, these systems would likely need to be replaced one or more times during the life of a Laker. However, annualization of the costs over the 25-year useful life of the BWMS is mathematically equivalent to annualizing the costs of two BWMS, one installed in the first year, and a replacement installed, in year 26, over the assumed useful life of a Laker of 50 years.

Mark W. Barker	$198,000	$135,000
Erie Trader	$90,000	$124,000

Table 4-34. Total Annualized Cost of Procuring, Operating, and Maintaining Ballast Water Management Systems - UV + Filtration and Chemical Addition, (2022$) at a 2% Discount Rate

Vessel	UV + Filtration	Chemical Addition
Mark W. Barker	$284,000	$170,000
Erie Trader	$237,000	$175,000

4.5.4.1.3 Annualized Cost of the Equipment Standard for New Lakers

As discussed earlier in this EA, only six new U.S. flagged Lakers have been built over the last 20-year period (2003 - 2022). To calculate the cost of the equipment standard for New Lakers, the EPA assumed the historical trend would continue over the 25-year period of this analysis. A 25-year period of analysis was chosen to match the useful life of a BWMS. Since the EPA does not know when a New Laker may be built, the EPA assumed one laker will be built in years 1, 4, 7, 11, 14, 17, 21, and 24. By the end of the 25-year period of analysis, 8 New Lakers would be in service. EPA is making this assumption about timing which is based on a steady pace of building new vessels. Different timing assumptions would lead to different costs, which could be either higher (closer to the present) or lower (further into the future).

The EPA does not know which technology each new vessel will adopt. To be conservative, the EPA assumed each new vessel's cost would equal the highest BWMS total annualized cost estimate, which is the Mark W. Barker using UV + Filtration. In Table 4-35, this calculation is shown. The total annualized cost of the equipment standard for New Lakers is $1,373,000 at a 2 percent discount rate. Note that this is a high-end estimate that includes any unused capital from vessels that still have remaining years of useful life.

Table 4-35. Total Annualized Cost of the Equipment Standard for New Lakers, (2022$) at a 2% Discount Rate

Year	Number of New Lakers Operating	Annual Capital Cost Allocation for Converted Lakers Operating in Year	Annual O&M Costs for New Lakers Operating in Year	Total Cost in Year	Present Value of Cost
1	1	$1,676,000	$198,000	$1,874,000	$1,874,000
2	1	$0	$198,000	$198,000	$194,000
3	1	$0	$198,000	$198,000	$190,000

4	2	$1,676,000	$396,000	$2,072,000	$1,952,000
5	2	$0	$396,000	$396,000	$366,000
6	2	$0	$396,000	$396,000	$359,000
7	3	$1,676,000	$594,000	$2,270,000	$2,016,000
8	3	$0	$594,000	$594,000	$517,000
9	3	$0	$594,000	$594,000	$507,000
10	3	$0	$594,000	$594,000	$497,000
11	4	$1,676,000	$792,000	$2,468,000	$2,025,000
12	4	$0	$792,000	$792,000	$637,000
13	4	$0	$792,000	$792,000	$624,000
14	5	$1,676,000	$990,000	$2,666,000	$2,061,000
15	5	$0	$990,000	$990,000	$750,000
16	5	$0	$990,000	$990,000	$736,000
17	6	$1,676,000	$1,188,000	$2,864,000	$2,086,000
18	6	$0	$1,188,000	$1,188,000	$848,000
19	6	$0	$1,188,000	$1,188,000	$832,000
20	6	$0	$1,188,000	$1,188,000	$815,000
21	7	$1,676,000	$1,385,000	$3,061,000	$2,060,000

22	7	$0	$1,385,000	$1,385,000	$914,000
23	7	$0	$1,385,000	$1,385,000	$896,000
24	8	$1,676,000	$1,583,000	$3,259,000	$2,067,000
25	8	$0	$1,583,000	$1,583,000	$984,000
				Total Present Value:	$26,807,000
				Total Annualized Cost:	$1,373,000

4.5.4.2 COSTS ASSOCIATED WITH CONVERTED LAKERS

The EPA also estimated the capital and O&M cost of installing and operating two BWMSs on a Laker that undergoes a major conversion.

4.5.4.2.1 Capital Costs

The EPA reviewed two sources to estimate the BWMS capital costs for converted Lakers: a report by the USCG (2013) and a report by Choice Ballast Solutions (2017).

In the USCG (2013) report, costs are reported by vessel type. Vessel category 4: Newer, Intermediate Capacity 800-900 feet Laker was determined to be the most appropriate category for the equipment standard because it best represents recently converted Lakers such as the St. Mary's Challenger. However, the USCG (2013) report was not utilized because Table D-3 of the USCG (2013) report list $0 for BWT Filter and UV Assemblies. In addition, the USCG (2013) report does not include an equipment list for the Vessel category 4 (Newer, Intermediate Capacity 800-900 feet Laker) which the EPA has determined is the most appropriate category for the equipment standard. Hence, the EPA could not verify the equipment estimated in this calculation. Furthermore, the USCG (2013) report does not provide the corresponding O&M costs for the BWMS. Due to the uncertainty and the lack of an O&M cost of this estimate, the EPA relied on the retrofit costs in the Choice Ballast Solutions (2017) report which did not have the USCG (2013) shortcomings and provides the purchase, installation, and O&M cost for the BWMSs.

In the Choice Ballast Solutions (2017) report, Arthur M. Anderson is used as a proxy for other vessels (**Table 4-36**). The capital cost estimate is based on installing two Hyde Guardian HG2500G UV systems – each with a nominal rating of 11,014 gpm (2,500 m^3/hr).[20] The capital cost estimate of the purchase and

[20] The information available in the Choice Ballast (2017) study only included costs on UV disinfection systems based on a feasibility analysis. Unlike the cost estimates for New Lakers, no chemical addition is included in the capital or O&M costs for converted lakers.

installation of these two systems is $3,860,000 ($2017). The EPA assumed that BWMSs have the same useful life (25 years) for a newly constructed Laker and a converted Laker.

Table 4-37 presents annualized capital costs for converted Lakers at a 2 percent discount rate.

Table 4-36. Characteristics of a Converted Laker

Vessel	Year Converted	Capacity (tons)	Length	Number of Ballast Tanks	Number of Ballast Pumps	Ballast pump capacity (m^3/hr)	Vessel Ballasting Capacity (m^3/hr)
Arthur M. Anderson	1981/1982	28,400	767	20	2	4,770	17,247

Table 4-37. Ballast Water Management System Capital Costs for Converted Lakers

Capital Costs		Annualized Capital Costs (2022 Dollars)
2017 Dollars	2022 Dollars	2 % Discount Rate
$3,860,000	$4,478,000	$229,000

4.5.4.2.2 Operation and Maintenance Costs

According to the Choice Ballast (2017) report, the annual recurring costs of operating and maintaining two Hyde Guardian 2,500 m^3/hr UV systems was $60,000 in 2017 dollars. Using the GDP implicit price deflator, this corresponds to approximately $70,000 in 2022 dollars.

The EPA added the annualized capital cost ($229,000) and annual O&M cost ($70,000) to calculate the total annualized costs of procuring, installing, operating, and maintaining the BWMS for a converted Laker at a 2 percent discount rate which is $299,000 (see Table 4-38).

Table 4-38. Total Annualized Cost of Procuring, Operating, and Maintaining Ballast Water Management Systems for Converted Lakers

Annual O&M Cost		Annualized Capital + O&M Costs (2022 Dollars)
2017 Dollars	2022 Dollars	2 % Discount Rate
$60,000	$70,000	$299,000

4.5.4.2.3 Annualized Cost of the Equipment Standard for Converted Lakers

As discussed in the Great Lakes Baseline section, only three U.S. Lakers have been converted over the last 20-year period. To calculate the cost of the equipment standard for converted Lakers, the EPA assumed the historical trend would continue over the 25-year period of this analysis. Since the EPA does not know when a Laker may be converted, EPA assumed a laker would be converted in years 1, 8, 15, and 22 of the period of analysis. By the end of the 25-year period of analysis 4 converted Lakers would be in service. EPA is making this assumption about timing which is based on a steady pace of converting existing Lakers; different timing assumptions would lead to different costs, which could be either higher (closer to the present) or lower (further into the future).

As shown in Table 4-39, the total annualized cost of the equipment standard for converted Lakers is $909,000 at a 2 percent discount rate. Similarly to the analysis for New Lakers, this is a high-end estimate that includes any unused capital from vessels that still have remaining years of useful life.

Table 4-39. Total Annualized Cost of the Equipment Standard for Converted Lakers, (2022$) at a 2% Discount Rate

Year	Number of Converted Lakers Operating	Annual Capital Cost Allocation for Converted Lakers Operating in Year	Annual O&M Costs for New Lakers Operating in Year	Total Cost in Year	Present Value of Cost
1	1	$4,478,000	$70,000	$4,548,000	$4,548,000
2	1	$0	$70,000	$70,000	$69,000
3	1	$0	$70,000	$70,000	$67,000
4	1	$0	$70,000	$70,000	$66,000
5	1	$0	$70,000	$70,000	$65,000
6	1	$0	$70,000	$70,000	$63,000
7	1	$0	$70,000	$70,000	$62,000
8	2	$4,478,000	$140,000	$4,618,000	$4,020,000
9	2	$0	$140,000	$140,000	$119,000
10	2	$0	$140,000	$140,000	$117,000
11	2	$0	$140,000	$140,000	$115,000

12	2	$0	$140,000	$140,000	$113,000
13	2	$0	$140,000	$140,000	$110,000
14	2	$0	$140,000	$140,000	$108,000
15	3	$4,478,000	$209,000	$4,687,000	$3,552,000
16	3	$0	$209,000	$209,000	$155,000
17	3	$0	$209,000	$209,000	$152,000
18	3	$0	$209,000	$209,000	$149,000
19	3	$0	$209,000	$209,000	$146,000
20	3	$0	$209,000	$209,000	$143,000
21	3	$0	$209,000	$209,000	$141,000
22	4	$4,478,000	$279,000	$4,757,000	$3,139,000
23	4	$0	$279,000	$279,000	$180,000
24	4	$0	$279,000	$279,000	$177,000
25	4	$0	$279,000	$279,000	$173,000
				Total Present Value:	$17,749,000
				Total Annualized Cost:	$909,000

4.5.4.3 TOTAL ANNUALIZED COSTS OF THE EQUIPMENT STANDARD

The total annualized cost of the equipment standard as shown in Table 4-40, is the sum of the annualized capital, operation, and maintenance costs of BWMSs on New Lakers (Table 4-35) and the annualized capital, installation, operation, and maintenance costs of BWMSs on converted Lakers over the 25-year period of analysis (Table 4-39).

Table 4-40. Total Annualized Cost of the Equipment Standard for Lakers, (2022$) at a 2% Discount Rate

New Lakers	**$1,373,000**
Converted Lakers	$909,000
Total Annualized Cost	$2,051,000

4.5.5 DESALINATION AND PURIFICATION SYSTEMS (40 CFR 139.16)

The EPA's new standard for discharges from desalination and purification systems clarifies the prohibition on discharges resulting from cleaning these systems with hazardous or toxic materials. This standard is consistent with the 2013 VGP, which prohibits discharges from distillation and reverse osmosis systems that come into contact with machinery or industrial equipment, toxic or hazardous materials or wastes.

Water purification systems onboard vessels generally use either vacuum distillation or reverse osmosis technologies. These technologies produce purified water from surrounding waters and generate a reject stream (referred to as brine in the case of seawater desalination). The final standard does not change any 2013 VGP requirements regarding the discharge of brine, reject water, or similar residuals but clarifies toxic or hazardous materials used for cleaning these systems are not allowed to be discharged. Specifically, desalination and purification systems require periodic maintenance to clean the treatment vessels and associated piping of scale and other types of fouling. Typical cleaning solutions include citric acid, sodium hypochlorite, sulfuric acid, sodium hydroxide, and sodium bisulfite. Common practice onboard vessels, based on discussion with cruise ship owners, is to collect and store spent cleaning solutions for disposal onshore. Therefore, the EPA estimated zero incremental costs to comply with the prohibition on discharge of these residuals.

4.5.6 EXHAUST GAS RECIRCULATION (EGR) SYSTEMS (40 CFR 139.18)

The final standards include new requirements for discharges from EGR systems; the 2013 VGP did not address EGR system discharges. These new requirements codify standards for pH, polyaromatic hydrocarbons, nutrients, and turbidity as expressed in the IMO's guidelines for discharges from EGR systems. As the preamble to the final rule discusses, the EPA does not anticipate vessels owners will experience any incremental cost impacts from the new EGR requirements because vessels already follow the international guidelines for EGR discharges as part of standard industry practices.

4.5.7 FIRE PROTECTION EQUIPMENT (40 CFR 139.19)

The EPA's final rule includes several changes to 2013 VGP requirements for fire protection equipment:

- Prohibition of fluorinated firefighting foam discharges excluding USCG-required inspection and certification.
- Prohibition of discharges from fire protection equipment for training, testing, maintenance, inspection, and certification in port, excluding USCG-required inspection or certification.

4.5.7.1 PROHIBITION OF FLUORINATED FOAM DISCHARGES, EXCLUDING USCG-REQUIRED INSPECTION OR CERTIFICATION (40 CFR 139.19(B))

The final rule clarifies and maintains the 2013 VGP prohibition on discharge of fluorinated firefighting foam; however, it adds the exclusion from this prohibition of any USCG-required inspection or certification under 46 CFR 31.10-18(c), 46 CFR 107.235(b)(4), or by the marine inspector to ensure vessel safety and seaworthiness.

The EPA is aware of several alternatives currently available that can be implemented onboard a vessel for training, maintenance, and testing purposes. Alternatives include performing testing, maintenance, and training with non-foaming substances (e.g., water), non-fluorinated foams that do not contain bioaccumulative, toxic, or hazardous materials, or collecting firefighting foam before discharge to surface waters and storing for onshore disposal. The USCG has indicated that, in limited circumstances, USCG-required inspections and certification testing of vessels with fluorinated foam systems may result in discharges of fluorinated foam while in port to ensure vessel safety. This change does not impose additional costs.

4.5.7.2 PROHIBITION OF FIREMAIN DISCHARGES IN PORT, EXCLUDING USCG-REQUIRED INSPECTION OF CERTIFICATION (40 CFR 139.19(C))

The requirements in the final rule for discharges from fire protection equipment are fundamentally the same as the 2013 VGP requirements with one exception. The new standard allows for discharge from fire protection equipment for inspection and certification in port, if required by the USCG under 46 CFR 31.10-18(c), 46 CFR 107.235(b)(4), or by the marine inspector to ensure vessel safety. This change does not impose additional costs.

4.5.8 HULLS AND ASSOCIATED NICHE AREA MANAGEMENT (40 CFR 139.22)

The final rule adds three new requirements for hulls and associated niche areas:

- Prohibition of coatings containing cybutryne
- Prohibition of in-water cleaning of macrofouling
- Prohibition of in-water cleaning of deteriorated anti-fouling coating

4.5.8.1 PROHIBITION OF COATINGS CONTAINING CYBUTRYNE (40 CFR 139.22(C)(5))

The final standard prohibits hull coatings that contain cybutryne and requires any vessel with cybutryne-containing coatings must either apply an effective overcoat to the hull or remove the coating. The 2013

VGP does not prohibit or impose any limitations on the use of hull coatings that contain cybutryne. The EPA notes cybutryne is being phased out as an anti-fouling paint biocide and is in the process of being banned under the International Convention on the Control of Harmful Anti-fouling Systems in Ships (AFS Convention). At its 71st session in July 2017, MEPC approved a new output to amend Annex 1 to the AFS Convention to include controls on cybutryne. Amendments to the AFS Convention in IMO Resolution MEPC.331(76) prohibit ships from applying or reapplying anti-fouling systems containing cybutryne on or after January 1, 2023, and states that existing vessels bearing an anti-fouling system that contains cybutryne in the external coating layer of their hulls or external parts must either remove the anti-fouling system or apply a coating that forms a barrier to this substance leaching from the underlying non-compliant anti-fouling system.

Cybutryne has a small market in the U.S., primarily for recreational vessels, and the EPA anticipates few, if any, impacts to U.S.-owned vessels subject to the VIDA. For these reasons, the EPA assumed zero incremental costs resulting from this new requirement.

4.5.8.2 PROHIBITION OF IN-WATER CLEANING OF MACROFOULING (40 CFR 139.22(D)(4))

The final standard prohibits in-water cleaning of macrofouling. The 2013 VGP does not prohibit in-water cleaning of macrofouling.

The final rule defines “macrofouling” and “microfouling” slightly differently than the definitions presented in the supplemental notice to provide additional clarity and consistency. These definitions dispense with the use of the Navy Fouling Rating scale. The EPA defines macrofouling as biofouling caused by the attachment and subsequent growth of visible plants and animals on surfaces and structures immersed in or exposed to the aquatic environment, and microfouling as biofouling caused by bacteria, fungi, microalgae, protozoans, and other microscopic organisms on structures and surfaces immersed in or exposed to the aquatic environment that creates a biofilm (also called a slime layer). To comply with the standard, the EPA is requiring vessels clean hulls and niche areas regularly to minimize biofouling. However, the EPA assumed vessels are already actively cleaning because the cost savings associated with reduced fouling exceed the costs of cleaning (see discussion below). Accordingly, the EPA assumed requirements for in-water cleaning will not result in incremental costs.

Studies have estimated that even a biofilm can increase the drag on a vessel by up to 25 percent (Townsin 2003; Schultz 2007). Predictive analytics have shown frequent cleaning reduces fuel consumption and increasing cleaning to an interval of approximately six months can save hundreds of thousands of dollars per vessel in fuel costs (Forbes, 2017). Studies have also shown even a layer of microfouling on a typical commercial cargo vessel traveling at twenty knots can result in an additional $4,500 per day in fuel costs. This equates to over $1.6 million for a single vessel if operated under such conditions for a full year (The Hydrex Group, 2010).

However, the EPA recognizes vessel owners must balance the costs to clean their hulls and to accumulate biofouling. Excessive cleaning of hulls (beyond the slime layer) is likely to damage hull coatings and result in greater long-term costs. Damaged coatings refoul more quickly, resulting in even higher fuel costs and the need for even more frequent cleaning. Damaged coatings may also present a risk of corrosion. Therefore, frequent cleaning of a slime layer results in cost reductions for vessel owners in terms of both fuel consumption and coating maintenance.

The final rule also includes a slightly revised description of cleaning processes to allow for use of an in-water cleaning and capture system (referred to as vacuum or other similar technologies) and account for cleaning being conducted prior to departure from a port. These changes were included to encompass processes deployed with emerging cleaning technologies and will not add to existing compliance costs compared to the compliance burden vessels experience under the VGP.

4.5.8.3 PROHIBITION OF IN-WATER CLEANING OF DETERIORATED ANTI-FOULING COATINGS (40 CFR 139.22(D)(6))

The final rule prohibits in-water cleaning on any section of anti-fouling coating that has shown significant deterioration since the most recent application of the coating. The 2013 VGP does not prohibit such cleaning.

The EPA defines significant deterioration as including signs of excessive cleaning actions or blistering due to the internal failure of the paint system. The EPA notes the anti-fouling coating of vessels that are compliant with the coating selection, cleaning, and reapplication requirements of the 2013 VGP are not expected to show significant deterioration and are expected to realize their projected lifespan. Based on the assumption of full compliance with existing federal and state regulations in the analytic baseline, the EPA projects this new requirement will not result in any incremental costs.

4.6 ADMINISTRATIVE COST

4.6.1 RELIEF FROM EXCLUSION OF SMALL VESSELS AND FISHING VESSELS

As discussed above in Section 4.3.2, the Agency estimates that excluding small vessels and large commercial fishing vessels from needing to comply with the paperwork portion of current discharge requirements will result in a net savings to the maritime community of approximately $3.6 million annually.

4.6.2 TRANSITIONING FROM VGP TO VIDA

The EPA did not assess potential cost impacts from changes in recordkeeping and reporting that vessel owners will experience as a result of the transition from the VGP to the new CWA section 312(p) requirements. All reporting and recordkeeping requirements and burden under the VIDA will be set out under USCG authority, in keeping with the scope of the USCG responsibilities as articulated in the new law. The EPA does not expect that vessels will experience any new recordkeeping and reporting burden on top of what they currently experience under the VGP specifically as a result of the standards, but the EPA cannot anticipate how vessels will be impacted by USCG's future rulemakings. Once the USCG finalizes their regulatory program for the VIDA, the EPA will update its accounting of recordkeeping and reporting burden under the Paperwork Reduction Act to reflect that the burden that vessels owners previously experienced as a result of the VGP is now being managed by another federal agency.

4.6.3 STATE PETITIONS

The VIDA also contains provisions for requests from states that may ultimately result in cost impacts to state governments. These are:

- Petitions by states to establish no-discharge zones [§ 312(p)(10)(D)]
- Petitions by governors for review of national standards [§ 312(p)(7)(A)(ii)]
- Petitions for emergency orders [§ 312(p)(7)(A)(i)]
- Petitions by governors for enhanced Great Lakes System requirements [§ 312(p)(10)(B)]

As part of this rulemaking, the Agency generated cost estimates for each VIDA petition type that reflect the cost of activities including reviewing the relevant regulations and guidance documents, gathering and analyzing the required information, and preparing and submitting the application. These costs are captured in the Information Collection Request (ICR) document that the EPA prepared for this rule, which has been assigned EPA ICR number 2605.01.

For purposes of the ICR, the EPA projected that state respondents will submit a petition to establish a no-discharge zone once every three years, a petition to review national standards of performance once every three years, a petition to issue an emergency order once every five years, and that the EPA would not receive a petition to establish enhanced Great Lakes System requirements during the ICR's three-year cycle. The EPA arrived at these frequency estimates based on best professional judgment and experience with the comparable programs for sewage and UNDS under existing sections of the CWA section 312 program. To derive estimates for annual labor hours and costs for each petition type, the total burden for a single petition was annualized based on the projected frequency of the petition.

Greater detail on the information collection activities described, as well as a snapshot of anticipated burden over the first three-year period following the issuance of the final rule, is available in the ICR submitted for approval to the Office of Management and Budget as part of this final rulemaking.

Table 4-41, below, is taken from the ICR and shows the final costs were calculated as $5,666 in connection with the VIDA provisions for state petitions to the EPA requesting the Agency to establish more stringent discharge requirements.

Table 4-41. Total Annual Cost of State Petitions under VIDA (2022$)

Petition Type	Number of Petitions Per Year	Hours Per Year	Cost Per Year (per ICR, 2023$)	Cost Per Year (long term, 2022$)
Petitions to Establish NDZ	0.33	77.5	$3,502	$3,379
Petitions for Review	0.33	15.42	$1,051	$1,014
Petitions for Emergency Order	0.33	9.25	$1,051	$1,014
Petitions to Establish Enhanced Great Lakes System Requirements	0.10	3.98	$0[a]	$260
Total:	**1.1**	**106.14**	**$5,604**	**$5,666**

** Table 4 of the BLS report (http://www.bls.gov/news.release/ecec.t04.htm, last modified in December 2023) contains employee compensation data for state and local government employers. The labor rates for respondent management, technical, and clerical personnel in Tables 1 to 4 of the ICR were obtained from the "State and local government workers Occupational group" category. Values in 2022$ were extrapolated using A191RD3A086NBEA, such that $1 in 2023 was worth $0.96 in 2022.*
[a] ICR Cost burden estimated a $0 burden to states due to Petitions to Establish Enhanced Great Lakes System Requirements due to the shorter time span of the viability of the ICR and the estimated number of petitions being less than one per 3 year cycle.

4.7 TOTAL COST OF THE FINAL RULE

This section aggregates the estimated costs and savings in 2022 dollars for the changes in discharge standards compliance, ballast water management, administrative costs due to mandates directly attributed to the VIDA and to the EPA's final rule. The EPA estimated the incremental and total annualized costs for the final rule at a two percent discount rate over the lifetime of various systems, per OMB's 2023 Circular A-4.

Table 4-42 summarizes the total annualized costs of the final rule, by the various provisions described in the sections above. Here, the rule provisions are organized in three groups: rule provisions dictated by the VIDA, rule provisions unchanged from VGP, and other rule provisions, including changes from the VGP.

The VIDA related rule provisions result in total cost savings of approximately $21.9 million which are largely driven by the exclusions for small vessels and fishing vessels. Unchanged rule provisions for environmentally acceptable lubricants are associated with approximately $5.7 million in costs, and other rule provisions, which include graywater systems, MGPS, and BWMS for New Lakers cost approximately $5 million. The rule results in $11.3 million in annualized net savings, in aggregate.

Table 4-42. Total Annualized Cost of the Final Rule, by Rule Provision, ($2022) at a 2% Discount Rate

Rule Provisions	Annualized Cost
Rule Provisions Dictated by VIDA	
Changes to BWMS	$5,479,000
Overseas and coastal vessels	*$3,268,000*
St. Lawrence Seaway	*$165,000*
Pacific Region	*$1,640,000*
Pacific Region, low salinity BW	*$406,000*
Exclusions for Small Vessels and Fishing Vessels	($27,410,000)
State Petitions	$6,000
Subtotal	**($21,925,000)**
Rule Provisions Unchanged from VGP	
Environmentally Acceptable Lubricants	$5,690,000
Subtotal	**$5,690,000**

Other Rule Provisions, including Changes from VGP	
Graywater Systems	$2,399,000
New Build Vessels 400 GT or more Carrying 15 or more passengers and overnight accommodations	*$2,280,000*
New Build Ferries Carrying 250 or more passengers	*$119,000*
MGPS to prevent macrofouling	$295,000
BWMSs for New Lakers	$2,282,000
New Builds	$1,373,000
Conversions	$909,000
Subtotal	$4,976,000
Total Annualized Cost:	**($11,259,000)**

4.8 LIMITATIONS AND UNCERTAINTIES

The EPA encountered several data limitations that may cause uncertainty in the economic analysis. Table 4-3 presents a summary of issues. The preceding sections also include a more detailed analysis of all relevant analytical assumptions (see the Description column of Table 4-3 for specific section references).

Table 4-43: Description of Analysis Limitations and Uncertainties

Type of Limitation/Uncertainty	Impact	Description
Large Vessel Type	Up to 1,900 (less than 3%) large vessels may have incorrect type assigned.	Vessel type could not be determined for a relatively small percent of large vessels. These vessels were assigned to a vessel type based on relative shares of vessel types (see Section 3.1.1 for details).
Small Vessel Counts	22,600 (19.6 percent) potentially small vessels	Approximately 115,000 vessels were clearly small based on the data (see Section 3.1.2 for details), no length is recorded for an additional 22,600 vessels. If these vessels were also small, then the sVGP count would total almost 137,600 (19.6 percent higher). The EPA presents small vessel counts as a range with a lower bound excluding all vessels of unknown length and an upper bound including all vessels of unknown length
Small Vessel Type	Up to 27,400 small vessels may have incorrect type assigned.	Records for over 15,000 vessels 79-feet long or less, and 12,400 with unknown length did not specify type (see Section 3.1.2 for details). The EPA distributed these across all type categories based on the relative share of small vessels with known type, with one exception. Communications with the USCG Fishing Vessel Safety Program suggested that the small commercial fishing

		vessel count was reasonably accurate, so the analysis did not allocate any additional vessels to that category.
Small Vessel Business Category	Up to 60,000 small vessels may have incorrect business category assigned.	Nearly 60,000 vessels had no business category indicated (see Section 3.1.2 for details). To adjust the tallies for this deficiency in categorization, the EPA assigned those vessels where no business category was indicated to the other business categories based on the pattern of distribution exhibited for the vessels with known business categories. The EPA did not assign vessels with unknown codes to the small commercial fishing vessel category.
Foreign-owned/ foreign-flagged vessels	Number of vessels affected, and total costs could be larger than estimated.	The EPA estimated the universe of foreign-flagged, foreign-owned vessels that will be subject to these regulations (see Table 3-6); however, the Agency did not have information on the breadth of international regulations to which these vessels may already be subject or how the direct costs to these vessels may indirectly effect U.S. interests. Though the Agency did not have the forgoing data, the EPA estimates costs to be similar (per vessel) to those of domestic vessels. Benefits to the U.S. from the regulation of foreign-owned, foreign-flagged vessels are expected to be less than that of domestic vessels since these foreign vessels spend significantly less time in U.S. waters. Additionally, the EPA expects costs and benefits associated with foreign vessels' compliance with the Laker ballast water equipment standard (in this case, Canadian-owned only) to be negligible as current Canadian ballast water regulations impose similar requirements. The EPA also notes that the requirement that vessels use EALs is an existing requirement from the 2013 VGP and does not represent a change from the baseline, its inclusion in this EA was to rectify an omission of the administrative record.
Pollutant Reduction	The pollutant reduction benefits could not be quantified.	The EPA did not have baseline data for existing quantities of discharged pollutants. While implementation of these standards is expected to decrease the quantity of pollutants discharged, the EPA was unable to quantitatively predict the decrease in pollutants due to this mandated regulation.

5 BENEFITS ANALYSIS

Commercial vessels are a vital component of our nation's economy, supporting our transportation network and international trade. However, the daily operations of vessels can have significant adverse impacts on water quality, and incidental discharges from vessels can introduce aquatic pollutants such as aquatic nuisance species, metals, nutrients, and bacteria. Controlling these discharges first through the VGP and now through the VIDA rule is expected to yield important benefits to ecosystems and to society at large by limiting the adverse water quality impacts from these vessel operations.

This benefits analysis largely recaps the benefits assessment performed for the 2013 VGP. The Agency does not expect the final rule to change benefits significantly compared to those deriving from implementation of the VGP because the discharge standards largely mirror the existing VGP requirements. The Agency's analysis also discusses a few key areas where benefits could potentially be lost due to VIDA's repeal of the sVGP. Although the EPA did not quantify the expected benefits of the VGP and sVGP at the time the permits were issued due to data limitations, the Agency collected and considered relevant information to enable qualitative consideration of ecological and human health benefits and to assess the importance of the ecological gains (and losses) from revisions to the VGP. This EA summarizes these benefits below for informational purposes as follows:

- Section 5.1 presents an assessment of the ecological, economic, and human health impacts of invasive species introductions associated with ballast water and biofouling discharges and the expected benefits of reducing the occurrence of invasive species, and potential loss of benefits associated with deregulation of small vessels and fishing vessels.
- Section 5.2 describes the expected benefits of reduced vessel discharges of pollutants of concern (POCs), their environmental effects, and the benefits associated with the final rule, and potential loss of benefits associated with deregulation of small vessels and fishing vessels.

5.1 BALLAST WATER, BIOFOULING, AND INVASIVE SPECIES

5.1.1 AQUATIC NUISANCE SPECIES IMPACTS

Introductions of aquatic nuisance species (ANS) have received significant attention since the 1980s, when the extent of the zebra mussel invasions in the Great Lakes region was first recognized as a serious problem (Ruiz and Reid, 2007). ANS invasions have caused significant economic and ecological damages to critical coastal and inland waters throughout the United States. Several of the most harmful invasive species currently known to exist in the United States, including the zebra mussel and the green crab, are thought to have been introduced and spread into U.S. waters from vessels.

The primary vectors for ANS introduction to U.S. waters from commercial vessels are the uptake and discharge of ballast water and biofouling on the hull and niches. Often, aquatic invertebrates, plants, or microorganisms, as well as suspended sediments that may contain organisms, are unintentionally taken onboard when vessels fill ballast tanks in one water body, then are discharged into a different aquatic environment when the tanks are emptied. Additionally, introduction and spread by biofouling may occur when organisms attach themselves to the hull and niche areas and are transported along the vessel's route, where they can spawn, produce larvae, or detach. Broadly, the biofouling process begins with the formation of a microfilm on the wetted portion of the vessel hull and niche areas, followed by adherence of bacteria, and subsequent attachment of larger organisms, such as seaweeds and mussels (Buskens et al., 2013).

Ballast water and hull fouling have long been recognized as vectors for species invasions (Carlton, 1985). Glassner-Shwayder (1999) refers to ships with ballast water as "biological islands" because they carry such a wide variety of organisms in their ballasts; some studies have found as many as 4,000 species in a typical ship's untreated ballast water at one time. NOAA's Great Lakes Environmental Research Laboratory (GLERL) found that a majority of ships and close to half the tanks surveyed contained non-indigenous strains of pathogens known to cause human health impacts (Johengen et al., 2005; Reid et al., 2007). The Johengen et al. (2005) study also found that viable populations of non-native dinoflagellate and invertebrate species were present in a large majority of tanks sampled. Additionally, a 2011 study (Ruiz et al., 2011) determined that approximately 60 percent of the 257 marine invasions to California's coast include biofouling as a possible mechanism of initial introduction. Furthermore, a survey of 82 sea chests from 39 commercial vessels while in dry dock on the West and East coasts of Canada found that 80 percent of the sampled vessels showed evidence of sea chest fouling, and 46 percent harbored at least one non-indigenous species (Frey et al., 2014).

In 2012, the USCG finalized new ballast water management standards to revise rules at 33 CFR 151 (77 FR 17254) and specify limits on the discharge of living organisms that are similar to the International Maritime Organization's (IMO) Ballast Water Management Regulation D-2.[21] The EPA incorporated the USCG Standards/IMO D-2 requirements in its VGP. Under 33 CFR 151, the USCG also required that vessels equipped with ballast tanks follow biofouling management procedures, including the rinsing of anchors and anchor chains when the anchor is retrieved to remove organisms and sediments at their places of origin (33 CFR 151.2050(e)), and removal of fouling organisms from the vessel's hull, piping, and tanks on a regular basis (33 CFR 151.2050(f)). Guidance issued by the USCG refers to the required fouling maintenance and sediment removal procedures as a "Biofouling Management and Sediment Plan" (USCG, 2019). Significantly, the VIDA specifically includes ANS in the category of nonconventional pollutants (4(B)(i)) and therefore requires the best practicable control technology available and the best available technology economically achievable to progress toward the national goal of eliminating ANS in vessel discharges. Stricter standards under the VIDA for ballast water discharges and for biofouling management in hulls and associated niches, as well as seawater piping, are expected to contribute to reducing the risk of ANS invasions and their consequences. The estimated total costs associated with ANS in the United States are substantial. The USCG estimates the avoided damages from preventing future initial invasions over a 10-year period at $6 to $518 million dollars annually, at a 3 percent discount rate, depending on the assumed effectiveness of the standards and control costs per species (USCG, 2012).[22] The EPA considers these estimates to be under-estimated and given that the benefits are cumulative beyond ten years, they may be far higher over an average vessel's service life. A 2005 study

[21] If practicability review shows that it is feasible, this Phase One standard would be followed by a "Phase Two" standard that set concentration limits at 1,000 times more stringent than Phase One standards for viable organisms greater than 10 microns and for bacteria and viruses.

[22] The annual range of benefits would have been higher if discounted using 2 percent discount rate as now required per OMB's Circular A-4.

suggests that expenditures on control alone for ANS in the United States total approximately $9 billion annually (Pimentel et al., 2005).

Examples of ANS impacts include the following (reported dollars are for the publication year):

- ***Sea Lamprey:*** The sea lamprey, which is native to the Atlantic Ocean, was not initially introduced to the Great Lakes by ballast water but has been spread elsewhere through contaminated ballast water (Toledo, 2001). Upon its initial introduction, the sea lamprey caused a massive collapse of the trout fisheries in the Great Lakes. Control measures to counteract the impacts of sea lampreys cost more than $12 million annually (ANSTF, 2007).
- ***European Green Crab:*** The most likely mode of the initial European green crab introduction on the East Coast of North America was ship fouling (Cohen et al., 1995). The annual estimated economic damages from European green crab predation to commercial and recreational shellfisheries and eelgrass restoration efforts range from $18.6 to $22.6 million per year in the United States (EPA, 2008b).
- ***Round Goby:*** The round goby is native to Eurasia and was first introduced into the Great Lakes region via ballast water. It is thought to have adverse impacts on fisheries due to its lack of value as a sport or commercial catch and its aggressive tendencies toward baited lines (Marsden and Jude, 1995). The round goby also takes over prime spawning sites of native species, including mottled sculpin, logperch, and darters, thus changing the balance of the ecosystem (Glassner-Shwayder, 1999). No attempts to quantify the value of these impacts have been completed to date.
- ***Zebra Mussel:*** Zebra mussels are native to the Caspian Sea and were introduced to U.S. waters in ballast water and likely spread by ballast and/or biofouling (Minchin et al., 2002). Proliferation of the zebra mussel beyond the Great Lakes led to a halt in the $3 billion dollar Mississippi River shellfishing industry (Randall, 2001). Zebra mussels also affect plant viability and substantially increase competition for food for indigenous mollusks, thereby significantly changing ecosystems (Griffiths et al., 1991; MacIsaac et al., 1995). In addition, zebra mussels attach to surfaces of water intake structures, navigation dams, pumping stations, and gears, often making them inoperable. A 1995 study (O'Neill, 1997) found that the total costs of zebra mussels control and monitoring were $69 million.
- ***European Ruffe:*** The European ruffe was introduced into the Great Lakes via ballast water and poses a serious threat by preying on native species like the walleye, yellow perch, and whitefish, and competing with them for habitat (Leigh, 1998). When populations of spawning European ruffe in the St. Louis River increased from 200,000 in 1989 to 1.8 million in 1991, populations of yellow perch, trout-perch, emerald shiners, and spottail shiners decreased by 75 percent (RTF, 1992).
- ***Snowflake Coral:*** *Carijoa riisei*, or snowflake coral, an invasive coral species, believed to have arrived either as a biofouling or ballast water organism (Hawaii DLNR, 2019). It is threatening the ecosystem stability of the ecologically sensitive Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve and is also a threat to the native black coral, which a local industry harvests to make jewelry, and is valued at $30 million (NOAA, 2004a; Toonen, 2005).

A broad range of adverse impacts are associated with any introduction of a given type of species. Although some species cause no economic damage, others may cause hundreds of millions of dollars in damages.

ANS can pose an especially serious risk to commercial and recreational fisheries. ANS may affect native species through direct predation, increased competition for food sources, alteration or destruction of habitat, or simply by replacing marketable, high value species with unmarketable, low value species in fishermen's catch (OTA, 1993; EPA, 2008b; Marsden and Jude, 1995).

ANS can also have adverse impacts on recreation and tourism by damaging water quality and flow. Invasive plants have been found to clog the water's surface, blocking boating and swimming, impeding water flow, and disrupting plant and animal communities (Van Driesche et al., 2002). Invasive bivalves may discourage use of infested beaches by covering shorelines with sharp-edged shells and rotting flesh. Recreational boaters may be deterred by the cost and inconvenience of vessel cleaning resulting from boating in infested waters (USACE, 2002); one study suggested these incremental costs to boat owners might total almost $500 per year per boat (Vilaplana and Hushak, 1994).

Introductions of ANS can also drastically alter virtually every characteristic of an aquatic ecosystem. ANS can affect the "composition, density, and interactions of native species" that can then cause "significant changes to the ecosystem, such as alterations to the food webs, nutrient dynamics and biodiversity" (IDNR, 2003).

With respect to threatened and endangered species, ANS can impact threatened and endangered species by predation, alteration of habitat, or further competition for limited resources. An early study estimated that non-indigenous species are a contributing factor to the endangered status of 70 percent of listed fish species (OTA, 1993). Much of the ANS research since then has focused on predictive modeling for understanding ANS dispersion patterns and impacts (Carlson, 2014; Rodrigues, 2015).

ANS can also cause significant damage to infrastructure. Facilities that purify water, generate electricity, and manufacture goods often depend on water intake structures to perform their services. Several species of ANS bivalves have been shown to attach themselves to such structures and clogging intakes and preventing proper cooling or interfering with other processes dependent on that water. Industries have been estimated to spend millions of dollars per year in monitoring, prevention, maintenance, and repair necessitated by these species. (USACE, 2002; OTA, 1993; Benson et al., 2002; GSMFC, 2003)

The link between human health impacts and ANS invasions through ballast water and biofouling is poorly understood, but studies have established that pathogenic invasive species such as *E. coli, enterococci, Vibrio cholerae, Clostridium perfingens, Salmonella spp. Cryptosporidium spp., Giardia spp*., and a variety of viruses (Knight et al., 1999; Reynolds et al., 1999; Zo et al., 1999) can be transported in ballast water (Ruiz and Reid, 2007). Ballast water can also be a vector for the microorganisms associated with "red tide", a type of harmful algal bloom (HAB). These HABs can occur when certain species of algae release toxins into an aquatic environment, which adversely impacts aquatic life and can also impact human health if fish contaminated with the toxin are consumed (Hallegraeff and Bolch, 1992).

5.1.2 BENEFITS OF ENHANCED BALLAST WATER AND BIOFOULING MANAGEMENT PRACTICES

5.1.2.1 LOSS OF BENEFITS DUE TO DEGULATION OF INCIDENTAL DISCHARGES FROM SMALL VESSELS AND FISHING VESSELS

The incorporation of ballast water discharge and biofouling management standards through ten years of the VGP program, enhanced under the VIDA, provides benefits to human health and the environment by reducing the adverse impacts delineated in Section 5.1.1 above. Some reduction in benefits is anticipated from the VIDA's deregulation of incidental discharges from small vessels and fishing vessels, although for ANS impacts, since small vessels and fishing vessels will continue to be required to manage ballast water, the loss of benefits is primarily associated with these vessels no longer having to maintain the vessel hull as detailed in the sVGP. Hull maintenance activities required in the sVGP and established to reduce the discharge of ANS included regularly cleaning and maintaining the hull, inspecting the hull for attached living organisms at least quarterly and prior to transporting the vessel from one waterbody to another overland, and cleaning as necessary. Benefits from reduction of other pollutants associated with hull maintenance activities are described in section of this EA.

Benefits potentially lost, as originally identified in the sVGP analysis (EPA, 2014) include protection of human health, biodiversity, ecosystem function, improved fishery conditions (minimizing imbalance of native ecosystems), and increased opportunities for water-based recreation.

5.1.2.2 BENEFITS OF THE NEW LAKER EQUIPMENT STANDARD

The U.S. Laker fleet is an essential part of the Great Lakes regional and national economies providing reliable and inexpensive transportation of raw materials including iron ore, coal, limestone, cement, salt, sand, and gravel needed by the region's steel mills, construction and manufacturing establishments, and power generation plants (MARAD, 2013). In enacting the VIDA, Congress identified ballast water discharges from Lakers as a risk and established the Great Lakes and Lake Champlain Invasive Species Program to develop BWMSs for Lakers to prevent the spread of aquatic nuisance species populations. Lakers perform frequent uptake and discharge of large quantities of ballast water concurrent with unloading and loading cargoes at ports. This movement of ballast water potentially contributes to the secondary spread of aquatic non-indigenous species, many are believed to have been originally brought into the Great Lakes by the discharge of ballast water (or hull and associated niche area biofouling) from oceangoing vessels entering the Great Lakes through the St. Lawrence Seaway. Ballast water is a vector for ANS because often aquatic invertebrates, plants, or microorganisms, as well as suspended sediments that may contain organisms are unintentionally taken on board when vessels fill ballast tanks in one water body, and then discharge into a different aquatic environment when the tanks are emptied. Other vectors of ANS into the Great Lakes include recreational boating, bait fishing, aquaculture, aquaria, canals, and rivers (MARAD, 2013). Although there has been a dramatic reduction in the introduction of new ANS entering the Great Lakes associated with ballast water discharges from oceangoing vessels due to "no ballast on board" regulations and regular inspections of the ballast tanks of oceangoing vessels, the number of established ANS in each lake continues to increase as species spread from lake-to-lake.

The 2022 State of the Great Lakes report, prepared jointly by the EPA and Environment and Climate Change Canada, summarizes the evidence of the increase in spread of ANS within and between the Great Lakes over the last decade. To date, 188 aquatic non-native species have been reported as established in the Great Lakes, of which 64 are considered invasive and have known negative environmental and/or socioeconomic impacts and continue to expand their ranges. The overall economic impact of invasive species on the Great Lakes region—spanning direct operating costs, decreased productivity, and reduced demand within sport and commercial fishing, power generation, industrial facilities, tourism and recreation, water treatment, and households—is estimated at well over $100 million annually. The top ten aquatic invasive species in the Great Lakes – zebra mussel, quagga mussel, alewife, sea lamprey, round goby, white perch, Eurasian watermilfoil, viral hemorrhagic septicemia, bacterial kidney disease, and fishhook waterflea – are responsible for approximately 50% of the overall cumulative impact. Currently 33% of non-indigenous species established in the Great Lakes have spread to all 5 lakes and 67% of the aquatic non-indigenous species in the Great Lakes still pose a significant risk for additional spread including species with known negative environmental and/or socioeconomic impacts. In the last decade (2011 – 2020), new non-indigenous species have become established in all five Great Lakes due to secondary invasions from spread from the other Great Lakes (Lake Superior – 8 new species; Lake Michigan - 3 new species; Lake Huron – 8 new species; Lake Erie – 2 new species; Lake Ontario – 6 new species) (2022 State of the Great Lakes report).

In addition, acknowledging the long-term trend of ANS spread in the Great Lakes is critical because inter-basin transport results in a time lag effect in which individual lakes continue to accumulate new species and have high overall establishment rates despite the decline in the rate of introductions from outside the region to the Great Lakes. As of 2020, 118 aquatic non-indigenous species have become established in Lake Superior; 140 species in Lake Michigan; 114 species in Lake Huron; 153 species in Lake Erie; and 130 species in Lake Ontario. Over the historic record, Lake Superior has received 86% of its new invaders from the other 4 lakes, Lake Huron 91%, Lake Michigan 73%, Lake Erie 64%, and Lake Ontario 55% (2022 State of the Great Lakes report).

The 2022 State of the Great Lakes report acknowledges partitioning by vector (e.g., ballast water discharge, deliberate release, new canal, etc.) can only be accomplished for establishments coming from outside the Great Lakes and currently there are not consistent data attributing species movements between lakes to particular vectors. Lakers may pose a relatively high risk of spreading ANS because they are large, bulk carrier vessels that uptake and discharge large quantities of ballast water when unloading and loading cargoes at Great Lakes ports. They also have a high frequency of ballast water discharge events and short voyages (Casas-Monroy et al., 2014; DFO, 2019). An acceptable level of environmental risk associated with the discharge of ANS in ballast water from Laker vessels has not been defined. Risk associated with ANS establishment is a function of many variables including number of propagules and frequency/magnitude of ballast discharge events (i.e., propagule pressure), and the relative differences between source and receiving environments (Aliff et al., 2018). A ballast water monitoring study conducted in 2017 onboard U.S. and Canadian Lakers documented five ANS species not previously reported in Lake Superior in samples collected from ballast water being discharged to commercial ports within western Lake Superior. The documented ANS species included *Hemimysis anomala, Nitrokra hibernica, Heteropsyllus nunni, Schizopera borutzkyi*, and *Thermocyclops crassus* (Cangelosi et al., 2018). However, despite highlighting the challenge described above, no information definitively linked discharges of these species to an establishment in Lake Superior. EPA did not conduct a geospatial analysis to estimate the impacts of ballast water discharge from Lakers on the movement of invasive species within the Great Lakes. However, for future analyses EPA will consider the use of predictive geospatial analysis to help estimate the impacts of VIDA regulatory actions.

The benefit of the final equipment standard for New Lakers to install, operate and maintain a USCG type-approved BWMS is that these systems can substantially reduce the concentration of organisms in ballast water and therefore reduce the risk of spread of ANS both between Great Lakes and within a single Great Lake to minimize its effect. ANS may have been introduced into the Great Lakes by ocean-going vessels, but preventing or slowing their secondary spread to uninvaded habitats within the same waterbody is also an important aspect of ANS management (Vander Zanden and Olden, 2008). The biological efficacy of many of these systems has been demonstrated in freshwater of organisms meet the numeric ballast water discharge standard during type-approval testing. If the USCG type-approved BWMS is operating in water quality conditions more challenging than those present when tested for type-approval, significant reduction of organisms may still occur (GSI, 2011; GSI 2015). It does however remain a question as to whether installation and operation of these BWMSs on the full range of U.S. Laker vessels – though that is not a requirement of this rule – would result in a similar efficacy of BWMSs despite variations in pumping rate and water quality conditions.

Reducing the risk of the spread of ANS by Lakers in the Great Lakes decreases the risk of adverse impacts to commercial and recreational fisheries, threatened and endangered species, recreation and tourism. For more details on the impacts of ANS and the benefits of ballast water management please consult the “Regulatory Impact Analysis of the EPA Proposed Rulemaking for “Vessel Incidental Discharge Standards of Performance” (U.S. EPA, 2020).

The EPA acknowledges for the foreseeable future New Lakers will constitute only a modest proportion of the broader Laker fleet, and thus the equipment standard will only apply to a small number of Lakers. The EPA further acknowledges the equipment standard for New Lakers will only eliminate a small percentage of total organisms, and potential ANS discharged within the Great Lakes. The EPA views the requirement to install BWMSs on New Lakers as an incremental step and one that could “result in reasonable further progress” towards the ultimate goal of eliminating the discharge of untreated ballast water in the Great Lakes. 33 USC 1311(b)(2)(A). Ocean-going vessels on the Great Lakes are already required to treat ballast water discharges. The requirement to install BWMSs on New Lakers will further reduce the amount of untreated ballast water discharged in the Great Lakes, leaving existing Lakers as the only significant source of such discharges.

The EPA sees three primary benefits of the equipment standard for New Lakers. First, the EPA expects the equipment standard for New Lakers will have the effect of capping the number of vessels operating without a BWMS in the Great Lakes and that over time this regulation would make incremental progress towards the elimination of untreated ballast water discharges in the Great Lakes. As such, the EPA expects the equipment standard will lead to a reduction in the number of organisms discharged and thus a reduction in propagule pressure (a key indicator of ANS establishment (NRC, 2011)). The second primary benefit of the equipment standard will be to promote greater experience and familiarity with BWMS among Lakers.. The EPA anticipates the experiences of New Lakers operating with a BWMS, as well as the VIDA’s long-term research program to develop improved BWMS technologies for a broader range of

Lakers, will provide important information to support a future update to the standards of performance that could address the full universe of Lakers. In this way, the EPA views the equipment standard for New Lakers as an incremental step towards a longer-term goal of achieving more significant reductions in the risk of ANS transfer within and between the Great Lakes. Third, the EPA has determined there is additional benefit from the implementation of the equipment standard as it more closely aligns with Canada's regulatory framework for ballast water in the Great Lakes. Beyond pollutant reduction benefits obtained from the equipment standard itself, EPA expects additional benefits can be expected by vessel operators not having to comply with drastically different requirements as they navigate within the entire shared Great Lakes System.

5.2 OTHER POLLUTANTS

The numerous individual harmful constituents found in vessel discharges may be grouped into five broad categories: pathogens, oil and grease, metals, other pollutants with toxic effects, and other non-toxic pollutants. Many of the discharges covered by the VIDA are associated with one of these types of pollution. Table 5-1 identifies pollutant types potentially reduced by the final standards.[23]

Table 5-1. Pollutants Found in Vessel Discharges

Type of Discharge[a]	Pathogens	Oil & Grease	Metals	Toxic and Non-conventional Pollutants with Toxic Effects	Other Non-Conventional And Conventional Pollutants (Except Fecal Coliform)
Fire Protection			X	X	X
Graywater	X	X	X	X	X
Hulls and associated niche areas			X	X	X
Seawater Piping Biofouling Prevention				X	
Adapted from Battelle (2007)					

Impacts from these types of pollutants are described in more detail below.

[23] Ballast water provisions are discussed in section 5.1 regarding impacts from the introduction of ANS.

5.2.1 IMPACTS FROM OTHER POLLUTANTS

5.2.1.1 PATHOGENS

Pathogens are another important constituent of discharges from vessels, particularly in graywater and ballast water. The introduction of pathogens into waterbodies can adversely impact local ecosystems, fisheries, and human health. Though fecal coliform is considered a conventional pollutant, it is discussed here because it shares characteristics with many other pathogens potentially discharged from vessels. The EPA's study of graywater discharges from cruise ships found that constituents of untreated graywater are similar to, and in some cases have a higher concentration than, domestic sewage entering land-based wastewater treatment plants (EPA, 2008a). In fact, levels of pathogen indicator bacteria exceeded *enterococci* standards for marine water bathing 66 percent of the time and fecal coliform standards for harvesting shellfish over 80 percent of the time (EPA, 2008a).

Specific pathogens of concern found in graywater include *Salmonella* spp, *E. coli*, enteroviruses, hepatitis, and pathogenic protists (National Research Council, 1993). Pathogens associated with ballast water discharges, include *E. coli*, *enterococci*, *Vibrio cholerae*, *Clostridium perfingens*, *Salmonella* spp. *Cryptosporidium* spp., *Giardia* spp., and a variety of viruses (Knight et al., 1999; Reynolds et al., 1999; Zo et al., 1999). Pathogens can potentially even be transported in unfilled ballast water tanks (Johengen et al., 2005). Elevated levels of these pathogens from all sources, including ballast water, have increasingly resulted in beach closures in recent years, which in turn have reduced the recreational value of impacted beaches (NRDC, 2005).

5.2.1.2 OIL AND GREASE

Starting with the 2008 VGP, the EPA has regularly increased requirements to minimize and reduce discharges of oil and grease. Vessels discharge a variety of oils, including lubricants and hydraulic oils, during normal operations. Oil and grease can alter the immune systems and liver functions of aquatic organisms.

Studies have consistently found that compounds with hydrocarbon chains (especially aromatic hydrocarbon compounds) are associated with acute toxicity and harmful effects in aquatic biota due to their inability to break down in water. Oils with hydrocarbon chains build up in aquatic organisms' tissues and contaminate the marine environment. Impacts are observed in both developing and adult organisms, and include reduced growth, enlarged livers, fin erosion, reproduction impairment, and modifications to heartbeat and respiration rates (Dupuis and Ucan-Marin, 2015). Laboratory experiments have shown that fish embryos exposed to hydrocarbons exemplify symptoms collectively referred to as blue sac disease (BSD). Symptoms of BSD range from reduced growth and spinal abnormalities, to hemorrhages and mortality (Dupuis and Ucan-Marin, 2015). Oils can also taint organisms that are consumed by humans, resulting in economic impacts to fisheries and potential human health effects.

The application of environmentally acceptable lubricants (EALs) significantly reduces the negative health impacts to aquatic organisms. Unlike traditional lubricants with hydrocarbon compounds, EALs are composed of compounds with oxygen atoms, which make them soluble in water. This means EALs degrade faster and have a smaller residual, do not bioaccumulate appreciably and have a lower toxicity to marine organisms. Since the 2013 VGP, the EPA has mandated the use of EALs in oil-to-sea interface applications, including equipment that extends overboard, for both existing and new vessels (subject to technical feasibility).

5.2.1.3 METALS

Metals are a diverse group of pollutants, many of which are toxic to aquatic life and humans. Vessel discharges can contain a variety of metal constituents. For example, studies of untreated graywater and bilgewater have found significant metal discharges including, but not limited to, copper, nickel, and zinc (EPA, 2008a; Battelle, 2007).

While some metals, including copper, nickel, and zinc, are known to be essential to organism function, many others, including thallium and arsenic, are non-essential or are known to have only adverse impacts. Thallium is known to cause a large variety of gastrointestinal, neurologic and dermatologic symptoms including abdominal pain, vomiting, peripheral neuropathies, seizures, hypohidrosis (inadequate sweating), and death in humans that can persist even after exposure is discontinued and blood thallium levels decrease (EPA, 2009, Kemnic and Coleman, 2023). Arsenic can cause acute gastroenteritis, diarrhea, hypotension, chest pain, seizures and death at doses as low as 0.6mg/kg (Kuivenhoven and Mason, 2023, DHHS, 2007). However, even essential metals can do serious damage to organism function in elevated concentrations. Metals may bioaccumulate in the tissues of aquatic organisms, resulting in adverse impacts like impaired organ function; impaired reproduction and birth defects; and, at extreme concentrations, acute mortality (Tchounwou et. al., 2012). Additionally, through a process known as biomagnification, metals may not be fully removed from blood and tissues by natural processes and may accumulate in predator organisms further up the food chain (Mirzaei VandKhanghah et. al., 2022). This process can result in adverse health impacts for humans, who may consume contaminated fish and mollusks.

Copper, while one of a few essential metals to organism function, can also be toxic at high concentrations. Copper anti-fouling paints are toxic to aquatic organisms, interfering in enzyme functions and inhibiting photosynthesis. Elevated concentrations of copper can adversely impact survivorship, growth, and reproduction of aquatic organisms (EPA, 2023). Many studies have found that copper released from copper-based anti-fouling paints is toxic to non-targeted aquatic organisms (Katranitsasa et al., 2003). Copper became a popular substitute in anti-fouling paints after tributyltin (TBT) was prohibited under the International Convention on the Control of Harmful Anti-Fouling Systems on Ships. TBT can cause deformities in aquatic life and the potential to disrupt reproductive capabilities (Crawford et. al., 2020).

5.2.1.4 TOXIC AND NON-CONVENTIONAL POLLUTANTS WITH TOXIC EFFECTS

The term "toxic and non-conventional pollutants with toxic effects," as it applies to constituents of vessel discharges, encompasses a variety of chemical compounds known to have a broad array of adverse impacts on aquatic species and human health. These compounds can cause a variety of adverse impacts on ecosystems, including fisheries, as well as on human health.

Phthalates are known to interfere with reproductive health and liver and kidney function in both animals and humans (Sekizawa et al., 2003; DiGangi et al., 2002). Chlorine, though toxic to humans at high concentrations, is of much greater concern to aquatic species, which can experience respiratory problems, hemorrhaging, and acute mortality even at relatively low concentrations (EPA, 2008a). Per- and polyfluoroalkyl substances (PFAS), including perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), are persistent, bioaccumulative, and potentially toxic and carcinogenic chemical compounds. The human health impacts of all PFAS are not entirely understood; however, increased risks may include developmental effects to fetuses and infants, cancer, liver effects, immune effects, thyroid effects, and cholesterol changes (EPA, 2024). The EPA reviewed the weight of existing evidence and determined that PFOA is "Likely to be Carcinogenic in Humans" (EPA, 2024), and the Agency is currently implementing a PFAS Strategic Roadmap for addressing per- and polyfluoroalkyl substances (PFAS) and protecting public health (see https://www.epa.gov/pfas for more on recent actions the EPA has taken to address PFAS).

There are also certain biocides used in vessel coatings, such as cybutryne, that can be extremely toxic to aquatic organisms. Studies have shown cybutryne is, in some cases, more toxic than TBT. Also known as Irgarol 1051, cybutryne inhibits the electron transport mechanism in algae, which stunts growth. Since algae form the basis for the marine food web, detrimental impacts to them can have similar detrimental impacts further along in the aquatic ecosystem. Cybutryne is highly persistent, and both acutely and chronically toxic to a range of marine organisms, thus fish and other aquatic organisms can also experience negative impacts from cybutryne exposure (Carbery et al., 2006; Konstantinou and Albanis, 2004; Van Wezel and Van Vlaardingen, 2004). Cybutryne has also been shown to impair settlement and photosynthesis of corals (Downs and Downs, 2007; Knutson et al., 2012; Owens et al., 2002; Shaw et al., 2008).

5.2.1.5 OTHER NON-CONVENTIONAL AND CONVENTIONAL POLLUTANTS (EXCEPT FECAL COLIFORM)

The category "other non-conventional and conventional pollutants" includes all non-conventional pollutants, except fecal coliform (discussed in pathogens) as applied to vessel discharges and includes many other pollutants with disparate impacts. The most important types are those that affect pH, temperature and turbidity, which may result from discharges such as graywater and bilgewater.

Vessel discharges that are more acidic or basic than the receiving waters can have a localized effect on pH (ADEC, 2007). Though no research has been done linking vessel pollution specifically to pH impacts on aquatic ecosystems, for nearly all fish populations, a pH more acidic than 5 or more basic than 10 will cause rapid mortality (EPA, 2007; Wurts and Durborrow, 1992). Even minor changes in ambient pH can cause developmental defects, reduce larval survivorship, and decrease calcification of corals and shellfish (Oyen et al., 1991; Zaniboni-Filho et al., 2009, Marubini and Atkinson, 1999).

Similarly, vessel discharges that are warmer or colder than the ambient temperature of the receiving water can affect temperature locally (Battelle, 2007). Thermal impacts of vessel discharges are generally much smaller than those from better-known sources such as dams, power plant cooling water, and runoff, being a smaller flow. However, even small temperature changes can impact some sensitive organisms' growth, reproduction, and even survival, which implies that temperature changes to ambient waters from some vessel discharges may have adverse impacts on aquatic ecosystems and fisheries (Abbaspour et al., 2005; Cairns, 1972; Govorushko, 2007).

Some vessel discharges, like those from deck washdown, ballast water, graywater, and bilgewater, can have an elevated level of turbidity and total suspended sediment (TSS). There are multiple effects from turbidity and TSS on aquatic life. Excess sediment can smother benthic organisms, altering the surface layer of the benthos. Increased turbidity can reduce biodiversity, primary productivity, and growth (Hall et al. 2015, Bejarano and Appeldoorn 2013, Wenger et al., 2012). Turbidity can also diminish the viability of both commercial and recreational fishing in exposed waterbodies. The impacts of turbidity are likely to be localized though, as sediment loadings from vessel discharges are likely to be much smaller than those from land-based sources.

5.2.2 BENEFITS OF REDUCING POLLUTANT DISCHARGES

A 2007 study of water quality impairments in U.S. ports determined that many of the nation's busiest ports were impaired by a variety of pollutants found in vessel discharges, as summarized in Table 5-2. Updates to these impairments are available on the EPA's 303(d) impairment website (https://www.epa.gov/tmdl/impaired-waters-and-tmdls-program-your-epa-region-state-or-tribal-land). The final rule is expected to reduce discharges of nutrients, metals, oil, grease, toxics, and other pollutants in waters with high levels of vessel traffic, although the EPA is unable to quantify the estimated reductions due to data limitations (see Table 4-43 for more details).

Table 5-2. Impairment Status of the Top 20 Ports by Annual Vessel Calls

Port	Impairments by Pollutants Found in Vessel Discharges
Houston, TX	Bacteria, Nutrients[a]
New York City, NY	Nitrogen, Oxygen Demand[b], Cadmium, Mercury
Port Everglades, FL	Fecal Coliform, Dissolved Oxygen, Nutrients
Miami, FL	None listed
Los Angeles/Long Beach, CA	Polycyclic Aromatic Hydrocarbons (PAHs),[c] Zinc, Copper, Chromium, Lead, Mercury, Cadmium, Nickel
San Juan, PR	Ammonia, Fecal Coliform, Dissolved Oxygen
Savannah, GA	Mercury, Dissolved Oxygen
St. Thomas, Virgin Islands	Dissolved Oxygen, Fecal Coliform, Oil and Grease, pH
Seattle, WA	PAHs, Fecal Coliform, pH
New Orleans, LA	Fecal Coliform
Charleston, SC	None listed
Baltimore, MD	Zinc, Chromium
Elizabeth River, VA	Phosphorus, Fecal Coliform
Oakland, CA	Mercury, Selenium
Bayou Lafourche, LA	Dissolved Oxygen, Nutrients, Total and Fecal Coliform
Galveston, TX	Bacteria
Tacoma, WA	Bis(2-ethylhexyl) phthalate, PAHs
Jacksonville, FL	Coliform, Nutrients, Turbidity
South Louisiana, LA	Fecal Coliform

Source: Battelle (2007)

[a] *Two of the listed pollutants are found in the areas surrounding the shipping route through the Bay of Galveston to Houston, rather than in the Port of Houston itself.*

[b] *Oxygen demand is associated with eutrophication (see the subsection on Nutrient pollution).*

[c] *PAHs are a subset of volatile and semi-volatile organic compounds and are associated with petroleum products.*

As discussed in this chapter, vessel discharges are associated with a variety of detrimental impacts to U.S. waters. The EPA anticipates that more stringent controls that started with the 2008 VGP and will continue with the new VIDA discharge standards have and will generate benefits through reducing risks associated with these pollutant discharges and providing water quality improvements in already-impaired waters. Benefits that are conceptually monetizable include the prevention of fishery closures and of adverse human health impacts, as well as increased opportunities for recreation. Additional benefits may accrue from the prevention of further stress on biodiversity and ecosystems. Table 5-3 presents a general overview of potential benefits resulting from reductions in discharges due to the cumulative effect of both the earlier VGPs and the final rule.

Table 5-3. Overview of Benefits from Reducing Pollutants Found in Vessel Discharges

Type of Benefit	ANS	Nutrients	Pathogens	Oil & Grease	Metals	Other Toxics	Other Non-Toxics
Human Health	X	X	X	X	X	X	
Biodiversity	X	X		X	X	X	X
Ecosystem Function	X	X		X	X	X	X
Improved Fishery Conditions	X	X	X		X	X	X
Increased Recreational Opportunities	X	X	X			X	

5.2.3 BENEFITS FROM DEREGULATION OF SMALL VESSELS AND FISHING VESSELS

Some reduction in benefits is anticipated from the deregulation of incidental discharges from small vessels and fishing vessels. As described in the economic and benefits analysis for the sVGP (EPA, 2014), the impacts of vessel discharges, and therefore the benefits of reducing pollutant loadings from these vessels, may be particularly significant where the waters are already impaired, the number of vessels is large, or flushing of the waterbody is limited. These waters, many of which are in the nation's busiest ports, are impaired for toxic organics, pathogens, noxious aquatic plants, oil and grease, nutrients, and organic enrichment/oxygen depletion. These impairments are caused by many of the same types of pollutants that small vessels and fishing vessels discharge. Table 5-4 identifies nine types of discharges controlled in the now-repealed sVGP and the six categories of pollutants commonly found in those discharges.[24]

Table 5-4. Pollutants in Discharges from Small Vessels

Type of Discharge	Classical Pollutants[a]	Nutrients	Pathogens	Metals	VOCs and SVOCs	Nonyl-phenols
Bilgewater	•	•	•	•	•	•

[24] Ballast water provisions are discussed in section 5.1 regarding impacts from the introduction of ANS.

Stern Tube Packing Gland	•			•	•	•
Deck Washdown	•	•	• [b]	•	•	•
Fish Hold[b]	•	•	•	•		
Fish Hold Cleaning Effluent[b]	•	•	•	•	•	
Graywater	•	•	•	•		•
Propulsion Engine Effluent				•	•	
Generator Engine Effluent				•	•	
Firemain System	•			•	•	
Vessel Hull Maintenance				•		

Source: EPA, 2014.

a "Classical pollutants" include the following 14 pollutants or water quality indicators: temperature, conductivity, salinity, turbidity, dissolved oxygen, total suspended solids, biochemical oxygen demand, chemical oxygen demand, total organic carbon, oil and grease, pH, sulfide, and total residual chlorine.

b Fishing vessels only.

The sVGP economics and benefits analysis (EPA, 2014) highlighted impacts and associated benefits from the sVGP requirements for three specific discharges: bilgewater, graywater, and anti-fouling hull coatings. Much of the information presented had been gathered as part of an earlier EPA study of small vessels and fishing vessels (EPA, 2010b). Deregulation of these vessels may result in the loss of these benefits to the extent that these vessels no longer adhere to the practices that had been required in the sVGP.

5.2.3.1 BILGEWATER

Depending on the ship design and function, bilgewater may contain contaminants such as oil, fuel, graywater, detergents, solvents, chemicals, pitch, and particulates. The volume of bilgewater that accumulates during regular vessel operations depends on the vessel construction, size, precipitation, frequency of deck cleaning, amount of spray reaching the deck, accidental spills, integrity of piping systems, and the potential for condensate formation in below-deck areas.

Many vessels 400 gross tonnage and above are required to use oily-water separators prior to discharging bilgewater; however, generally those requirements did not apply to the vessels covered by the sVGP. The sVGP controlled bilgewater discharges by, for example, requiring the vessel operator to use preventative practices to minimize oil entering the bilgewater and to monitor visually the bilgewater for an oily sheen prior to discharging. If a visible sheen was observed, the operator was required to suspend the discharge until the problem was corrected and cleaned up. Though these requirements were not expected to eliminate all discharges of harmful pollutants via bilgewater, they were expected to reduce the loads in areas with heavy vessel traffic that are in nearshore environments.

5.2.3.2 GRAYWATER

Graywater, particularly if untreated, can contain many different pollutants, including pathogens, oil and grease, organic and inorganic compounds, nutrients, and metals (U.S. EPA, 2010b).

Under the sVGP, all vessel operators were required to minimize production of graywater while stationary in confined waters such as marinas or harbors. The sVGP also required operators to minimize the discharge of graywater in heavy traffic areas, areas used for recreation, marine sanctuaries, and other similar sensitive areas. The sVGP also mandated use of biodegradable, phosphate-free and non-toxic detergents, soaps, or cleaners for any activity where these products may find their way to graywater to reduce harmful constituents in these discharges.

5.2.3.3 VESSEL HULL MAINTENANCE

Biocides used in anti-fouling systems (AFSs), in particular ones that are copper-based, can be toxic to a range of aquatic organisms, not just to fouling organisms. The AFS coating formulations can benefit from periodic hull cleaning to remove fouling growth, maintain a smooth surface, and improve the copper release, but underwater cleaning can be a source of pollution if not done carefully. Several studies reviewed by the EPA (EPA, 2010b) have documented the plume of dissolved copper released during hull cleaning and quantified AFS biocide loadings into marinas and enclosed embayments or basins.

The sVGP included provisions intended to reduce the discharge of copper and other toxic biocides from hulls. For example, the sVGP required vessel operators to consider, to the extent practicable and available, the use of non-copper-based coatings or other less-toxic alternatives or even to abstain from use anti-fouling coatings altogether. The sVGP also established hull cleaning practices intended to prevent excessive release of toxic biocides. For example, operators were required to perform regular and gentle cleaning of the hull so as to not release a plume or cloud of paint and generally were prohibited from cleaning hulls with biocide-release coatings within the first 90 days after application. By reducing the use of copper-based and other toxic AFS and limiting the release of these biocides during cleaning, the sVGP practices were expected to reduce the adverse environmental impacts of AFS on aquatic fauna and biota.

6 COMPARISON OF COSTS AND BENEFITS

At a 2 percent discount rate, the VIDA related rule provisions result in total annualized cost savings of approximately $21.9 million which are largely driven by the exclusions for small vessels and fishing vessels. Unchanged rule provisions for environmentally acceptable lubricants are associated with approximately $5.7 million in annualized costs, and other rule provisions, which include graywater systems, MGPS, and BWMS for New Lakers cost approximately $5 million in annualized costs. The rule results in $11.3 million in annualized cost savings, in aggregate.

While the EPA anticipates the final rule will reduce discharges of pollutants from vessels, it does not expect the final rule to change benefits significantly compared to those deriving from implementation of the 2013 VGP because the discharge standards largely mirror the existing VGP requirements. The Agency identifies few key areas where benefits could potentially be lost due to VIDA's repeal of the sVGP. In particular, the EA examines possible losses in benefits from elimination of sVGP discharge management requirements for bilgewater, graywater, and anti-fouling hull coatings. A summary of cost and benefit categories is included in Table 6-1.

Table 6-1. Cost and Benefits, by provision ($2022)

Rule Provisions	Annualized Cost, 2 percent discount rate	Qualitative Benefits
Rule Provisions Dictated by VIDA	($21,926,000)	• Reduction in spread of ANS • Reduction in spread of pathogens (Salmonella, E. coli, etc.) • Reduced discharge of oil and grease • Reduced discharge of metals • Reduced discharge of toxic pollutants (PFAS, etc.)
Rule Provisions Unchanged from VGP	$5,690,000	
Other Rule Provisions, including Changes from VGP	$4,976,000	
Total:	**($11,260,000)**	**N/A**

Although the EPA did not quantify the expected benefits of the VGP and sVGP at the time the permits were issued due to data limitations, the Agency collected and considered relevant information to enable qualitative consideration of ecological benefits and to assess the importance of the ecological gains (and losses) from revisions to the VGP.

Consistent with the guidance of Office of Management and Budget's (OMB's) Circular A-4 (2023), this analysis applies a discount rate of 2 percent representing the social rate of time preference to adjust the estimated benefits and costs for differences in timing.[25] For the current rule, EPA does not have reason to expect a substantial impact on capital investment in equilibrium. However, we consider the implications of such an outcome. Regulations that displace or induce capital investments may have social costs and/or benefits that exceed the private value of those changes in capital investments due to distortions in capital

25 US Office of Management and Budget, Circular No. A-4, November 9, 2023, pp 75-79.

markets. In general, to account for those distortions, the analytically preferred approach is to convert those changes in capital investments into consumption equivalents using the shadow price of capital, and discounting at the consumption discount rate. However, this requires the availability of a suitable estimate of the shadow price of capital and an estimate of the regulatory incidence that falls on capital investment. For the current rule, EPA does not have such information. To examine the potential impacts of an expected incidence on capital, Circular A-4 (2023) suggests examining the sensitivity of the net benefits estimate to potential capital investment effects, using a range of shadow prices (1.0 and 1.2) in cases where the benefits and costs fully induce or displace capital investment, respectively.[26] However, due to this lack of monetized benefits, it is not possible to conduct a sensitivity analysis around net benefits to examine the role of potential capital impacts.

26 Circular A-4 (2023) suggests a lower value of 1.0 reflecting an economy with perfect capital mobility, and a higher value of 1.2 reflecting a closed economy estimate with no foreign capital flows. See pp 78 – 79.

7 ECONOMIC IMPACTS OF THE FINAL RULE

7.1 INTRODUCTION

CWA § 312(p)(4)(B)(i) requires the EPA to set standards using the "best available technology economically achievable." This chapter describes the analysis demonstrating that the final rule requirements are economically achievable. In the sections below, certain rule provisions are not directly discussed; these are the provisions that have the smallest cost impacts or result in cost savings.

7.1.1 RULE PROVISIONS DICTATED BY VIDA OR UNCHANGED FROM VGP

There are two main rule provisions either dictated by the VIDA or unchanged from the VGP that lead to cost impacts whose economic impacts are discussed in this section: changes to BWMS (dictated by the VIDA) and the use of Environmentally Acceptable Lubricants for equipment extending overboard (unchanged from VGP). The annual incremental costs for changes to BWMS here are $5.5 million. These costs will be incurred by an industry with revenues of at least three orders of magnitude greater than these costs. The annual incremental cost of EALs for this final rule are $5.7 million, which are less than half the costs considered for EALs at the time the 2013 VGP was issued. Thus, the additional costs considered here increase the costs of EALs, but not substantially.

7.1.2 OTHER RULE PROVISIONS, INCLUDING CHANGES FROM VGP

7.1.2.1 COST COMPARISON WITH THE CONSTRUCTION AND OPERATING COST OF A NEW LAKER

To determine the relative economic and financial impact the equipment standard might have on owners/operators of New Lakers, the EPA compared the annualized capital, operation, and maintenance costs of BWMSs for a New Laker to the annualized cost of constructing, operating, and maintaining a New Laker. The former is described on a per vessel basis in Table 4-33 and Table 4-34.

For the latter, the EPA estimated the construction cost for a New Laker which ranges between approximately $137 million (cost of Mark W. Barker in 2022 dollars) to $145 million (cost of the Erie Trader in 2022 dollars). To develop these construction costs, the EPA gathered costing data for building bulk carriers with similar capacities as ships in overseas shipyards. The EPA then multiplied by a factor of 4 to account for the increased cost associated with building Jones Act compliant vessels. This cost factor was used because U.S. Lakers are regulated under Section 27 of the Merchant Marine Act of 1920 (more commonly referred to as "the Jones Act") which requires a vessel trading between U.S. ports to be U.S.-built, primarily U.S.-owned, U.S.-flagged, and with a majority of the crew U.S. citizens. According to the Congressional Research Service (2019), U.S.-built ships cost more than those built in foreign yards. Today, the price of a U.S.-built tanker is estimated to be about four times the global price of a similar vessel, while a U.S.-built container ship may cost five times the global price, according to one maritime consulting firm[27]. A recent purchase by Matson of vessels from a U.S. shipyard was also estimated to be four to five times greater than in foreign ports (Drewry Maritime Research, 2019) (Appendix B).

To estimate the *overall* annual operating and maintenance (O&M) costs for New Lakers, the EPA used estimates (Martin Associates, 2017) of the percentages of various O&M cost categories. The EPA was able to back-calculate the individual costs for each O&M cost category. Based on this methodology and assuming Lakers operate 10 months in a year, the EPA estimates the annual O&M cost are approximately $9.7 million per year ($2022). This methodology is described in Appendix B.

As shown in Table 7-1, the annual cost of procuring and operating a UV + Filtration BWMS as a percentage of the annual cost of building and operating a New Laker is 1.7% assuming a 7% private cost of capital, while the same ratio for a Chemical Addition BWMS is 1.1%. To be conservative, the EPA compared the highest estimate of the annual cost of procurement, operation, and maintenance of each BWMS technology to the annual cost of building and operating a New Laker. Even under these conservative assumptions, for both technologies, the annual BWMS cost is a small fraction of the annual cost of a New Laker, and therefore, the EPA finds both BWMS technologies are economically achievable for New Lakers.

Table 7-1. Annualized Cost of BWMS as a Percent of the Annualized Cost of a New Laker (2022$, Commercial Rate of Capital at 7 Percent)

New Laker	Annualized Capital Cost[1]	$9,926,999
	Annual O&M Cost	$9,656,078
	Total Annualized Costs	**$19,583,077**
UV + Filtration BWMS	Total Annualized Costs[2]	$341,774
Chemical Addition BWMS	Total Annualized Costs[2]	$209,108
Annualized UV + Filtration BWMS Cost as a Percent of New Laker Annualized Costs		1.70%
Annualized Chemical Addition + Filtration BWMS Cost as a Percent of New Laker Annualized Costs		1.10%

[1] The EPA assumed the average useful life of a New Laker is 50 years. The EPA does not have historical data on the useful life of Lakers. However, as seen in Table 3-7, it is reasonable to assume the useful life is at least 50 years on average. The EPA assumed a 7% cost of capital.
[2] To be conservative, the EPA compared the annual cost of building and operating a New Laker and the highest estimate of the annual cost of procurement, operation, and maintenance of each BWMS technology. The EPA assumed a 7% cost of capital.

[27] Journal of Commerce, "Drewry: Repeal the Jones Act," November 18, 2013.

7.1.2.2 COST COMPARISON WITH THE RETROFITTING AND OPERATING COST OF A CONVERTED LAKER

To determine the relative economic and financial impact the equipment standard might have on owners/operators of converted Lakers, the EPA compared the annualized cost associated with purchasing, maintaining, and operating a BWMS for the converted Laker to the annualized cost of converting, maintaining, and operating a Laker. The former is described in Table 4-38.

For the latter, the EPA conducted a literature search to produce an estimate of the cost to convert a Laker. The EPA found an estimate of approximately $10 million in 2013 dollars (Professional Mariner, 2014) to convert the St. Mary's Challenger. For this analysis, the EPA inflated this cost to $12.1 million in 2022 dollars using the GDP deflator. The EPA assumed the costs of operating and maintaining converted Lakers would be the same as New Lakers ($9.7 million).

As shown in Table 7-2, the average annualized cost of procuring, installing, and operating the BWMS as a percentage of the average annualized cost of converting and operating a Laker is 4.3% assuming a private cost of capital of 7%. The EPA compared the estimate of the annualized cost of procuring, operating, and maintaining the BWMS to the annualized cost of converting and operating a Laker. The annualized BWMS cost is a small fraction of the annualized cost of converting and operating a Laker. Even though the percentage is higher than that for a New Laker, given that the total annualized cost of converting a Laker is much lower than the total annualized cost of a New Laker, the EPA finds that the equipment standard is economically achievable for converted vessels.

Table 7-2. Annualized Cost of the BWMS as a Percent of the Annual Cost of a Converted Laker (2022$, Commercial Rate of Capital at 7 Percent)

Converted Laker	Annualized Capital Cost[1]	$874,048
	Annual O&M Cost	$9,656,078
	Total Annualized Costs	**$10,530,126**
BWMS	Total Annualized Costs	$454,050
Annualized BWMS Cost as a Percent of Converted Laker Annualized Costs		4.30%

[1] *The EPA assumed that the average useful life of a converted Laker is 50 years.*

7.1.2.3 GRAYWATER SYSTEMS

The EPA analyzed the cost of graywater systems for two types of vessels: new build vessels of 400 Gross Tonnage and above that are certificated to carry 15 or more persons and provide overnight accommodations, and new build ferries authorized by the USCG to carry 250 or more passengers. The annual incremental cost per vessel for these two categories are $17,200 and $23,700, respectively. These costs are unlikely to result in a barrier to building new vessels in these two categories.

7.2 ECONOMIC ACHIEVABILITY OF THE FINAL RULE

Several factors contribute to the EPA's analysis of the economic achievability of the final rule. First, the EPA notes for the standards that were dictated by the VIDA, should the agency have conducted a test that showed those standards to be anything other than economically achievable, the EPA did not have the authority to modify those standards. Second, for the many standards that are being codified unchanged from the VGP, the EPA can rely on its 2013 finding of economic achievability, over a decade of implementation, and receiving no public comments disputing the economic achievability of these provisions. For the other rule provisions, including changes from the VGP, the EPA is relying on the analysis in the previous section.

Considering all the information presented above, the EPA has determined that the final rule is economically achievable.

8 STATUTORY AND ADMINISTRATIVE REQUIREMENTS

8.1 INTRODUCTION

As part of the rulemaking process, the EPA is required to address the burden that the final rule may place on certain types of governments, businesses, and populations. This chapter presents analyses performed by the EPA in accordance with the following federal mandates and statutory requirements:

1. Executive Order 12866: Regulatory Planning and Review, Executive Order 13563: Improving Regulation and Regulatory Review and Executive Order 14094: Modernizing Regulatory Review.

2. The Regulatory Flexibility Act (RFA) of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA) of 1996.

Others statutory requirements and executive orders are discussed in the preamble to the final rule.

8.2 EXECUTIVE ORDERS 12866, 13563 AND 14094

Executive Order 12866 (58 FR 51735, October 4, 1993), as amplified by Executive Order 13563 (76 FR 3821, January 21, 2011), and as amended by Executive Order 14094 (88 FR 21879, April 11, 2023) gives OMB the authority to review regulatory actions that are categorized as "significant" under section 3(f) of Executive Order 12866. The Order defines "significant regulatory action" as one that is likely to result in a rule that may:

1. Have an annual effect on the economy of $200 million or more (adjusted every 3 years by the Administrator of OIRA for changes in gross domestic product); or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or state, local, or tribal governments or communities;

2. Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;

3. Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or

4. Raise legal or policy issues for which centralized review would meaningfully further the President's priorities or the principles set forth in this Executive order, as specifically authorized in a timely manner by the Administrator of OIRA in each case.

This action is a significant regulatory action that was submitted to the OMB for review. Any changes made in response to OMB recommendations have been documented in the docket. The analysis in Chapter 6 compares the annualized estimated incremental costs and the annualized incremental benefits of the final rule.

8.3 REGULATORY FLEXIBILITY ACT

The Regulatory Flexibility Act (RFA) under 5 U.S.C. 601-612 generally requires agencies to prepare a regulatory flexibility analysis for any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act (APA) or any other statute unless an agency certifies that the rule will not have a significant economic impact on a substantial number of small entities (SISNOSE).

8.3.1 DISCHARGE STANDARDS

The EPA undertook a two-step process to examine whether its VIDA rulemaking qualifies for a no-SISNOSE certification. First, the Agency generated a current estimate of affected small businesses by combining U.S. Census data on businesses in North American Industry Classification System (NAICS) codes covered by the VIDA together with small business thresholds as set out by the Small Business Administration (SBA, 2019). As Section 3.3.1.3.1 and Table 8-1 show, this analysis determined that at least 9 out of 13 of the primary industrial sectors covered by the standards are comprised primarily of small businesses, with both the Coastal and Great Lakes Passenger Transportation sector (NAICS Code 483113) and Inland Waterways Passenger Transportation sector (NAICS Code 483212) being composed entirely of small businesses. The Agency then proceeded to examine the potential impacts on small businesses from the VIDA discharge standards.

Table 8-1. Small Businesses by Industry Sector, 2023

Industry Sector [a]	NAICS Code	Small Business Threshold [b]	Firms Operated Entire Year	Number of Small Businesses	Percent Small Businesses
Water Transportation					
Deep Sea, Coastal, and Great Lakes Water Transp	4831				
Deep Sea Freight Transp	*483111*	1,050 employees	190	179	93.95%
Deep Sea Passenger Transp	*483112*	1,500 employees	60	57	95.00%
Coastal and Great Lakes Freight Transp	*483113*	800 employees	353	339	95.89%
Coastal and Great Lakes Passenger Transp	*483114*	550 employees	141	140	99.29%
Inland Water Transp	4832				
Inland Waterways Freight Transp	*483211*	1,050 employees	271	259	95.39%
Inland Waterways Passenger Transp	*483212*	550 employees	255	253	99.22%
Scenic and Sightseeing Transp, Water	4872	$14 million	1,768	1,735	98.13%
Support Activities for Water Transp	4883				
Port and Harbor Operations	*488310*	$47 million	261	206	78.93%
Marine Cargo Handling	*488320*	$47 million	275	219	79.64%
Navigational Services to Shipping and Salvage	*488330*	$47 million	860	816	94.88%
Other Support Activities for Water Transp	*488390*	$47 million	708	669	94.49%
Support Activities for Mining					

Support Activities for Mining	2131				
Drilling Oil and Gas Wells [c]	*213111*	1,000 employees	1,750	1,727	98.69%
Fishing					
Fishing [d]	1141				
Finfish Fishing	*114111*	$25 million	1,194	1,176	98.49%
Shellfish Fishing	*114112*	$14 million	1,226	1,226	100%
Other Marine Fishing	*114119*	$11.5 million	108	108	100%
Total Firms			9,420	9,108	96.68%

[a] Source: U.S. Census Bureau, 2017 (from tables: "The Number of Firms and Establishments, Employment, Annual Payroll, and Receipts by Industry and Enterprise Receipts Size: 2017" and "The Number of Firms and Establishments, Employment, Annual Payroll, and Receipts by State, Industry, and Enterprise Employment Size: 2017").

[b] Based on SBA thresholds defining small businesses as of March 17, 2023 (SBA, 2023).

[c] The U.S Census does not provide employment data specifically for firms with <1,000 employees for this NAICS code. As a proxy for estimating the number of firms small enough to classify as small businesses, the Agency computed the sum of (1) the number of firms with <500 employees and (2) the midpoint of the number of firms w/ >500 employees.

[d] Revenue reported as receipts for this NAICS code.

8.3.1.1 IMPACTS TO SMALL BUSINESSES DUE TO CHANGES TO THE REQUIREMENTS FOR GRAYWATER DISCHARGES IN 40 CFR 139.21(E)(1) AND 139.21(E)(4)

The change to the graywater standard compared to requirements in the VGP applies to discharges from any new build vessel of 400 gross tonnage and above (40 CFR 139.21(e)(1)) and any new build ferry with capacity for 250 passengers and above (40 CFR 139.21(e)(4)). As previously described in section 4, the EPA estimates that incremental annual costs to comply with the new standard for graywater could be as high as $17,200 per vessel for a new build of 400 gross tonnage and above or $23,700 for a new ferry. It is unlikely that the incremental cost to comply with the graywater standard will feature prominently in a small business' decision to build a new vessel due to the overall high cost of purchasing and operating a new vessel. By comparison, a sampling of listings with one of the international marine brokerage firms revealed a variety of used vessels for sale (EPA, 2020a). Used passenger vessels with passenger capacities of 245-330 had a list price ranging from $1.2 million to $3.5 million and a range of 88-478 gross tonnage. Used cargo vessels rated for 400 GT and above had a list price ranging from $1.6 million to $12 million and a range of 897-12,078 gross tonnage. Over time, degradation of capital could result in a decline in the stock of used vessels; however, determining the market effects that could arise from potential changes to the availability of used vessels is beyond the scope of the analysis. While these new standards apply only to new vessels constructed after the effective date of the USCG regulations promulgated pursuant to CWA section 312(p)(5)(A)(i), even retrofitting a used vessel to comply with the graywater standard would be a small part of the cost compared to the cost to purchase that vessel.

8.3.1.2 IMPACTS TO SMALL BUSINESSES DUE TO CHANGES TO THE REQUIREMENTS FOR MGPS IN 40 CFR 139.28(C)

As discussed in Chapter 4, the EPA estimates that compliance with the MGPS requirement will cost vessel owners approximately $2,700 annually (see Table 4-28) per vessel for a total of 107 vessels. To assess the impacts to small business owners from this requirement, the EPA's screening analysis assumed that the entirety of the 107 seagoing vessels that will need to comply with the new MGPS requirement for seawater piping systems are owned by businesses operating in NAICS code 4831 "Deep Sea, Coastal, and Great Lakes Water Transportation," since vessels operated by businesses in this industry sector are most likely to fall within the scope of the MGPS requirements.

Using Census data on businesses in the smallest size category for operations in the four relevant subsectors of NAICS code 4831, the Agency then calculated, as shown in the two right-hand columns of Table 8-2, the respective compliance cost thresholds that represent one and three percent of annual revenue. Comparing these cost thresholds to the MGPS compliance cost of $2,700 annually allowed the Agency to conclude that even businesses in the subsector with the smallest annual revenue, "Deep Sea Passenger Transportation," will not experience costs more than that subsector's one percent cost/revenue threshold of $6,000 annually.

Table 8-2. Cost Impact Thresholds for Small Businesses in Smallest Size Categories at 1% and 3% of Annual Revenue, 2022$

Industry Sector	NAICS Code	Avg Revenue of Firms in Smallest Size Category (2022$)[a]	Number of Small Firms[b]	Number of Small Firms in Smallest Size Category[c]	Percent of Total Small Firms	Cost Threshold @ 1% of Revenue (2022$)	Cost Threshold @ 3% of Revenue (2022$)
Water Transportation							
Deep Sea, Coastal, and Great Lakes Water Transp	4831						
Deep Sea Freight Transp	*483111*	$1,381,000	179	105	58.82%	$14,000	$41,000
Deep Sea Passenger Transp	*483112*	$556,000	57	42	73.68%	$6,000	$17,000
Coastal and Great Lakes Freight Transp	*483113*	$1,923,000	339	170	50.22%	$19,000	$58,000
Coastal and Great Lakes Passenger Transp	*483114*	$1,210,000	140	87	62.14%	$12,000	$36,000
Total firms			714	404	56.58%		

[a] Source: U.S. Census Bureau, 2012 (from table: "Transportation and Warehousing: Subject Series - Estab and Firm Size: Summary Statistics by Employment Size of Firms for the U.S.: 2012")
[b] From Table 8-1. Small Businesses by Industry Sector, 2023.
[c] See Footnote a.

The Agency's approach of assuming that affected vessels are predominantly found in the Deep Sea, Coastal, and Great Lakes Water Transportation sector (NAICS code 4831) potentially underestimates small business impacts to other maritime sectors; on the other hand, it presents a conservative estimate of the potential maximum impacts to the sector mostly likely to be operating vessels subject to the new MGPS standard. Although the impacts by sector may be biased by this assumption, the overall impact to small entities is captured in its entirety.

8.3.2 LAKERS

The EPA determined that at least 9 of the 13 owner/operator companies qualify as small under the current SBA requirements. Those 8 entities own slightly over half (32 of 63) of all currently operating Lakers. The final equipment standard, however, only applies to new or converted vessels and the EPA has no information under whose ownership any New Lakers might be constructed or converted. However, as shown in Table 7-1 and Table 7-2 the annualized cost of BWMS is only 1.10 to 4.30 percent of annualized cost of a new or converted Laker. The final equipment standard is relatively small and thus this rule would likely not substantially affect a company's revenue or influence the decision to buy a converted or new Laker.

Based on the above findings, the EPA has determined that this action will not have a significant economic impact on small entities. Although the proposed equipment standard may impose equipment requirements on any small entity that operates a vessel subject to the standards, the EPA does not believe that the projected cost burden would not exceed the cost thresholds used for small entity impact screening analyses (costs greater than 1 percent and 3 percent of annual revenue).

8.3.3 THE EPA'S DETERMINATION UNDER RFA

Given the compliance costs for Lakers and vessels account for a small fraction of owning and operating cost, the EPA finds that the final rule does not have a significant impact on a substantial number of small entities.

8.4 E.O. 13990, PROTECTING PUBLIC HEALTH AND THE ENVIRONMENT AND RESTORING SCIENCE TO TACKLE THE CLIMATE CRISIS

8.4.1 BACKGROUND

Since 2008, the EPA has used estimates of the social cost of various greenhouse gases (i.e., social cost of carbon (SC-CO_2), social cost of methane (SC-CH_4), and social cost of nitrous oxide (SC-N_2O)), collectively referred to as the "social cost of greenhouse gases" (SC-GHG), in analyses of actions that affect GHG emissions. The values used by the EPA from 2009 to 2016, and since 2021 have been consistent with those developed and recommended by the Interagency Working Group (IWG) on the SC-GHG. The values used from 2017 to 2020 were consistent with those required by E.O. 13783, which disbanded the IWG. During 2015–2017, the National Academies conducted a comprehensive review of the SC-CO_2 and issued a final report in 2017 recommending specific criteria for future updates to the SC-CO_2 estimates, a modeling framework to satisfy the specified criteria, and both near-term updates and longer-term research needs pertaining to various components of the estimation process (National Academies, 2017). The IWG was reconstituted in 2021 and E.O. 13990 directed it to develop a comprehensive update of its SC-GHG estimates, recommendations regarding areas of decision-making to which SC-GHG should be applied, and a standardized review and updating process to ensure the recommended estimates continue to be based on the best available economics and science going forward.

The EPA is a member of the IWG and is participating in the IWG's work under E.O. 13990. While the process continues, as noted in previous EPA rulemakings, the EPA is continuously reviewing developments in the scientific literature on the SC-GHG. This includes more robust methodologies for estimating damages from emissions, and looking for opportunities to further improve SC-GHG estimation going forward.[28] In the December 2022 RIA for the Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review, the agency included a sensitivity analysis of the climate benefits of the Supplemental Proposal using a new set of SC-GHG estimates that incorporates recent research addressing recommendations of the National Academies (2017). In addition, the RIA used the interim SC-GHG estimates presented in the Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990 (IWG, 2021) recommended by the IWG for use until updated estimates that address the National Academies' recommendations are available.

The EPA solicited public comment on the sensitivity analysis and the accompanying draft technical report, *EPA Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances*, which explains the methodology underlying the new set of estimates, in the December 2022 Supplemental Proposal.[29] The response to comments document can be found in the docket for the Standards of Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review.

To ensure the methodological updates adopted in the technical report are consistent with economic theory and reflect the latest science, the EPA also initiated an external peer review panel to conduct a high-quality review of the technical report, completed in May 2023. The peer reviewers commended the agency on its development of the draft update, calling it a much-needed improvement in estimating the SC-GHG and a significant step towards addressing the National Academies' recommendations with defensible modeling choices based on current science. The peer reviewers provided numerous recommendations for refining the presentation and for future modeling improvements, especially with respect to climate change impacts and associated damages that are not currently included in the analysis. Additional discussion of omitted impacts and other updates have been incorporated in the technical report to address peer reviewer recommendations. Complete information about the external peer review, including the peer reviewer selection process, the final report with individual recommendations from peer reviewers, and the EPA's response to each recommendation is available on the EPA's website.[30]

A detailed explanation of each input and the modeling process is provided in the technical report, Supplementary Material for the RIA: EPA Report on the Social Cost of Greenhouse Gases: Estimates Incorporating Recent Scientific Advances (U.S. EPA, 2023a), included in the docket for the Standards of

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[28] EPA strives to base its analyses on the best available science and economics, consistent with its responsibilities, for example, under the Information Quality Act.

[29] See https://www.epa.gov/environmental-economics/scghg for a copy of the final report and other related materials.

[30] https://www.epa.gov/environmental-economics/scghg-tsd-peer-review

Performance for New, Reconstructed, and Modified Sources and Emissions Guidelines for Existing Sources: Oil and Natural Gas Sector Climate Review, and included in the docket for this action.

8.4.2 SOCIAL COST OF GREENHOUSE GAS EMMISIONS ESTIMATION

The vessels affected by this Final Rule must conduct ballast water exchange (BWE) at least 50 nautical miles away from shore. The EPA has determined to comply with this requirement, some of the affected vessels will have to travel additional distance for BWE. The cost analysis of this Final Rule quantifies and monetizes the incremental fuel costs for the additional travel distance (see Table 4-12). This section quantifies the emissions created from the additional fuel consumed and estimates the associated social cost of carbon.

As part of the cost analysis, the EPA estimated the total number of coastal voyages for affected vessels, the total travel distance in nautical miles for all voyages, and the fuel usage rate in metric tons per nautical mile (see Section 4.3.1 for a detailed discussion of these estimates). Based on an estimated consumption rate of approximately 0.1 ton per nautical mile (Bialystocki and Konovessis, 2016), the analysis determined that the additional 58,700 nautical miles traveled resulted in a little over 5,700 tons of additional fuel consumption per year. At a rate of 6.35 barrels per ton[31], and 42 gallons per barrel, this results in a little over 1.5 million additional gallons of fuel consumed per year.:

The EPA calculated the total emissions of CO_2, CH_4, and N_2O from the additional 1.5 million gallons of fuel consumed using estimates for emission factors for residual fuel oil from greenhouse gas inventories.[32] The factors used were 11.27 kg CO_2 per gallon of residual fuel oil used (see Table 2 in the emissions factor document) and 0.55g ofCH_4 and N_2O per gallon of residual fuel oil used (Table 5 in the emissions factor document).[33] After converting to metric tons, the EPA found that the additional travel resulted in the emission of 17,000 tons of CO_2, and less than 1 ton of both CH_4, and N_2O per year. Given the small amount of both CH_4 and N_2O, emissions the EPA assumed than the associated social costs will be *de minimis* and did not monetize them.

The EPA estimated the social cost of SC-CO_2 using the unit costs summarized in the May 2023 Technical Report Peer Review.[34] The supplementary material estimates an annual cost of $120 to $340 per metric ton of CO_2 for 2020 in current dollars, and projects it to 2080.[35] The unit SC-CO2 increases over time (i.e., the societal harm from one metric ton emitted in year 10 is higher than the harm caused by one metric ton emitted in year 1) because future emissions produce larger incremental damages as physical

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[31] See https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2021-approximate-conversion-factors.pdf.

[32] See https://www.epa.gov/sites/default/files/2021-04/documents/emission-factors_apr2021.pdf.

[33] These emissions factors are for Residual Fuel Oil Number 6. EPA assumed Residual Fuel Oil Number 6 would be used as it is a common fuel for vessel bunkering.

[34] See https://www.epa.gov/system/files/documents/2023-12/epa_scghg_2023_report_final.pdf.

[35] The unit costs are projected at three different near-term discount rates: 2.5 percent ($120 per gallon per year), 2 percent ($190), and 1.5 percent ($120). The EPA retained all three discount rates in this analysis.

and economic systems become more stressed in response to greater climatic change, and because GDP is growing over time and many damage categories are modeled as proportional to GDP.

The EPA updated the unit costs to 2022 dollars and estimated the disbenefit in each year over a period of 25 years by multiplying the unit costs for the corresponding year to the estimated annual CO_2 emissions, using 2024 values for year 1 (see Table 8-3). The EPA also annualized costs over the 25-year period using a near term Ransey discount rate and presents them in Table 8-4.

Table 8-3. Estimates of the Social Cost of CO2, Years 1-25 (millions of 2022$ per metric ton CO2)

Year	Near-Term Ramsey Discount Rate		
	2.50%	2.00%	1.50%
1	$2.3	$3.8	$6.6
2	$2.3	$3.8	$6.6
3	$2.3	$3.8	$6.6
4	$2.3	$3.8	$6.6
5	$2.3	$3.8	$6.6
6	$2.3	$3.8	$6.6
7	$2.3	$3.8	$6.5
8	$2.3	$3.8	$6.5
9	$2.3	$3.7	$6.5
10	$2.2	$3.7	$6.5
11	$2.2	$3.7	$6.5
12	$2.2	$3.7	$6.5
13	$2.2	$3.7	$6.4
14	$2.2	$3.7	$6.4
15	$2.2	$3.6	$6.4
16	$2.1	$3.6	$6.4
17	$2.1	$3.6	$6.3
18	$2.1	$3.6	$6.3
19	$2.1	$3.6	$6.3
20	$2.1	$3.5	$6.2
21	$2.1	$3.5	$6.2
22	$2.1	$3.5	$6.2
23	$2.0	$3.5	$6.2
24	$2.0	$3.5	$6.2
25	$2.0	$3.4	$6.2

Note: This table displays the values rounded to one significant figure. The annual unrounded values used in the calculations in this EA are available in Appendix A.5 of U.S. EPA (2023b) and at: www.epa.gov/environmental-economics/scghg. All amounts are in millions (2022 dollars).

Table 8-4. Annualized Monetized Social Cost Greenhouse Gas Emissions Associated with the Final Rule (millions of $2022)

Ramsey Near Term Discount Rate	Annualized Value
2.5 percent	$3.0
2 percent	$4.7
1.5 percent	$7.7

Note: This table displays the values rounded to one significant figure. The annual unrounded values used in the calculations in this EA are available in Appendix A.5 of U.S. EPA (2023b) and at: www.epa.gov/environmental-economics/scghg. All amounts are in millions (2022 dollars).

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APPENDIX A SUMMARY OF RULE COST: 3 AND 7 PERCENT DISCOUNT RATE

In this appendix, the EPA provides the annualized compliance costs of the final rule at both 3 percent and 7 percent discount rates.

Table A-0-1. Total Annualized Costs of the Final Rule, by Provision, (2022$) at a 3% Discount Rate

Rule Provisions	Annualized Cost
Rule Provisions Dictated by VIDA	
Changes to BWMS	$5,479,000
Overseas and coastal vessels	*$3,268,000*
St. Lawrence Seaway	*$165,000*
Pacific Region	*$1,640,000*
Pacific Region, low salinity BW	*$406,000*
Exclusions for Small Vessels and Fishing Vessels	($27,410,000)
State Petitions	$7,000
Subtotal	**($21,924,000)**
Rule Provisions Unchanged from VGP	
Environmentally Acceptable Lubricants	$5,690,000
Subtotal	**$5,690,000**
Other Rule Provisions, including Changes from VGP	
Graywater Systems	$2,588,000
New Build Vessels 400 GT or more Carrying 15 or more passengers and overnight accommodations	*$2,460,000*
New Build Ferries Carrying 250 or more passengers	*$128,000*
MGPS to prevent macrofouling	$304,000
BWMSs for New Lakers	$2,287,000
New Builds	*$1,361,000*
Conversions	*$926,000*
Subtotal	**$5,179,000**
Total Annualized Cost:	**($11,043,000)**

Table A-0-2. Total Annualized Costs of the Final Rule, by Provision, (2022$) at a 7% Discount Rate

Rule Provisions		Annualized Cost
Rule Provisions Dictated by VIDA		
Changes to BWMS		$5,479,000
Overseas and coastal vessels		*$3,268,000*
St. Lawrence Seaway		*$165,000*
Pacific Region		*$1,640,000*
Pacific Region, low salinity BW		*$406,000*
Exclusions for Small Vessels and Fishing Vessels		($27,410,000)
State Petitions		$5,000
	Subtotal	**($21,924,000)**
Rule Provisions Unchanged from VGP		
Environmentally Acceptable Lubricants		$5,690,000
	Subtotal	**$5,690,000**
Other Rule Provisions, including Changes from VGP		
Graywater Systems		$3,439,000
New Build Vessels 400 GT or more Carrying 15 or more passengers and overnight accommodations		*$3,270,000*
New Build Ferries Carrying 250 or more passengers		*$169,000*
MGPS to prevent macrofouling		$339,000
BWMSs for New Lakers		$2,321,000
New Builds		*$1,317,000*
Conversions		*$1,004,000*
		$6,099,000
Total Annualized Cost:		**($10,135,000)**

APPENDIX B CAPITAL AND OPERATION AND MAINTENANCE COST OF A NEWLY CONSTRUCTED LAKER

The EPA estimated capital and operation and maintenance (O&M) costs for constructing a New Laker, assuming these vessels would be similar to recently built Lakers including the Mark W. Barker (constructed in 2022 with a cargo capacity of 26,000 tons)[36] and the Erie Trader (constructed in 2012 with a cargo capacity of 37,600 tons)[37]. Actual costs for these vessels are not publicly available to the best of the EPA's knowledge.

CAPITAL COSTS

The EPA compiled data from a number of sources on the capital cost to build new bulk carriers at overseas shipyards for vessels ranging in capacity from 25,000 to 180,000 tons.[38] The EPA adjusted these costs to 2022 dollars. The EPA then multiplied these costs by a factor of four to account for the increased cost associated with building U.S.-flagged vessels pursuant to Section 27 of the Merchant Marine Act of 1920 (more commonly referred to as "the Jones Act") (Table B-1). The Jones Act requires that a vessel trading between U.S. ports must be U.S.-built, primarily U.S.-owned, U.S.-flagged, and with a majority of the crew U.S. citizens. According to the Congressional Research Service (2019), U.S.-built ships cost more than those built in foreign yards. Today, the price of a U.S.-built tanker is estimated to be about four times the global price of a similar vessel, while a U.S.-built container ship may cost five times the global price, according to one maritime consulting firm. A recent purchase by Matson of vessels from a U.S. shipyard was also estimated to be four to five times greater than in foreign ports (Drewry Maritime Research, 2019). The EPA used these adjusted cost data to develop a cost curve to estimate the capital cost based on the vessel capacity (tons) (Figure B-1). Based on this cost curve, the EPA estimates the construction cost for a new vessel similar to the Mark W. Barker is approximately $137M and $145M for a new vessel similar to the Erie Trader (Table B-2).

Table B-0-1. Capital Cost Estimate for Bulk Carriers

Bulk Carrier	Capacity (tons)	Cost	Cost	Predicted Jones Act Capital Cost
		($ millions)[6]	($ millions 2022)[4]	($ millions 2022)
Algoma Intrepid[3, 7]	25,019	$37	$37.79	$151
Algoma Equinox[2,8]	39,400	$38	$41.00	$164
Dry Bulk[5]	52,500	$32	$37.33	$149
Handymax[1]	56,000	$31	$35.15	$141
Panamax[1]	76,000	$36	$40.92	$164

[36] http://www.interlake-steamship.com/our-fleet/mark-w-barker/

[37] Know Your Ships, 2017. Field Guide to boats on the Great Lakes and St. Lawrence Seaway.

[38] The EPA also consulted an additional study, Schinas 2021 in which the author's developed a regression equation, presented in Figure 11 of that report, that estimates similar capital costs (~$25-50M) for similarly sized bulk carriers (~50,000-200,000 tons).

Cape Size[1]	180,000	$56	$64.55	$258

[1] Ventura, Manuel, 2009 Costs Estimate Presentation. Ship Design 1, Msc in Marine Engineering and Navel Architecture.
[2] New stage in revitalization of Canada's great lakes/seaway fleet. 2014 Motorship Marine Technology. https://www.motorship.com/news101/ships-and-shipyards/423652.article?adredir=1 Note: Cost for 6 Algoma vessels is C$300m.
[3] Canada received its biggest self-unloading bunker. 2020. https://www.fleetmon.com/maritime-news/2020/31301/canada-receives-its-biggest-self-unloading-bunker/ . Note: Algoma Intrepid costs C$36.5m.
[4] Producer Price Index by Industry: Ship Building and Repairing. St. Louis Fed. https://fred.stlouisfed.org/series/PCU3366113366118.
[5] Lindstad et al, 2012. The importance of economies of scale for reductions in greenhouse gas emissions from shipping. Energy Policy.
[6] Conversion from Canadian dollars to US dollars for Algoma Equinox is 0.75 from https://www.currency-converter.org.uk/currency-rates/historical/table/CAD-USD.html
[7] Marine Traffic. Capacity of the Algoma Intrepid. https://www.marinetraffic.com/en/ais/details/ships/shipid:6335647/mmsi:316043882/imo:9773387/vessel:ALGOMA_INTREPID
[8] Know Your Ships, 2017. Field Guide to boats on the Great Lakes and St. Lawrence Seaway. Capacity of the Algoma Equinox.

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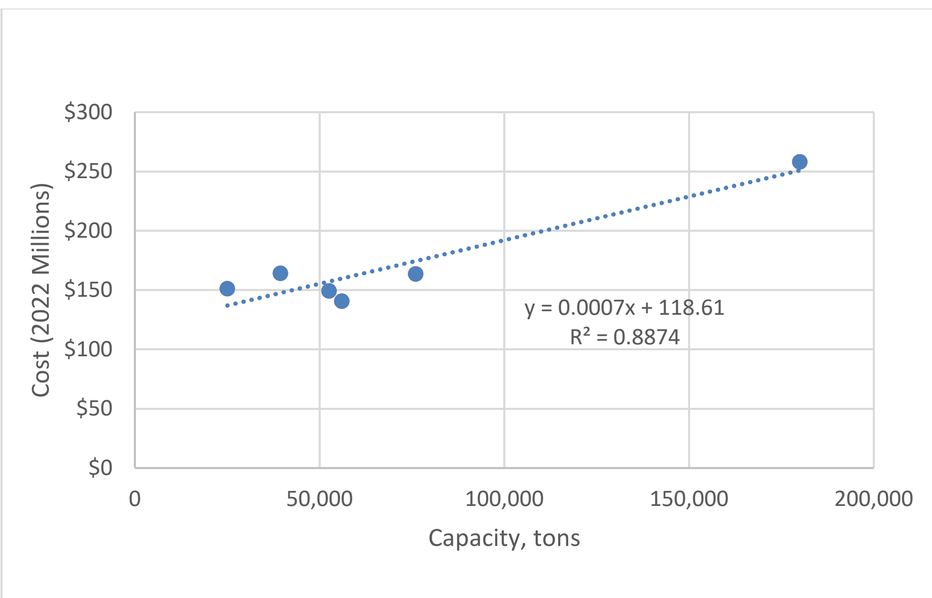

Figure B0-1. Estimated capital cost ($2022 millions) of bulker vessels based on vessel capacity in tons.

Table B-0-2. Estimated Capital Cost for Newly Built Lakers

	Capacity (tons)	Capital Cost (2022 millions)
Mark W. Barker	26,000[1]	$137
Erie Trader	37,600[2]	$145

[1] *Interlake Steamship Company, http://www.interlake-steamship.com/our-fleet/mark-w-barker/* [2] *Know Your Ships, 2017. Field Guide to boats on the Great Lakes and St. Lawrence Seaway.*

ANNUAL OPERATION AND MAINTENANCE (O&M) COSTS

To estimate annual operation and maintenance (O&M) costs for a newly constructed Laker, the EPA estimated daily O&M costs for both a sailing day and port day and then combined those daily costs based on operation of that vessel for a full sailing season. The EPA estimated the categories of costs based on the *Analysis of Great Lakes Pilotage Costs on Great Lakes Shipping and the Potential Impact of Increases in U.S. Pilotage Charges* (Martin, 2017). As described in Martin, 2017, the source of the values for the daily fuel consumption is U.S. Army Corps of Engineers' Voyage Operating Costs and actual proprietary voyage records. Martin (2017) modeled only two foreign flag vessel classes, Class 2 (12,000-17,000 DWT) and Class 4 (30,000 to 35,000 DWT). However, the EPA has determined these vessel classes adequately account for the Mark W. Barker (26,000 DWT) and the Erie Trader (37,600 DWT).

The EPA considers the annual O&M costs estimated using the published model values provided by Martin Associates (2017) to be accurate in an order of magnitude for the purpose of this O&M cost estimate for New Lakers. A more detailed, Laker vessel-specific, annual O&M cost estimate would require vessel specific information to account for variables of fuel use including vessel engine type and efficiency, vessel age, voyage pattern, and Laker company-specific operating and maintenance practices. The EPA considers its approach using the published values to be a conservative cost estimate because if Laker vessel O&M costs are greater than what is estimated, then the ratio of BWMS cost to Laker vessel cost would decrease, thus making the equipment standard even more economically achievable.

SAILING DAY O&M COST

For the cost of a sailing day, the EPA first estimated the daily fuel cost for a Laker ($11,049) as the fuel consumption while sailing (17.4 tons/day) times the cost of marine very low sulfur fuel oil ($635/ton).[39] As described in Martin, 2017, this fuel rate is representative of Class 2 and Class 4 vessels. The EPA used that daily fuel cost as part of the calculation of the baseline daily sailing O&M cost ($100,354) for a vessel operating on the Great Lakes based on the assumption that the daily fuel cost ($11,049) is 11.01 percent of the total daily sailing cost (Martin, 2017). The EPA then back-calculated the individual costs of each of the remaining O&M categories from the percentages of the total daily sailing cost (Table 3). The EPA then adjusted the daily O&M cost to exclude costs not incurred by a U.S. Laker:

- Capital/charter costs (U.S. Lakers are company owned rather than chartered)
- Pilotage costs (U.S. Lakers are piloted by USCG-licensed captains and therefore such fees are not required)

[39] https://shipandbunker.com/prices/am/usgac/us-hou-houston

- Port costs and stevedoring[40] (these costs only apply while in port)
- Toll costs (U.S. Army of Engineers locks at Sault Ste. Marie in Michigan do not charge tolls for passage).

The adjusted daily O&M cost when sailing ($31,963) includes crew wages, maintenance/repair, insurance, stores/supplies, miscellaneous, and fuel (Table B-0-3).

Table B-0-3. Daily Sailing O&M Cost Based on Published Fuel Use

Cost Category	Percentages of costs for foreign-flagged vessel [a]	Daily O&M cost for foreign-flagged vessel (baseline)	Daily O&M cost for U.S. Laker (sailing)
Capital/Charter	17.31	$17,371	NA [d]
Crew Wages	8.42	$8,450	$8,450
Maintenance/Repair	4.57	$4,586	$4,586
Insurance	3.73	$3,743	$3,743
Stores and Supplies	2.46	$2,469	$2,469
Misc.	1.67	$1,676	$1,676
Fuel	11.01	$11,049[b]	$11,049
Stevedoring	21.2	$21,275	NA[d]
Pilotage	12.58	$12,625	NA [d]
Port Cost	10.39	$10,427	NA [d]
Tolls	6.67	$6,694	NA [d]
Total Daily O&M Cost		$100,354[c]	$31,963[c]

[a] Exhibit II-12 of Martin Associates (2017) for a Class 4 vessel.
[b] Based on the fuel consumption for a Laker at sea (17.4 tons/day) times the cost ($635) of marine very low sulfur fuel oil (VLSFO).
[c] The daily O&M cost for foreign flagged vessels ($100,354) is based on the fuel cost ($11,049) divided by the fuel cost percent of the total cost (11.01%). The sum of each cost category is slightly different than the calculated daily cost due to rounding.
[d] NA – Not available.

PORT DAY O&M COST

For the cost of a port day, the EPA estimated the daily fuel cost for a Laker ($1,905) as the fuel consumption at port (3 tons/day) times the cost of marine very low sulfur fuel oil ($635/ton). As described in Martin, 2017 the daily fuel rate is representative of Class 2 and Class 4 vessels. The EPA used the percentage of the overall cost for each of the other cost categories as was done for sailing day costs and for which the EPA similarly excluded those costs not expected to be incurred by a U.S. Laker (capital/charter, stevedoring, pilotage, and tolls). Notably, stevedoring costs were subtracted from the

[40] Stevedoring charges are the cost of loading and discharging cargo to and from the ship and the marine terminal, elevation fees for the grain, and terminal charges imposed by the terminal operator for cargo storage, truck and rail loading and off-loading, chassis repairs, etc.

daily port day costs assuming the mines pay for stevedoring rather than the vessel. The adjusted total daily port cost was $33,256.00 (Table B-4).

Table B-0-4. Daily Port O&M Cost Based on Published Fuel Use

Cost Category	Percentages of costs for foreign-flagged vessel [a]	Daily O&M cost for foreign-flagged vessel (baseline)	Daily O&M cost for U.S. Laker (in port)
Capital/Charter	17.31	$17,371	NA [d]
Crew Wages	8.42	$8,450	$8,450
Maintenance/Repair	4.57	$4,586	$4,586
Insurance	3.73	$3,743	$3,743
Stores and Supplies	2.46	$2,469	$2,469
Misc.	1.67	$1,676	$1,676
Fuel	11.01	$1,905[b]	$1,905
Stevedoring	21.2	$21,275	NA [d]
Pilotage	12.58	$12,625	NA [d]
Port Cost	10.39	$10,427	$10,427
Tolls	6.67	$6,694	NA [d]
Total Daily Cost		$100,354[c]	$33,256

[a] *Exhibit II-12 of Martin Associates (2017)*
[b] *Based on the fuel consumption for a Laker in port (3 tons/day) times the cost ($635) of marine very low sulfur fuel oil (VLSFO).*
[c] *The daily O&M cost for foreign flagged vessels ($100,354) is based on the fuel cost ($11,049) divided by the fuel cost percent of the total cost (11.01%). The sum of each cost category is slightly different than the calculated daily cost due to rounding.*
[d] *NA – Not available.*

ESTIMATED ANNUAL O&M COST PER VESSEL

Lakers typically operate approximately 10 months/year (~300 days/year). To estimate the breakdown of time sailing or in port, the EPA based its estimate on a typical U.S. Laker voyage from Duluth, MN to Gary, IN (Table 5). The EPA calculated the annual O&M cost by multiplying the daily costs shown in Table 3 (sailing day) and Table 4 (port day) by the number of annual sailing days or port days estimated in Table 3. The voyage is approximately 62.6 hours (2.6 days) according to U.S. Army Corps of Engineers transit times. Assuming 0.5 days are spent in Duluth and Gary loading and unloading, respectively, the EPA estimated 5.2 days spent sailing (83.9% of the time) and 1 day in port (16.1% of the time) for a roundtrip voyage. Applying these percentages to the 300 operational days, the EPA estimated 252 sailing days and 48 days port days per year. The annual sailing cost was estimated as the daily sailing cost times the 252 sailing days. The annual port cost was estimated as the port day cost times the 48 port days. The total annual O&M cost is estimated to be $9.7M/year (2022). Actual operating costs for individual Lakers will depend on a number of factors including voyage patterns and fuel consumption, maintenance/parts, and contractual crewing costs.

Table B-0-5. Estimated Annual O&M Cost Per Vessel

Estimated Annual Cost	Value
Operating Days/yr.	300
Typical Voyage Sailing Time (hrs.)	62.6 (Duluth to Gary, IN)[a]
Typical Voyage Sailing Time (days)	2.6
Port Load Time (days)	0.5 (Duluth)
Port Unload Time (days)	0.5 (Gary)
Round Trip Sailing Days	5.2
Round Trip Port Days	1
Percentage of Time Sailing	83.9
Percentage of Time in Port	16.1
Sailing Days/yr.	252
Port Days/yr.	48
Sailing Days Annual Cost	$8,046,404
Port Days Annual Cost	$1,609,674
Total Annual Vessel O&M Cost	**$9,656,078**
[a] *U.S. Army Corps of Engineers transit time*	