Economic and Benefits Analysis of the Final Vessel General Permit (VGP)

Developed for:

Office of Wastewater Management
U.S. Environmental Protection Agency

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Acronyms

ACSI	Alaska Cruise Ship Initiative
ADEC	Alaska Department of Environmental Conservation
AFFF	Aqueous film-forming foam
AMSA	Australian Maritime Safety Authority
ANS	Aquatic non-indigenous species
ANSTF	Aquatic Nuisance Species Task Force
APPS	Act to Prevent Pollution from Ships
BMP	Best management practice
BOD	Biochemical oxygen demand
CCC	Criterion Continuous Concentration
CDC	Centers for Disease Control
CLIA	Cruise Line International Association
CMC	Criterion Maximum Concentration
COTP	Captain of the Port
CPI	Consumer Price Index
CWA	Clean Water Act
DOD	Department of Defense
EEZ	Exclusive Economic Zone
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection
GLERL	Great Lakes Environmental Research Laboratory
GSMFC	Gulf States Marine Fisheries Commission
IADC	International Association of Drilling Contractors
ICCP	Impressed Current Cathodic Protection
ICST	International Classification of Ships by Type
IDNR	Indiana Department of Natural Resources
IMO	International Maritime Organization
ISA	Infectious salmon anemia
MARPOL	International Convention for the Prevention of Marine Pollution from Ships
MISLE	Marine Information for Safety and Law Enforcement
MODU	Mobile Offshore Drilling Unit
NAICS	North American Industry Classification System
NANCPA	Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990
NBIC	National Ballast Information Clearinghouse
NDC	Navigation Data Center
NISA	National Invasive Species Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NoBOB	No ballast on board
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRDC	National Resources Defense Council
NRWQC	National recommended water quality criteria
OTA	Office of Technology Assessment
PAH	Polycyclic aromatic hydrocarbon

PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
POC	Pollutant of concern
RFA	Regulatory Flexibility Act
RO-RO	Roll-on/roll-off
RTF	Ruffe Task Force
SAB	Science Advisory Board
SBA	Small Business Administration
SBAC	Small Business Advocacy Chair
SBREFA	Small Business Regulatory Enforcement and Fairness Act
SIC	Standard Industrial Classification
TBT	Tributyl tin
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of the Interior
USGS	U.S. Geological Survey
VDS	Vessel Documentation System
VESDOC	Merchant Vessels of the United States
VHS	Viral hemorrhagic septicemia
VTCC	Vessel Type, Construction, and Characteristics
WCSC	Waterborne Commerce Statistics Center
WHOI	Woods Hole Oceanographic Institute
WTLUS	Waterborne Transportation Lines of the United States

Executive Summary

EPA developed new permitting requirements for discharges incidental to the normal operation of a vessel into inland waters or the territorial sea of the United States under the National Pollutant Discharge Elimination System (NPDES).

This report presents EPA's final economic and benefits analysis of the Vessel General Permit's impact on all affected vessels. Though the issuance of this Permit is not a Federal regulation, EPA is conducting this analysis due to the potential impacts of this Permit. The Executive Summary provides an overview of the costs and benefits of the regulation.

The Vessel General Permit for Discharges Incidental to the Normal Operation of Vessels (herein referred to as the Vessel General Permit or VGP) covers, with the exception of ballast water discharges, non-recreational vessels less than 79 feet in length, including uninspected passenger vessels less than 79 feet in length, and all commercial fishing vessels, regardless of length.[1] The Vessel General Permit defines effluent limits for 26 discharge categories as well as specifying certain practices and discharges for various vessel categories.

All vessels operating in a capacity of transportation are eligible for coverage under the Vessel General Permit. The types of vessels covered under the Vessel General Permit include commercial fishing vessels (only for ballast water requirements), cruise ships, ferries, barges, mobile offshore drilling units (MODUs), oil tankers or petroleum tankers, bulk carriers, cargo ships, container ships, other cargo freighters, refrigerant ships, government vessels not a part of the armed forces (e.g. NOAA and USACE vessels), research vessels, and emergency response vessels, including firefighting and police vessels, and any other vessel operating in a capacity of transportation. Vessels of the armed forces of the United States are not eligible for coverage by this Permit. EPA estimates that 61,069 domestic flag and 7,927 foreign flag vessels will be affected by the final VGP requirements.[2] Chapter 3 of this report, *Population of Affected Vessels*, presents EPA's assessment of the numbers and types of vessels likely to be impacted by the new permitting requirements.

Water transportation accounts for a majority of the vessels sailing on U.S. waters and thus affected by VGP. The water transportation industry is a $34 billion industry that employs nearly 150,000 people on a payroll of just over $6 billion. Overall, the industry has experienced mild growth in the number of establishments, revenues, and payroll, but a decline in the number of employees. The fishing industry is responsible for slightly more than a quarter of all commercial vessels in the United States. This industry is much smaller, with total revenues of $1.65 billion, employing just over 6,500 people on a payroll of $253 million. The fishing industry is experiencing more of a decline, although it still shows some revenue growth despite declines in the number of establishments and employees, and in total payroll. The drilling oil and gas wells sector, a subset of the mining industry (which includes the 131 MODUs covered under the VGP), is a $9 billion sector that employs nearly 60,500 people on a payroll of approximately $2.5 billion. This sector has experienced relatively strong growth, demonstrating a 24 percent increase in revenues from 1997 to 2002. On the whole, the three industries contain more than 90 percent small businesses. Of the 5,037 firms in the water transportation industry, 4,770 (94.3 percent) are small.

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[1] Commercial fishing vessels and other non-recreational vessels less than 79 feet may seek permit coverage under this permit for their ballast water discharges. If auxiliary vessels or craft, such as lifeboats or rescue boats onboard larger vessels require permit coverage (i.e. they are greater than 79 feet in length or they are subject to the current NPDES permit moratorium under S. 3298 but are required to obtain an NPDES permit following lapse of that moratorium), they are eligible for coverage under this permit and are covered by submission of the Notice of Intent for larger vessels. Recreational vessels as defined in section 502(25) of the Clean Water Act are not subject to this permit. Such vessels are not subject to NPDES permitting under Section 402 of the Clean Water Act, and are instead subject to regulation under Section 312(o) of the Clean Water Act.

[2] Due to congressional action that took place during July 2008 (Senate bill S. 2766 and 3298, described in Section 2.1), the estimated vessel universe covered by the final VGP *decreased* from the proposed VGP (and subsequently decreased in the final VGP economic analysis).

In the fishing industry, 1,843 (96.2 percent) of the 1,916 firms are small. In the drilling oil and gas wells sector, 1,470 (97.7 percent) of the 1,504 firms are small. Chapter 5: *Profile of the Water Transportation, Fishing, and Mining Industries* provides an economic profile of these industries. Though the overwhelming majority of fishing vessels need not obtain coverage under the VGP, the profile of the fishing industry remains in this analysis to account for potential expenses for the limited number of fishing vessels (as defined in 33 CFR 1342) which may need to obtain coverage for ballast water under this permit.

To estimate the effect of the Permit on an industry as a whole, EPA's analysis takes into account previous conditions and determines how the industry would act in the future in the absence of the Permit. The baseline for this analysis is full industry compliance with existing federal and state regulations; and current industry practices or standards that exceed current regulations to the extent that they can be empirically observed. In addition, a number of laws and associated regulations (including the National Invasive Species Act; the Act to Prevent Pollution from Ships; the Comprehensive Environmental Response, Compensation, and Liability Act; the Organotin Anti-fouling Paint Control Act; and others) already cover certain discharges that would be subject to the new permitting regime. In analyzing economic impacts of the vessel vacatur of the NPDES requirements, EPA has assumed that the entities subject to existing regulations will not incur significant incremental costs. Chapter 4, *Permit Overlap with Existing Regulations*, summarizes laws and associated regulations that already cover certain discharges that would be subject to the new permitting regime.

Overall, EPA finds that the Permit has modest economic impacts on the water transportation, fishing, and mining industries. The total annual incremental costs for both domestic and foreign vessels range from $8.9 to $23 million annually (2007$). This includes the paperwork burden costs and the sum of the ballast water management costs, the costs of all other BMPs, the costs to cruise ships, and (for the high end estimate) the cost to vessels expected to employ ballast water treatment systems which discharge biocides of monitoring for residual biocides or derivatives. The estimated total costs to domestic vessels of the paperwork burden (including recordkeeping, Notice of Intent (NOI) filing, routine inspections, drydock inspections, annual inspections, and a one-time report) range from $0.6 to $4.5 million. The estimated VGP compliance costs (excluding paperwork costs and $1.1 million for ballast water practices for foreign vessels) range from $7.2 to $17.4 million (2007$). Chapter 6: *Cost of Best Management Practices* presents EPA's analysis of compliance costs to commercial vessels associated with each of the BMPs identified and the paperwork burden costs.

To evaluate economic impacts of VGP requirements on the water transportation, fishing, and mining industries, EPA performed the firm-level analysis. The firm-level analysis examines the impact of the introduced BMP costs per vessel on model firms that represent the financial conditions of "typical" businesses in each of the examined industry sectors. Since more than 90 percent of the firms in the water transportation and fishing industries, and in the drilling oil and gas wells segment of the mining industry are small, it is unlikely that firm-level impacts would be material among large firms in this industry. Therefore, a firm-level analysis focuses on assessment of impacts on small businesses, as required by the Regulatory Flexibility Act and the Small Business Regulatory Enforcement and Fairness Act (SBREFA). To evaluate the potential impact of the Vessel General Permit on small entities, EPA used a cost-to-revenue test to evaluate the potential severity of economic impact on vessels and facilities owned by small entities. The test calculates annualized pre-tax compliance cost as a percentage of total revenues and uses a threshold of 1 and 3 percent to identify facilities that would be significantly impacted as a result of this Permit.

The firm-level analysis shows that the "rule is presumed not to have a significant economic impact on a substantial number of small entities." The total number of small entities in the *fishing industry* that are expected to exceed the 1 percent cost-to-revenue threshold is 3 (or 0.01 percent) under the low end and high end cost assumptions. The total number of small entities in the *water transportation industry* sectors that are expected to exceed the 1 percent cost-to-revenue threshold is 209 under the low end cost assumptions and 304 under the high end cost assumptions. Finally, one small entity in the *drilling oil and gas wells* sector is expected to exceed the 1 percent cost-to-revenue threshold under both the low end and high end cost assumptions. *Chapter 7 Analysis of*

Impacts on Firm Revenues and Financial Performance details EPA's assessment of the cost and economic impact of regulatory requirements on firms in the shipping industry, and the implications of the Permit in terms of financial viability of shipping industry firms subject to the Permit.

Although EPA was unable to evaluate the expected benefits of the Permit in dollar terms due to data limitations, the Agency collected and developed relevant information to enable qualitative consideration of ecological benefits and to assess the importance of the ecological gains from the Permit. EPA expects that reductions in vessel discharges will benefit society in two broad categories: (1) enhanced water quality from reduced pollutant discharges and (2) reduced risk of invasive species introduction.

The Permit covers many discharges and contains special provisions for numerous vessel types (see EPA (2008b) for information on the affected discharges and provisions by vessel type). Many of the discharges regulated by EPA's Vessel General Permit (2008b) were previously regulated under only certain select circumstances covering a small fraction of total discharges, if at all. Nonetheless, several discharges are associated with a wide variety of harmful pollutants in substantial concentrations. For example, untreated graywater may contain pathogenic bacteria, toxic and carcinogenic organic and inorganic compounds, nutrients, and metals (EPA, 2007a). Because many of the nation's busiest ports are considered to be impaired by a variety of pollutants found in vessel discharges, the Permit is expected to have benefits associated with the reduction of concentrations of nutrients, metals, oil, grease, and toxics in waters with high levels of vessel traffic. These impacts will be particularly significant in those nutrient-impaired areas frequented by cruise ships (e.g., San Francisco Bay and Chesapeake Bay), which can discharge large volumes of graywater and are subject to stringent discharge requirements under the Permit.

The ballast water provisions of EPA's final Vessel General Permit are expected to reduce the number of introductions of aquatic non-indigenous species (ANS) and thus may prevent significant future damages to fisheries, tourism, recreation, infrastructure, and human health, as well as further stresses on native biodiversity and ecosystems. Although estimating the monetary value of benefits from preventing future invasions with a reasonable degree of certainty would not be possible due to the lack of data on rates of invasive species introduction associated with ballast water releases, the type of species introduced in the future and the range of potential economic impacts associated with each species type is very large. The potential benefits of preventing the introduction of even one harmful ANS could be substantial.

2 Introduction

2.1 Background

On June 17, 2008, EPA proposed new permitting requirements for discharges incidental to the normal operation of a vessel into inland waters or the 3 mile territorial sea of the United States under the National Pollutant Discharge Elimination System (NPDES) (73 CFR 117).

On July 29, 2008, Senate bill S. 2766 ("the Clean Boating Act of 2008") was signed into law (P.L. No. 110-288). This law provides that recreational vessels shall not be subject to the requirement to obtain an NPDES permit to authorize discharges incidental to their normal operation. It instead directs EPA to evaluate recreational vessel discharges, develop management practices for appropriate discharges, and promulgate performance standards for those management practices. It then directs the Coast Guard to promulgate regulations for the use of the management practices developed by EPA and requires recreational boater compliance with such practices. On July 31, 2008, Senate bill S. 3298 was signed into law (P.L. No. 110-299). This law generally imposes a two-year moratorium during which time neither EPA nor states can require NPDES permits for discharges incidental to the normal operation of vessels of less than 79 feet and commercial fishing vessels of any length. It also directs EPA to conduct a study of vessel discharges and issue a report to Congress within 15 months. Among other things, the moratorium does not apply to ballast water. EPA has incorporated the permitting requirements into the existing NPDES framework.

The Vessel General Permit for Discharges Incidental to the Normal Operation of Non-Recreational Vessels (herein referred to as the Vessel General Permit or VGP) covers non-recreational vessels at least 79 feet long.[3] To obtain authorization under the Vessel General Permit:

- Vessel operators must meet the Vessel General Permit eligibility requirements.
- Operators of some vessels will have to submit NOIs. If a vessel weighs at least 300 gross tons or has the capacity to discharge more than 8 cubic meters of ballast water, the operator must submit a complete and accurate NOI. For operators required to submit NOIs, submission must meet specified submission deadlines. If the vessel is not in one of the aforementioned categories, it automatically receives permit coverage under the Vessel General Permit and is authorized to discharge in accordance with Permit conditions.
- Vessel operators must implement the effluent limits according to the requirements in Part 2 of the Vessel General Permit, and document the implementation as part of their recordkeeping documentation. If the vessel is equipped to carry ballast water or carries ballast water at any time, it must have a ballast water management plan consistent with part 33 CFR 151.2035(a)(7).

Based on an analysis of several vessel data sources (described in *Section 3*), EPA estimated the population of vessels affected by the NPDES requirements. The total count of the domestic flag vessel population is 61,069.[4] The foreign flag vessel population totals 7,927.

The Vessel General Permit defines effluent limits for 26 discharge categories and specifies certain practices for various vessel categories. This report presents EPA's economic and benefits analyses of the Vessel General Permit's impact on all affected vessels. Though the issuance of this permit is not a Federal regulation, EPA is conducting these analyses due to the potential impacts of this permit. These analyses are consistent with the

[3] The descriptions of permitting requirements in this report are based upon the December 17, 2008 Draft Permit provided by EPA.

[4] This count includes 26 commercial fishing vessels that have ballast water requirements. Although there are 28,875 commercial fishing vessels found in the vessel databases, only 26 perform ballast water exchange or flushing.

Regulatory Flexibility Act as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (RFA/SBREFA).

2.2 Organization within the Analysis

This report is organized in seven chapters and two appendices, as follows:

Chapter 3*: Population of Affected Vessels* presents an assessment of the numbers and types of vessels likely to be affected by the new permitting requirements.

Chapter 4: *Permit Overlap with Existing Regulations* summarizes laws and associated regulations that already cover certain discharges that would be subject to the new permitting regime.

Chapter 5: *Profile of the Water Transportation, Fishing, and Mining Industries* provides an economic profile of the sectors that have vessels subject to the VGP.

Chapter 6: *Cost of Best Management Practices* presents EPA's analysis of compliance costs to commercial vessels associated with each of the BMPs identified by EPA in the Permit at the vessel level. This chapter also presents an estimation of national-level industry compliance costs.

Chapter *7*: *Analysis of Impacts on Firm Revenues and Financial Performance* presents EPA's assessment of the cost and economic impact of regulatory requirements on firms in the shipping industry, and the implications of a Permit in terms of financial viability of shipping industry firms subject to the Permit.

Chapter 8: *Benefits Analysis* presents EPA's assessment of the environmental effects associated with vessel discharges and the benefits of reducing these discharges.

Appendix A presents the questionnaires sent to the industry representatives.

Appendix B presents a summary of responses from the industry questionnaires.

3 Population of Affected Vessels

The Vessel General Permit is applicable to discharges incidental to the normal operation of a vessel into the navigable waters within the meaning of the Clean Water Act (CWA) Section 502(7). All vessels operating in a capacity of transportation are eligible for coverage under the Vessel General Permit. The types of vessels covered under the Vessel General Permit include commercial fishing vessels (only for ballast water exchange requirements), cruise ships, ferries, barges, mobile offshore drilling units, oil tankers or petroleum tankers, bulk carriers, cargo ships, container ships, other cargo freighters, refrigerant ships, research vessels, emergency response vessels, including firefighting and police vessels, and any other vessel operating in a capacity of transportation. Vessels of the armed forces of the United States are not eligible for coverage by this permit.

EPA used the following data sources to estimate the population of affected vessels:

- *Domestic flag vessels*: The Waterborne Transportation Lines of the United States (WTLUS) and Merchant Vessels of the United States (VESDOC) databases provided information on the number and type of domestic flag vessels subject to the Vessel General Permit.
- *Foreign flag vessels*: The Foreign Vessel Traffic Entrance and Clearance records of U.S. Customs and Border Protection provided information on the number and type of foreign flag vessels operating in the navigable waters of the United States.
- *Vessels subject to ballast water management requirements*: The National Ballast Information Clearinghouse (NBIC) provided data on U.S. port calls, traffic patterns, ballast capacity, whether a vessel declared ballast water on board, and whether ballast water exchange was performed.

In addition, the Cruise Line International Association (CLIA) provided information on the number and size of cruise ships operating in U.S. waters.

3.1 Domestic Vessel Population

EPA used three data sources to determine the population of domestic flag vessels: (1) the WTLUS data file compiled by the Waterborne Commerce Statistics Center (WCSC) of the U.S. Army Corps of Engineers (USACE) Navigation Data Center (NDC) (USACE, 2005a, 2005b, and 2005c), (2) the VESDOC data file compiled by the U.S. Coast Guard (USCG, 2007), and (3) information submitted from the International Association of Drilling Contractors (IADC), which provided a vessel count of 131 MODUs.

WTLUS is a three-volume annual product that provides both an inventory of vessel companies, along with their American flag vessels operating in the transportation of freight and passengers, and a national summary of all vessels. The database lists the vessel companies in alphabetical sequence 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. Detailed vessel characteristics may not be available for all vessels included in the total WTLUS vessel inventory (USACE NDC, 2008). The data files for the WTLUS vessel characteristics and operator names were downloaded directly from the USACE NDC website on December 5, 2007, and loaded into a Microsoft® Access file (USACE NDC, 2007). The data cover vessels available for operation as of December 31, 2005.

VESDOC is a data file of merchant and recreational vessels documented under the laws of the United States by the U.S. Coast Guard. The source for this file is the U.S. Coast Guard's Marine Information for Safety and Law Enforcement (MISLE) and Vessel Documentation System (VDS) databases, a comprehensive system serving many Coast Guard marine safety units, including the National Vessel Documentation Center. The data file of merchant vessels has been specifically prepared from several data tables contained in MISLE and VDS. Vessel specific data include vessel name, call sign, official number (Coast Guard number), International Maritime Organization (IMO) number, hull number, vessel service type, flag, self-propelled indicator, registered gross and net tons, length, breadth, depth, measuring organization name, hailing port and state, numerous trade indicators, vessel builder and managing owner information, horsepower, propulsion type, and hull construction material and configuration. Vessels in this file have a valid Certificate of Documentation (U.S. Bureau of Transportation Statistics, 2008). These data were downloaded from the Bureau of Transportation Statistics' Maritime Data Working Group website as a zipped Access file on November 28, 2007 and extracted the same day (U.S. Bureau of Transportation Statistics, 2008). The file contains updated data through July 7, 2007.

To estimate the domestic vessel population subject to the Vessel General Permit, EPA created a master database by combining the WTLUS and VESDOC data files. The combined database allowed the Agency to obtain a comprehensive estimate of the vessel population and to minimize the number of missing data fields. The Coast Guard number, which serves as the unique vessel identifier, was used to merge the two databases. EPA used the WTLUS data as the base of the population and, as a general rule, used the majority of the data fields contained therein, inputting similar data attributes from VESDOC into this format. As shown in *Table 3-1,* the estimated number of domestic flag vessels subject to the Vessel General Permit is 61,069. The 131 mobile offshore drilling units identified by IADC are included among the population of 10,892 utility vessels.

Table 3-1: Domestic Vessel Population

Vessel Class	Total Domestic Vessels		Domestic Vessels Required to Submit NOI[a]	
	Count	Percentage of Total	Count	Percentage of Total
Commercial Fishing	26[b]	<1	26	<1
Freight Barge	32,842	54	30,961	74
Freight Ship	697	1	469	1
Passenger Vessel	11,521	19	1,270	3
Tank Barge	4,944	8	4,808	11
Tank Ship	147	<1	117	<1
Utility Vessel	10,892	18	4,255	10
Total	**61,069**	**100**	**41,906**	**100**

a The count of vessels required to submit an NOI is a conservative estimate since data on gross tonnage are not complete. Thus, this count is based on the number of vessels that are either >78' in length or >299 Gross Tons.
b 26 commercial fishing vessels conduct either ballast water exchange or saltwater flushing.

This analysis will examine the following vessel population groups, defined by USACE WTLUS and USCG VESDOC categorizations:

- *Commercial Fishing*. Includes commercial fishing vessels (only for ballast water exchange requirements).
- *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, and vehicle carriers.
- *Passenger Vessel*. Includes cruise ships, combination passenger and cargo ships, ferries, railroad car ferries, excursion and sightseeing vessels, and passenger barges.
- *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.

As shown in *Table 3-1,* freight barges (54 percent), passenger vessels (19 percent), and utility vessels (18 percent) account for the majority of domestic vessels eligible for coverage under the VGP. *Table 3-1* also provides the number of vessels required to provide a Notice of Intent (NOI) to EPA (i.e., vessels weighing at least 300 gross tons or that have the capacity to hold or discharge more than 8 cubic meters (2113 gallons) of ballast water). Of the 61,069 domestic flagged commercial vessels subject to the Vessel General Permit, 41,906 are required to submit a NOI.

3.2 Foreign Vessel Population

The Foreign Traffic Vessel Entrances and Clearances database provides information on foreign vessels entering or clearing U.S. Customs ports in calendar year 2005 (U.S. Customs and Border Protection, 2007). The data are collected by U.S. Customs and Border Protection and include entrance/clearance characteristics such as the date a vessel made entry into or cleared the U.S. Customs port or waterway, as well as 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, whether foreign or domestic, Net and Gross Registered Tonnage, and draft in feet. The database includes both foreign flagged and domestic vessels. However, only foreign flagged vessels are included in the estimate of the foreign vessel population. The estimate of the foreign vessel population also excludes several other Permit-exempt boats.[5] EPA estimates that 7,927 foreign flagged vessels are subject to the Vessel General Permit requirements.

EPA used ICST codes to group foreign flagged vessels into the classes used in the analysis of the domestic vessel population. (This classification scheme is described in the preceding section.) *Table 3-2* presents the number of foreign flagged vessels by vessel class. As shown in *Table 3-2,* the majority of foreign flagged vessels entering U.S. ports are freight ships (65 percent), followed by tank ships (22 percent). Of the 7,927 foreign flagged vessels, 7,830 are required to provide an NOI to EPA (i.e., they weigh at least 300 gross registered tons).

The foreign flagged vessels were excluded from the analysis of the total costs of best management practices (BMPs) because the cost to foreign flagged vessels does not have a direct impact on the U.S. firms. There is also considerable uncertainty regarding management practices employed by these vessels under the baseline scenario. The only exception is ballast water management, for which sufficient data were available to estimate incremental costs of the Vessel General Permit to both domestic and foreign flagged vessels (see *Sections 6.2.3: Discharges of Ballast Water – Pacific Nearshore Vessels* and *6.2.4: Discharges of Ballast Water – Vessels with Empty Tanks).*

[5] The database does not provide vessel length. Therefore, the length limit was not used in analyzing the population of foreign vessels subject to the Vessel General Permit.

Table 3-2: Foreign Vessel Population

Vessel Class	Total Foreign Vessels		Foreign Required to Submit NOI	
	Count	Percentage of Total	Count	Percentage of Total
Freight Barge	127	2	125	2
Freight Ship	5,610	71	5,577	71
Passenger Vessel	146	2	146	2
Tank Barge	30	<1	30	<1
Tank Ship	1,896	24	1,891	24
Utility Vessel	118	1	61	1
Total	**7,927**	**100**	**7,830**	**100**

a The count of vessels required to submit an NOI is based on gross registered tonnage.

3.3 Vessels Subject to the Ballast Water Management Requirements

The analysis of national costs and impacts from the ballast water management requirements relies on the USCG National Ballast Information Clearinghouse. The database (NBIC, 2005) compiles information from ballast water reports submitted to the USCG by all ballast tank-equipped vessels entering U.S. waters. The information provided by the NBIC database includes vessel name and type, port, state, arrival date, the last port the vessel called at, information on ballast water management practices (i.e., ballast capacity, volume discharged, whether ballast water exchange was performed, and treatment methods). This analysis is based on information on foreign and domestic flag arrivals to U.S. ports during calendar year 2005. For the purpose of this analysis, NBIC provided two data files to EPA: "Oceangoing Arrivals" and "Pacific Nearshore Arrivals."

The Vessel General Permit requires that all vessels entering from outside the 200-nautical mile (nm) U.S. Exclusive Economic Zone (EEZ) with at least one ballast water tank empty must flush all empty tanks with saltwater or seal them off while they remain in the EEZ. The Oceangoing Arrivals dataset captures all arrivals of ballast-capable vessels to U.S. ports, where the vessel's last port of call was foreign (non-Canadian). The dataset includes 38,912 arrivals by 6,857 vessels, of which 60 arrivals by 37 vessels entered a Great Lakes or Upper Hudson River port. These freshwater arrivals are excluded from costing, however, due to coverage under existing regulations in those jurisdictions (70 CFR 168). *Table 3-3* summarizes the number of vessels and arrivals by water body type (marine or freshwater) and flag (i.e., foreign vs. domestic).

Table 3-3: Oceangoing Arrivals

Vessel Flag	All Saltwater Ports		Great Lakes and Upper Hudson Ports	
	Vessel Count	Arrival Count	Vessel Count	Arrival Count
Domestic	336	3,443	3	3
Foreign	6,484	35,409	34	57
Total	6,820	38,852	37	60

EPA used the Pacific Nearshore Arrivals dataset in analyzing impacts of the Vessel General Permit requirements that vessels engaged in Pacific nearshore voyages while operating inside 200 nm from shore must now conduct ballast water exchanges at 50 nm from shore before arrival. Prior federal regulations required that exchanges be conducted only upon entrance into the U.S. EEZ, and not upon crossing Captain of the Port (COTP) zones. The dataset includes all arrivals to ports in California, Oregon, Washington, and Alaska that originated in North, Central, or South America or the Caribbean. The total number captured is 11,006 arrivals made by 1,314 vessels. Existing state regulations in California and Washington overlap with the Vessel General Permit requirements for vessels engaged in Pacific nearshore voyages; thus, arrivals to these states will incur no additional costs. Excluding the California and Washington arrivals yields 2,468 arrivals by 328 vessels that are likely to incur additional ballast water management cost due to the Vessel General Permit (see *Table 3-4)*.

Table 3-4: Pacific Nearshore Arrivals

Vessel Flag	All Pacific Ports		Oregon and Alaskan Ports	
	Vessel Count	Arrival Count	Vessel Count	Arrival Count
Domestic	218	3,350	121	946
Foreign	1,096	7,656	207	1,522
Total	1,314	11,006	328	2,468

3.4 Uncertainties and Limitations

This section discusses limitations and uncertainties in the estimation of the affected vessel population. Whether these limitations and uncertainties, taken together, are likely to lead to an understatement or overstatement of the estimated vessel population is not known.

- The domestic vessel population was estimated using WTLUS and VESDOC databases, and MODU vessel population data submitted by IADC. The main limitations of these data sources are:
  - *Missing data fields.* Even after merging both databases and using methods to maximize the amount of available data, several data fields remained with non-negligible deficiencies. Some but not all of these fields were populated using assumptions.
  - *Conflicting vessel classifications.* A relatively small number of vessels were found to be classified by WTLUS and VESDOC differently. In these cases EPA used the WTLUS classification and ignored the VESDOC.
  - *Estimate of vessels required to submit an NOI:* The count of vessels required to submit an NOI is a conservative estimate since data on gross tonnage are not complete. Thus, this count is based on the number of vessels that are either >78' in length or >299 Gross Tons.
- The estimated number of vessels affected by the ballast water management requirements is based on the NBIC data. The main sources of uncertainty in this analysis are:
  - *Self-reporting of ballast management practices.* The NBIC system for gathering and organizing information on ballast-related activities calls for vessels to self-report with limited oversight. This may result in some vessels conducting incomplete reporting or failing to report altogether. The exact margin of this uncertainty is unknown, but will likely have a relatively low impact on total costs.
  - *Vessel classification.* The vessels in the NBIC database were coded primarily by IMO number, not Coast Guard number as was the case with the WTLUS, VESDOC, and U.S. Customs vessels. Although NBIC did provide a vessel class table that corresponded to the Oceangoing and Pacific Nearshore Arrivals datasets, the classification scheme was slightly different from the one that was used in the domestic and foreign vessel populations. A manual lookup approach was finally employed in order to typecast unidentified vessels. This may result in some uncertainty around estimated number of vessels by class.

Finally, the estimate of the population of affected vessels is also subject to the reporting accuracy of the data providers. Typographical errors and incorrect entries exist to an unknown extent. Those that were discovered were amended.

4 Permit Overlap with Existing Regulations

Several categories of best management practices outlined in the Vessel General Permit overlap with existing regulations and statutes at the federal and state level. In accordance with these regulations, some vessels have adopted BMPs required under the Vessel General Permit. This chapter cross-references existing regulations affecting vessel discharges and BMP requirements under the Vessel General Permit. EPA used the analysis of the overlap to adjust the number of vessels that are likely to incur incremental costs as a result of the Vessel General Permit implementation.

4.1 Ballast Water and Invasive Species Management

Certain provisions of the new Permit applying to all vessels with ballast tanks are incorporated from a previous U.S. Coast Guard regulation, last revised in the July 2004 Final Rulemaking for the Mandatory Ballast Water Management Program for U.S. Waters (codified in 33 CFR 151), issued under the authority of the National Invasive Species Act (NISA). Thus, these provisions will not be associated with any additional costs to vessel owners or operators, nor will they accrue any additional benefits to society. These requirements specify that masters, owners, operators, or persons-in-charge of all vessels equipped with ballast water tanks that operate in U.S. waters must:

- Avoid the discharge or uptake of ballast water in areas within or that may directly affect marine sanctuaries, marine preserves, marine parks, or coral reefs or in waters listed in Part 12.1 of the Permit.
- Minimize or avoid uptake of ballast water in the following areas and situations:
  - In areas known to have infestations or populations of harmful organisms and pathogens (e.g., toxic algal blooms).
  - In areas near sewage outfalls.
  - In areas near dredging operations.
  - In areas where tidal flushing is known to be poor or at times when a tidal stream is known to be more turbid.
  - In darkness, when bottom-dwelling organisms may rise up in the water column.
  - In shallow water or where propellers may stir up the sediment.
  - In areas with pods of whales, convergence zones, and boundaries of major currents.
- Clean the ballast tanks regularly to remove sediments. Clean the tanks in mid-ocean, under controlled arrangements in port, or at dry dock. Dispose of sediments in accordance with local, state, and federal regulations.
- Discharge only the minimal amount of ballast water essential for vessel operations while in the waters of the United States.
- Rinse anchors and anchor chains when retrieving the anchor to remove organisms and sediments at their place of origin.
- Remove fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations.

- Maintain a ballast water management plan developed specifically for the vessel that will allow those responsible for the plan's implementation to understand and follow the vessel's ballast water management strategy.

Provisions of the Vessel General Permit requiring ballast water exchanges for vessels operating outside the U.S. EEZ are also preserved from the July 2004 U.S. Coast Guard Mandatory Ballast Water Management Program for U.S. Waters, with the exception of the stipulation that exchanges should be conducted as early in the voyage as possible (33 CFR 151). Therefore, oceangoing vessels that travel outside of the U.S. EEZ would not incur any incremental costs associated with ballast water exchanges. The regulatory specifications did not include small vessels that, in their voyage track, were not expected to exceed a distance of 200 nm or vessels that do not carry a sufficient amount of ballast water. The U.S. Coast Guard estimates that 7,420 vessels entering U.S. waters would conduct a ballast water exchange.

The new Permit contains several provisions for ballast water management that the Mandatory Ballast Water Management Program does not cover. The first specifies that vessels engaged in Pacific nearshore voyages must conduct ballast water exchanges at least 50 nm from shore between ballasting events, even if their voyage track is not expected to exceed a distance of 200 nm. The second Permit provision requires vessels with empty ballast tanks or tanks containing only residual unpumpable ballast water to conduct saltwater flushing. However, there is some overlap between these provisions and existing state regulations, summarized in *Table 4-1*. In addition, the Permit specifies that vessels must conduct ballast water exchange as early as possible. The Permit also allows vessel operators not to exchange ballast water (or conduct saltwater flushing if applicable) if the vessel uses a USCG approved technology to treat ballast water or shore treatment (if readily available). The incremental cost of the latter two provisions is expected to be negligible and thus it is not included in subsequent analyses.

Table 4-1: Summary Crosswalk between Current Ballast Requirements and EPA Permit Requirements

EPA Permit Requirements	Overlap with USCG Regulations	Overlap with State Regulations[a]
Mandatory BMPs for all vessels taking up or discharging ballast water	Yes	------
Mandatory ballast exchange for vessels traveling outside the U.S. EEZ	Yes	------
Mandatory reporting and provisions for ballast water management	Yes[b]	------
Mandatory saltwater flushing for vessels declaring empty ballast tanks and no ballast on board (NoBOB)	No	OR[c]
Mandatory ballast water exchanges for vessels engaged in Pacific nearshore voyages	No	CA, WA, OR[d]
Requirements for vessels entering the Great Lakes	Yes	------

a Though Maryland and Virginia have ballast water regulations, these regulations overlap with the 2004 U.S. Coast Guard rule to such an extent that they will not impact this analysis. Michigan's ballast treatment regulation is also excluded from this table because it sets a treatment standard for discharges of ballast, which only affects provisions of the Vessel General Permit already excluded due to overlap with USCG regulations.
b Mandatory reporting and provisions for ballast water management of the 2004 USCG rule did not apply to tankers engaged in Pacific nearshore voyages, but will apply to these vessels under the new EPA rule.
c Current Oregon law prohibits discharge of ballast water mixed with sediments from other regions.
d State-approved treatment options are also authorized as an alternative to ballast water exchange in the listed states, and while treatment options will be authorized under the new Permit, they must first be authorized by USCG, and no such options are yet authorized. Thus, any vessels currently opting to treat their ballast water to comply with the regulations of these states will incur additional compliance costs.

California and Washington's Ballast Water Management Laws, passed in 2003 and 2004, respectively, mandate ballast exchange for vessels engaged in Pacific nearshore voyages (Cal. Pub. Res. Code 71200-71271 and Wash. Admin. Code 77-120-030).[6] Thus, vessels engaged in Pacific nearshore voyages that make calls at ports in Washington and California will not incur additional costs under this Permit. Oregon's Ballast Water Management Rule, established in 2002, also requires ballast exchange for vessels engaged in Pacific nearshore voyages, but

[6] California's regulations use only a tonnage criterion (300 gross weight tons) to establish applicability, so vessels longer than 79 feet but weighing less than 300 tons will incur incremental costs under the Vessel General Permit.

exempts vessels traveling only between 40 and 50 degrees latitude (Or. Admin. R. 340-143-0010). Therefore, vessels engaged in Pacific nearshore voyages calling at ports in Oregon traveling within this range but passing through more than one COTP zone will incur additional costs; those vessels traveling outside this range will not incur additional costs.

An existing regulation in Oregon prohibits the discharge of ballast water mixed with foreign sediments into its territorial waters, so vessels with empty ballast water tanks calling at ports in Oregon will not incur any additional costs under the Vessel General Permit (340 OAR 143).

The Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 (NANCPA), the predecessor regulation to NISA, established mandatory ballast management procedures for the Great Lakes and portions of the Hudson River. The only Great Lakes vessels covered by this regulation that will incur additional ballast-related costs under the new Permit are those with ballast tanks that are empty or contain only unpumpable residual ballast, as detailed above. These vessels, which are estimated to constitute 75–95 percent of the total number of vessels entering the Great Lakes and Upper Hudson, are subject to voluntary BMPs under the U.S. Coast Guard's 2005 Notice of Policy for Ballast Water Management for Vessels Entering the Great Lakes That Declare No Ballast on Board (70 FR 168). These voluntary BMPs are similar to the requirements of the new Permit. Additionally, saltwater flushing is already required by Canadian ports on the Great Lakes. Furthermore, a recently promulgated regulation from the St. Lawrence Seaway System (33 CFR Part 401.30) requires all oceangoing vessels to conduct saltwater flushing of ballast water tanks 200 nautical miles from any shore before entering either the U.S. or Canadian waters of the Seaway System, which serves as the gateway to the Great Lakes. Therefore, EPA estimates that no Great Lakes NOBOB vessels will incur additional costs under the Vessel General Permit, given implementation of voluntary BMPs.

4.2 Graywater

Graywater is defined in the Vessel General Permit as the discharge derived from "galley, bath and shower water, as well as wastewater from lavatory sinks, laundry, and water fountains" (EPA, 2008b). The new Vessel General Permit under NPDES contains a number of special provisions applying to discharges of graywater from cruise ships, specifying treatment standards for graywater discharges in port or within 1 nm of shore, and requiring that releases between 1 and 3 nm of shore occur only when traveling at a speed of at least 6 knots. These requirements are based on the U.S. Coast Guard Limitations on Discharge of Treated Sewage or Graywater in Alaska, established in 2001 (33 CFR 159). Cruise ships traveling in the territorial waters of Alaska therefore will not incur any additional costs under the new Permit requirements.

Several other states have existing requirements that will diminish incremental costs associated with these provisions of the new Permit:

- Maine has adopted Alaska's discharge requirements for vessels with passenger capacities of at least 250 under the 2003 Act to Protect Maine's Coastal Waters, so vessels traveling in its territorial waters will not incur additional costs under the Vessel General Permit (Me. Rev. Stat. Ann. tit. 38, 423D).
- The California Clean Coast Act, enacted in 2004, prohibits cruise ships from discharging any graywater into California's territorial waters; therefore, vessels will not incur any additional costs when making port calls in California (Cal. Pub. Res. Code. 72420-72425).

Several states, including Washington, Hawaii, and Florida, have voluntary memoranda of understanding with the cruise ship industry that discourage the discharge of untreated graywater in port or within 4 nm of shore, and claim a high level of operator compliance with these provisions.[7] Vessels already in compliance with these

[7] See ICCL (2001), Washington Dept. of Ecology (2007), and Maehara (2004).

memoranda of understanding will not incur additional costs under the Vessel General Permit. Applicable state regulations are summarized in *Table 4-2.*

Table 4-2: Summary Crosswalk between Current Cruise Ship Requirements and EPA Permit Requirements

EPA Permit Requirements	Overlap with State-Level Regulations[a]	Overlap with State MOUs
Treatment standards for graywater discharges	AK, ME	None
Limits on discharges within 3 nm of shore	AK, ME, CA	FL, HI, WA

a The term "State-Level Regulations" includes both state and federal regulations for Alaska.

Also relevant to graywater discharges are two other federal regulations. First, under Section 312(a) of the CWA, graywater discharges from vessels in the Great Lakes region are currently treated as sewage and thus are excluded from the scope of the new Permit. Second, the National Marine Sanctuaries Act authorizes the National Oceanic and Atmospheric Administration (NOAA) to designate National Marine Sanctuaries wherein certain discharges, including graywater, may be restricted to protect sensitive ecosystems.

4.3 Anti-fouling Hull Coatings

The new Vessel General Permit under NPDES prohibits the use of organotin-based anti-fouling hull coatings. The Organotin Anti-fouling Paint Control Act of 1988 already prohibits the use of these compounds on vessels under 25 feet in length; therefore, these vessels will not incur any additional costs under this provision (33 USC 2401–2410). Furthermore, the United States recently ratified the 2001 International Convention on the Control of Harmful Anti-fouling Systems on Ships, which bans the use of all organotin compounds, although it has not amended the Act to reflect these new treaty obligations to date. As a result, the long-run costs of the organotin provisions of the Vessel General Permit are assumed to be zero since the anti-fouling treaty came into effect on September 22, 2008.

4.4 Bilgewater Discharges

The new Vessel General Permit under NPDES reinforces several of the requirements of the Act to Prevent Pollution from Ships (APPS), the U.S. implementation of the 1973/78 International Convention for the Prevention of Marine Pollution from Ships (MARPOL), regarding discharges of oily bilgewater. Additionally, the Vessel General Permit prohibits the discharge of bilgewater by vessels weighing more than 400 tons within 1 nm of shore except during emergencies (unless vessel owner operators use a oily water separator which discharges bilgewater with oil content below 5 ppm), and requires that vessels discharging bilgewater between 1 and 3 nm from shore only do so when underway at a speed of at least 6 knots. It also requires vessels weighing less than 400 tons to minimize discharges of bilgewater.

These Permit requirements complement current requirements found in the USCG regulations governing Oily Mixture (Bilge Slops) Discharges on Oceangoing Ships Over 400 Tons, implemented under the authority of APPS and last amended in 1999. These regulations require the use of oily-water separators on discharges of bilgewater by vessels larger than 400 tons (33 CFR 155). While the new Permit requirements will be associated with additional costs for most subject vessel operators, the requirements consistent with APPS will not.

4.5 Overlap with Existing Clean Water Act Provisions

Certain discharges are exempt from the NPDES requirements under the Clean Water Act; the vessel vacatur therefore does not apply to them. Discharges occurring more than 3 nm from shore and discharges by Armed Forces vessels are exempt from the previous 122.3(a) exclusion, and are therefore excluded from the requirements of this permit. Sewage/blackwater is covered by performance standards for sanitation equipment, and is excluded from the definition of pollutant contained in Section 502(6)(A) of the CWA and thus is not subject to NPDES permitting. These discharges, as well as discharges from vessels not functioning as a means of transportation, are outside the scope of this analysis.

EPA's 1996 revisions to its Regulations of the Discharge of Oil, implemented under the authority of the CWA, prohibit the discharge of bilge slops containing sufficient oil to create a film or sheen in the territorial waters of the United States (40 CFR 110). This requirement regarding oil levels in bilgewater for non-MARPOL vessels remains the same in the new Permit.

4.6 Issues and Uncertainties

There exists some degree of overlap between the Vessel General Permit and the graywater provisions of the National Marine Sanctuaries Act. However, since the areas affected by this Act are relatively small, EPA will assume that vessels' graywater discharges were simply retained on board in designated sanctuaries and discharged outside these areas, and therefore incremental costs will remain the same.

5 Profile of the Water Transportation, Fishing, and Mining Industries

5.1 Introduction

The water transportation, fishing, and mining industries consist of the establishments that own and operate the commercial vessels that will be subject to the Vessel General Permit for Discharges Incidental to the Normal Operation of Commercial Vessels.[8]

The water transportation industry is a $34 billion industry that employs nearly 150,000 people on a payroll of just over $6 billion. The fishing industry is much smaller, with total revenues of $1.65 billion, employing just over 6,500 people on a payroll of $253 million. The drilling oil and gas wells sector (a subset of the mining industry) is a $9 billion sector that employs nearly 60,500 people on a payroll of approximately $2.5 billion.

Water transportation accounts for a majority of the vessels sailing on U.S. waters and is made up of several industry sectors, described in *Section 5.2.2: Water Transportation*. Overall, the industry has experienced mild growth in the number of establishments, revenues, and payroll, but a decline in the number of employees.

The fishing industry, responsible for slightly more than a quarter of all commercial vessels in the United States, is experiencing more of a decline, although it still shows some revenue growth despite declines in the number of establishments and employees, and in total payroll.

The drilling oil and gas wells sector, which covers the 131 MODUs covered by the VGP, has experienced relatively strong growth, demonstrating a 24 percent increase in revenues from 1997 to 2002.[9]

5.1.1 Data Sources Used

Overviews of the various industry sectors were created using information from industry groups, trade associations, and other reference sources.

Data for numbers of firms, establishments, revenues, and employment were obtained from the U.S. Census Bureau, with the exception of data for North American Industry Classification System (NAICS) code 11411-Fishing, because it is not covered by the Economic Census. In this case, the data come from the U.S. Small Business Administration (SBA).

Data for the number of vessels were extracted from the combined vessel information of WTLUS and VESDOC (detailed further in *Section 3.1: Domestic Vessel Population)* and from information submitted by the IADC on the number of MODUs. NAICS codes were assigned to vessels according to the NAICS codes of their owner/operators, which were obtained from the Dun & Bradstreet (2006) and ReferenceUSA (2006) databases. Where owner/operator information was unavailable or no corresponding company was found in these databases, the most likely NAICS code was assigned to a vessel using information on vessel type and area of operation.

[8] Though the overwhelming majority of fishing vessels need not obtain coverage under the VGP, the profile of the fishing industry remains in this analysis to account for potential expenses for the limited number of fishing vessels (as defined in 33 CFR 1342) which may need to obtain coverage for ballast water under this permit.

[9] The 131 MODUs only account for a small percentage of establishments reported in the 2002 Economic Census for the drilling oil and gas wells sector overall: approximately 7 percent (131 out of 1,926 establishments). Other establishments classified in the drilling oil and gas wells sector conduct operations that do not involve the use of MODUs; for example, these firms may drill oil and gas wells on land.

Note that other vessels that are involved in, or provide support to, oil and gas activities (e.g. offshore supply vessels), are classified within NAICS 488310 (Port and Harbor Operations).

5.1.2 Organization of This Chapter

This chapter presents an overview of the water transportation, fishing, and mining industries. *Section 5.2* provides definitions and overviews of the industries and their sectors, as well as the number of vessels associated with each industry, as classified by NAICS.

Section 5.3 summarizes recent trends in these industries, including changes in the number of establishments and financial performance.

Section 5.4 describes the industries' market structures, including details of performance according to employment size, numbers and percentages of small businesses, employment trends, and payroll trends.

5.2 Overview of the Water Transportation, Fishing, and Mining Industries

5.2.1 Definition of the Water Transportation, Fishing, and Mining Industries

The water transportation industry, for the purpose of this chapter, includes NAICS codes 483-Water Transportation; 4872-Scenic and Sightseeing Transportation, Water; and 4883-Support Activities for Water Transportation.

The fishing industry includes NAICS 11411-Fishing.

The mining industry includes NAICS 213111-Drilling oil and gas wells

Table 5-1 lists the relevant NAICS codes for the water transportation, fishing, and mining industries.

Table 5-1: Relevant 2002 NAICS Codes and Descriptions

2002 NAICS Code	Meaning of 2002 NAICS Code
Water Transportation Industry	
4831	Deep Sea, Coastal, and Great Lakes Water Transportation
➢ 483111	Deep Sea Freight Transportation
➢ 483112	Deep Sea Passenger Transportation
➢ 483113	Coastal and Great Lakes Freight Transportation
➢ 483114	Coastal and Great Lakes Passenger Transportation
4832	Inland Water Transportation
➢ 483211	Inland Waterways Freight Transportation
➢ 483212	Inland Waterways Passenger Transportation
4872	Scenic and Sightseeing Transportation, Water
4883	Support Activities for Water Transportation
➢ 488310	Port and Harbor Operations
➢ 488320	Marine Cargo Handling
➢ 488330	Navigational Services to Shipping and Salvage
➢ 488390	Other Support Activities for Water Transportation
Fishing Industry	
1141	Fishing
Mining Industry	
213111	Drilling Oil and Gas Wells sector

Source: U.S. Census Bureau, 2002

5.2.2 Water Transportation

Establishments in the water transportation industry provide water transportation of passengers and cargo using watercraft, such as ships, barges, and boats. The industry is composed of two industry groups: (1) one for deep sea, coastal, and Great Lakes water transportation; and (2) one for inland water transportation. This split typically reflects the difference in equipment used (U.S. Census Bureau, 2002).

Scenic and sightseeing water transportation services are also included under this industry heading, as are support activities for water transportation. These two industry groups are technically classified under different NAICS codes by the Census Bureau, but will be included under water transportation for the purposes of this chapter.

Total waterborne commerce in the United States has increased rather steadily over the past 50 years, fueled mostly by growth in foreign commerce, which overtook domestic shipments (in terms of weight) in the mid-1990s. Foreign commerce accounted for nearly 60 percent of total waterborne commerce by weight in 2005 (USACE, 2005a).

Deep Sea, Coastal, and Great Lakes Water Transportation

This industry group comprises establishments primarily engaged in providing deep sea, coastal, and Great Lakes water transportation, as well as transportation via the St. Lawrence Seaway. Marine transportation establishments using the facilities of the St. Lawrence Seaway Authority Commission are considered to be using the Great Lakes Water Transportation System (U.S. Census Bureau, 2002). Firms in this NAICS grouping are further classified based on their area of operation (deep sea or coastal/Great Lakes) and payload type (cargo or passengers).

The Jones Act of 1920 requires that all domestic waterborne trade (between two points in the United States) be conducted on vessels built in the United States, documented in the United States, and owned by U.S. citizens or companies (Transportation Institute, undated). Thus, many vessels operating in the Coastal and Great Lakes Freight Transportation sector are subject to this law.

Deep Sea Freight Transportation

The businesses in this industry sector are primarily engaged in providing deep sea transportation of cargo to or from foreign ports. This sector encompasses oceangoing barges, oil tankers, and other large freight vessels (U.S. Census Bureau, 2002). A large portion of U.S. foreign trade merchandise (1.2 billion metric tons) is transported via water, making this sector the cornerstone of U.S. international trade (Transportation Institute, undated).

Because of its close relationship to international trade, deep sea freight transportation has been increasing steadily over the past 20 years, driven by increasing imports to the United States from foreign ports. Outbound freight has not grown substantially over this period, now accounting for less than a third of cargo carried between U.S. and foreign ports (USACE, 2005a).

Over the last half-century, the United States' merchant fleet has declined in number, as increasingly strict regulations have prompted the registration of vessels under foreign flags to limit liability. Though the U.S. vessel fleet has shrunk, it has also become more efficient, with today's merchant vessels carrying 40 percent more cargo and requiring fewer crew members (Transportation Institute, undated).

Deep Sea Passenger Transportation

Establishments in this sector are primarily engaged in providing deep sea transportation of passengers to or from foreign ports (U.S. Census Bureau, 2002). The most common type of deep sea passenger transportation is the cruise ship. Starting in the 1990s, there has been a reversal to the decline this industry sector had been facing since the 1960s, with steady growth in the number of passengers over the last 10 years (Cruise Lines International Association, 2006).

Currently, several cruise line corporations are planning additions to their fleets in anticipation of increased demand for cruises in the next decade (Transportation Institute, undated). Cruise Lines International Association indicates that 48 million Americans say they intend to take a cruise in the next three years, nearly double the number that took a cruise in the three preceding years. This industry is thus one of the strongest sources of growth in the water transportation industry, a trend that is expected to continue.

Coastal and Great Lakes Freight Transportation

Firms transporting cargo in coastal waters; the Great Lakes System (including the St. Lawrence Seaway); or deep seas between ports of the United States, Puerto Rico, and U.S. island possessions or protectorates fall into this NAICS code classification (U.S. Census Bureau, 2002).

The vessels in this sector are similar to those used for deep sea freight transport, though less numerous. The majority of the vessels in this sector are barges, though the sector also contains other freight transport vessels, as well as tugboats (Transportation Institute, undated).

Coastal domestic trade to and from Alaska, Hawaii, and U.S. Territories consists mainly of the shipment of petroleum and petroleum products, chemicals, and agricultural products. The primary products transported on the Great Lakes System are coal, limestone, and iron ore (Transportation Institute, undated).

Coastal and Great Lakes freight transportation accounts for about 30 percent of all U.S. domestic waterborne shipments by weight. Great Lakes freight transportation has remained relatively constant over the past 20 years, hovering around 150 million tons per year (approximately two-thirds domestic and one-third foreign cargo). Coastal freight transportation has grown over the same period, from around 1.1 billion tons per year to more than 1.6 billion tons in 2005, as a result of increased foreign shipments (USACE, 2005).

Coastal and Great Lakes Passenger Transportation

This industry sector contains establishments primarily engaged in providing water transportation of passengers in coastal waters, the Great Lakes System (including the St. Lawrence Seaway), or deep seas between ports of the United States, Puerto Rico, and United States island possessions and protectorates. This industry sector includes many coastal and Great Lakes ferries used to travel short distances between coastal ports, or from shores to nearby islands, as well as larger vessels used on the Alaska Marine Highway, which travels between ports on the southern coast of Alaska and northwestern Canada (Reference for Business, 2007c).

Inland Water Transportation

Businesses primarily engaged in providing inland water transportation of passengers and cargo on lakes, rivers, or intracoastal waterways (except on the Great Lakes System) are classified under this NAICS grouping, and are further classified between freight and passenger transportation (U.S. Census Bureau, 2002).

As required by the Jones Act, all vessels in this industry sector are domestic flagged and owned.

Inland Waterways Freight Transportation

The companies in this industry sector are primarily engaged in providing inland water transportation of cargo on lakes, rivers, or intracoastal waterways (except on the Great Lakes System) (U.S. Census Bureau, 2002). This sector contains a large portion of the vessels in the United States, as it encompasses river barges, as well as the tug and towboats that propel them. The vast majority of boats in this sector are barges, which outnumber other inland freight vessels by about 10 to 1 (Transportation Institute, undated).

The products carried by this industry sector include more than half of U.S. grain shipments, a quarter of chemical and petroleum exports, and a fifth of domestic coal shipments (Transportation Institute, undated). Barges account for 79 percent of domestic waterborne freight.

Inland waterways freight transportation, similar to Great Lakes and coastal water transportation, has remained stagnant over the past two decades in terms of total tonnage transported, with a modest increase in the mid-1980s. Nevertheless, it accounts for more than 50 percent of all domestic waterborne freight shipments (U.S. Army Corps of Engineers, 2005).

Inland Waterways Passenger Transportation

This industry sector provides inland water transportation of passengers on lakes, rivers, or intracoastal waterways (except on the Great Lakes System) (U.S. Census Bureau, 2002). This sector includes water taxis and ferries (except coastal and Great Lakes ferries), usually traveling short distances between inland ports, such as in New York harbor or in San Francisco Bay.

The ferry industry has been rebounding from historic lows in the 1970s, and short-distance ferries in urban areas have become alternatives to crowded highways and urban transit systems. In 2000, the 677 ferries operating in the United States served 578 destinations along 352 routes, transporting 113 million passengers (these figures include coastal and Great Lakes ferries) (Reference for Business, 2007c).

Scenic and Sightseeing Transportation, Water

This industry group comprises establishments primarily engaged in providing scenic and sightseeing transportation on water. The services provided are usually local and involve same-day return to place of origin (U.S. Census Bureau, 2002).

This sector encompasses a wide variety of vessel types, from small "swamp buggies" used to tour the Florida Everglades to chartered dinner cruisers to larger whale-watching boats. The range of services offered has continued to expand over the past decade, with gambling boats becoming popular in Indiana and Iowa, and similar gaming "cruises-to-nowhere" becoming popular in Florida (Reference for Business, 2007d).

This leisure-based industry sector is more vulnerable to economic fluctuations, since its revenues draw on discretionary consumer spending.

Support Activities for Water Transportation

This NAICS grouping includes establishments classified in the following NAICS sectors: 48831, Port and Harbor Operations; 48832, Marine Cargo Handling; 48833, Navigational Services to Shipping and Salvage; and 48839, Other Support Activities for Water Transportation (U.S. Census Bureau, 2002).

Businesses in these sectors are the link between a vessel's load (cargo or passengers) and that load's final destination. This sector provides the highest percentage of employment in the industry, as many of these services are labor-intensive.

Port and Harbor Operations

Businesses in this industry sector operate ports, harbors (including docking and pier facilities), or canals (U.S. Census Bureau, 2002). The vessels in this industry sector are likely to be smaller, auxiliary vessels as opposed to the large container ships and barges that they serve.

Marine Cargo Handling

This industry comprises establishments primarily engaged in providing stevedoring and other marine cargo handling services (except warehousing) (U.S. Census Bureau, 2002). This sector contains only a small number of vessels, as most of its business is land-based.

This particular industry sector, along with port and harbor operations, has been growing over the last decade or two as a result of the increase in foreign trade, mostly with Asian countries. Marine cargo handling and port and harbor operations on the Pacific Coast account for about half of all such operations in the United States (Reference for Business, 2007e).

Despite the increase in volume of shipments handled, employment in marine cargo handling, as well as in port and harbor operations, has been on the decline in recent years, due to increased automation of tasks and other technological advances that reduce the need for manual labor. The industry's unions, the International Longshoremen's Association and the International Longshore and Warehouse Union, are nevertheless still strong and maintain high membership rates (Reference for Business, 2007e).

Navigational Services to Shipping and Salvage

This NAICS classification includes two main types of businesses: navigational services to shipping and marine salvage (U.S. Census Bureau, 2002).

Vessels in this industry do not typically carry passengers or cargo, but rather assist larger vessels in entering and leaving port, or in other operations. The salvage subsector of this industry sector includes maintenance vessels that prepare ships for salvage and scrap.

Other Support Activities for Water Transportation

Other auxiliary services of the water transportation industry are grouped into this category, which includes maintenance and repair of vessels, inspections, security, and other operations. The strong growth in this industry between 1997 and 2001 may be attributable to the rapid increase in cargo security since the terrorist attacks of September 11, 2001 (Reference for Business, 2007f).

5.2.3 Fishing[10]

The fishing industry includes commercial catching or taking of finfish, shellfish, or miscellaneous marine products from a natural habitat, such as the catching of bluefish, eels, salmon, tuna, clams, crabs, lobsters, mussels, oysters, shrimp, frogs, sea urchins, and turtles (U.S. Census Bureau, 2002).

Since the 1990s, finfish volume has been declining, due to severely depleted fisheries in the Atlantic and loss of breeding grounds to pollution, as well as to increasingly strict regulations aimed at preventing these problems (Reference for Business, 2007a, b). Demand has not been strong enough to prevent declines in the value of the catches. Shellfish volume has remained relatively constant, with the total value of the catch increasing slightly. Fish and seafood imports have increased over the same period, intensifying the competition in this industry (National Marine Fisheries Service, 2003).

Alaska leads the nation in both volume and value of fish caught, followed by Louisiana in both measures. California ranks third in volume of fish caught, while Massachusetts takes third place in terms of value (National Marine Fisheries Service, 2003).

5.2.4 Mining

The mining industry comprises establishments that extract naturally occurring mineral solids, such as coal and ores; liquid minerals, such as crude petroleum; and gases, such as natural gas. Within the mining industry, the drilling oil and gas wells sector (NAICS 213111) operates vessels covered by the VGP (131 MODUs). This sector comprises establishments primarily engaged in drilling oil and gas wells for others on a contract or fee basis (U.S. Census Bureau, 2002). According to data provided by the IADC, the 131 MODUs covered by the VGP include 5

[10] Vessels subject to the ballast water requirements of the Permit include an estimated 26 commercial fishing vessels.

drillships, 24 semi-submersible units, 5 submersible units, 40 inland barge units, and 57 jackup units (IADC, 2007). Note that these MODUs represent only a very small fraction of the total number of establishments reported overall in the drilling oil and gas wells sector, as described in *Section 5.3.2*.

In the remainder of this report, unless otherwise noted, the term *mining industry* refers more specifically to the drilling oil and gas wells sector within the industry rather than the mining industry as a whole.

5.2.5 Number of Water Transport Vessels by Industry Sector

Table 5-2 summarizes the number of vessels, operators, and average number of vessels per operator[11] for each industry sector in 2005. In this table and in *Table 5-3: Number of Vessels in the WTLUS Database, 2001-2005*, the Deep Sea Freight Transportation and Coastal and Great Lakes Freight Transportation sectors are considered together, due to the difficulties of determining which vessels fall under which NAICS code based on the information provided by the VESDOC and WTLUS databases. The same is true for the Deep Sea Passenger Transportation and Coastal and Great Lakes Passenger Transportation sectors. The distinctions between these industry sectors will be maintained for the rest of this analysis.

There were approximately 90,000 commercial vessels operating in U.S. waters in 2005. Of these, more than 32,000 were involved in inland water transportation, which includes barges, ferries, and water taxis. The inland water transportation industry group, along with the marine cargo handling industry group, contain the highest concentration of vessels per operator, approximately 26 and 27, respectively. This may be due to the fact that each barge counts as a separate vessel and a single barge company may own a large number of barges.

In sum, passenger transportation vessels accounted for about 11,000 vessels, freight transportation for about 38,000, and support activities for the remaining 12,000 vessels classified under the water transportation industry. Fishing vessels made up the majority of the remainder of commercial vessels, with nearly 29,000.[12] Mobile offshore drilling units accounted for 131 vessels.

Table 5-2: Number of Vessels and Operators by Industry Sector, 2005

Industry Sector	Total Number of Vessels	Number of Vessels With an Operator Name Listed	Number of Operators	Average Number of Vessels per Operator
Water Transportation Industry				
Deep Sea, Coastal, and Great Lakes Water Transportation				
Deep Sea, Coastal, and Great Lakes Freight Transportation	7,768	5,831	1,073	5
Deep Sea, Coastal, and Great Lakes Passenger Transportation	9,128	4,558	3,678	1
Subtotal-Deep sea, Coastal, and Great Lakes	**16,896**	**10,389**	**4,751**	**2**
Inland Water Transportation				
Inland Waterways Freight Transportation	30,482	30,088	1,141	26
Inland Waterways Passenger Transportation	1,674	948	686	1
Subtotal-Inland	**32,156**	**31,036**	**1,827**	**17**
Scenic and Sightseeing Transportation, Water				
Scenic and Sightseeing Transportation, Water	546	417	146	3

[11] The number of operators is based on unique companies that own and operate each vessel, as indicated in the vessels databases.

[12] However, the overwhelming majority of fishing vessels must not obtain coverage under the VGP. Only 26 commercial fishing vessels are estimated to potentially need to obtain coverage for ballast water under this permit.

Table 5-2: Number of Vessels and Operators by Industry Sector, 2005				
Industry Sector	**Total Number of Vessels**	**Number of Vessels With an Operator Name Listed**	**Number of Operators**	**Average Number of Vessels per Operator**
Support Activities for Water Transportation				
Port and Harbor Operations	3,402	3,213	1,095	3
Marine Cargo Handling	182	183	7	27
Navigational Services to Shipping and Salvage	7,315[a]	6,468	2,252	3
Other Support Activities for Water Transportation	1,001[a]	586	545	1
Subtotal-Support Activities	**11,900**	**10,867**	**4,045**	**3**
TOTAL-Water Transportation	**61,498[b]**	**52,2**	**10,623**	**5**
Fishing Industry				
Fishing	28,867[c]	6,709	5,833	1
Mining Industry				
Mobile Offshore Drilling Units	131[d]	118	35	3

a One vessel in Navigational Services to Shipping and Salvage sector and 925 vessels in Other Support Activities for Water Transportation sector are considered recreational vessels and are not included in the universe of vessels subject to VGP.
b The total number of vessels reported for the water transportation industry excludes 340 vessels that could not be assigned to a specific NAICS sector.
c While there are 28,867 commercial fishing vessels in total, only 26 conduct either ballast water exchange or saltwater flushing.
d Number obtained from IADC comments submitted to EPA in August 2007.
Source: U.S. Army Corps of Engineers, 2005d; U.S. Coast Guard, 2007a

5.3 Recent Trends

This section reviews the recent trends in the water transportation and fishing industries in terms of number of firms, numbers of vessels, and financial performance. It also highlights trends in the drilling oil and gas wells sector of the mining industry.

Overall, there were slight upward trends in the water transportation industry in terms of number of vessels, firms, and total revenues; however, the fishing industry experienced declines in the number of firms and in revenues (no data were available for its number of vessels). The drilling oil and gas wells sector experienced relatively strong firm, revenue, and employment growth.

The reference period is from 1997 through 2002, the years of the two most recent Economic Censuses, except for the number of vessels. Changes in the number of vessels are measured between 2001 and 2005, the largest range of years available for these data. There were no changes to the NAICS codes for these industries between these years.

Employment, establishment, and payroll data for the Fishing Industry are from 1998, as 1997 data was classified by SIC code and was not comparable. Where Fishing Industry data was not available from the Census Bureau, it was taken from the SBA.

5.3.1 Number of Vessels by Industry Sector

Table 5-3 shows changes in the number of vessels in the 2001 and 2005 versions of the WTLUS database.[13] Over this period, the WTLUS database recorded a loss of 1.1 percent in the total number of vessels. Though most sectors of the water transportation industry actually experienced increases in the number of vessels, inland water freight transportation, the sector with the largest number of vessels (as it accounts for a large number of barges), lost more than 1,000 vessels over this period.

[13] These vessel totals only include vessels in the WTLUS database, and do not encompass those vessels listed only in VESDOC. A version of VESDOC was not available for 2001.

The number of deep sea, coastal, and great lakes passenger transportation vessels (including cruise ships) grew by 143, an increase of more than 20 percent. Scenic and sightseeing transportation added 125 new vessels over this period, for a nearly 40 percent increase. Port and harbor operations and navigational services to shipping and salvage both added more than 350 vessels to their ranks, representing increases of 26 percent and 8 percent, respectively.

Table 5-3: Number of Vessels in the WTLUS Database, 2001-2005

Industry Sector	2001	2005	% Change
Water Transportation Industry			
Deep Sea, Coastal, and Great Lakes Water Transportation			
Deep Sea, Coastal, and Great Lakes Freight Transportation	4,779	5,083	6.4%
Deep Sea, Coastal, and Great Lakes Passenger Transportation	678	821	21.1%
Subtotal-Deep Sea, Coastal, and Great Lakes	**5,457**	**5,904**	**8.2%**
Inland Water Transportation			
Inland Waterways Freight Transportation	28,338	27,239	-3.9%
Inland Waterways Passenger Transportation	242	267	10.3%
Subtotal- Inland	**28,580**	**27,506**	**-3.8%**
Scenic and Sightseeing Transportation, Water			
Scenic and Sightseeing Transportation, Water	333	458	37.5%
Support Activities for Water Transportation			
Port and Harbor Operations	1,389	1,753	26.2%
Marine Cargo Handling	73	86	17.8%
Navigational Services to Shipping and Salvage	4,868	5,251	7.9%
Other Support Activities for Water Transportation	19	15	-21.1%
Subtotal-Support Activities	**6,349**	**7,105**	**11.9%**
TOTAL-Water Transportation[a]	**41,481**	**41,028**	**-1.1%**

Source: U.S. Army Corps of Engineers, 2001 and 2005d.
Note: Data for the number of fishing vessels in 2001 were not available.
a Totals include vessels for which no NAICS code could be determined.

5.3.2 Number of Establishments by Industry Sector

Table 5-4 summarizes the changes in numbers of establishments for each sector of the water transport, fishing, and mining industries between 1997 and 2002. The water transportation industry experienced a slight increase of 0.2 percent in the number of establishments over this period, though several sectors, notably deep sea freight transportation, inland waterways freight transportation, and navigational services to shipping and salvage, saw a decline in the number of establishments. The increase is less dramatic than the overall U.S. increase of 4.4 percent in the number of establishments over this period (U.S. SBA, 2004).

The largest increase in the number of establishments was in port and harbor operations, with a nearly 39 percent change in the number of establishments over the five-year period.

Deep sea passenger transportation, which includes cruise ships, also grew by about 9 percent in number of establishments, and inland waterways passenger transportation experienced a 17 percent increase in this area. The drilling oil and gas wells sector experienced an 18.3 percent increase in the number of establishments.

Conversely, the fishing industry experienced a decline of 9.3 percent in the number of establishments between 1998 and 2002.

Table 5-4: Number of Establishments by Industry Sector, 1997 and 2002

NAICS Description	1997	2002	% Change
Water Transportation Industry			
Deep Sea, Coastal, and Great Lakes Water Transportation			
Deep Sea Freight Transportation	487	456	-6.4%
Deep Sea Passenger Transportation	80	87	8.8%
Coastal and Great Lakes Freight Transportation	616	677	9.9%
Coastal and Great Lakes Passenger Transportation	125	114	-8.8%
Subtotal-Deep Sea, Coastal, Great Lakes	**1,308**	**1,334**	**2.0%**
Inland Water Transportation			
Inland Waterways Freight Transportation	383	321	-16.2%
Inland Waterways Passenger Transportation	230	269	17.0%
Subtotal Inland	**613**	**590**	**-3.8%**
Scenic and Sightseeing Transportation			
Scenic and Sightseeing Transportation, Water	1,692	1,726	2.0%
Support Activities for Water Transportation			
Port and Harbor Operations	168	233	38.7%
Marine Cargo Handling	623	567	-9.0%
Navigational Services to Shipping and Salvage	865	778	-10.1%
Other Support Activities for Water Transportation	869	924	6.3%
Subtotal-Support Activities	**2,525**	**2,502**	**-0.9%**
TOTAL-Water Transportation	**6,138**	**6,152**	**0.2%**
Fishing Industry			
Fishing	2,113	1,916	-9.3%
Mining Industry			
Drilling oil & gas wells sector	1,628	1,926	18.3%

Source: U.S. Census Bureau, 1997, 1998, 2002a, 2002b

5.3.3 Establishment and Employment Births and Deaths

Table 5-5 summarizes average establishment birth and death rates for each industry sector for which these data were available. The reference period for these trends is 1998–2003, as data before 1998 are classified according to the Standard Industry Classification (SIC) system. Average birth and death rates in the water transportation, fishing, and mining industries fall between 10 and 15 percent of their total numbers of establishments.[14]

In general, deaths outnumber births over this period for all water transportation industry sectors except for inland water transportation, where the average net change was close to five establishment births per year. The largest average net change came in support activities for water transportation, with an average of nearly 25 establishment deaths per year.

The fishing industry averaged a net change of close to two establishment births per year between 1998 and 2003, while the support activities for mining sector averaged a net change of nearly 46 establishment births per year between 1998 and 2003.

[14] For the mining industry, the fraction is based on births and deaths relative to the 9,104 establishments reported in the 2002 Economic Census for NAICS 213 – Support activities for mining. According to the 2002 Economic Census, the drilling oil and gas wells sector (NAICS 213111) represented about a fifth (1,926 establishments) of the establishments reported in the support activities for mining sector (NAICS 213) that year.

Table 5-5: Establishment Births and Deaths, Five-Year Annual Average: 1998–2003

Industry Sector	Net Change	Births	Deaths
Water Transportation Industry			
Deep Sea, Coastal, and Great Lakes Water Transportation	-19.0	122.8	141.8
Inland Water Transportation	4.8	67.7	62.8
Scenic and Sightseeing Transportation, Water	-13.7	171.5	185.2
Support Activities for Water Transportation	-24.5	203.0	227.5
Water Transportation Industry Average	-13.3	141.3	154.3
Fishing Industry			
Fishing	1.7	227.3	225.7
Mining Industry			
Support Activities for Mining[a]	45.5	985.0	939.5

a Data were only available for NAICS 213 (Support Activities for Mining) and were not available at the 6-digit NAICS level. The 2002 Economic Census reports 9,104 establishments in NAICS 213.

Source: U.S. SBA, 2004

Table 5-6 summarizes the net change in employment (difference between births and deaths) for each industry sector for which these data are available. Specific information on job creation and elimination was not available for many industry sectors.

Of the water transportation industry sectors, deep sea, coastal, and Great Lakes water transportation averaged the largest change in employment per year, with an average of 665 jobs eliminated per year. Scenic and sightseeing transportation also averaged more than 500 jobs eliminated per year between 1998 and 2003. Inland water transportation and support activities for water transportation averaged net job creation rates of 136 and 156 employees per year, respectively.

The fishing industry averaged a reduction of 130 jobs per year over the same period whereas the support activities for mining sector (NAICS 213) averaged an increase of nearly 3,095 jobs per year. According to the 2002 Economic Census, the drilling oil and gas wells sector (NAICS 213111) accounts for about a third of paid employees reported overall in the support activities for mining sector (NAICS 213) (60,450 paid employees as compared to 181,199 paid employees).

Table 5-6: Net Change in Employment: Five-Year Annual Average, 1998-2003

Industry Sector	Net Change
Water Transportation Industry	
Deep Sea, Coastal, and Great Lakes Water Transportation	-665.0
Inland Water Transportation	136.4
Scenic and Sightseeing Transportation, Water	-517.0
Support Activities for Water Transportation	156.2
Water Transportation Industry Average	-222.4
Fishing Industry	
Fishing	-129.4
Mining Industry	
Support Activities for Mining[a]	3,094.7

a Data were only available for NAICS 213 (Support Activities for Mining) and were not available at the 6-digit NAICS level. The number of paid employees reported for NAICS 213 in the 2002 Economic Census is 181,199.

Source: U.S. SBA, 2004

5.3.4 *Financial Performance*

Overall, the water transportation industry experienced growth of almost 4 percent over the period 1997–2002 (see *Table 5-7),* which is less robust than the overall U.S. economy's growth of nearly 25 percent during this period (U.S. Bureau of Economic Analysis, 2007). There was much variability in the performance of the various industry sectors, with revenues dropping by 41 percent in deep sea freight transportation and by 37 percent in inland waterways freight transportation.

Conversely, deep sea passenger transportation, which encompasses cruise ships, posted the strongest growth throughout this period, more than doubling revenues in the five years from 1997 to 2002. Revenues for inland waterways passenger transportation also increased by 22 percent over this period.

Revenues from freight and passenger transportation in the Great Lakes increased by 20 percent and 17 percent, respectively.

In the fishing industry, revenues declined by nearly 5 percent over the same period. Fishing industry data are from the U.S. Small Business Administration because they are not included in the Economic Census.

The drilling oil and gas wells sector experienced an increase of 24.3 percent over the same period.

Table 5-7: Revenues by Industry Sector, 1997 and 2002

Industry Sector	1997 ($ millions)	2002 ($ millions)	Percent Change
Water Transportation Industry			
Deep Sea, Coastal, and Great Lakes Water Transportation			
Deep Sea Freight Transportation	11,571	6,731	-41.8%
Deep Sea Passenger Transportation	3,908	8,081	106.8%
Coastal and Great Lakes Freight Transportation	4,678	5,607	19.9%
Coastal and Great Lakes Passenger Transportation	182	212	16.6%
Subtotal-Deep Sea, Coastal, and Great Lakes	**20,339**	**20,631**	**1.4%**
Inland Water Transportation			
Inland Waterways Freight Transportation	3,387	2,134	-37.0%
Inland Waterways Passenger Transportation	293	359	22.3%
Subtotal-Inland	**3,680**	**2,493**	**-32.3%**
Scenic and Sightseeing Transportation, Water			
Scenic and Sightseeing Transportation, Water	1,129	964	-14.6%
Support Activities for Water Transportation			
Port and Harbor Operations	889	1,463	64.5%
Marine Cargo Handling	4,456	4,748	6.5%
Navigational Services to Shipping and Salvage	1,513	2,150	42.1%
Other Support Activities for Water Transportation	656	1,441	119.6%
Subtotal-Support activities	**7,515**	**9,801**	**30.4%**
TOTAL-Water Transportation	**32,663**	**33,890**	**3.8%**
Fishing Industry			
Fishing[a]	1,739	1,655	-4.8%
Mining Industry			
Drilling oil & gas wells sector	7,298	9,069	24.3%

Source: U.S. Census Bureau, 1997, 2002b; U.S. SBA, 1997, 2002b
a 1997 Fishing revenue data according to SIC code, which also included plant aquaculture. Percent change is thus exaggerated.

5.4 Industry Market Structure

The water transportation and fishing industries, and the drilling oil and gas wells segment of the mining industry are comprised of a large number of small businesses, whether classified by employment size or by annual revenues. The vast majorities of firms in these industries employ fewer than 100 people and earn revenues of less than $1 million per year.

This large concentration of small firms earning relatively low amounts of revenue may make the water transportation and fishing industries, and the drilling oil and gas wells segment of the mining industry more sensitive to changes in operating costs.

5.4.1 Firms and Revenues

Table 5-8 details the number of firms and revenues by employment size in 2002. In the water transportation industry, 56 percent of firms employ fewer than 20 people, though these firms only account for 7 percent of the industry’s revenue. Large firms employing more than 500 people, on the other hand, account for only 1 percent of businesses in the industry, but earn nearly half of its revenue.

The fishing industry also contains a large percentage of firms employing fewer than 20 people (60 percent), though in this industry they account for a larger share of total industry revenue (36 percent). The large firms in the fishing industry account for less than 1 percent of total firms, and earn 15 percent of the industry’s revenue.

The drilling oil and gas wells sector contains an even larger percentage of firms employing fewer than 20 people (72 percent) but these firms account for a much smaller share of total industry revenue (11 percent). The large firms in this sector account for approximately 2 percent of total firms, and earn 50 percent of the sector’s revenue. Firms not operating the entire year do not report employment data, and are classified under “NR” in the table. There are large numbers of these in both the water transportation and fishing industries, and about 11 percent in the drilling oil and gas wells sector.

Table 5-8: Firms and Revenues by Employment Size, 2002										
	Number of Firms					Revenues ($ millions)				
Number of Employees	**1-19**	**20-99**	**100-499**	**500+**	**NR**	**1-19**	**20-99**	**100-499**	**500+**	**NR**
Water Transportation										
Deep Sea, Coastal, and Great Lakes Water Transportation										
Deep Sea Freight Transportation	127	42	20	6	35	$478	$1,492	$2,636	$0	$29
Deep Sea Passenger Transportation	52	8	6	4	13	$63	$57	$461	$7,333	$5
Coastal and Great Lakes Freight Transportation	274	108	40	8	64	$468	$802	$1,904	$1,853	$38
Coastal and Great Lakes Passenger Transportation	46	21	5	1	36	$39	$116	$0	$0	$18
Subtotal-Deep Sea, Coastal, Great Lakes	**493**	**174**	**69**	**17**	**148**	**$959**	**$2,411**	**$5,084**	**$11,243**	**$90**
Inland Water Transportation										
Inland Waterways Freight Transportation	148	53	29	6	66	$66	$379	$1,019	$0	$50
Inland Waterways Passenger Transportation	138	24	6	0	63	$304	$88	$0	$0	$13
Subtotal-Inland	**286**	**77**	**35**	**6**	**129**	**$194**	**$468**	**$1,220**	**$0**	**$62**
Scenic and Sightseeing Transportation, Water										
Scenic and Sightseeing Transportation, Water	882	112	10	2	708	$304	$332	$103	$0	$160
Support Activities for Water Transportation										
Port and Harbor Operations	95	29	15	1	26	$141	$296	$0	$0	$33
Marine Cargo Handling	175	85	37	17	55	$202	$623	$890	$2,568	$49
Navigational Services to Shipping and Salvage	461	85	23	1	117	$396	$588	$299	$0	$45
Other Support Activities for Water Transportation	467	93	14	5	106	$233	$425	$350	$0	$18
Subtotal-Support activities	**1,198**	**292**	**89**	**24**	**304**	**$937**	**$1,806**	**$2,150**	**$3,777**	**$142**
TOTAL-Water Transportation	**2,859**	**655**	**203**	**49**	**1,289**	**$2,395**	**$5,016**	**$8,557**	**$15,020**	**$454**
Percentage of Industry	**56%**	**13%**	**4%**	**1%**	**25%**	**7%**	**15%**	**26%**	**45%**	**1%**
Fishing										
Fishing	1145	41	12	7	696	$593	$309	$327	$241	$185
Percentage of Industry	**60%**	**2%**	**0.6%**	**0.4%**	**37%**	**36%**	**19%**	**20%**	**15%**	**11%**
Mining Industry										
Drilling oil & gas wells sector	1,084	178	44	34	164	554	957	995	2,543	37
Percentage of Sector	**72%**	**12%**	**3%**	**2%**	**11%**	**11%**	**19%**	**20%**	**50%**	**1%**

Source: U.S. Census Bureau, 2002b; U.S. SBA, 2002a

Table 5-9 details the number of firms according to annual revenue in each sector of the water transportation, fishing, and mining industries. In the water transportation industry, firms earning less than $1 million per year account for 65 percent of the industry's firms, and firms earning between $1 and $5 million add another 21 percent. A large majority (86 percent) of firms are thus earning revenues less than $5 million.

In the fishing industry, this trait is even more pronounced, with 90 percent of all firms earning less than $1 million in revenues, and 99 percent earning less than $5 million.

In the drilling oil and gas wells segment of the mining industry, 77 percent of all firms earn less then $1 million in revenues and approximately 95 percent earn less than $5 million.

Table 5-9: Number of Firms According to Revenue Size

	Number of Firms				
Revenues (millions of dollars)	**<1**	**1-5**	**5-25**	**25-100**	**100+**
Water Transportation					
Deep Sea, Coastal, and Great Lakes Water Transportation					
Deep Sea Freight Transportation	67	50	36	23	19
Deep Sea Passenger Transportation	34	22	5	3	6
Coastal and Great Lakes Freight Transportation	212	108	71	29	10
Coastal and Great Lakes Passenger Transportation	36	22	14	1	0
Subtotal-Deep Sea, Coastal, and Great Lakes	**349**	**202**	**126**	**56**	**35**
Inland Water Transportation					
Inland Waterways Freight Transportation	115	59	37	18	7
Inland Waterways Passenger Transportation	124	33	8	3	0
Subtotal-Inland	**239**	**92**	**45**	**21**	**7**
Scenic and Sightseeing Transportation, Water					
Scenic and Sightseeing Transportation, Water	851	122	30	3	0
Support Activities for Water Transportation					
Port and Harbor Operations	61	43	27	6	3
Marine Cargo Handling	133	96	56	18	11
Navigational Services to Shipping and Salvage	384	119	53	13	1
Other Support Activities for Water Transportation	423	108	38	7	3
Subtotal-Support	**1001**	**366**	**174**	**44**	**18**
TOTAL-Water Transportation	**2440**	**782**	**375**	**124**	**60**
Percentage of Industry	**65%**	**21%**	**10%**	**3%**	**2%**
Fishing Industry					
Fishing	1674	169	26	13	10
Percentage of Industry	**90%**	**9.0%**	**1.4%**	**0.7%**	**0.5%**
Mining Industry					
Drilling oil & gas wells sector	1,087	251	72	12	32
Percentage of Sector	**77%**	**18%**	**5%**	**1%**	**2%**

Source: U.S. Census Bureau 2002b; U.S. SBA, 2002b

5.4.2 *Small Businesses*

The U.S. SBA defines small businesses for the various sectors of these industries as follows:

- Deep sea, coastal, and Great Lakes water transportation; inland water transportation – fewer than 500 employees
- Scenic and sightseeing transportation; navigational services to shipping and salvage; other support activities for water transportation – revenues less than $7 million
- Port and harbor operations; marine cargo handling – revenues less than $25.5 million

- Fishing – revenues less than $4 million
- Drilling oil and gas wells sector – fewer than 500 employees (U.S. SBA, 2008).

Table 5-10 summarizes the number of small businesses in each sector of the water transportation, fishing, and mining industries. On the whole, all industries contain more than 90 percent small businesses. Inland waterways freight transportation, the industry sector encompassing barges, has the lowest number of small businesses, which may also contribute to its high number of vessels per establishment.

These percentages were calculated based on the number of firms operating the entire year, as employment figures are not available for firms operating only part of the year.

Table 5-10: Small Businesses by Industry Sector

Industry Sector	Small Business Threshold	Firms Operated Entire Year	Small Businesses	Percent Small Business
Water Transportation Industry				
Deep Sea, Coastal, and Great Lakes Water Transportation				
Deep Sea Freight Transportation	500 Employees	195	189	96.9%
Deep Sea Passenger Transportation	500 Employees	70	66	94.3%
Coastal and Great Lakes Freight Transportation	500 Employees	430	422	98.1%
Coastal and Great Lakes Passenger Transportation	500 Employees	73	72	98.6%
Subtotal-Deep Sea, Coastal, and Great Lakes		**768**	**749**	**97.5%**
Inland Water Transportation				
Inland Waterways Freight Transportation	500 Employees	278	230	82.7%
Inland Waterways Passenger Transportation	500 Employees	168	168	100.0%
Subtotal-Inland		**446**	**398**	**89.2%**
Scenic and Sightseeing Transportation, Water				
Scenic and Sightseeing Transportation, Water	$7 million	1006	989	98.3%
Support Activities for Water Transportation				
Port and Harbor Operations	$25.5 million	140	131	93.6%
Marine Cargo Handling	$25.5 million	314	285	90.8%
Navigational Services to Shipping and Salvage	$7 million	570	526	92.3%
Other Support Activities for Water Transportation	$7 million	579	545	94.1%
Subtotal-Support Activities		**1603**	**1487**	**92.8%**
TOTAL-Water Transportation		**5037**	**4770**	**94.3%**
Fishing Industry				
Fishing	$4 million	1916	1843	96.2%
Mining Industry				
Drilling oil & gas wells sector	500 Employees	1504	1470	97.7%

Source: U.S. Census Bureau, 2002b; U.S. SBA, 2002a

5.4.3 Employment and Payroll

Employment in the water transportation and fishing industries declined over the period between 1997 and 2002, by 8 percent and 9 percent, respectively (see *Table 5-11).* However, payroll in both industries managed to increase despite this decline in employment numbers. The only exception is the marine cargo handling sector, where payroll dropped by 25 percent. Employment and payroll in the drilling oil and gas wells sector increased by 14 percent and 31 percent, respectively, over the same period.

In all industry sectors where employment and payroll both decreased, changes in payroll were less extreme than changes in employment, implying that the employees remaining in the industry saw an increase in the average salary. The only exception is the marine cargo handling sector, where payroll dropped by 25 percent while employment dropped by 22 percent.

Total Number of Employees by Industry Sector

In 2002, the water transportation industry employed about 146,000 people. Nearly half of these people were employed by businesses providing support activities for water transportation. Another third worked in the deep sea, coastal, and Great Lakes water transportation sector, with the remaining 20 percent being split almost evenly between inland water transportation and scenic and sightseeing transportation on water. The fishing industry employed about 6,500 people in 2002, while the drilling oil and gas wells employed about 60,500 people.

Overall, the water transportation industry saw an 8.2 percent decline in its number of employees between 1997 and 2002. The fishing industry experienced a similar decline in employment of 9.3 percent. This contrasts with the increase in employment of 14.4 percent in the drilling oil and gas wells sector and the overall 6.7 percent increase in employment in the U.S. economy (U.S. SBA, 2004).

The largest drops in employment numbers came in deep sea freight transportation and inland waterways freight transportation, industry sectors that also experienced revenue declines over this period. Scenic and sightseeing transportation on water, which also experienced a decline in revenue, had a milder decrease of 18.5 percent in employment.

Despite its strong performance in terms of revenues, deep sea passenger transportation employed 6.3 percent fewer people in 2002 than in 1997.

The strongest growth in employment came from other support activities for water transportation, which more than doubled its number of employees between 1997 and 2002. This sector now accounts for nearly 9 percent of all employees in the water transportation industry.

Table 5-11: Employment by Industry Sector, 1997-2002

Meaning of 2002 NAICS code	1997 Number of Employees	2002 Number of Employees	Percent Change
Water Transportation Industry			
Deep Sea, Coastal, and Great Lakes Water Transportation			
Deep Sea Freight Transportation	18,542	13,803	-25.6%
Deep Sea Passenger Transportation	12,266	11,491	-6.3%
Coastal and Great Lakes Freight Transportation	21,690	24,333	12.2%
Coastal and Great Lakes Passenger Transportation	1,802	2,382	32.2%
Subtotal-Deep Sea, Coastal, and Great Lakes	**54,300**	**52,009**	**-4.2%**
Inland Water Transportation			
Inland Waterways Freight transportation	15,663	10,040	-35.9%
Inland Waterways Passenger Transportation	2,894	3,277	13.2%
Subtotal-Inland	**18,557**	**13,317**	**-28.2%**
Scenic and Sightseeing Transportation, Water			
Scenic and Sightseeing Transportation, Water	14,185	11,557	-18.5%
Support Activities for Water Transportation			
Port and Harbor Operations	6,802	5,593	-17.8%
Marine Cargo Handling	48,463	37,707	-22.2%
Navigational Services to Shipping and Salvage	10,800	13,157	21.8%
Other Support Activities for Water Transportation	6,415	13,112	104.4%
Subtotal-Support activities	**72,480**	**69,569**	**-4.0%**
TOTAL-Water Transportation	**159,522**	**146,452**	**-8.2%**

Table 5-11: Employment by Industry Sector, 1997-2002			
Meaning of 2002 NAICS code	**1997 Number of Employees**	**2002 Number of Employees**	**Percent Change**
Fishing Industry			
Fishing	7,206	6,537	-9.3%
Mining Industry			
Drilling oil & gas wells sector	52,858	60,450	14.4%
Source: U.S. Census Bureau, 1997, 1998, 2002a, 2002b			

Payroll by Industry Sector

Despite the decreases in employment between 1997 and 2002, payroll in the water transportation and fishing industries rose by 3 percent and 0.2 percent, respectively, over the same period (see *Table 5-12).* The drilling oil and gas wells sector saw increases in both employment and payroll, with payroll increasing by 31.0 percent.

In general, those sectors that experienced a decline in employment also saw lower payrolls. Two notable exceptions are deep sea passenger transportation, which increased its payroll by 17 percent while having 6 percent fewer employees, and port and harbor operations, which saw a mild 2.5 percent increase in payroll while employment declined by nearly 18 percent.

The fishing industry's payroll rose by a modest 0.2 percent, despite a relatively large 9.3 percent decrease in its employment base.

Table 5-12: Payroll by Industry Sector, 1997-2002			
Industry Sector	**1997 Annual Payroll ($ millions)**	**2002 Annual Payroll ($ millions)**	**Percent Change**
Water Transportation Industry			
Deep Sea, Coastal, and Great Lakes Water Transportation			
Deep Sea Freight Transportation	$842	$735	-12.7%
Deep Sea Passenger Transportation	$380	$445	16.9%
Coastal and Great Lakes Freight Transportation	$925	$1,189	28.4%
Coastal and Great Lakes Passenger Transportation	$50	$69	37.9%
Subtotal-Deep sea, Coastal, and Great Lakes	**$2,198**	**$2,438**	**10.9%**
Inland Water Transportation			
Inland Waterways Freight Transportation	$552	$482	-12.8%
Inland Waterways Passenger Transportation	$84	$112	33.8%
Subtotal-Inland	**$637**	**$594**	**-6.6%**
Scenic and Sightseeing Transportation, Water			
Scenic and Sightseeing Transportation, Water	$283	$267	-5.7%
Support Activities for Water Transportation			
Port and Harbor Operations	$238	$244	2.5%
Marine Cargo Handling	$1,941	$1,452	-25.2%
Navigational Services to Shipping and Salvage	$377	$577	53.2%
Other Support Activities for Water Transportation	$207	$491	136.9%
Subtotal-Support activities	**$2,763**	**$2,764**	**0.03%**
TOTAL-Water Transportation	**$5,880**	**$6,063**	**3.1%**

Table 5-12: Payroll by Industry Sector, 1997-2002

Industry Sector	1997 Annual Payroll ($ millions)	2002 Annual Payroll ($ millions)	Percent Change
Fishing Industry			
Fishing	$252	$253	0.2%
Mining Industry			
Drilling oil & gas wells sector	$1,901	$2,491	31.0%

Source: U.S. Census Bureau, 1997, 1998, 2002a, 2002b

6 Cost of Best Management Practices

6.1 Summary

The first step in assessing costs of the new NPDES permitting requirements was determining the population of vessels that will be affected by the Permit. As detailed in *Section **3**,* the total population of domestic vessels is 61,069[15], and the total population of foreign vessels is 7,927.[16] NPDES requirements for discharges incidental to the normal operation of a vessel will impact virtually every non-military vessel in use in a capacity of transportation entering U.S. territorial waters. However, some vessels will be subject only to certain BMPs because some discharges are not applicable to all vessel types. For example, practices associated with graywater discharges are not applicable to barges since this vessel class does not produce this type of discharge. Practices associated with aqueous film-forming foam (AFFF) discharges are only applicable to some utility vessels and to freight and tank ships since other vessel classes do not have a firefighting system.

To estimate the effect of the Permit on the industry as a whole, a baseline must be identified from which to measure this effect. The baseline takes into account previous conditions and determines how the industry would act in the future in the absence of the Permit. The baseline for this analysis is full industry compliance with existing federal and state regulations; and current industry practices or standards that exceed current regulations to the extent that they can be empirically observed.

A number of laws and associated regulations (including NISA; APPS; the Comprehensive Environmental Response, Compensation, and Liability Act; the Organotin Anti-fouling Paint Control Act; and others) already cover certain discharges that would be subject to the new permitting regime. In analyzing economic impacts of the Vessel Vacatur of the NPDES requirements, EPA has assumed that the entities subject to existing regulations will not incur significant incremental costs.

The second step in assessing costs of the new NPDES permitting requirements is establishing per-vessel (or per-firm) costs for each BMP. The majority of these costs are derived from industry communication and survey responses. Additional cost inputs are also derived from manufacturers, field experts, and the NBIC database for the ballast water cost analysis. Per-vessel costs are established for the BMP categories in which vessels are expected to incur incremental costs. The annual per-vessel cost of each BMP is estimated based on the per-instance cost of performing each practice the number of times per year the BMP needs to be performed.

Several BMP categories were not analyzed for incremental costs because (1) the industry is already practicing these BMPs or (2) the expected cost of the relevant BMP is negligible.

Finally, the total annual cost per BMP category is estimated by multiplying the BMP cost per vessel by the number of vessels expected to incur incremental costs due to the Permit requirements.

6.2 Cost of Individual BMPs

Most of the BMPs involve a change in customary operating practices and additional labor hours. For these BMPs, EPA has used labor rates and hourly estimates provided by the questionnaire responses to estimate the total cost for the specific BMP. If any of the BMPs have more specific requirements (e.g., involving equipment purchase

[15] There are 28,875 commercial fishing vessels within the vessel databases. However, only 26 of these vessels actual incur costs due to ballast water exchange/flushing requirements.

[16] Due to congressional action that took place in July 2008 (Senate bill S. 2766 and 3298, described in Section 2.1), the estimated vessel universe covered by the final VGP *decreased* from the proposed VGP. This final VGP economic analysis reflects this smaller universe of vessels.

and use) these costs have also been added to the labor-based cost estimates. Most of the cost estimates for the individual BMPs are dependent upon industry communications; some are also derived from outside research as well as additional data sources. EPA contacted four industry associations for information regarding population estimates, current practices, and estimated costs.[17] The four industries contacted represent (1) passenger vessels, (2) towing vessels and barges, (3) freight and tank ships, and (4) cruise ships. The population of vessels that are subject to each BMP within a discharge category is dependent upon the type of vessel and whether certain vessels already practice the BMPs required by the Permit. Personnel from different industry organizations provided information regarding which discharge categories were applicable to their member vessel types. Every category of vessel is accounted for by an industry representative. Furthermore, survey responses have determined the percentage of vessels that already practice a specific BMP requirement within all discharge categories.

The following analysis of BMP costs (including per vessel cost and the population of vessels expected to incur additional costs) relies on industry survey responses and additional information from manufacturers and field experts. Appendix A provides a copy of the questionnaire administered to the industry representatives. Appendix B summarizes industry responses.

6.2.1 Discharges of Deck Washdown and Runoff and Above Water Line Hull Cleaning

Affected Vessel Population

Based on the description of practices within this discharge category, deck washdown and runoff is potentially applicable to 61,043 vessels.[18]

Based on review of public comment documents from the June 2007 EPA information request and preliminary survey responses sent out for this economic analysis, vessels already generally practice the BMPs listed below. The American Waterways Operators, an industry organization representing barges and towing vessels, provided information regarding vessel practices within the public comments. All their member tank barges currently use drip pans on machinery, and all perform drip pan cleaning and/or draining. Furthermore, towing vessels currently clear decks of debris, garbage, residue, and spills before conducting deck washdowns, and all currently use environmentally friendly cleaners. Additionally, based on preliminary responses from industry representatives, most deck runoff BMPs are already practiced by other vessels: (1) deck cleanup is currently performed prior to deck washdowns, and (2) passenger vessels are assumed to practice deck cleanup prior to departing from port. However, most towing vessel/barge companies responded that it is not as common to perform deck cleanup prior to departing from port.

The population potentially affected by BMPs applicable to the deck runoff discharge category is shown in *Table 6-1*. Note that utility vessels include the 131 MODUs operating within the drilling oil and gas wells sector of the mining industry.

[17] EPA also contacted the commercial fishing industry for information necessary for the proposal Economic Analysis. However, since commercial fishing vessels are not subject to the final Permit (except for ballast water requirements, for which information was gathered from the NBIC database and not from industry surveys), the commercial fishing industry responses are not included within this final Economic Analysis.

[18] The total excludes the 26 commercial fishing vessels.

Table 6-1: Vessel Counts for BMPs Applicable to Deck Runoff

Vessel Class	Vessel Count
Freight Barges	32,842
Freight Ships	697
Passenger Vessels	11,521
Tank Barges	4,944
Tank Ships	147
Utility Vessels	10,892
TOTAL	**61,043**

Permit Requirements

Permit Text:

Vessel owner/operators must minimize the introduction of on-deck debris, garbage, residue and spill into deck washdown and runoff discharges. When required by their class societies (e.g., oil tankers),their flag Administrations, or the U.S. Coast Guard, vessels must be fitted with and use perimeter spill rails and scuppers to collect the runoff for treatment. Where feasible, machinery on deck must have coamings or drip pans to collect any oily water from machinery and prevent spills. The drip pans must be drained to a waste container for proper disposal and/or periodically wiped and cleaned. The presence of floating solids, visible foam, halogenated phenol compounds, and dispersants, or surfactants in deck washdowns must be minimized. Vessel operators must minimize deck washdowns while in port.

Vessel operators must maintain their topside surface and other above water line portions of the vessel to minimize the discharge of rust (and other corrosion by-products), cleaning compounds, paint chips, non-skid material fragments, and other materials associated with exterior topside surface preservation. Furthermore, vessel owner/operators must minimize residual paint droplets from entering waters subject to this permit whenever they are conducting touch-up painting. Possible minimization techniques include, but are not limited to, avoiding paint spraying in windy conditions or avoiding overapplication of paint. This permit does not authorize the disposal of unused paint into waters subject to this permit.

If deck washdowns or above water line hull cleaning will result in a discharge, they must be conducted with non-toxic and phosphate free cleaners and detergents. Furthermore, cleaners and detergents should not be caustic or only minimally caustic and should be biodegradable.

Estimates of Cost

Preliminary responses from industry representatives determined that deck cleanup is currently performed prior to deck washdowns. Also, based on the survey responses, passenger vessels are assumed to practice deck cleanup prior to departing from port, while most towing vessel/barge companies responded that it is not as common to perform deck cleanup prior to departing from port. Thus, EPA determined that all vessel classes except passenger vessels will incur this cost. However, since this cleanup *is* practiced but only for a percentage of departures, the incremental cost is only incurred for a small percentage of these vessels' departures from port. The baseline assumptions detail the percentages used.

EPA has assumed that performing cleanup before a deck washdown takes significantly more time as compared to performing cleanup prior to departing from port. Cleanup prior to a deck washdown would entail moving all pieces of machinery and cargo so as to clean the entire deck. However, cleanup prior to departing from port would only require clearing loose items from the deck. Survey responses indicated a wide range of cleanup time necessary prior to conducting a deck washdown: from 1 to 6 hours. EPA has estimated that it would only take 30 minutes to perform cleanup prior to departing from port. In the sensitivity analysis, the Agency estimated a potential low and high incremental cost associated with deck cleanup prior to departing from port. These low and high estimates are based upon the percentage of departures from port prior to which a vessel performs deck cleanup.

Survey responses also determined that it is common for all vessels to have drip pans installed for every piece of machinery on deck. However, there may be a small population of older vessels that need to install drip pans. It is also common practice for vessels to perform regular drip pan cleaning and/or draining. However, EPA did receive one response from a towing vessel/barge company that stated that it "rarely" performs drip pan cleaning. Thus, the Agency performed a sensitivity analysis to examine the potential cost to older vessels that may have to install drip pans and for those that may need to perform cleaning and/or draining.

Furthermore, based upon online research of these products and communication with a manufacturer, EPA has found that the incremental cost of purchasing a gallon of non-/low-phosphorus cleaner compared to standard cleaners is negligible due to the variability among cleaners. There are varied prices among high- and low-end products. However, there is enough variability among prices that a vessel could opt for a standard non-/low-phosphorus cleaner in lieu of a high-end phosphorus cleaner.

Sensitivity Analysis

The cost input values are shown in *Table 6-2,* and the estimates/assumptions derived for each practice are described below.

Table 6-2: Per-Vessel Costs for BMPs Associated with Deck Runoff

BMP	Labor Hours	Unit Cost	Cost Description
Performing deck cleanup prior to departing from port	0.5	$8.27[a]	Per Instance
Draining and/or wiping and cleaning the drip pans or coamings	1.5	$424.80[b]	Per Instance
Installing drip pans or coamings for every piece of machinery on deck	N/A	$161.17	Annualized Cost of a One-time Installation

a Unit cost is estimated by multiplying the labor hours by the average hourly labor rate of $16.53.
b Includes additional cost of $400 per instance to dispose of drip pan waste.

- ***Deck Cleanup***
  - *Average Labor Hours:* Since most towing vessel/barge companies estimated a per-instance cleanup time within the range of 1 to 6 hours, EPA has taken the median of 3.5 hours to estimate the time it would take to perform deck cleanup prior to conducting a deck washdown. However, the time requirement to perform cleanup prior to departing from port is assumed to be significantly less: around 30 minutes.
  - *Average Labor Rate:* A weighted average labor rate of $16.53 was calculated from the industry responses from the towing vessel/barge companies. The same labor rate is applied to all other vessel classes except for passenger vessels, which are assumed to already perform cleanup prior to departing from port. Appendix B summarizes the industry responses regarding labor rates.
  - *Annual Number of Instances:* The number of times that a vessel departs from port ranges from 4 to 30 times per month. EPA has estimated an average of 15 times per month, thus 180 times per year.
  - *Baseline:*
    - — Low End Assumption: Deck cleanup prior to departing from port is currently practiced 100 percent of the time by passenger vessels and 95 percent of the time for all other vessel classes.

— High End Assumption: Deck cleanup prior to departing from port is currently practiced 100 percent of the time by passenger vessels and 90 percent of the time for all other vessel classes.

- ***Drip Pan Cleaning***
  - *Average Labor Hours:* Preliminary industry responses provided an estimate of 1 to 2 hours required per instance of cleaning. EPA has taken the average of 1.5 hours.
  - *Average Labor Rate:* The same weighted average labor rate of $16.53 was calculated from the industry responses from the towing vessel/barge companies. The same labor rate is applied to all other vessel classes. This BMP is assumed not to be applicable to passenger vessels. Appendix B summarizes the industry responses regarding labor rates.
  - *Additional Cost:* Most survey respondents provided an additional cost for drip pan waste disposal ranging from $200 to $1,200 per instance. EPA estimated an additional average cost per instance of $400.
  - *Annual Number of Instances:* The number of times that a vessel cleans and/or drains its drip pans ranges from 1 to 4 times per month. EPA estimated an average of 2 times per month, thus 24 times per year.
  - *Baseline:*
    - — Low End Assumption: Drip pan cleaning is currently practiced 100 percent of the time.
    - — High End Assumption: Drip pan cleaning is currently practiced 99 percent of the time.
- ***Installation of Drip Pans/Coamings***
  - *One-time Installation Cost:* Preliminary industry responses provided ranges for the total one-time cost per installation estimate for all machinery on deck of $500 to $8,000. EPA has estimated an average one-time cost of $2,000. Annualized over 30 years at a 7 percent discount rate, the cost is $161.17.
  - *Baseline:*
    - — Low End Assumption: 100 percent of vessels already have drip pans/coamings installed.
    - — High End Assumption: 99 percent of vessels already have drip pans/coamings installed. EPA is assuming that older vessels may need to install drip pans. Thus, the remaining 1 percent of vessels may incur this incremental cost.

The cost per vessel for each BMP and the total cost associated with all vessels is listed in *Table 6-3*. At the low end, approximately $3.7 million is a potential annual incremental cost. At the high end, approximately $12.5 million is a potential annual incremental cost.

Table 6-3: Deck Runoff Sensitivity Analysis

Vessel Class	Vessel Count	% Vessels Applicable to BMP	Annual Cost per Vessel[a]	Total Annual Cost
Low End Estimate				
Deck Cleanup				
Freight Barges	32,842	100%	$74.40	$2,443,361
Freight Ships	697	100%	$74.40	$51,855
Passenger Vessels	11,521	0%	$0.00	$0
Tank Barges	4,944	100%	$74.40	$367,821
Tank Ships	147	100%	$74.40	$10,936
Utility Vessels	10,892	100%	$74.40	$810,337

Table 6-3: Deck Runoff Sensitivity Analysis				
Vessel Class	**Vessel Count**	**% Vessels Applicable to BMP**	**Annual Cost per Vessel[a]**	**Total Annual Cost**
Deck Cleanup TOTAL	61,043			**$3,684,310**
Drip Pan Cleaning TOTAL	61,043	100%	$0.00	$0
Installation of Drip Pans/Coamings TOTAL	61,043	100%	$0.00	$0
			Low End TOTAL	**$3,684.310**
High End Estimate				
Deck Cleanup				
Freight Barges	32,842	100%	$148.79	$4,886,722
Freight Ships	697	100%	$148.79	$103,710
Passenger Vessels	11,521	0%	$0.00	$0
Tank Barges	4,944	100%	$148.79	$735,642
Tank Ships	147	100%	$148.79	$21,873
Utility Vessels	10,892	100%	$148.79	$1,620,674
Deck Cleanup TOTAL	**61,043**			**$7,368,620**
Drip Pan Cleaning				
Freight Barges	32,842	100%	$101.95	$3,348,301
Freight Ships	697	100%	$101.95	$71,060
Passenger Vessels	11,521	0%	$0.00	$0
Tank Barges	4,944	100%	$101.95	$504,050
Tank Ships	147	100%	$101.95	$14,987
Utility Vessels	10,892	100%	$101.95	$1,110,459
Drip Pan Cleaning TOTAL	**61,043**			**$5,048,857**
Installation of Drip Pans/Coamings				
Freight Barges	32,842	1%	$161.17	$52,932
Freight Ships	697	1%	$161.17	$1,123
Passenger Vessels	11,521	0%	$0.00	$0
Tank Barges	4,944	1%	$161.17	$7,968
Tank Ships	147	1%	$161.17	$237
Utility Vessels	10,892	1%	$161.17	$17,555
Installation of Drip Pans/Coamings TOTAL	**61,043**			**$79,816**
			High End TOTAL	**$12,497,293**

a Cost for the installation of drip pans/coamings is annualized at a 7% discount rate over 30 years.

6.2.2 Discharges of Bilgewater

Affected Vessel Population

There is overlap in this discharge category between the Permit and existing regulations: the Act to Prevent Pollution from Ships (APPS) 33 CFR 155.310-380, 33CFR155.410-440, 33 CFR151.10, and section 311 of the Clean Water Act. The vessel population that applies to this Permit is already in compliance since all vessels are covered under these existing regulations. Thus, there is no incremental cost under this Permit for these discharge category BMPs.

Permit Requirements

Permit Text:

All bilgewater discharges must be in compliance with the regulations in 40 CFR Parts 110 (Discharge of Oil), 116 (Designation of Hazardous Substances), and 117 (Determination of Reportable Quantities for Hazardous Substances) and 33 CFR §151.10 (Control of Oil Discharges). In addition:

- *Vessel operators may not use dispersants, detergents, emulsifiers, chemicals or other substances to remove the appearance of a visible sheen in their bilgewater discharges.*
- *Except in the case of flocculants or other required additives (excluding any dispersants or surfactants) used to enhance oil/water separation during processing (after bilgewater has been removed from the bilge), vessel operators may not add substances that drain to the bilgewater that are not produced in the normal operation of a vessel. The use of oil solidifiers, flocculants, or other required additives are allowed only as part of an oil water separation system provided they do not alter the chemical make-up of the oils being discharged and they are not discharged into waters subject to this permit. Routine cleaning and maintenance activities associated with vessel equipment and structures are considered to be normal operation of a vessel if those practices fall within normal marine practice.*
- *All vessels must minimize the discharge of bilgewater into waters subject to this permit. This can be done by minimizing the production of bilgewater, disposing of bilgewater on shore where adequate facilities exist, or discharging into waters not subject to this permit (i.e., more than 3 nautical miles (nm) from shore) for vessels that regularly travel into such waters. Though not regulated under this permit, EPA notes that discharges of bilgewater outside waters subject to this permit (i.e. more than 3 nm from shore) are regulated under Annex I of the International Convention for the Prevention of Pollution from Ships as implemented by the Act to Prevent Pollution from Ships and U.S. Coast Guard regulations found in 33 CFR 151.09.*
- *Vessels greater than 400 gross tons shall not discharge untreated oily bilgewater into waters subject to this permit.*
- *Vessels greater than 400 gross tons that regularly sail outside the territorial sea (at least once per month) shall not discharge treated bilgewater within 1 nm of shore if technologically feasible (e.g. holding would not impact safety and stability, would not contaminate other holds or cargo, would not interfere with essential operations of the vessel). Any discharge which is not technologically feasible to avoid must be documented as part of the requirements in Part 4.2.*
- *Vessels greater than 400 gross tons shall not discharge treated bilgewater into waters referenced in Part 12.1 unless the discharge is necessary to maintain the safety and stability of the ship. Any discharge of bilgewater into these waters must be documented as part of the recordkeeping requirements in Part 4.2 and vessel operators must document whether this bilgewater discharge was made for safety reasons.*
- *For vessels greater than 400 gross tons that regularly sail outside the territorial sea (at least once per month), if treated bilgewater is discharged into waters subject to this permit, it must be discharged when vessels are underway (sailing at speeds greater than 6 knots), unless doing so would threaten the safety and stability of the ship. EPA notes that vessel operators may also choose to dispose of bilgewater on shore where adequate facilities exist. Any discharge which is made for safety reasons must be documented as part of the requirements in Part 4.2.*

Estimates of Cost

No requirements within this discharge category require cost analysis because these practices are already covered by the abovementioned regulations or EPA assumes there is no cost associated with holding the vessel's bilgewater in certain waters.

6.2.3 Discharges of Ballast Water – Pacific Nearshore Vessels

Affected Vessel Population

EPA has estimated the population of and cost to vessels engaged in Pacific nearshore voyages that must exchange ballast water or flush empty ballast water. The population comes directly from the NBIC database.

Other regulations, including the National Invasive Species Act (NISA), its predecessor NANCPA, and associated regulations (33CFR151 subparts 15, 20) apply to all other vessels.

Permit Requirements

Specific Ballast Water Discharge Sections within the Permit:

All discharges of ballast water must comply with the Coast Guard regulations found in 33 CFR Part 151. Vessels that operate solely within one Captain of the Port (COTP) zone are exempt from certain requirements, as described in 33 CFR 151.2010(b). Additionally, owner/operators of all vessels subject to coverage under this permit which are equipped with Ballast Tanks must comply with any additional BMPs in this section.

All discharges of ballast water may not contain oil, noxious liquid substances (NLSs), or hazardous substances in a manner prohibited by U.S. laws, including section 311 of the Clean Water Act.

Ballast Water Management Plans

All owner/operators of vessels equipped with ballast water tanks must maintain a ballast water management plan that has been developed specifically for the vessel that will allow those responsible for the plan's implementation to understand and follow the vessel's ballast water management strategy. Owner/operators must make that plan available upon request to any EPA representative. Vessel owner/operators must assure that the master and crew members who actively take part in the management of the discharge or who may affect the discharge understand and follow the management strategy laid out in the plan.

EPA notes that these plans are being imposed as "conditions to assure compliance" with effluent limitations under CWA 402(a)(2) and 40 CFR 122.43(a).

Pacific nearshore vessel requirements for vessels carrying Ballast Water and for those with Ballast Water Tanks but certify No Ballast on Board (NoBOB) or Partial NoBOB

Unless the vessel meets one of the exemptions in Part 2.2.3.11, any vessel engaged in Pacific Nearshore Voyages as defined in Part 2.2.3.6 which the owner/operator has reported as having No Ballast on Board in accordance with Coast Guard regulations, or which have any ballast water tank that is empty or contains unpumpable residual water, must follow the applicable requirements in Part 2.2.3.6 for those tanks with ballast water and Part 2.2.3.8.1 for those tanks which are empty or contain unpumpable residual water.

Unless the vessel meets one of the exemptions in Part 2.2.3.11, any vessel engaged in Pacific nearshore voyages that carry ballast water that was taken on in areas less than 50 nautical miles from any shore must carry out an exchange of ballast water in accordance with this Part before discharging from any tanks that carry ballast water *into waters subject to this permit if the vessel travels through more than one COTP zone as listed in 33 CFR Part 3 or the vessel crosses international boundaries.*

Vessels engaged in Pacific nearshore voyages are:

- *Vessels engaged in the Pacific coastwise trade and vessels transiting between Pacific ports that travel between more than one Captain of the Port Zone, and*
- *All other vessels that sail from foreign, non-U.S Pacific, Atlantic (including the Caribbean Sea), or Gulf of Mexico ports, which do not sail further than 200 nm from any shore, and that discharge or will discharge ballast water into the territorial sea or inland waters of Alaska or off the west coast of the continental United States.*

Ballast water exchange for vessels subject to this Part must occur in waters more than 50 nautical miles from any shore (US or otherwise), and in waters more than 200 meters deep, prior to discharging ballast water into waters subject to this permit. Exchange should occur as far from the shore, major estuary and oceanic river plumes, subsurface physical features (e.g. seamounts), and known fishery habitats as practicable. Vessels engaged in voyages that take them further than 200 nm from any shore and who will remain outside 200 nm from for a sufficient period to conduct exchange, are not allowed to exchange ballast water between 50 and 200 nm from shore to meet the requirements of Part 2.2.3.5 (unless the master determines that flushing farther than 200 nm from shore would interfere with essential vessel operations or safety of the vessel but the master determines that the vessel is able to safely flush more than 50 nm from shore) and instead, must conduct exchange more than 200 nm from shore in accordance with Part 2.2.3.5 of this permit. For vessels engaged in the coastwise trade who are not outside 200 nm for a sufficient period to conduct exchange, they may conduct exchange outside 50 nm (even if they voyage beyond 200 nm) to meet the requirements of this permit.

For those tanks which are empty or contain unpumpable residual water, you must either seal the tank so that there is no discharge or uptake and subsequent discharge of ballast water within waters subject to this permit or conduct saltwater flushing of such tanks in an area 50 nautical miles from any shore and in waters at least 200 meters deep prior to the discharge or uptake and subsequent discharge of any ballast water to or from any waters subject to this permit. For purposes of Part 2.2.3.8, saltwater flushing means the addition of water from the "coastal exchange zone" to empty ballast water tanks; the mixing of the flush water with residual water and sediment through the motion of the vessel; and the discharge of the mixed water, such that the resulting residual water remaining in the tank has either a salinity greater than or equal to 30 parts per thousand (ppt) or a salinity concentration equal to the ambient salinity of the location where the uptake of the added water took place. In order to conduct saltwater flushing, the vessel should take on as much coastal exchange zone water into each tank as is safe (for the vessel and crew). These requirements apply to all vessels carrying ballast water that will enter any US port in the states of Alaska, California, Oregon, or Washington and that travels through more than one COTP zone.

Vessels engaged in voyages that take them further than 200 nm from any shore and who will remain outside 200 nm from for a sufficient period to flush ballast water, are not allowed to exchange ballast water between 50 and 200 nm from shore to meet the requirements of Part 2.2.3.7 (unless the master determines that flushing farther than 200 nm from shore would interfere with essential vessel operations or safety of the vessel but the master determines that the vessel is able to safely flush more than 50 nm from shore) and instead, must conduct flushing more than 200 nm from shore in accordance with Part 2.2.3.7 of this permit. For vessels engaged in the coastwise trade who are not outside 200 nm for a sufficient period to conduct flushing, they may flush outside 50 nm (even if they voyage beyond 200 nm) to meet the requirements of this permit.

For all vessel owner/operators subject to this section that contain some empty ballast water tanks and some full ballast water tanks, if you elect to seal those empty tanks, you must not allow water from the full tanks to *commingle with waters from the empty tanks if it will subsequently be discharged into waters subject to this permit.*

Estimates of Cost

This cost estimate relies on previous estimates of ballast water exchange presented in USCG's *Regulatory Evaluation for the Mandatory Ballast Water Management Program for U.S. Waters* (USCG, 2004a), NBIC data, and WTLUS/VESDOC populations. The USCG's Regulatory Evaluation provided cost estimates that were extrapolated to 2007 dollars and used to estimate exchange and saltwater flushing costs. The cost inputs used to determine total ballast water exchange costs to Pacific nearshore vessels are shown in *Table 6-4*. Saltwater flushing costs to Pacific nearshore vessels are estimated in Section *6.2.4: Discharges of Ballast Water – Vessels with Empty Tanks.*

Table 6-4: Unit Cost Inputs for Ballast Water Practices - Pacific Nearshore Vessels

Unit Cost Input	Unit Cost
Pumping 1 cubic meter of ballast water	$0.014/m^3$
Annual maintenance to the ballast pumps	See *Table 6-5*
Annual addition of saltwater flushing practices to the ballast water management plan	$109.90[a]
Recordkeeping per instance of exchange	$18.32[b]

a Based on a labor rate of $109.90 and 1 hour.
b Based on a labor rate of $109.90 and 10 minutes of labor required per exchange.

The total annual cost of ballast water exchange for Pacific nearshore vessels is also based on the following data and assumptions:

- ***Population***:[19] The population of vessels was determined by the NBIC database. EPA queried the database for both domestic and foreign ballast-capable vessels that called at ports in Oregon and Alaska at least once during 2005. Vessels calling at Washington and California were excluded due to existing state permits that matched or exceeded the NPDES requirements.
- ***Number of Exchanges***: Arrivals data were also produced by the NBIC database. The number of exchanges that occur was determined by querying the database for all arrivals where the vessel had at least 1 full ballast tank. The previous USCG analysis was used to determine the percentage of time that safety and weather claims are made to prevent ballast water exchange. From these data, 61 percent was determined as the percentage of time that an exchange would occur. Weather conditions were assumed to prevent the other 39 percent of exchanges.
- ***Ballast Tank Capacity***: The average number of full ballast water tanks that vessels are carrying upon arrival is multiplied by the average capacity of each tank, yielding an average, per arrival, measure of ballast water that is further broken down by vessel class. Expressed in metric tons, this measure represents the average volume of water that arriving vessels must exchange.
- ***Ballast Exchange Method***: The method (i.e., sequential or flow-through exchange) is dependent upon ship type and determines the water volume multiplier. The flow-through exchange method, used by tank and freight ships, requires the pumping of three times the volume of water being exchanged. The sequential exchange method, used by all other vessel types, requires the pumping of two times the volume of water being exchanged.

[19] Ballast water requirements are the only BMP to which commercial fishing vessels are subject. Out of 28,875 commercial fishing vessels, twenty-six commercial fishing vessels are estimated to incur cost to comply with the ballast water requirements.

- ***Pumping Cost***: A uniform cost for pumping 1 cubic meter of ballast water is estimated at ($0.014/$m^3$).[20] The USCG analysis developed unit cost estimates of ballast water exchange based on personal communication with the industry.
- ***Maintenance Cost***: Annual maintenance costs are equal to 10 percent of the ballast water system's capital cost. These costs were derived from the USCG analysis. *Table 6-5* lists the average annual maintenance costs for each vessel class.

Table 6-5: Annual Maintenance Cost Estimates for Pacific Nearshore Vessels

Vessel Class	Annual Maintenance Cost	Number of Domestic Vessels	Number of Foreign Vessels
Commercial Fishing	$1,500	16	0
Freight Barges	$1,500	16	0
Freight Ships	$2,000	13	9
Tank Barges	$1,500	13	0
Tank Ships	$3,000	12	16
Utility Vessels	$1,500	27	1
	TOTAL	**97**	**26**

- ***Management Plan***: A ballast water management plan is already required for all vessels equipped with ballast tanks under NISA (33 CFR 151). Thus, there is no incremental cost associated with general management plan development. However, EPA is assuming that since vessels are now required to conduct saltwater flushing for empty tanks, vessel operators will need to incorporate their saltwater flushing plan into the ballast water management plan. EPA has assumed that this will represent a 1-hour annual burden for all oceangoing vessels. The hourly labor rate of $100 provided in the previous USCG analysis was prorated to 2007 dollars ($109.90) and was verified by industry contacts. The relatively high labor rate is due to the level of senior personnel involved in ballast water management decisions and activities.
- ***Recordkeeping Costs***: The same hourly labor rate of $109.90 was used for the recordkeeping cost estimate. EPA assumes that 10 minutes is required to perform recordkeeping per instance of exchange and saltwater flushing.

The annual cost of the ballast water exchange requirements per vessel is a sum of the estimated pumping, maintenance, addition to the management plan, and recordkeeping costs. Summary tables for both domestic and foreign vessels that represent the cost calculations and the derived total costs are shown in *Table 6-6* and *Table 6-7*.

[20] One cubic meter (m^3) of water = 1 metric ton.

Table 6-6: Summary of Costs of Ballast Water Exchanges for Vessels Engaged in Pacific Nearshore Voyages: Domestic Flag

Vessel Type	Number of Vessels	Annual Number of Ballast Water Exchanges/ Flushes[a,b]	Average Cost per Exchange[c]	Records, Management and Maintenance Cost[d,e]	Total Annual Cost
Ballast Water Exchanges					
Commercial Fishing	17	14	$5.99	$24,421	$24,506
Freight Barges	20	23	$42.60	$24,696	$25,690
Freight Ships	18	151	$200.98	$30,507	$60,863
Tank Barges	13	23	$69.75	$20,178	$21,762
Tank Ships	22	107	$1,482.68	$39,188	$197,591
Utility Vessels	31	26	$3.69	$41,288	$41,385
Exchange TOTAL	**121**	**344**		**$180,278**	**$371,798**
Saltwater Flushing					
Commercial Fishing	26	28	$0.08	$3,132	$3,135
Freight Barges	34	217	$0.58	$6,613	$6,739
Freight Ships	62	569	$0.85	$8,627	$9,112
Tank Barges	15	271	$1.22	$3,627	$3,957
Tank Ships	37	628	$5.63	$7,254	$10,790
Utility Vessels	44	213	$0.04	$7,822	$7,830
Flushing TOTAL	**218**	**1,925**		**$37,075**	**$41,563**
TOTAL		**2,269**		**$217,353**	**$413,360**

a Only includes Alaska and Oregon arrivals. California and Washington arrivals were excluded due to existing state regulations.
b A 61% probability of performing saltwater flushing is applied to vessels with empty ballast tanks. This probability is equal to the probability of conducting ballast water exchange.
c The average cost per saltwater flushing is a weighted average of the average cost determined for NoBOB and partial NoBOB vessels.
d The recordkeeping cost is only applied to full ballast and NoBOB vessels.
e Management plan and maintenance costs are only applied to non-oceangoing vessels that conduct exchange, or 80% of the exchange vessel total.

Table 6-7: Summary of Costs of Ballast Water Exchanges for Vessels Engaged in Pacific Nearshore Voyages: Foreign Flag

Vessel Type	Number of Vessels	Annual Number of Ballast Water Exchanges/ Flushes[ab]	Average Cost per Exchange[c]	Records, Management and Maintenance Cost[de]	Total Annual Cost
Ballast Water Exchanges					
Freight Ships	160	155	$309.76	$22,617	$70,545
Passenger Vessels	29	617	$26.74	$18,412	$34,910
Tank Ships	17	12	$518.50	$3,348	$9,397
Utility Vessels	1	1	$30.52	$18	$37
Exchange TOTAL	**207**	**784**		**$44,395**	**$114,889**
Saltwater Flushing					
Freight Ships	870	1,765	$1.47	$96,218	$98,805
Passenger Vessels	36	1,063	$0.55	$7,620	$8,202
Tank Barges	1	0	$0.00	$110	$110
Tank Ships	183	449	$4.69	$21,724	$23,828
Utility Vessels	3	6	$3.27	$421	$442
Flushing TOTAL	**1,093**	**3,283**		**$126,093**	**$131,387**
TOTAL		**4,067**		**$170,488**	**$246,276**

a Only includes Alaska and Oregon arrivals. California and Washington arrivals were excluded due to existing state regulations.
b A 61% probability of performing saltwater flushing is applied to vessels with empty ballast tanks. This probability is equal to the probability of conducting ballast water exchange.
c The average cost per saltwater flushing is a weighted average of the average cost determined for NoBOB and partial NoBOB vessels.
d The recordkeeping cost is only applied to full ballast and NoBOB vessels.
e Management plan and maintenance costs are only applied to non-oceangoing vessels that conduct exchange, or 80% of the exchange vessel total.

To arrive at these estimates, EPA made some critical assumptions and dealt with certain data limitations. These are addressed below:

- Due to the nature of the NBIC data, the number of vessels engaged in Pacific nearshore voyages is most likely understated. The NBIC system for gathering and organizing information on ballast-related activities calls for vessels to self-report with limited oversight. This inevitably results in some vessels conducting incomplete reporting or failing to report altogether. The exact margin of this uncertainty is unknown, but will likely have a relatively low impact on total costs.
- The probability of ballast water exchange is a flat figure across all vessels. It is calculated by using an adjusted average of the USCG Regulatory Evaluation's weighted probability figures, which are primarily for freight and tank ships of varying types and sizes. The USCG's figures are calculated to estimate the likelihood of exchange, taking into account weather, sea state, and the previous requirement that exchanges could only take place beyond 200 nm from shore. In our analysis, the vessel population includes more vessel types and does not break down by size. Also, the NPDES requirement has withdrawn the 200 nm line to 50 nm for Pacific Coast arrivals, making safe exchanges significantly more likely. However, no data are available that provide specific probabilities for ballast water exchange within the 50 nm zone. With these critical differences, EPA has opted to average the USCG results and adjust this average by a multiple of 1.5 to represent the 150 nm reduction in the exchange restriction zone. Thus, we assume that vessels are less likely to encounter conditions that lessen the likelihood of exchange. This is a conservative assumption and thus may overestimate the number of exchanges that may actually occur.
- Maintenance costs are also based on USCG findings, where yearly upkeep is estimated at 10 percent of the total capital cost of the ballast water pump system itself. Again, USCG breakdowns for this cost do not correlate directly to EPA's vessel classification scheme, so the Agency used the mode of all cost

estimates for each of its vessel classes, except for its freight ships and tank ships vessel groups, where the mode of freight ship and tank ship cost estimates was used to obtain greater specificity.

6.2.4 Discharges of Ballast Water – Vessels with Empty Tanks

Affected Vessel Population

EPA has estimated the population of and cost to all oceangoing vessels with empty ballast water tanks that must perform saltwater flushing. The population comes directly from the NBIC database. EPA has not estimated the cost to all Great Lakes vessels. The cost is negligible for these vessels since only three domestic flag vessels subject to the saltwater flushing requirement exist in the ballast water database, and they already perform this practice on a voluntary basis.

Other regulations, including NISA, its predecessor NANCPA, and associated regulations (33 CFR 151 subparts 15, 20), apply to all other vessels.

Permit Requirements

Specific Ballast Water Discharge Sections within the Permit:

Vessels entering the Great Lakes

In addition to complying with the requirements of this permit, all vessels that are equipped to carry ballast water and enter the Great Lakes must comply with 33 CFR Part 151, Subpart C titled: "Ballast Water Management for Control of Nonindigenous Species in the Great Lakes and Hudson River." Vessels that operate outside the EEZ and more than 200 nm from any shore and then enter the Great Lakes via the Saint Lawrence Seaway System must also comply with 33 CFR Part 401.30, which requires oceangoing vessels to conduct saltwater flushing of ballast water tanks 200 nautical miles from any shore before entering either the U.S. or Canadian waters of the Seaway System.

Vessels with any Ballast Water Tanks that are empty or have unpumpable residual water

For vessels that travel between more than one COTP Zone while undertaking voyages described in Part 2.2.3.5 and which either reported No Ballast on Board in accordance with Coast Guard regulations or which have any ballast water tank that is empty or contains unpumpable residual water, you must follow the applicable requirements in Part 2.2.3.5 for those tanks with ballast water. For those tanks which are empty or contain unpumpable residual water, you must either seal the tank so that there is no discharge or uptake and subsequent discharge of ballast water within waters subject to this permit or conduct saltwater flushing of such tanks in an area 200 nautical miles from any shore prior to the discharge or uptake and subsequent discharge of any ballast water to any U.S. waters subject to this permit, unless you meet one of the exemptions in Part 2.2.3.11. For the purposes of Part 2.2.3.7, saltwater flushing means the addition of mid-ocean water to empty ballast water tanks; the mixing of the added water with residual ballast water and sediment through the motion of the vessel; and the discharge of the mixed water until loss of suction, such that the resulting residual water remaining in the tank has either a salinity greater than or equal to 30 parts per thousand (ppt) or a salinity concentration equal to the ambient salinity of the location where the uptake of the added water took place. In order to conduct saltwater flushing, the vessel should take on as much mid-ocean water into each tank as is safe (for the vessel and crew).

For all vessel owner/operators subject to this section that contain some empty ballast water tanks and some full ballast water tanks, if you elect to seal those empty tanks, you must not allow water that will be discharged into waters subject to this permit to commingle with waters from the empty tanks if you have not conducted saltwater flushing as specified above.

Estimates of Cost

The Permit requires all oceangoing vessels with empty ballast tanks either to seal the tanks or to conduct saltwater flushing of such tanks in an area 200 nm from any shore prior to the discharge or uptake of any ballast water to or from any U.S. waters. Saltwater flushing costs were the only option estimated within this analysis. Costs of saltwater flushing were estimated in a similar manner to ballast water exchange costs. However, because current regulations (33 CFR 151.2035 and 33 CFR 151.2045) already require implementation of a management plan for all vessels (excluding Pacific nearshore vessels), the only additional cost was the annual 1-hour burden to supplement the management plan with saltwater flushing practices. Also, EPA assumes that recordkeeping is already performed when the vessel exchanges one or more ballast water tanks. Thus, recordkeeping costs were added into the estimates only for NoBOB vessels since partial NoBOB vessels are already assumed to conduct recordkeeping during ballast water exchange. *Table 6-8* shows the annual cost inputs of saltwater flushing for vessels with empty ballast tanks.

Table 6-8: Unit Cost Inputs for Ballast Water Practices – Vessels with Empty Ballast Tanks

Unit Cost Input	Unit Cost
Pumping 1 cubic meter of ballast water	$0.014/m^3$
Annual addition of saltwater flushing practices to the ballast water management plan	$109.90[a]
Recordkeeping per instance of saltwater flushing for partial NoBOB vessels	$18.32[b]

a Based on a labor rate of $109.90 and 1 hour.
b Based on a labor rate of $109.90 and 10 minutes of labor required per exchange.

The total annual cost of saltwater flushing for all oceangoing and Pacific nearshore vessels is also based on the following data and assumptions:

- ***Population***: The population of vessels was determined by the NBIC database. EPA queried the database for both domestic and foreign ballast-capable vessels that called at U.S. ports at least once during 2005. Vessels calling at Great Lakes and Upper Hudson River ports were excluded due to existing permits that matched or exceeded the NPDES requirements. Reporting numbers for these regions were very low (37 vessels) for 2005, due to the lack of a data exchange program with Canadian St. Lawrence Seaway reporting agencies, which was established in 2006.
- ***Number of Exchanges***: The NBIC database also produced arrivals data providing for the number of saltwater flushes that should occur. This was done for the two arrival types: vessels arriving with zero metric tons of ballast water (NoBOB) and those arriving with at least one tank empty (partial NoBOB). Based on personal communication with the USCG, the risk involved in performing saltwater flushing based on weather concerns is significantly less than the risk involved in performing ballast water exchange (Cummins, 2007). However, no estimates of the percentage of time that safety or weather claims prevent saltwater flushing are currently available. Thus, EPA has assumed that it is generally safe to conduct saltwater flushing regardless of weather conditions. This assumption may result in an overstatement of saltwater flushing costs if weather prevents saltwater flushing. However, for partial NoBOB vessels, it was assumed that saltwater flushing occurs only if ballast water exchange is performed. EPA used the same probability as was used for ballast water exchange (61 percent). For NoBOB vessels, it was assumed that flushing occurs 100 percent of the time.
- ***Ballast Tank Capacity***: Estimates of the ballast capacities that pertain to saltwater flushing for the vessels subject to the Permit requirements were derived from additional NBIC data queries. For NoBOB arrivals EPA used average total ballast capacity. For partial NoBOB vessel arrivals EPA multiplied the average capacity per ballast water tank by the average number of tanks that are reported empty, similar to the

water volume calculation for ballast exchange described above for Pacific nearshore voyages. This provides a realistic, per vessel class, average measure of water volume on which to base flushing costs in cases where a vessel may not report NoBOB yet still have empty ballast tanks to manage. To estimate the cost of saltwater flushing, EPA adjusted the estimated capacity of empty tanks to reflect the capacity that would be sufficient for performing saltwater flushing. Based on personal communication with a ship expert, an average empty ballast water tank contains approximately 0.5 percent to 1 percent of residual water (this may be a crude estimate because of the number of variables that determine the residual percentage, e.g., ship age, design, type). However, approximately two times the amount of residual water is required in order to complete saltwater flushing. This would produce an estimate of around 1.5 percent of average total ballast capacity that would be sufficient for saltwater flushing practices (Jenkins, 2007).

- ***Pumping Cost***: The same uniform cost for pumping 1 cubic meter of ballast water is applied to these vessels, estimated at ($0.014/$m^3$).[21]
- ***Management Plan***: A ballast water management plan is already required for all vessels equipped with ballast tanks under NISA (33 CFR 151). Thus, there is no incremental cost associated with general management plan development. However, EPA is assuming that since vessels are now required to conduct saltwater flushing for empty tanks, vessel operators will need to incorporate their saltwater flushing plan into the ballast water management plan. The Agency has assumed that this will represent a 1-hour annual burden for all oceangoing vessels. The hourly labor rate of $100 provided in the previous USCG analysis was prorated to 2007 dollars ($109.90) and was verified by industry contacts. The relatively high labor rate is due to the level of senior personnel involved in ballast water management decisions and activities.
- ***Recordkeeping Cost***: Again, the hourly labor rate of $109.90 was used for the recordkeeping cost estimate. EPA assumes that 10 minutes is required to perform recordkeeping per instance of saltwater flushing. Recordkeeping costs are only attributed to NoBOB vessels since partial NoBOB vessels already perform recordkeeping during exchange.

The annual cost of the ballast water saltwater flushing requirements per vessel is a sum of the estimated pumping, management plan, and recordkeeping costs. Summary tables for both domestic and foreign vessels that represent the cost calculations and the derived total costs are shown in *Table 6-9* and *Table 6-10*.

Table 6-9: Summary of Costs of Saltwater Flushing for Oceangoing Vessels with Ballast Tanks Empty: Domestic Flag

Vessel Type	Number of Vessels	Annual Number of Saltwater Flushings[a]	Average Cost Per Saltwater Flushing[b]	Records and Management Cost[c]	Total Annual Cost
Freight Barges	36	478	$1.19	$12,090	$12,659
Freight Ships	167	1,797	$0.71	$18,628	$19,902
Passenger Vessels	2	1	$0.02	$238	$238
Tank Barges	17	188	$1.62	$4,781	$5,085
Tank Ships	40	212	$3.07	$6,155	$6,806
Utility Vessels	74	303	$0.04	$10,184	$10,197
TOTAL	**336**	**2,979**		**$52,077**	**$54,887**

a A 61% probability of performing saltwater flushing is applied to vessels with some empty ballast tanks. This probability is equal to the probability of conducting ballast water exchange.

b The average cost per saltwater flushing is a weighted average of the average cost determined for NoBOB and partial NoBOB vessels.

c The recordkeeping cost is only applied to NoBOB vessels.

[21] One cubic meter (m^3) of water = 1 metric ton.

Table 6-10: Summary of Costs of Saltwater Flushing for Oceangoing Vessels with Ballast Tanks Empty: Foreign Flag

Vessel Type	Number of Vessels	Annual Number of Saltwater Flushings[a]	Average Cost Per Saltwater Flushing[b]	Records and Management Cost[c]	Total Annual Cost
Freight Barges	3	4	$4.81	$348	$367
Freight Ships	4,451	18,277	$1.13	$521,152	$541,839
Passenger Vessels	166	4,389	$0.53	$24,179	$26,506
Tank Barges	5	5	$3.10	$604	$620
Tank Ships	1,824	8,999	$5.31	$271,667	$319,437
Utility Vessels	33	33	$0.41	$3,810	$3,823
TOTAL	**6,482**	**31,707**		**$821,761**	**$892,592**

a A 61% probability of performing saltwater flushing is applied to vessels with some empty ballast tanks. This probability is equal to the probability of conducting ballast water exchange.

b The average cost per saltwater flushing is a weighted average of the average cost determined for NoBOB and partial NoBOB vessels.

c The recordkeeping cost is only applied to NoBOB vessels.

As with the cost estimation of ballast water exchange for Pacific nearshore voyages, some significant data shortcomings existed, and some key assumptions were made. These are addressed below:

- Due to the nature of the NBIC data, the number of vessels requiring saltwater flushing of ballast tanks is most likely understated. The NBIC system for gathering and organizing information on ballast-related activities calls for vessels to self-report with limited oversight. This inevitably results in some vessels conducting incomplete reporting or failing to report altogether. The exact margin of this uncertainty is unknown, but will likely have a relatively low impact on total costs.
- The probability of saltwater flushing for vessels arriving with any empty tanks, as with an exchange, is a flat figure across all vessels. It is calculated by using an adjusted average of the USCG Regulatory Evaluation's weighted probability figures, which are primarily for freight and tank ships of varying types and sizes. The USCG's figures are calculated to estimate the likelihood of exchange, taking into account weather, sea state, and the previous requirement that exchange could only take place beyond 200 nm from shore. In our analysis, the vessel population includes more vessel types and does not break down by size. Also, the NPDES requirement has withdrawn the 200 nm line to 50 nm for Pacific Coast arrivals, making safe exchanges and flushing significantly more likely. EPA can presume that for the other coasts where the 200 nm line still holds, some vessels will opt to flush their empty tanks, even when safe exchanges are not feasible. With these critical differences, the Agency has opted to average the USCG results and adjust this average by a multiple of 1.5 to represent the 150 nm reduction in the exchange restriction zone.

6.2.5 Anti-fouling Hull Coatings

Affected Vessel Population

Since the Global Anti-fouling System Treaty came into effect on September 22, 2008, the requirements of the TBT restriction on the vessel population that would apply to this Permit are null since all vessels are covered under the treaty. Few, if any, vessels still use TBT on their hulls.

Permit Requirements

Permit Text:

- *All anti-fouling hull coatings subject to registration under FIFRA (see 40 CFR 152.15) must be registered, sold or distributed, applied, maintained, and removed in a manner consistent with applicable requirements on the coatings' FIFRA label.*
- *For anti-fouling hull coatings not subject to FIFRA registration (i.e. not produced for sale and distribution in the United States), hull coatings must not contain any biocides or toxic materials banned for use in the United States (including those on EPA's List of Banned or Severely Restricted Pesticides). This requirement applies to all vessels, including those registered and painted outside the United States.*

At the time of initial application or scheduled reapplication of anti-fouling coatings, you must give consideration, as appropriate for vessel class and vessel operations, to the use of hull coatings with the lowest effective biocide release rates, rapidly biodegradable components (once separated from the hull surface), or non-biocidal alternatives, such as silicone coatings.

Some ports and harbors are impaired by copper. These waters include Shelter Island Yacht Basin in San Diego, California and waters in and around the ports of Los Angeles/Long Beach. A complete list of such waters may be found at www.epa.gov/npdes/vessels. When vessels spend considerable time in these waters (defined as spending more than 30 days per year), or use these waters as their home port (i.e. house boats, ferries or rescue vessels), vessel owner/operators shall consider using antifouling coatings that rely on a rapidly biodegradable biocide or another alternative rather than copper based coatings. If after consideration of alternative biocides, vessel operators continue to use copper based antifoulant paints, they must document in their recordkeeping documentation how this decision was reached.

The discharge of Tributyltin (TBT) or any other organotin compound is prohibited by this permit. Therefore, vessel operators covered by this permit have a zero discharge standard for TBT or any other organotin compound. You may not use an antifoulant coating containing TBT or any other organotin compound. If the vessel has previously been covered with a hull coating containing TBT or any other organotin compound, vessels must be effectively overcoated so that no TBT or other organotin leaches from the vessel hull or the TBT or other organotin coating must have been removed from the vessel's hull.

Estimates of Cost

No requirements within this discharge category for TBT require cost analysis because these practices are under the authority of the Global Anti-fouling System Treaty. EPA has assumed that the requirements for other anti-fouling paints are negligible for this permit.

6.2.6 Aqueous Film-Forming Foam

Affected Vessel Population

Based on the Permit's description of practices in this discharge category, aqueous film-forming foam (AFFF) practices apply only to a subset of the total population of vessels. Freight ships, tank ships, and various utility vessels are the only vessel classes to which this discharge category applies. Other vessel classes are not expected to have a firefighting system on board. Furthermore, separate population estimates were produced for oceangoing and non-oceangoing vessels since separate practices are applicable to each type of vessel.

The population potentially affected by BMPs applicable to the AFFF discharge category is shown in *Table 6-11*.

Table 6-11: Vessel Counts for AFFF BMPs			
Vessel Class	**Non-Oceangoing Vessel Count[a]**	**Oceangoing Vessel Count**	**Total Vessel Count**
Freight Barges	0	0	0
Freight Ships	112	555	667
Passenger Vessels	0	0	0
Tank Barges	0	0	0
Tank Ships	13	129	142
Utility Vessels	5,697	5,121	10,818
TOTAL	**5,822**	**5,805**	**11,627**

a Includes vessels operating on the Great Lakes, Mississippi River, and intracoastal waterways.

Permit Requirements

Permit Text:

Discharges of AFFF are authorized for emergency purposes when needed to ensure the safety and security of the vessel and her crew.

For all vessels that sail outside of the territorial sea more than once per month, maintenance and training discharges of fluorinated AFFF are not authorized within waters subject to this permit (Any such discharges should be collected and stored for onshore disposal or scheduled when the vessel is outside such waters). Discharge volumes associated with regulatory certification and inspection must be minimized and a substitute foaming agent (i.e. non-fluorinated) must be used if possible within waters subject to this permit.

For vessels that do not leave the territorial sea more than once per month, if maintenance and training discharges are required, AFFF must be collected and stored for onshore disposal if technologically feasible unless the vessel uses non-fluorinated or alternative foaming agent. For those vessels for which it is not technologically feasible to collect and store the fluorinated AFFF foam, vessel owner/operators must limit the discharge to that amount necessary to conduct legally required tests. Training should be conducted as far from shore as is practicable. Maintenance and training discharges are not allowed in port.

For all vessels, AFFF discharges may not occur in or within 1 nm of a water referenced in Part 12.1 unless they are discharged:

- *For emergency purposes*
- *By rescue vessels such as fireboats for firefighting purposes,*
- *By vessels owned or under contract to do business exclusively in or within 1 nm of those protected areas by the United States government or state or local governments.*

If AFFF discharge occurs in waters in Part 12.1 for emergency purposes, a written explanation must be kept in the ship's log or other vessel recordkeeping documentation consistent with Part 4.2 of this permit.

Estimates of Cost

Cost estimates of non-fluorinated foams are in the sensitivity analysis section, as these foams are not required for vessels. Within the sensitivity analysis EPA has estimated a potential low and high incremental cost associated with AFFF practices. These low and high estimates are based upon the percentage of vessels that would purchase non-fluorinated foams and a foam aspirating device, and the percentage of time that a vessel documents an emergency discharge.

Other BMPs are not included in the sensitivity analysis since cost estimates and applicable vessel populations are not currently known.

Sensitivity Analysis

Cost estimates are based upon assumptions and communication with a foam manufacturer as to the incremental cost per gallon of non-fluorinated foams and the cost of the non-fluorinated foaming device compared to the standard AFFF and device. The cost input values are shown in *Table 6-12,* and the estimates/assumptions derived for each practice are described below.

Table 6-12: Per-Vessel Costs for BMPs Associated with AFFF

BMP	Labor Hours	Unit Cost	Cost Description
Purchase of non-fluorinated foaming agents and the aspirating device	N/A	$3.94	Annual cost of purchasing foams and device
▫ Non-fluorinated foams	N/A	-$125	Annual cost of purchasing 20 gallons of foam
▫ Non-fluorinated foam aspirating device	N/A	$128.94	Annual cost of purchasing device
Documentation of an emergency discharge taking place in *waters listed in Part 12.1 [waters federally protected wholly or in part for conservation purposes] in VGP*	0.16	$5.06[a]	Assumption of cost per instance
Collection and storage of maintenance and training discharges from non-oceangoing vessels	N/A	Unknown Cost	One-time installation cost

a Unit cost is estimated by multiplying the labor hours by the average hourly labor rate of $31.61.

- ***Purchase of Non-Fluorinated Foams***: Foams are typically not changed out of ships any more frequently than 5 years (respondents provided a range of 5 to 25 years in which foams may need to be replaced). AFFF is by far the most frequent foam used by vessels; some vessels also use protein and polar solvent foams. The type of foam that is carried onboard is dependent on the type of cargo. The amount of foam in the tanks ranges from 300 to 6,000 gallons, dependent on ship type. We have estimated that an annual amount of 100 gallons of foam would regularly be purchased. Furthermore, since non-fluorinated foams may be required in a greater volume, we have assumed that an additional 30 gallons of non-fluorinated foam would need to be purchased annually. The population of vessels that currently use non-fluorinated foams is unknown. However, a cost is determined by estimating an average incremental cost and assuming that a low percentage of vessels will purchase the non-fluorinated foams.
  - *Gallons of Foam Purchased:* An average vessel purchases 100 gallons of AFFF per year. It was assumed that an additional 30 gallons of non-fluorinated foam would need to be purchased annually.
  - *Incremental Cost of Non-Fluorinated Foams:* There is a cost savings per gallon achieved from purchasing non-fluorinated foams versus the typical AFFF. Based upon communication with a foam manufacturer, the average cost of AFFF is approximately $11/gallon, whereas the average cost of a non-fluorinated foam is approximately $7.50/gallon, a cost savings of $3.50/gallon.
  - *Incremental Cost of Non-Fluorinated System:* There is an additional annual cost per vessel of $128.94 for the special device that is required for non-fluorinated foam use. This device is expected to last for the lifetime of the vessel. The total incremental cost of the device is approximately $1,600, annualized at a 7 percent discount rate over 30 years.
  - *Baseline:*
    - Low End Assumption: 95 percent of vessels already use non-fluorinated foams and have the necessary device.
    - High End Assumption: 90 percent of vessels already use non-fluorinated foams and have the necessary device.

- ***Documentation of Emergency AFFF Discharge within 1 nm of in waters listed in Part 12.1 [waters federally protected wholly or in part for Conservation Purposes] in the Vessel General Permit***: The per-instance cost of this practice as well as the population of vessels that currently document these emergency discharges is unknown. However, by estimating an average documentation time and assuming that these discharges are infrequent, a low end and high end cost estimate can be determined.
  - *Average Labor Hours Assumption:* 10 minutes is required for documentation.
  - *Average Labor Rate:* Since this discharge category is primarily applicable to freight ships, tank ships, and utility vessels and these industries have not provided this information, a weighted average labor rate of $31.61 was calculated from all the industry responses. Appendix B summarizes the industry responses regarding labor rates.
  - *Annual Number of Instances Assumption:* Emergency discharges of AFFF occur within these waters, on average, once every two years.
  - *Baseline:*
    - Low End Assumption: Vessels document the discharge 95 percent of the time.
    - High End Assumption: Vessels document the discharge 90 percent of the time.
- ***Collect and Store All AFFF Maintenance and Training Discharges:*** This requirement is applicable to non-oceangoing vessels only. This cost estimate is based upon required technology (i.e., holding tanks and a pump system). The one-time installation cost of this system as well as the population of vessels that currently have this system installed is unknown until further information is received from industry representatives.
- In general, we are aware that it is not standard to have the technology to collect and store maintenance/training discharges of foams. It is common practice to wash the foam over the side of the ship. However, it is uncommon to perform these maintenance/training discharges while in inland waters. Most vessels perform these discharges while at sea.

The cost per vessel for each BMP and the total cost associated with all vessels is listed in *Table 6-13*. At the low end, approximately $3,800 is a potential annual incremental cost. At the high end, approximately $7,500 is a potential annual incremental cost.

Table 6-13: Aqueous Film-Forming Foam Sensitivity Analysis				
Vessel Class	**Vessels**	**% Vessels Applicable to BMP**	**Annual Cost per Vessel[a]**	**Total Annual Cost**
Low End Estimate				
Purchase Non-Fluorinated Foams and System				
Freight Barges	0	0%	$0.00	$0
Freight Ships	667	5%	$3.94	$131
Passenger Vessels	0	0%	$0.00	$0
Tank Barges	0	0%	$0.00	$0
Tank Ships	142	5%	$3.94	$28
Utility Vessels	10,818	5%	$3.94	$2,130
Foam Purchase TOTAL	**11,627**			**$2,289**
Document Emergency Discharge				
Freight Barges	0	0%	$0.00	$0
Freight Ships	667	100%	$0.13	$84
Passenger Vessels	0	0%	$0.00	$0
Tank Barges	0	0%	$0.00	$0
Tank Ships	142	100%	$0.13	$18
Utility Vessels	10,818	100%	$0.13	$1,368
Documentation TOTAL	**11,627**			**$1,470**
			Low End TOTAL	**$3,760**
High End Estimate				
Purchase Non-Fluorinated Foams and System				
Freight Barges	0	0%	$0.00	$0
Freight Ships	667	10%	$3.94	$263
Passenger Vessels	0	0%	$0.00	$0
Tank Barges	0	0%	$0.00	$0
Tank Ships	142	10%	$3.94	$56
Utility Vessels	10,818	10%	$3.94	$4,260
Foam Purchase TOTAL	**11,627**			**$4,579**
Document Emergency Discharge				
Freight Barges	0	0%	$0.00	$0
Freight Ships	667	100%	$0.25	$169
Passenger Vessels	0	0%	$0.00	$0
Tank Barges	0	0%	$0.00	$0
Tank Ships	142	100%	$0.25	$36
Utility Vessels	10,818	100%	$0.25	$2,703
Documentation TOTAL	**11,627**			**$2,941**
			High End TOTAL	**$7,520**

a Cost for the non-fluorinated foaming system is annualized at a 7% discount rate over 30 years.

6.2.7 Boiler/Economizer Blowdown

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible and/or the industry is assumed to currently practice the Permit requirements. Thus, the vessel population that would apply to this Permit was not estimated since no vessels will experience any cost.

Permit Requirements

Permit Text:

Minimize the discharge of boiler/economizer blowdown in port if chemicals or other additives are used to reduce impurities or prevent scale formation. For vessels greater than 400 gross tons which leave the territorial sea at least once per week, boiler/economizer blowdown may not be discharged in waters subject to this permit, unless:

- *The vessel remains within waters subject to this permit for a longer period than the necessary duration between blowdown cycles,*
- *The vessel needs to conduct blowdown immediately before entering drydock, or*
- *For safety purposes.*

For all vessels, boiler/economizer blowdown may not be discharged in waters referenced in Part 12.1 except for safety purposes. Furthermore, boiler/economizer blowdown should be discharged as far from shore as practical.

Estimates of Cost

No requirements in this discharge category require cost analysis because these practices are assumed to have negligible costs and/or the industry is assumed to currently practice the Permit requirements.

6.2.8 Cathodic Protection

Affected Vessel Population

Based on the description of practices within this discharge category, all vessel classes are subject to the cathodic protection BMPs. However, only vessels that have steel hulls are applicable to this discharge category. Thus, the total count of domestic vessels applicable to this discharge category is nearly 80 percent of the total domestic count.

The population potentially affected by BMPs applicable to the cathodic protection discharge category is shown in *Table 6-14*.

Table 6-14: Vessel Counts for Cathodic Protection[a] BMPs

Vessel Class	Vessel Count
Freight Barges	32,646
Freight Ships	552
Passenger Vessels	1,724
Tank Barges	4,927
Tank Ships	141
Utility Vessels	9,184
TOTAL	**49,174**

a Applies to steel hulled vessels only

Permit Requirements

Permit Text:

Cathodic protection must be maintained to prevent the corrosion of the ship's hull. The discharge of zinc, magnesium, and aluminum are expected from properly functioning cathodic protection sacrificial electrodes. However, vessel operators must minimize the flaking of large, corroded portions of these anodes. Sacrificial *anodes must not be used more than necessary to adequately prevent corrosion of the vessel's hull, sea chest, rudder, and other exposed areas of the vessel. Vessel operators must appropriately clean and/or replace these anodes in periods of maintenance (such as drydocking), so that release of these metals to waters is minimized.*

Vessel operators should be cognizant that magnesium is less toxic than aluminum, which is less toxic than zinc. If vessel operators use sacrificial electrodes, they must use the metals that are less toxic to the extent technologically feasible and economically practicable and achievable.

EPA recommends the use of Impressed Current Cathodic Protection (ICCP) in place of or to reduce the use of sacrificial electrodes when technologically feasible (e.g. adequate power sources, appropriate for vessel hull size and design), safe, and adequate to protect against corrosion, particularly for new vessels. If vessel operators use ICCP, they must maintain dielectric shields to prevent flaking.

Estimates of Cost

Based upon communication with a maritime engineer from the U.S. Maritime Administration (Ghosh, 2008) as well as preliminary industry responses, there is no incremental cost to vessels for these specific BMPs. As a baseline, all steel hulled vessels currently have either an ICCP or a sacrificial electrodes system of cathodic protection. Furthermore, the cost of either type of cathodic protection system is the same. There is no additional cost for using a less toxic metal such as aluminum in lieu of a more toxic metal such as zinc. In addition, in EPA's discussions with a representative from a cathodic protection manufacturing company (Peters, 2008), magnesium is not recommended over either of these metals because magnesium has a higher potential and could cause damage to the hull paint coating, thus allowing for a faster rate of dissolution.

A sensitivity analysis was performed to estimate potential costs of cathodic protection installation for vessels that will opt to purchase an ICCP system in accordance with the Permit recommendations. In the sensitivity analysis EPA has estimated a potential low and high incremental cost associated with cathodic protection installation. These low and high estimates are based upon the percentage of vessels that may need to install an updated system.

BMPs associated with maintenance and replacement of the cathodic protection system will not incur incremental costs, and no sensitivity analysis will be performed since these practices are regularly performed when deemed necessary.

Sensitivity Analysis

Costs of installing either an ICCP or a sacrificial electrodes system of cathodic protection were estimated based upon communication with a cathodic protection manufacturing company.

The cost input values of cathodic protection system installation are shown in *Table 6-15,* and the estimates/assumptions derived for each practice are described below.

Table 6-15: Cathodic Protection Installation Cost Estimates

Vessel Class	Low End Installation Cost	High End Installation Cost	Average Installation Cost
Freight Barges	$10,000	$11,000	$10,500
Freight Ships	$15,000	$18,000	$16,500
Tank Barges	$15,000	$18,000	$16,500
Tank Ships	$24,000	$28,000	$26,000
Utility Vessels	$15,000	$18,000	$16,500
Passenger Vessels	$20,000	$25,000	$22,500

- *Installation Costs:* a representative from a cathodic protection manufacturing company provided cost estimates for a system. The figures are dependent upon the area of steel on the hull as well as other minor components. The cost estimates that were provided are shown in *Table 6-15.*

- *Baseline:*
  - Low End Assumption: 2.5 percent of vessels will install an ICCP system due to the Permit recommendations.
  - High End Assumption: 5 percent of vessels will need to install an ICCP system due to the Permit recommendations.

The average installation cost was taken for each vessel class. This system is expected to last for the lifetime of the vessel. Thus, the total incremental cost of the device is annualized at a 7 percent discount rate over 30 years to yield the annual cost per vessel presented in *Table 6-16*.

The cost per vessel and the total cost associated with all vessels is listed in *Table 6-16*. At the low end, if 2.5 percent of vessels install an ICCP system, approximately $1.3 million is a potential incremental cost. At the high end, if 5 percent install an ICCP system, approximately $2.5 million is a potential incremental cost.

Table 6-16: Cathodic Protection Sensitivity Analysis, Purchase of a Cathodic Protection System

Vessel Class	Total Number of Vessels[a]	% of Vessels Need to Purchase System	Annual Cost per Vessel[b]	Total Annual Cost
Low End Estimate				
Freight Barges	32,646	2.5%	$846.16	$690,591
Freight Ships	552	2.5%	$1,329.68	$18,350
Passenger Vessels	1,724	2.5%	$1,813.19	$78,149
Tank Barges	4,927	2.5%	$1,329.68	$163,783
Tank Ships	141	2.5%	$2,095.25	$7,386
Utility Vessels	9,184	2.5%	$1,329.68	$305,294
Low End TOTAL	**49,174**			**$1,263,551**
High End Estimate				
Freight Barges	32,646	5%	$846.16	$1,381,182
Freight Ships	552	5%	$1,329.68	$36,699
Passenger Vessels	1,724	5%	$1,813.19	$156,297
Tank Barges	4,927	5%	$1,329.68	$327,566
Tank Ships	141	5%	$2,095.25	$14,771
Utility Vessels	9,184	5%	$1,329.68	$610,587
High End TOTAL	**49,174**			**$2,527,103**

a Applies to steel hulled vessels only.

b Annualized at a 7% discount rate over 30 years.

6.2.9 Chain Locker Effluent

Affected Vessel Population

Based on the description of practices within this discharge category, a subset of vessel classes is applicable to the chain locker effluent discharge category. Freight ships, tank ships, and various utility vessels are the vessel classes that are applicable to this discharge category. Other vessel classes are not applicable to this discharge category because their anchors are rarely or never deployed or other equipment is used (e.g., anchor cable). The population potentially affected by BMPs applicable to the chain locker effluent discharge category is shown in *Table 6-17*.

Table 6-17: Vessel Counts for Chain Locker Effluent BMPs	
Vessel Class	**Vessel Count**
Freight Barges	0
Freight Ships	697
Passenger Vessels	0
Tank Barges	0
Tank Ships	147
Utility Vessels	10,892
TOTAL	**11,736**

Permit Requirements

Permit Text:

The anchor chain must be carefully and thoroughly washed down (i.e., more than a cursory rinse) as it is being hauled out of the water to remove sediment and marine organisms. In addition, chain lockers must be cleaned thoroughly during dry docking to eliminate accumulated sediments and any potential accompanying pollutants. For vessels that regularly sail outside waters subject to this permit, if technically feasible, periodically clean, rinse, and/or pump out the space beneath the chain locker prior to entering waters subject to this permit (preferably mid ocean) if the anchor has been lowered into any nearshore waters. Furthermore, for vessels that leave waters subject to this permit at least once per month, chain lockers may not be rinsed or pumped out in waters subject to this permit, unless not emptying them would compromise safety. Such a safety claim must be documented in the vessel's recordkeeping documentation consistent with Part 4.2.

Estimates of Cost

Based on preliminary survey responses, most BMPs in the chain locker effluent discharge category are already practiced by the industry. While in drydock (which occurs very infrequently, e.g., once every two years), the chain lockers are *always* cleaned. Rinsing or pumping of the space beneath the chain locker within 3 nm from shore is *never* performed. Furthermore, while the vessel is being hauled out of the water, the anchor chain is *nearly always* washed down. However, the BMP that is not common practice for any of the vessel classes included in the vessel population is inspection, cleaning, and pumping out of the space beneath the chain locker prior to entering nearshore waters. An industry representative commented that chain lockers are typically cleaned during drydocks and not in the deep sea or in nearshore waters because the locker is full of the anchor chain. The potential cost of this BMP was not estimated since this practice is only required if technically feasible.

EPA has performed a sensitivity analysis only for the potential incremental costs associated with washing down the anchor chain as it is being hauled out of the water. In the sensitivity analysis EPA has estimated a potential low and high incremental cost associated with washing down the anchor chain. These low and high estimates are based upon the percentage of time that a vessel washes down the anchor chain while hauling it out of the water.

Sensitivity Analysis

These cost estimates were based upon industry communication (via survey response). The cost input values are shown in *Table 6-18,* and the estimates/assumptions derived for this practice are described below.

Table 6-18: Per Vessel Costs for BMPs Associated with Chain Locker Effluent			
BMP	**Labor Hours**	**Unit Cost**	**Cost Description**
Washing down the anchor chain as it is being hauled out of the water	0.75	$23.71[a]	Per Instance
Rinsing out the space beneath the chain locker prior to entering nearshore waters	Unknown	Unknown	Per Instance

a Unit cost is estimated by multiplying the labor hours by the average hourly labor rate of $31.61.

- ***Washing Down the Anchor Chain***:
  - *Average Labor Hours Assumption:* Since most towing vessel/barge companies estimated a per-instance washdown time within the range of 0.5 to 1 hour, EPA took the average of 0.75 hours to estimate the time it would take to wash down the anchor chain as it is being hauled out of the water.
  - *Average Labor Rate:* Since this discharge category is primarily applicable to freight ships, tank ships, and utility vessels and these industries have not provided this information, a weighted average labor rate of $31.61 was calculated from all the industry responses. Appendix B summarizes the industry responses regarding labor rates.
  - *Annual Number of Instances Assumption:* The number of times that a vessel hauls the anchor chain out of the water ranges from 12 to 50 times per year. EPA estimated an average of 20 times per year.
  - *Baseline:*
    - — Low End Assumption: The vessel currently washes down the anchor chain as the chain is hauled out of the water 100 percent of the time.
    - — High End Assumption: The vessel currently washes down the anchor chain as the chain is hauled out of the water 99 percent of the time.

The annual incremental cost per vessel and the total cost associated with all vessels for washing down the anchor chain is listed in *Table 6-19*.

Table 6-19: Chain Locker Effluent Sensitivity Analysis, Wash Down Anchor Chain				
Vessel Class	**Vessels**	**% Vessels Applicable to BMP**	**Annual Cost per Vessel**	**Total Annual Cost**
		High End Estimate		
Freight Barges	0	0%	$0.00	$0
Freight Ships	697	100%	$4.74	$3,305
Passenger Vessels	0	0%	$0.00	$0
Tank Barges	0	0%	$0.00	$0
Tank Ships	147	100%	$4.74	$697
Utility Vessels	10,892	100%	$4.74	$51,652
Wash Anchor Chain, High End TOTAL	**11,736**			**$55,654**

6.2.10 Controllable Pitch Propeller and Thruster Hydraulic Fluid and other Oil Sea Interfaces including Lubrication discharges from Paddle Wheel Propulsion, Stern Tubes, Thruster Bearings, Stabilizers, Rudder Bearings, Azimuth Thrusters, Propulsion Pod Lubrication, and Wire Rope and Mechanical Equipment Subject to Immersion

Affected Vessel Population

Based on the description of practices within this discharge category, a subset of vessel classes is applicable to the discharge category of controllable pitch propeller hydraulic fluid. Freight ships, tank ships, and various utility vessels have the potential to produce this discharge. No other vessel classes are expected to operate controllable pitch propellers.

The population potentially affected by BMPs applicable to this discharge category is shown in *Table 6-20*.

Table 6-20: Vessel Counts for Controllable Pitch Propeller Hydraulic Fluid BMPs

Vessel Class	Vessel Count
Freight Barges	0
Freight Ships	697
Passenger Vessels	0
Tank Barges	0
Tank Ships	147
Utility Vessels	10,892
TOTAL	**11,736**

Permit Requirements

Permit Text:

The protective seals on controllable pitch propellers, azimuth thrusters, propulsion pods, rudder bearings, or any other oil to sea interfaces must be maintained in good operating order to minimize the leaking of hydraulic oil or other oils. The vessel owner/operator must not discharge oil in quantities that may be harmful as defined in 40 CFR Part 110 from any oil to sea interface. If possible, maintenance activities on controllable pitch propellers, thrusters and other oil-to-sea interfaces should be conducted when a vessel is in drydock.

Minimize maintenance activities on stern tube seals when a vessel is outside of drydock. If maintenance or emergency repair must occur on stern tubes or other oil-to sea interfaces which have a potential to release oil in quantities that may be harmful as defined in 40 CFR Part 110, appropriate spill response resources (e.g. oil booms) must be used to contain any oil leakage. Operators of the vessel must have ready access to any spill response resources to clean any potential oil spills.

After applying lubrication to wire rope and mechanical equipment subject to immersion, wire ropes and other equipment must be thoroughly wiped-down to remove excess lubricant.

Owner/operators should use an environmentally preferable lubricant, including vegetable oil, synthetic ester, or polyalkylene glycol as a base for these applications when feasible. Use of an environmentally preferable lubricant does not authorize the discharge of any lubricant in a quantity that may be harmful as defined in 40 CFR Part 110.

Estimates of Cost

Based upon the preliminary industry responses, maintenance of the controllable pitch propeller is already performed when in drydock and, when applicable, oil booms and oil absorbent pads are purchased and are in use. However, a sensitivity analysis will be performed to account for the potential incremental cost associated with purchasing an oil boom and oil absorbent pads. In the sensitivity analysis EPA has estimated a potential low and high incremental cost associated with the purchase of an oil boom and oil absorbent pads. These low and high estimates are based upon the percentage of vessels that need to purchase this equipment.

Sensitivity Analysis

Cost estimates were based upon communication with an oil boom manufacturer (Dawg, 2008) as to the cost of purchasing an oil boom as well as oil absorbent pads. The cost input values are shown in *Table 6-21,* and the estimates/assumptions derived for each practice are described below.

Table 6-21: Per-Vessel Costs for BMPs Associated with Controllable Pitch Propeller Hydraulic Fluid

BMP	Unit Cost		Cost Description
	Low End	High End	
Purchase (and use) of an oil boom for containing any hydraulic oil leakage during underwater maintenance of the controllable pitch propeller	$44.48 for <50 ft width vessels $80.67 for >50 ft width vessels		Annualized Cost of Purchasing an Oil Boom
Purchase of oil absorbent pads to clean any potential oil spills	$10.24	$16.00	Annualized Cost of Purchasing Oil Absorbent Pads

- ***Purchase and Use of an Oil Boom***:
  - *Oil Boom Cost:* a representative from a vessel oil boom manufacturer provided the cost estimates for an oil boom. From communication with a vessel oil boom manufacturer, a 50-foot oil boom can be purchased for $552, and a 100-foot oil boom can be purchased for $1,001. Since the rear of the vessel is where the oil boom would be necessary, the length of boom that is required for a vessel is dependent upon the width of the vessel. Most vessels classes have an average width less than or around 50 feet, thus requiring only the 50-foot purchase. However, tank ships hold an average width of 78 feet and would therefore require the 100-foot purchase. The oil boom is expected to last for the lifetime of the vessel. The total incremental cost of the device is annualized at a 7 percent discount rate over 30 years.
  - *Baseline:*
    - — Low End Assumption: 99 percent of vessels already have and use an oil boom.
    - — High End Assumption: 95 percent of vessels already have and use an oil boom.
- ***Purchase of Oil Absorbent Pads***:
  - *Cost of Oil Absorbent Pads:* a representative from a vessel oil boom manufacturer also provided the cost estimates for oil absorbent pads. The cost ranges from $34 to $50 for 100 oil absorbent pads. EPA took the average cost of $42 per purchase. The oil absorbent pads are assumed to be purchased every three or five years. Thus, for the low end estimate, the total incremental cost of the device is annualized at a 7 percent discount rate over five years. For the high end estimate, the total incremental cost of the device is annualized at a 7 percent discount rate over three years.
  - *Baseline:*
    - — Low End Assumption: Oil absorbent pads need to be purchased every five years, and 99 percent of vessels already have oil absorbent pads.

— High End Assumption: Oil absorbent pads need to be purchased every three years, and 95 percent of vessels already have oil absorbent pads.

The cost per vessel for each BMP and the total cost associated with all vessels are provided in *Table 6-22*.

Table 6-22: Controllable Pitch Propeller Hydraulic Fluid Sensitivity Analysis

Vessel Class	Vessels	% Vessels Applicable to BMP	Annual Cost per Vessel[a]	Total Annual Cost
Low End Estimate				
Purchase an Oil Boom				
Freight Barges	0	0%	$0.00	$0
Freight Ships	697	1%	$44.48	$310
Passenger Vessels	0	0%	$0.00	$0
Tank Barges	0	0%	$0.00	$0
Tank Ships	147	1%	$80.67	$119
Utility Vessels	10,892	1%	$44.48	$4,845
Oil Boom Purchase TOTAL	**11,736**			**$5,274**
Purchase Oil Absorbent Pads				
Freight Barges	0	0%	$0.00	$0
Freight Ships	697	1%	$10.24	$71
Passenger Vessels	0	0%	$0.00	$0
Tank Barges	0	0%	$0.00	$0
Tank Ships	147	1%	$10.24	$15
Utility Vessels	10,892	1%	$10.24	$1,102
Oil Pads Purchase TOTAL	**11,736**			**$1,202**
			Low End TOTAL	**$6,476**
High End Estimate				
Perform Maintenance on the Controllable Pitch Propeller when Drydocked				
Purchase an Oil Boom				
Freight Barges	0	0%	$0.00	$0
Freight Ships	697	5%	$44.48	$1,550
Passenger Vessels	0	0%	$0.00	$0
Tank Barges	0	0%	$0.00	$0
Tank Ships	147	5%	$80.67	$593
Utility Vessels	10,892	5%	$44.48	$24,226
Oil Boom Purchase TOTAL	**11,736**			**$26,369**
Purchase Oil Absorbent Pads				
Freight Barges	0	0%	$0.00	$0
Freight Ships	697	5%	$16.00	$558
Passenger Vessels	0	0%	$0.00	$0
Tank Barges	0	0%	$0.00	$0
Tank Ships	147	5%	$16.00	$118
Utility Vessels	10,892	5%	$16.00	$8,611
Oil Pads Purchase TOTAL	**11,736**			**$9,391**
			High End TOTAL	**$35,760**

a Cost for the oil boom is annualized at a 7% discount rate over 30 years. Low end cost for oil absorbent pads is annualized at a 7% discount rate over five years. High end cost for oil absorbent pads is annualized at a 7% discount rate over three years.

6.2.11 Distillation and Reverse Osmosis Brine

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible and/or the industry is assumed to currently practice the Permit requirements. Thus, the vessel population that would apply to this Permit was not estimated since no vessels will experience any cost.

Permit Requirements

Permit Text:

Brine from the distillation system and reverse osmosis reject water shall not contain or come in contact with machinery or industrial equipment (other than that necessary for the production of potable water), toxic or hazardous materials, or wastes.

Estimates of Cost

No requirements within this discharge category require cost analysis because these practices are assumed to have negligible costs and/or the industry is assumed to currently practice the Permit requirements.

6.2.12 Elevator Pit Effluent

Affected Vessel Population

Based on the description of practices within this discharge category, a small subset of vessel classes is applicable to the elevator pit effluent discharge category. Only freight ships and tank ships have the potential to produce this discharge since no other vessels are expected to have exposed elevators. Passenger vessels do not produce this discharge because they are expected to have enclosed elevators.

The population potentially affected by BMPs applicable to discharges in the elevator pit effluent category is shown in *Table 6-23*.

Table 6-23: Vessel Counts for Elevator Pit Effluent BMPs

Vessel Class	Vessel Count
Freight Barges	0
Freight Ships	697
Passenger Vessels	0
Tank Barges	0
Tank Ships	147
Utility Vessels	0
TOTAL	**844**

Permit Requirements

Permit Text:

Discharges of untreated elevator pit effluent are not authorized within waters subject to this permit except in cases of emergency. Elevator pit effluent may be discharged into waters subject to this permit if it is managed with the vessel's bilgewater and meets all the requirements of Part 2.2.2 of this permit or it must otherwise be *treated with an oily-water separator and discharged with an oil content below 15 ppm as measured by EPA Method 1664 or other appropriate method for determination of oil content as accepted by the International Maritime Organization (IMO) (e.g. ISO Method 9377) or U.S. Coast Guard. Emergency discharges must be documented in the ship's log or other vessel recordkeeping documentation consistent with Part 4.2.*

Estimates of Cost

Based on survey responses, discharge of elevator pit effluent never occurs in either normal or emergency situations. Thus, there is no incremental cost associated with onshore disposal or for the use of an oily-water separator to ensure an oil content of less than 15 parts per million (ppm). No sensitivity analysis will be performed.

6.2.13 Firemain Systems

Affected Vessel Population

Based on the description of practices within this discharge category, a subset of vessel classes is applicable to the firemain systems discharge category. Only freight ships, passenger vessels, and tank ships have the potential to produce this discharge. Other vessel classes do not produce this discharge because it is associated with ballast water, and the other vessel classes are not expected to hold ballast.

The population potentially affected by BMPs applicable to the firemain systems discharge category is shown in *Table 6-24*.

Table 6-24: Vessel Counts for Firemain Systems BMPs

Vessel Class	Vessel Count
Freight Barges	0
Freight Ships	697
Passenger Vessels	11,521
Tank Barges	0
Tank Ships	147
Utility Vessels	0
TOTAL	**12,365**

Permit Requirements

Permit Text:

Discharges from firemain systems are authorized for emergency purposes when needed to ensure the safety and security of the vessel and her crew and for testing and inspection purposes as may be required to assure its operability in an emergency. Firemain systems may be discharged in port for certification, maintenance, and training requirements if the intake comes directly from the surrounding waters or potable water supplies and there are no additions to the discharge. Furthermore, firemain discharges may be discharged for deck washdown or other secondary uses if the intake comes directly from the surrounding waters or potable water supplies and the discharge meets all relevant effluent limitation associated with that activity. When feasible, maintenance and training should be conducted outside port and/or outside waters subject to this permit.

Do not discharge firemain systems in waters listed in Part 12.1 except in emergency situations or when washing down the anchor chain to comply with anchor wash down requirements in Part 2.2.8.

Estimates of Cost

Based on survey responses, discharges from the firemain system does not occur in normal situation. Though the industry responses to EPA's questionnaire indicate that discharges from firemain systems do not occur in emergency situations, EPA assumes that there are occasional discharges from the firemain systems in cases of fire emergency, training, or other situations.

6.2.14 Freshwater Layup

Affected Vessel Population

Based on EPA's survey results, the vessel population that would apply to this Permit may be null since this discharge category may not apply to any commercial vessels. EPA included this provision in the permit based on information from MARAD marine engineers that these vessel discharges may occur.

Permit Requirements

Permit Text:

Minimize the amount of disinfection agents used in freshwater layup to the minimum required to prevent aquatic growth.

Estimates of Cost

No requirements within this discharge category require cost analysis because this discharge is not applicable to commercial vessels or it is assumed vessel operators currently perform these practices.

6.2.15 Gas Turbine Wash Water

Affected Vessel Population

The vessel population that would apply to this Permit may be null since this discharge category may not apply to any commercial vessels. Only CLIA indicated that their vessels may have this vessel discharge type in their public comments.

Permit Requirements

Permit Text:

Gas turbine wash water must not be directly discharged within waters subject to this permit. Where feasible, such washwater must be prevented from commingling with bilge water that will be discharged in waters subject to this permit, for example by collecting it separately and properly disposing of it on-shore. Under no circumstances may oils, including oily mixtures, from gas turbine wash water be discharged in waters subject to this permit in quantities that may be harmful as determined in accordance with 40 CFR Part 110.

Estimates of Cost

No requirements within this discharge category require cost analysis because this discharge may not be applicable to commercial vessels and it was assumed that vessel operators could easily comply with these permit terms if these requirements are applicable.

6.2.16 Graywater

Affected Vessel Population

Based on the description of practices within this discharge category, graywater discharges are applicable to every vessel class except for freight barges and tank barges. However, there is some overlap with the Clean Water Act's existing provisions and with 33 CFR159.309, as well as overlap regarding the number of vessels that currently practice specific BMPs. The American Waterways Operators, within the public comments, stated that all towing vessels currently use environmentally friendly detergents.

The population potentially affected by BMPs applicable to the graywater discharge category is shown in *Table 6-25*.

Table 6-25: Vessel Counts for Graywater BMPs

Vessel Class	Non-Oceangoing Vessel Count[a]	Oceangoing Vessel Count	Total Vessel Count
Freight Barges	0	0	0
Freight Ships	112	555	667
Passenger Vessels	1,688	9,682	11,370
Tank Barges	0	0	0
Tank Ships	13	129	142
Utility Vessels	5,697	5,121	10,818
TOTAL	**7,510**	**15,487**	**22,997**

a Includes vessels operating on the Great Lakes, Mississippi River, and intracoastal waterways.

Permit Requirements

Permit Text:

All vessels must minimize the discharge of graywater while in port. For those vessels that cannot store graywater, the owner or operator and their crews should minimize the production of graywater in port. All vessels that have the capacity to store graywater shall not discharge that graywater in waters listed in Part 12.1. For vessels that cannot store graywater, vessel operators must minimize the production of graywater while in waters listed in Part 12.1.

For vessels greater than 400 gross tons that regularly travel more than 1 nm from shore that have the capacity to store graywater for a sufficient period, graywater must be discharged greater than 1 nm from shore while the vessel is underway, unless the vessel meets the treatment standards and other requirements contained under Parts 5.1.1 and 5.1.2 or 5.2.1 and 5.2.2 of this permit. Additional specific requirements for Graywater apply to Cruise Vessels (Parts 5.1 and 5.2) and Large Ferries (Part 5.3).

Vessels that do not travel more than 1 nm from shore shall minimize the discharge of graywater and, provided the vessel has available graywater storage capacity, must dispose of graywater on shore if appropriate facilities are available and such disposal is economically practicable and achievable unless the vessel meets the treatment standards and other requirements contained under Parts 5.1.1 and 5.1.2 or 5.2.1 and 5.2.2 of this permit. Minimize the discharge of graywater when the vessel is not underway.

If graywater will be discharged in waters subject to this permit, the introduction of kitchen oils must be minimized to the graywater system. When cleaning dishes, you must remove as much food and oil residue as practicable before rinsing dishes. Oils used in cooking shall not be added to the graywater system. Oil from the galley and scullery shall not be discharged in quantities that may be harmful as defined in 40 CFR Part 110.

Vessel owner/operators must use phosphate free and non-toxic soaps and detergents for any purpose if they will be discharged into waters subject to this permit. These detergents must be free from toxic or bioaccumulative compounds and not lead to extreme shifts in receiving water pH.

If you are underway in a nutrient impaired water, or a water that is impaired as a result of nutrient enrichment (such as waters listed as impaired for phosphorus, nitrogen, or for hypoxia or anoxia (low dissolved oxygen concentrations)) you must follow these additional steps:

When the vessel has adequate graywater storage capacity, the vessel owner/operator shall not discharge graywater into nutrient impaired waters subject to this permit (e.g., the Chesapeake Bay). A complete list of such waters can be found at www.epa.gov/npdes/vessels. Where the vessel does not have adequate storage capacity to eliminate such discharges, graywater production and discharge must be minimized in such waters. Any such discharge must be conducted while the vessel is underway in areas with significant circulation and depth to the extent feasible. Graywater stored while in such waters can later be disposed of on shore or discharged in accordance with the other requirements of this permit.

Estimates of Cost

Based upon survey responses, practices associated with graywater involve no incremental cost. The majority of vessels (excluding passenger vessels) produce little to no graywater. Thus, they are not able to store their graywater in appropriate tanks. Instead, they produce and discharge graywater simultaneously. A survey response from a ferry company indicated that the company's vessels discharge all graywater onshore at appropriate facilities.

Furthermore, based upon outside research and communication with a vendor, there is no incremental cost associated with the purchase of phosphate free soaps or detergents. There are varied prices among high and low end products. However, there is enough variability among prices that a vessel could opt for a standard phosphate free product in lieu of a high end non-phosphate free product.

6.2.17 Motor Gasoline and Compensating Discharge

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible and/or the industry is assumed to currently practice the Permit requirements. Thus, the vessel population that would apply to this Permit was not estimated since no vessels are expected to experience any cost.

Permit Requirements

Permit Text:

The discharge of motor gasoline and compensating effluent must not have oil in quantities that may be harmful as defined in 40 CFR 110.3, which includes discharges resulting in a visible sheen, or an oil concentration that exceeds 15 ppm. Determination of oil concentration may be measured by EPA Method 1664 or other appropriate method for determination of oil content as accepted by the International Maritime Organization (IMO) (e.g. ISO Method 9377) or U.S. Coast Guard. Compliance with the 15 ppm oil concentration limitation may be established with visual monitoring for an oily sheen. Minimize discharge of motor gasoline and compensating discharge in port. If an oily sheen is observed, the vessel operator must deploy appropriate oil containment practices. Vessels shall not discharge motor gasoline and compensating discharge in waters subject to this permit listed in Part 12.1.

Estimates of Cost

No requirements within this discharge category require cost analysis because these practices are assumed to have negligible costs and/or the industry is assumed to currently practice the Permit requirements.

6.2.18 Non-Oily Machinery Wastewater

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible and/or the industry is assumed to currently practice the Permit requirements. Thus, the vessel population that would apply to this Permit was not estimated since no vessels are expected to experience any cost.

Permit Requirements

Permit Text:

If discharged directly overboard, non-oily machinery wastewater must be free from oils and any additives that are toxic or bioaccumulative in nature. Non-oily machinery wastewater may also be drained to the bilge.

Estimates of Cost

No requirements within this discharge category require cost analysis because these practices are assumed to have negligible costs and/or the industry is assumed to currently practice the Permit requirements.

6.2.19 Refrigeration and Air Condensate Discharge

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible and/or the industry is assumed to currently practice the Permit requirements. Thus, the vessel population that would apply to this Permit was not estimated since no vessels are expected to experience any cost.

Permit Requirements

Permit Text:

You must not allow refrigeration and air condensate discharge to come into contact with oily or toxic materials if it is discharged directly overboard. Refrigeration and air conditioning condensate that is collected and plumbed for internal recycling (e.g. recycled as "technical water") is allowed to commingle with oily water; however, the commingled discharge must meet all requirements of Part 2.1.4 of this permit and Part 2.2.2 of this permit if applicable.

Estimates of Cost

No requirements within this discharge category require cost analysis because these practices are assumed to have negligible costs and/or the industry is assumed to currently practice the Permit requirements.

6.2.20 Seawater Cooling Overboard Discharge (including non-contact engine cooling water; hydraulic system cooling water, refrigeration cooling water)

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible and/or the industry is assumed to currently practice the Permit requirements. Thus, the vessel population that would apply to this Permit was not estimated since no vessels are expected to experience any cost.

Permit Requirements

Permit Text:

When possible, seawater cooling overboard should be discharged when the vessel is underway so that any thermal impacts are dispersed.

To reduce the production and discharge of seawater cooling overboard discharge, EPA recommends that vessel owner/operators use shore based power when the vessel is in port if:

- *Shore power is readily available for vessel owner/operators from utilities or port authorities;*
- *Shore based power supply systems are capable of providing all needed electricity required for vessel operations; and*
- *The vessel is equipped to connect to shore-based power and such systems are compatible with the available shore power.*

Maintenance of all piping and seawater cooling systems must meet the requirements of Part 2.2.20 (Seawater-Piping Biofouling Prevention).

Estimates of Cost

No requirements within this discharge category require cost analysis because these practices are assumed to have negligible costs and/or the industry is assumed to currently practice the Permit requirements.

6.2.21 Seawater Piping Biofouling Prevention

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible and/or the industry is assumed to currently practice the Permit requirements. Thus, the vessel population that would apply to this Permit was not estimated since no vessels are expected to experience any cost.

Permit Requirements

Permit Text:

Seawater piping biofouling chemicals subject to FIFRA registration (see 40 CFR 152.15) must be used in accordance with their FIFRA label. No pesticides or chemicals banned for use in the United States may be discharged into waters subject to this permit.

Vessel owner/operators must use the minimum amount of biofouling chemicals needed to keep fouling under control. Discharges containing active agents must contain as little chlorine as possible.

Vessel owner/operators must remove fouling organisms from seawater piping on a regular basis and dispose of removed substances in accordance with local, State, and federal regulations. Removed fouling organisms shall not be discharged into waters subject to this permit and EPA recommends that if discharged into waters, should be discharged more than 50 nm from shore. Vessel owner/operators should remove any organisms while at sea to reduce the risk of invasive species introduction in ports.

Estimates of Cost

No requirements within this discharge category require cost analysis because these practices are assumed to have negligible costs and/or the industry is assumed to currently practice the Permit requirements.

6.2.22 Boat Engine Wet Exhaust

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible and/or the industry is assumed to currently practice the Permit requirements. Thus, the vessel population that would apply to this Permit was not estimated since no vessels are expected to experience any cost.

Permit Requirements

Permit Text:

Vessels generating wet exhaust must be maintained in good operating order, well tuned, and functioning according to manufacturer specifications if available to decrease pollutant contributions to wet exhaust. Vessel owner/operators should use low sulfur or alternative fuels for their vessels to reduce the concentration of pollutants in their discharge.

EPA encourages vessel operators to consider four stroke versus two stroke engines for vessels generating wet exhaust that are covered under this permit. Use of a four stroke engine may minimize the discharge of pollutants to US waters.

Estimates of Cost

No requirements within this discharge category require cost analysis because these practices are assumed to have negligible costs and/or the industry is assumed to currently practice the Permit requirements.

6.2.23 Sonar Dome Discharge

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible and/or the industry is assumed to currently practice the Permit requirements. Thus, the vessel population that would apply to this Permit was not estimated since no vessels are expected to experience any cost.

Permit Requirements

Permit Text:

The water inside the sonar dome shall not be discharged within waters subject to this permit for maintenance purposes. Vessel operators should not use biofouling chemicals that are bioaccumulative for the exterior of sonar domes when other viable alternatives are available.

Estimates of Cost

No requirements within this discharge category require cost analysis because these practices are assumed to have negligible costs and/or the industry is assumed to currently practice the Permit requirements.

6.2.24 Underwater Ship Husbandry Discharges

Affected Vessel Population

Based on the description of practices within this discharge category, the subset of vessels that would apply to practices in underwater ship husbandry was determined. The industry is assumed to currently practice the Permit requirements. However, the vessel population that would apply to this Permit was estimated since some of these vessels may follow the recommendation to use vacuum control technologies.

The population potentially affected by BMPs applicable to discharges in the underwater ship husbandry category is shown in *Table 6-26*.

Table 6-26: Vessel Counts for Underwater Ship Husbandry BMPs

Vessel Class	Vessel Count
Freight Barges	0
Freight Ships	0
Passenger Vessels	11,521
Tank Barges	0
Tank Ships	0
Utility Vessels	0
TOTAL	**11,521**

Permit Requirements

Permit Text:

Vessel owner/operators must minimize the transport of attached living organisms when they travel into U.S. waters from outside the U.S. economic zone or when traveling between COTP zones.

Whenever possible, rigorous hull-cleaning activities should take place in drydock, or another land-based facility where the removal of fouling organisms or spent antifouling coatings paint can be contained. If water-pressure based systems are used to clean the hull and remove old paint, use facilities which treat the washwater prior to discharge to remove the antifouling compound(s) and fouling growth from the washwater.

Vessel owner/operators who remove fouling organisms from hulls while the vessel is waterborne must employ methods that minimize the discharge of fouling organisms and antifouling hull coatings. These shall include:

- *Selection of appropriate cleaning brush or sponge rigidity to minimize removal of antifouling coatings and biocide releases into the water column.*
- *Limiting use of hard brushes and surfaces to the removal of hard growth.*
- *When available and feasible, use of vacuum control technologies to minimize the release or dispersion of antifouling hull coatings and fouling organisms into the water column.*

Vessel owner/operators must minimize the release of copper based antifoulant paint into the water column when they clean their vessel. Cleaning of copper based antifoulant paints must not result in any visible cloud or plume of paint in the water: if a visible cloud or plume of paint develops, shift to a softer brush or less abrasive cleaning technique. A plume or cloud of paint can be noted by the presence of discoloration or other visible indication that is distinguishable from hull growth or sediment removal. Production of a plume or cloud of sediment or hull growth is normal in some cases during vessel hull cleaning, but this plume or cloud should be substantially paint free (e.g. paint should not be clearly identifiable in the plume or cloud).

Vessels that use copper based anti-fouling paint must not clean the hull in copper impaired waters within the first 365 days after paint application unless there is a significant visible indication of hull fouling.

Estimates of Cost

Since practices associated with underwater ship husbandry are contracted to diving companies, information gathered from diving companies is most useful. According to communication with a diving company based in Florida (Seacor, 2008), it is standard to clean the hull using the appropriate Permit standards. It is also standard to use vacuum brushes to clean the hull. However, vacuum control technologies that completely avoid the release of hull coatings and organisms into the water column are not readily available to most diving companies because the cost of renting this advanced technology is near $1 million per cleaning. Thus, this practice is only recommended, not required.

The additional BMPs within this discharge category are currently practiced by the contracted diving companies. Therefore, the costs incurred for the additional BMPs are currently negligible. In general, the BMPs associated with underwater hull husbandry are applicable to the diving companies contracted by the vessel company. The practices that they perform to clean the hull depend on the hull's condition. The diving company gave an average cost of $25,000 to $35,000 to perform underwater hull cleaning for a large cruise ship. This price is dependent on the dive depth as well as other technologies that are necessary for hull cleaning.

6.2.25 Welldeck Discharges

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible and/or the industry is assumed to currently practice the Permit requirements. Thus, the vessel population that would apply to this Permit was not estimated since no vessels are expected to experience any cost.

Permit Requirements

Permit Text:

Welldeck discharges that contain graywater from smaller vessels should not be discharged within waters subject to this permit except in cases of emergency. Welldeck discharges from washdown of gas turbine engines may not be discharged within waters subject to this permit. Welldeck discharges from equipment and vehicle washdowns must be free from garbage and must not contain oil in quantities that may be harmful as defined in 40 CFR Part 110.

Estimates of Cost

No requirements within this discharge category require cost analysis because these practices are assumed to have negligible costs and/or the industry is assumed to currently practice the Permit requirements.

6.2.26 Graywater Mixed with Sewage from Vessels

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible and/or the industry is assumed to currently practice the Permit requirements. Thus, the vessel population that would apply to this Permit was not estimated since no vessels are expected to experience any cost.

Permit Requirements

Permit Text:

The commingled discharge of graywater mixed with sewage from vessels must comply with the effluent limits for graywater discharge in Part 2 or Part 5 of this permit if applicable. Though not a requirement of this permit, vessel owner/operators are advised that all discharges commingled with sewage must meet the requirements set forth in section 312 of the Clean Water Act and its implementing regulations found at 40 CFR Part 140 and 33 CFR Part 159. Hence, discharges of graywater mixed with sewage must meet both standards to be in compliance with the Clean Water Act.

Estimates of Cost

No requirements within this discharge category require cost analysis because these practices are assumed to have negligible costs and/or the industry is assumed to currently practice the Permit requirements.

6.2.27 Exhaust Gas Scrubber Washwater Discharge

Affected Vessel Population

The costs incurred in this discharge category are assumed to be negligible because of the limited number of vessels producing this discharge. Thus, the complete vessel population that would apply to this Permit was not estimated since a limited number of vessels, if any, are expected to experience any incremental cost.

Permit Requirements

Permit Text:

Exhaust gas scrubber washwater discharge must not contain oil, including oily mixtures, in quantities that may be harmful as determined in accordance with 40 CFR Part 110. Sludge generated from exhaust gas scrubber washwater discharge must not be discharged in waters subject to this permit. In addition, EPA recommends that owner/operators of vessels with exhaust gas cleaning systems that result in washwater discharges follow the guidelines set out in section 10 for Exhaust Gas Cleaning Systems (resolution MEPC.170(57)).

Estimates of Cost

EPA believes that these limits and BMPs are reasonable for the final Vessel General Permit and do not require cost analysis because the current volume of exhaust gas scrubber washwater discharge is low due to the limited number of vessels utilizing exhaust gas cleaning systems. At this time, EPA is aware of only one vessel that sails in U.S. waters and uses this technology.

6.3 Per-Vessel Costs for Vessel-Specific Requirements

6.3.1 Large and Medium Cruise Ships

Affected Vessel Population

The population estimate shown in *Table 6-27* is provided by Cruise Lines International Association (CLIA). Large sized cruise ships are in the 500+ passenger/crew capacity classification, and medium sized cruise ships are in the 100–499 passenger/crew capacity classification.[22]

Table 6-27: Cruise Ship Counts

Vessel Class[a]	Alaskan Certified Cruise Ships	Non- Alaskan Certified Cruise Ships	Total Count
Large Cruise Ships	30	113	143
Medium Cruise Ships[c]	0	32	32
TOTAL	**30**	**145**	**175[b]**

a Cruise ships fall within the passenger vessels category.
b This count is based upon CLIA populations. There may be an additional 5% that are non-CLIA members.
c The estimated number of medium cruise ships was determined based upon a 250-499 passenger/crew capacity classification rather than the 100-499 range. However, based on preliminary data provided by CLIA, there are very few cruise ships within the 100-249 passenger/crew capacity classification. EPA therefore expects that the estimate is only slightly below the actual universe of medium cruise ships.

Permit Requirements

Permit Sections Summary:

Sculleries and Galleys:

Cruise ship owner/operators must use detergents that are phosphate free. Degreasers must be non-toxic if they will be discharged as part of any waste stream.

Hazardous Waste

Waste from mercury containing products, dry cleaners or dry cleaner condensate, photo processing labs, medical sinks or floor drains, chemical storage areas, and print shops using traditional or non-soy based inks and chlorinated solvents must be prevented from entering the ship's graywater, blackwater, or bilgewater systems if water from these systems will ever be discharged into waters subject to this permit. Preventing these wastes from entering these systems can be accomplished by plugging all drains that flow to the graywater, blackwater, or bilge systems in areas where these wastes are produced and creating alternate waste receptacles or replumbing drains to appropriate holding tanks.

Vessel owner/operators must not discharge any toxic or hazardous materials, including products containing acetone, benzene, or formaldehyde into salon and day spa sinks or floor drains if those sinks or floor drains lead to any system which will ever be discharged into waters subject to this permit. This includes using these materials on passengers (or crew) and rinsing residuals into these sinks. Alternate waste receptacles or holding tanks must be used for these materials. Additions of these materials to any systems which will discharge into waters subject to this permit is a permit violation.

[22] The estimated number of medium cruise ships in *Table 6-27* was determined based upon a 250-499 passenger/crew capacity classification rather than the 100-499 range. However, based on preliminary data provided by CLIA, there are very few cruise ships within the 100-249 passenger/crew capacity classification. EPA therefore expects that the estimate is only slightly below the actual universe of medium cruise ships.

<u>*Discharge Standards:*</u>

Pierside Limits: While pierside, appropriate reception facilities for graywater must be used, if reasonably available unless the vessel treats graywater with a device to meet the standards in Part 5.1.1.1.2. If such facilities are not reasonably available, you must treat graywater with a device to meet the standards in Part 5.1.1.1.2 or hold the graywater for discharge while the vessel is underway and discharge according to the operational limits below. Appropriate reception facilities are those authorized for use by the port authority or municipality and that treat the discharge in accordance with its NPDES permit.

<u>Operational Limits</u>: You must meet the following restrictions:

- *While operating within 1 nm from shore, discharges of graywater are prohibited unless they meet the effluent standards in Part 5.1.1.1.2.*
- *If you operate between 1 nm and 3 nm from shore, discharges of graywater must either: (1) meet the effluent standards in Part 5.1.1.1.2, or (2) be released while the Cruise Ship is sailing at a speed of at least 6 knots in a water that is not listed in Part 12.1.*

<u>Nutrient Impaired Water Limits</u>: If you operate in nutrient impaired waters including the Chesapeake Bay or the territorial Sea surrounding the mouth of the Mississippi River in the Gulf of Mexico, you must:

- *Not discharge any graywater in nutrient impaired waters subject to this permit unless the length of voyage in that water exceeds the vessel's holding capacity for graywater; and*
- *Minimize the discharge of any graywater into nutrient impaired waters subject to this permit, which may require minimizing the production of graywater; and*
- *If your vessel's holding capacity for graywater is exceeded, treat such excess graywater (above the vessel holding capacity) by a device meeting the standards in Part 5.1.1.1.2 prior to discharge into nutrient impaired waters subject to this permit or*
- *Dispose of the graywater properly on shore.*
- *A list of nutrient impaired waters is available at www.epa.gov/npdes/vessels.*

<u>*Treatment Standards:*</u>

The discharge of treated graywater must meet the following standards:

1. *The discharge must satisfy the minimum level of effluent quality specified in 40 CFR 133.102;*
2. *The geometric mean of the samples from the discharge during any 30-day period may not exceed 20 fecal coliform/100 milliliters (ml) and not more than 10 percent of the samples exceed 40 fecal coliform/100 ml; and*
3. *Concentrations of total residual chlorine may not exceed 10.0 micrograms per liter (µg/l).*

Monitoring Requirements: The owner/operator must maintain records estimating all discharges of untreated graywater into waters subject to this permit, including date, location and volume discharged and speed of the vessel at the time of discharge in their recordkeeping documentation. These records can be maintained as part of the vessel's sewage and graywater discharge record book required under 33 CFR §159.315.

Prior to entering waters of the U.S., vessel operators must demonstrate that they have an effective treatment system that complies with the standards in Part 5.1.1.1.2 if they will discharge graywater:

- *within 1 nm of shore, or*
- *within 3 nm of shore and sailing less than 6 knots*

In order to demonstrate the effectiveness of the treatment system, the vessel operator must take at least five (5) samples taken from the vessel on different days over a 30-day period that are representative of the treated effluent to be discharged. Initial monitoring must be done within the first 90 days of permit coverage, within 90 days of AWTS installation onboard the vessel, or before vessels discharge into waters subject to this permit. Samples must be taken for biochemical oxygen demand (BOD), fecal coliform, suspended solids, pH, and total residual chlorine. Sampling and testing shall be conducted according to 40 CFR Part 136. If the measured samples meet the standards specified in Part 5.1.1.1.2, then the owner/operator has demonstrated the effectiveness of their treatment system for controlling their graywater discharge. Records of the sampling and testing results must be retained onboard for a period of 3 years in the vessel's recordkeeping documentation.

Records of monitoring information shall include:

- *The date, exact place, and time of sampling or measurements;*
- *The individual(s) who performed the sampling or measurements;*
- *The date(s) analyses were performed;*
- *The individual(s) who performed the analyses;*
- *The analytical techniques or methods used; and*
- *The results of such analyses.*

Analytical results for total residual chlorine below the method detection limit shall be deemed compliant with the effluent limits, provided the permittee uses a testing method with a detection limit no higher than 10.0 µg/L under ideal conditions. EPA recommends method SM4500-CL G (DPD Colorimetric Method) for these purposes as it is able to reach 10 µg/L under ideal conditions and so meets these requirements. SM4500-Cl G is typically the method that ADEC/USCG uses for compliance monitoring.

Testing and reporting for total residual chlorine is not required if chlorine is not used as disinfectant in the wastewater treatment works process and no water is drained to the graywater system from water with onboard chlorine additions (e.g. swimming pools, spas. . .).

If a permittee has already received certification for continuous discharges from AWTS by the United States Coast Guard to meet the requirements of Section 1411(b) of Title XIV, Pub. L. 106-554 (Dec. 31, 2000, 114 Stat. 2763) [Certain Alaska Cruise Ship Operations] (codified at 33 U.S.C. 1901 note), the vessel need not conduct initial monitoring and may commence conducting maintenance monitoring.

After demonstrating the effectiveness of their system, vessel owner/operators must collect and analyze one sample per quarter for each of the constituents analyzed in Part 5.1.2.2.1 to demonstrate treatment equipment maintenance and compliance with this permit. Records of the sampling and testing results must be retained onboard for a period of 3 years in the vessel's recordkeeping documentation.

<u>Educational and Training Requirements:</u>

The crews of cruise ships play a key role in minimizing the discharge of pollutants from cruise ship operations and passengers. Therefore cruise ship operators are subject to the following requirements:

- *The ship's crew members who actively take part in the management of a discharge or who may affect any discharge must receive training regarding shipboard environmental procedures and must be able to demonstrate proficiency in implementing these procedures.*
- *Advanced training in shipboard environmental management procedures must be provided for those directly involved in managing specific discharge types or areas of the ship and these crew members must be able to demonstrate proficiency in implementing these procedures.*

- *Appropriate reprimand procedures must be developed for crew whose actions lead to violations of any effluent limit set forth in this permit or procedures established by the cruise ship operator to minimize the discharge of pollutants.*

Cruise ships must also educate passengers on their potential environmental impacts. The goals of these education efforts should include preventing trash from entering any waste stream, eliminating the addition of unused soaps, detergents, and pharmaceuticals to the graywater or blackwater systems and minimizing production of graywater. This can be accomplished in a variety of ways including, but not limited to posting signage and informational material in guestrooms and common areas, incorporating environmental information passenger orientation presentations or packages at the start of cruises, incorporating this information into additional lectures and seminars, or broadcasting information via loudspeakers.

Estimates of Cost

The majority of the BMPs associated with cruise ship graywater management are already practiced by the cruise ship industry. The cruise line members (including both large and medium cruise ships) of CLIA—which represent approximately 95 percent of the entire cruise line industry—adhere to the CLIA industry standard for certain BMPs, including preventing hazardous waste from photo processing labs, dry cleaners or dry cleaner condensate, and print shops from entering the ship's graywater system. Furthermore, according to a CLIA industry representative based on survey response, nearly all of the other practices associated with the Permit standards are already practiced by the cruise line industry:

Pierside and Operational Limits: These discharge standards associated with the Permit involve no incremental cost because both large and medium cruise ships have sufficient holding capacity to avoid discharging within 1 nm from shore. Discharges within 3 nm from shore currently undergo graywater treatment or are discharged while the ship is sailing at a speed of at least 6 knots. Furthermore, regarding the Permit specifications, according to an industry representative, reception facilities for graywater are very rare and are not commonplace even at major ports.

Medium cruise ships will incur no incremental cost associated with this practice since the Permit standards are already practiced. Medium cruise ships that are able to voyage more than 1 nm are already complying with graywater treatment standards. These ships have the option to discharge graywater in nutrient impaired waters while sailing at a speed of at least 6 knots. Since this is already an industry standard, according to the CLIA representative, there is no incremental cost associated with this Permit requirement.

Limits Applicable to Operation in Nutrient Impaired Waters: These limits are applicable to only a subset of large cruise ships: those that operate in these waters whose graywater holding capacity is exceeded due to the voyage length. These cruise ships will be required to treat the graywater prior to discharge. According to an industry representative, all non-Alaskan operating cruise ships that operate in nutrient impaired waters have the capacity to hold their graywater until they are allowed to discharge. Therefore, there is no incremental cost for these ships.

According to estimates provided by an industry representative, there are 30 cruise ships operating in Alaska that already have a graywater treatment system installed. These ships are assumed to incur incremental operation and maintenance cost. EPA gathered information as part of its evaluation of standards for discharges of sewage and graywater from cruise ships operating in Alaska. Based upon these data, EPA estimates the average cost per passenger (including crew), per season, for operation and maintenance of a graywater treatment system at $7.09. This cost is applied to the preliminary average large cruise ship passenger/crew capacity of 3,211 to derive an average annual incremental cost per cruise ship of operating and maintaining a graywater treatment system:

$22,765.99. The total incremental cost for this requirement across the 30 large cruise ships is therefore estimated at $683,022.24.[23]

Existing medium cruise ships unable to voyage more than 1 nm from shore must not immediately meet graywater treatment standards found in Part 5.2.1.1.1 of the VGP. However, medium sized cruise ships that are unable to voyage 1 nm from shore must meet the graywater discharge requirements if they are constructed (including major conversions) on or after the permit issuance date. Within the Seatrade Cruise Review (December 2007 issue), a CLIA representative indicated that no ships within the medium sized cruise ship category and for the particular style (i.e. those that are unable to voyage 1 nm from shore) are scheduled to be newly constructed. However, EPA assumes that medium sized cruise ships are replaced or undergo a major conversion at a rate of approximately once every 30 years. EPA identified four medium sized cruise ships that are unable to voyage 1 nm from shore (CLIA). In estimating the costs of this requirement, EPA also assumed that an additional eight medium cruise ships during the 30-year period will install graywater treatment systems even if they have the ability to voyage 1 nm from shore so that they may discharge graywater within 1 nm. This brings the total number of medium cruise ships assumed to purchase a graywater treatment system over the 30-year period to twelve, or an average of two ships within each 5-year period. The estimate of costs of installing, operating and maintaining a graywater treatment system is based upon EPA information gathered as part of its evaluation of standards for discharges of sewage and graywater from cruise ships operating in Alaska. Based upon these data, EPA estimated the average capital cost of installing a graywater treatment system at $1,150 per passenger (including crew), while the cost of operating and maintaining the graywater treatment system is $7.09 per capita and per season. The average capital cost is annualized over 30 years using a 7 percent discount rate to derive an annual capital cost of $92.67 per passenger (including crew). Assuming an average number of 557 passengers and crew, the total cost per cruise ship is approximately $55,589. The total annual cost associated with the medium and large sized cruise ships is detailed in *Table 6-28*.

Table 6-28: Cruise Ship Costs Associated with the Purchase/Operation and Maintenance of a Graywater Treatment System[a]

Vessel Class	Total Number of Vessels	Incremental Number of Vessels that need to Install and/or Operate and Maintain a Graywater Treatment System[a]	Annual Cost per Passenger and Crew	Average Number of Passengers and Crew	Total Annual Cost
Large Cruise Ships	113	30	$7.09	3,211	$683,022
Medium Cruise Ships	12	12[b]	$99.76	557	$111,177
TOTAL	**125**	**42**			**$794,200**

a Large cruise ships are assumed to incur a cost of $7.09 per passenger and crew for operation and maintenance of the graywater system.. Medium cruise ships are assumed to incur costs of $92.67 + $7.09 per passenger and crew for the capital expense of installing the graywater system, and operating and maintaining the system, respectively.
b Twelve medium cruise ships are expected to need to install a graywater treatment system over a 30-year period. However, only two medium cruise ships are expected to undergo major conversions within each 5-year period (5 years is the scope of this Permit).

Sculleries and Galleys: Based upon industry communication as well as outside research with a vendor, EPA has found that there is no incremental cost of purchasing phosphate free soaps and non-toxic degreasers in lieu of standard soaps and degreasers. There are varied prices among high and low end products. However, there is enough variability among prices that a ship could opt for a standard phosphate free/non-toxic product in lieu of a

[23] Large cruise ships are not anticipated to install a graywater treatement system to comply with the VGP since they either currently have such a system in place, or have other compliance options available to them, including holding their graywater until they are allowed to discharge. If a graywater treatment system were required, EPA estimates that the capital cost of installing such as system averages $1,050 per passenger, or approximately $3.4 million for a large cruise ship having the average passenger/crew capacity of 3,211.

high end, non-phosphate free/toxic product. Also, the industry representative was not able to provide the percentage of large or medium ships that use these phosphate free/non-toxic products or the annual average number of gallons that are purchased by a ship. However, since there is no incremental cost associated with purchasing the phosphate free/non-toxic products, it is unnecessary to determine the population of ships to which this Permit requirement would apply.

Hazardous Waste: CLIA industry standards, as mentioned previously, already account for the Permit practices associated with some of the waste sources. Furthermore, based on communication with a CLIA representative, the other source drains (medical, salon, and chemical sources) are currently either replumbed to appropriate holding tanks, or are plugged and alternative waste receptacles are used. Thus, there is no incremental cost associated with this Permit standard for both large and medium cruise ships.

Untreated Graywater Documentation: Based on communication with a CLIA representative, documentation of these discharges is common practice. Thus, there is no incremental cost associated with this Permit standard for both large and medium cruise ships.

Monitoring: Sampling and analysis cost estimates of treated graywater are based upon communication with a CLIA representative and a field expert. The cost associated with one sampling event is approximately $1,000 per ship. The actual cost of testing an individual sample, such as for biochemical oxygen demand (BOD), is low (approximately $50–$100); however, there is much more cost involved with the administration, setup, quality control, reporting, etc., of the actual sampling event.[24] Furthermore, most non-Alaskan cruise ships would need to perform the samplings and have them sent to labs at foreign ports. Sampling costs at foreign ports are considerably higher than at domestic ports. Due to the varied itineraries of cruise ships, there can be wide variability among the cost of a sampling event—$1,000 per sampling event is an average provided by the industry.

The sampling event accounts for the testing of each of the four chemicals (i.e., BOD, suspended solids, pH, and total residual chlorine). The Permit specifications call for five sampling events over a 30-day period, four times a year. Thus, twenty sampling events per ship must occur on an annual basis. Based upon the $1,000 average sampling cost, an annual incremental cost per ship of $20,000 is estimated for both large and medium cruise ships that have a standard graywater treatment system and do not currently follow the Permit monitoring requirements. According to estimates from a CLIA representative, the population of large cruise ships that will incur this incremental cost is 40. The population of medium cruise ships was originally estimated to be five; however EPA assumes this number to now be seven with the addition of two medium sized cruise ships that are expected to undergo major conversions during the 5-year period. Thus, the total annual incremental cost for both large and medium cruise ships is $940,000. *Table 6-29* details the cost estimates.

Table 6-29: Cruise Ship Costs Associated with Sampling

Vessel Class	Total Number of Vessels	Incremental Number of Vessels that need to Perform Sampling	Annual Cost per Vessel	Total Cost
Large Cruise Ships	113	40	$20,000	$800,000
Medium Cruise Ships	0	7	$20,000	$140,000
TOTAL	113	**47**		**$940,000**

[24] The proposed VGP did not include fecal coliform in the sampling requirement. After communicating with analytical labs, it was determined that the addition of fecal coliform into the sampling event would not pose any substantial incremental cost (McKee, 2008). Therefore, the estimate of $1,000 per sampling event has not changed from the proposal analysis. Due to the nature of fecal coliform analysis, it is anticipated that cruise ship operators will need to sample at a time close to when they arrive to port since there is a six-hour window for analysis of fecal coliform samples. Since cruise ships are frequently close to port, however, EPA does not expect this requirement to be burdensome.

EPA estimates some additional costs corresponding to pool and spa water testing. According to a CLIA representative, cruise ships that use *chlorine* in pools and spas already conduct testing using methods listed in 40 CFR Part 136. However, cruise ships that use *bromine* in pools and spas commonly use a Hach pool and spa water colorimetric test, a test not listed in Part 136. This colorimetric test can be purchased for approximately $99 and has a detection limit of 1 ppm. However, a Bromine, Pocket Colorimeter II Test Kit is available that has an estimated detection limit of 0.5 ppm or lower. This more accurate instrument and testing kit can be purchased for $370 (Hach, 2008). Although not listed in Part 136, EPA considers the latter test appropriate for this particular Permit requirement. Therefore, EPA estimates incremental costs to cruise ships that use bromine in their pools and/or spas by assuming that cruise ships will need to purchase this more accurate test kit versus the Pool and Spa Water Colorimetric Test Kit they currently use. The exact population of cruise ships that would now need to purchase a new test kit is unknown. EPA assumes that no medium cruise ships have a pool and/or spa onboard and, therefore, will not incur costs due to this requirement. EPA assumes that 80 percent of large cruise ships have a pool and/or spa onboard and equal shares (50 percent each) of these large cruise ships use bromine or chlorine in their pools/spas. Therefore, 57 cruise ships ((80%*143)*50%) are expected to incur the $370 cost of purchasing a more accurate test kit for bromine.[25] *Table 6-30* details the cost estimate.

Table 6-30: Cruise Ship Costs Associated with Pool and Spa Water Bromine Testing

Vessel Class	Total Number of Vessels	Incremental Number of Vessels that need to Purchase Bromine Test Kit	Annual Cost per Vessel	Total Cost
Large Cruise Ships	143	57	$370	$21,164
Medium Cruise Ships	32	0	$370	$0
TOTAL	**175**	**57**		**$21,164**

Educational and Training Requirements: The required training in environmental procedures and the additional requirement to educate passengers is already provided and performed by cruise ships as a CLIA standard. Thus, there is no incremental cost.

6.3.2 Large Ferries

Affected Vessel Population

The population of vessels associated with large ferries is currently unknown pending finalization of the large ferry definition.

Permit Requirements

Permit Text:

Deck Water:

Large ferries may not discharge untreated below deck water from parking areas or other storage areas for motor vehicles or other motorized equipment into waters subject to this permit without first treating the effluent with an oily water separator or other appropriate device. Large ferry operators must use oil absorbent cloths or other

25 EPA assumes that there is no incremental cost to cruise ships for purchasing refills of reagents since these must already be purchased for the Pool and Spa Water Colorimetric Test Kit.

appropriate spill response resources to clean oily spills or substances from deck surfaces. Any effluent created by washing the decks may not be discharged into the waters subject to this permit listed in Part 12.1.

Coal ash from coal fired propulsion systems on ferries

The discharge of coal ash from coal fired propulsion systems on a ferry is authorized in waters subject to this permit until December 19, 2012. All coal ash discharges must comply with effluent limits in Part 5.3.2.3 of this permit. Vessel owner/operators must minimize the discharge of coal ash into waters subject to this permit. Minimization techniques shall include:

- *Efficient combustion of coal;*
- *Minimize the ash content of the coal used onboard, but in no event may the ash content exceed 9.5 % (by weight and as received); and*
- *Limiting discharge quantities to those necessary for the safe and efficient operation of the vessel.*

Vessel owner/operators must minimize the sulfur content of all coal ash discharged into waters subject to this permit by using coal with the lowest sulfur concentration technologically feasible and economically practicable and achievable, but in no event may the sulfur content of the coal exceed 1.023% (by weight and as received).

Except in emergency situations, as determined and documented in the ship's log by the vessel's master, coal ash discharge may only occur when the vessel is:

- *If in waters subject to this permit, more than 5 nm from any shore and in waters over 100 feet in depth; and*
- *Underway at a speed of at least 6 knots.*

<u>Pierside Limits –</u> While pierside, appropriate reception facilities for Graywater must be used, if reasonably available. If such facilities are not reasonably available, you must hold the graywater if the vessel has the holding capacity and discharge the effluent while the vessel is underway. Appropriate reception facilities are those authorized for use by the port authority or municipality and that treat the discharge in accordance with its NPDES permit.

<u>Operational Limits</u> – You must also meet the following restriction:

- *If you operate within 3 nm from shore, discharges of graywater must be released while the ferry is sailing at a speed of at least 6 knots if feasible.*
-

<u>Educational and Training Requirements</u>: The crews of ferries play a key role in minimizing the discharge of pollutants from ferry operations and its passengers. Therefore ferry operators are subject to the following requirements:

- *The ship's crew members who actively take part in the management of the discharge or who may affect the discharge must receive training regarding shipboard environmental procedures and must be able to demonstrate proficiency in implementing these procedures.*
- *Advanced training in shipboard environmental management procedures must be provided for those directly involved in managing specific discharge types or areas of the ship and these crew must be able to demonstrate proficiency in implementing these procedures.*
- *Appropriate reprimand procedures must be developed for crew whose actions lead to violations of any effluent limit set forth in this permit or procedures established by the Cruise Ship operator to minimize the discharge of pollutants.*

Ferry operators must also educate passengers on their potential environmental impacts. The goals of these education efforts should include eliminating the discharge of trash overboard, minimizing the production of trash from parking areas or other storage areas, eliminating the addition of unused soaps, detergents, and pharmaceuticals to the graywater or blackwater systems, and minimizing production of graywater. This can be accomplished in a variety of ways including, but not limited to posting signage and informational material in common areas, incorporating environmental information into orientation presentations, or broadcasting information via loudspeakers.

Estimates of Cost

Based upon the above Permit requirements, costs were not further analyzed for these BMPs since the costs are expected to be negligible. Thus, costs regarding graywater BMPs were not further analyzed in this analysis since these costs are also expected to be negligible.

6.3.3 Barges (such as hopper barges, chemical barges, tank barges, fuel barges, crane barges, dry bulk cargo barges)

Affected Vessel Population

The population of vessels associated with river barges is shown in *Table 6-31*.

Table 6-31: Vessel Counts for BMPs Associated with River Barges

Vessel Class	Vessel Count
Freight Barges	26,638
Freight Ships	0
Passenger Vessels	0
Tank Barges	3,856
Tank Ships	0
Utility Vessels	0
TOTAL	**30,494**

Permit Requirements

Permit Text:

Additional Effluent Limits

Barges must minimize the contact of below deck condensation with oily or toxic materials, and any materials containing hydrocarbon. Whenever barges are pumping water from below deck, the discharge shall not contain oil in quantities that may be harmful as defined in 40 CFR Part 110. If a visible sheen is noted, vessel operators must initiate corrective action in accordance with Part 3 and meet recordkeeping requirements in Part 4.2 of this permit.

All tank barges must have spill rails and must plug their scuppers before any cargo operations if required by the vessel class society. If any spills result during loading or unloading of cargo, vessel owner/operators must completely clean up spills or residue before scuppers are unplugged. Once all spills and residue have been cleaned, scuppers may be unplugged.

Vessel owner/operators must clean out cargo residues such that any remaining residue is minimized before washing the cargo compartment or tank and discharging wash water overboard.

<u>Supplemental Inspection Requirements</u>

After every instance of pumping water from areas below decks, or immediately following washing down the decks, you must conduct a visual sheen test. The visual sheen test is used to detect free oil by observing the surface of the receiving water for the presence of an oily sheen. The operator should focus the inspection on the area surrounding the vessel where discharges from below deck or deck washings are discharged into the receiving water. A visible sheen is defined in Part 7 of this permit. If a visible sheen is observed, you must initiate corrective actions required in Part 3 of this permit and meet recordkeeping requirements in Part 4.2 of this permit.

Estimates of Cost

Costs were not analyzed in this analysis since the costs are expected to be negligible.

6.3.4 Oil Tankers or Petroleum Tankers

Affected Vessel Population

The population of vessels associated with oil or petroleum tankers is shown in *Table 6-32*.

Table 6-32: Vessel Counts for BMPs Associated with Oil or Petroleum Tankers

Vessel Class	Vessel Count
Freight Barges	0
Freight Ships	0
Passenger Vessels	0
Tank Barges	0
Tank Ships	147
Utility Vessels	0
TOTAL	**147**

Permit Requirements

Permit Text:

The requirements in Part 5.5 apply to vessel discharges from Oil Tankers or Petroleum Tankers.

<u>Additional Authorized Discharges</u>

For vessels which have an inert gas system, the effluent produced from inert gas scrubbers (IGS) may be discharged into waters subject to this permit.

The discharges of water from deck seals are authorized when such seals are installed as an integral part of an IGS system.

Additional Effluent Limits

Owner/operators of oil tankers must plug scuppers during cargo loading and unloading operations to prevent the discharge of oil into waters subject to this permit. Any oil spilled must be cleaned with oil absorbent cloths or another appropriate approach. Additionally, owner/operators of oil tankers must comply with applicable requirements of 33 CFR 155.310.

Vessel owner/operators must minimize the discharge of effluent produced from inert gas scrubbers if feasible for their vessel design.

<u>*Supplemental Inspection Requirements*</u>

After every instance of loading or unloading operations or immediately following washing down the decks, you must conduct a visual sheen test. The visual sheen test is used to detect free oil by observing the surface of the receiving water for the presence of an oily sheen. The owner/operator should focus the inspection on the area surrounding the vessel where effluent from loading operations or deck washings discharge into the receiving water. A sheen is defined in Part 7 of this permit. If a visible sheen is observed, you must comply with all requirements contained in Part 4.4 of this permit and initiate corrective actions required in Part 3 of this permit.

<u>*Educational and Training Requirements*</u>

The crews of oil tankers play a key role in minimizing the discharge of pollutants from vessel operations. Therefore oil tanker operators are subject to the following requirements:

- *The ship's crew members who actively take part in the management of the discharge or who may affect the discharge must receive training regarding shipboard environmental procedures and must be able to demonstrate proficiency in implementing these procedures.*
- *Advanced training in shipboard environmental management procedures must be provided for those directly involved in managing specific discharge types or areas of the ship and these crew must be able to demonstrate proficiency in implementing these procedures.*
- *Appropriate reprimand procedures must be developed for crew actions that lead to violations of any effluent limit set forth in this permit or procedures established by the vessel operator to minimize the discharge of pollutants.*

Estimates of Cost

Costs were not analyzed in this analysis since the costs are expected to be negligible.

6.3.5 Research Vessels

Affected Vessel Population

The population of vessels associated with research vessels is shown in *Table 6-33*.

Table 6-33: Vessel Counts for BMPs Associated with Research Vessels

Vessel Class	Vessel Count
Freight Barges	0
Freight Ships	0
Passenger Vessels	0
Tank Barges	0
Tank Ships	0
Utility Vessels	233
TOTAL	**233**

Permit Requirements

Permit Text:

The requirements in Part 5.6 apply to vessel discharges from research vessels. Research vessels are those that are engaged in investigation or experimentation aimed at discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws.

Supplemental authorized discharges

In addition to the discharges incidental to the normal operation of a vessel authorized elsewhere in this permit, owner/operators of research vessels are authorized to discharge tracers (dyes, fluorescent beads, SF6), drifters, tracking devices and the like, and expendable bathythermograph (XBT) probes, into waters subject to this permit, provided such discharges are for the sole purpose of conducting research on the aquatic environment or its natural resources in accordance with generally recognized scientific methods, principles, or techniques.

Additional Effluent Limits

Owner/operators of research vessels must discharge only the minimal amount of materials referenced in Part 5.6.1 necessary to conduct research on the aquatic environment or its natural resources in accordance with generally recognized scientific methods, principles, or techniques.

Estimates of Cost

Costs were not analyzed in this analysis since the costs are expected to be negligible.

6.3.6 Emergency Vessels (Fire Boats, Police Boats)

Affected Vessel Population

The population of vessels associated with rescue boats is currently unknown.

Permit Requirements

Permit Text:

The requirements in Part 5.7 apply to vessel discharges from emergency and rescue boats.

Supplemental authorized discharges

In addition to the discharges incidental to the normal operation of a vessel authorized elsewhere in this permit, vessel owner/operators of emergency vessels are authorized to discharge waste streams in conjunction with training, testing, and maintenance operations, provided that they comply with all additional requirements of the Clean Water Act (e.g. section 311) and the National Contingency Plan (40 CFR 300). This section does not relieve vessel operators of any additional responsibilities under the CWA and the National Contingency Plan which prohibits the discharge of oil for research or demonstration purposes without Administrator approval. The use of foaming agents for oil or chemical fire response must be implemented in accordance with the National Contingency Plan (40 CFR 300).

Additional Effluent Limits

Owner/Operators are strongly encouraged to seek alternative formulations of AFFF that are less harmful to the aquatic environment, such as non-fluorinated foam, while maintaining their effectiveness in emergency operations. Furthermore, operators are encouraged to not use AFFF or discharge toxic substances in areas near active commercial or recreational fisheries, near swimmable waters, or in high traffic areas for maintenance or training purposes. Emergency vessel owner/operators are also encouraged to perform training, testing, and maintenance operations outside of port and as far from shore as possible. The use of foaming agents for oil or chemical fire response, and the control of their discharge from a vessel, must be implemented in accordance with the National Contingency Plan (40 CFR 300).

Estimates of Cost

Costs were not analyzed in this analysis since the costs are expected to be negligible.

6.3.7 Vessels Employing Ballast Water Treatment Systems

Affected Vessel Population

Vessels that need to meet the requirements of this section are those that have a ballast water treatment system that uses or generates biocides and will therefore discharge biocide residuals or derivatives into waters subject to this permit.[26] There are currently four vessels with applications pending admission to the USCG's Shipboard Technology Evaluation Program (STEP), which is intended to help develop effective alternative ballast water treatment technologies (USCG, 2008). In the future, it is conceivable that there will be additional vessels that will be accepted into state alternative ballast water treatment technologies programs. For the purpose of this analysis, EPA has assumed that the four vessels with applications pending admission to the USCG's STEP will be accepted into the program and, thereafter, an additional 20 vessels per year will employ these new systems under state programs which discharge residual biocides.[27] These assumptions were used to determine the average annual number of vessels that may employ ballast water treatment system. Since the classification of these vessels is currently unknown, EPA allocated the vessels into the appropriate vessel classes in proportion to the number of vessels in each classes from the total population of 61,069 vessels. The average annual population of vessels (over the 5 year permit term) estimated to use ballast water treatment systems is provided in *Table 6-34*.

Table 6-34: Vessel Counts for BMPs Associated with Vessels Employing Experimental Ballast Water Treatment Systems

Vessel Class	Vessel Count[a]
Freight Barges	22
Freight Ships	1
Passenger Vessels	8
Tank Barges	3
Tank Ships	1
Utility Vessels	7
TOTAL	**42**

a Since the vessel counts are based on the relative distribution among the different vessel classes, the vessel counts returned were not whole numbers. EPA rounded the vessel counts up to the nearest whole number.

Permit Requirements

Permit Text:

The requirements in Part 5.8 apply to ballast water discharges from vessels employing ballast water treatment systems that make use of biocides.

Authorization of Residual Biocides Associated with Experimental Ballast Water Treatment Systems

[26] Vessels whose ballast water treatment system does not use or generate biocides (e.g., ballast water system that rely strictly on physical removal) do not need to meet requirements of this section.

[27] EPA expects that fewer than 20 vessels will be installing ballast water treatment systems in the first few years of this permit, while more vessels will be using such systems during the later years of this permit as additional federal and state requirements require ballast water treatment systems. Twenty represents the average annual number of vessels over the five-year period of the permit.

Some experimental ballast water treatment systems produce or use biocides as an agent to reduce living organisms present in the ballast water tank. In order to be eligible for coverage under this permit, any ballast water technology must not use any biocide that is a "pesticide" within the meaning of the Federal Insecticide, Fungicide, Rodenticide Act (7 U.S.C § 136 et seq.) unless that biocide has been registered for use in ballast water treatment under such Act. The requirement in the preceding sentence does not apply if such biocide is generated solely by the use of a "device," as that term is defined in the Federal Insecticide, Fungicide, and Rodenticide Act, on board the same vessel as the ballast water to be treated by the biocide. In addition, if the ballast water treatment system uses or generates biocides and you will discharge ballast water treated with biocides into waters subject to this permit, you must meet one of the following conditions to be eligible for permit coverage:

- *The discharge of Total Residual Chlorine (TRC) as a biocide or derivative may not exceed 100 micrograms per liter (µg/l) as an instantaneous maximum. Any other biocides or derivatives may not exceed acute water quality criteria listed in EPA's 1986 Quality Criteria for Water [the Gold Book], and any subsequent revision, at the point of ballast water discharge. The Gold Book can be found at: www.epa.gov/waterscience/criteria/library/goldbook.pdf. Tables summarizing the subsequent revisions can be found at: http://www.epa.gov/waterscience/criteria/wqctable/index.html. Discharges of biocide residuals or derivatives must also meet monitoring requirements under Part 5.8.2.1, and reporting and recordkeeping requirements in Part 5.8.3.*
- *The permittee shall conduct whole effluent toxicity (WET) testing on samples of the discharges from shipboard ballast water treatment systems to establish and annually verify the appropriateness of methods for treating ballast water with biocides lacking EPA Water Quality Criteria or known to produce chemical biocides or derivatives lacking EPA Water Quality Criteria. The procedures for such WET testing are set forth in Part 15 (Appendix J) of this permit. The annual verification testing must demonstrate, for each organism tested, that the WET in the ballast water discharges, without allowance for mixing, does not exceed a chronic toxicity of 1.6 TUc as a daily maximum or 1.0 TUc as a monthly median. If the toxicity of the treatment system results in a discharge which exceeds 1.0 TUc as a monthly median or 1.6 TUc as a daily maximum, EPA may require the owner/operator to cease discharging from the treatment system until they obtain coverage under an individual NPDES permit.*

Monitoring Requirements

For vessels subject to Part 5.8.1.1, above: you must conduct monitoring of the vessel ballast water discharge for any residual biocides or derivatives used in the treatment process to demonstrate compliance with the conditions in Part 5.8.1.1. For instance, if chlorine is the biocide used in the ballast water treatment, you must test for chlorine in the vessel ballast water discharge to see if it complies with the standards in Part 5.8.1.1. If there are no Part 136 test methods for the residual biocide or derivatives of the residual biocide, you must comply with Part 5.8.1.2 or seek coverage under an individual NPDES permit pursuant to Part 1.8 of this permit. In order to demonstrate that residual biocides or derivatives are in compliance with this permit, the vessel operator initially must take at least five (5) samples on different days over a 90-day period that are representative of the treated ballast water discharge. Each sample must be tested independently and the individual results must be reported and not averaged. Samples must be tested as soon as possible after sampling, and may not be held longer than recommended for each tested constituent as given in 40 CFR Part 136. Sampling and testing shall be conducted according to 40 CFR Part 136.

Records of monitoring information shall include:

- *The date, exact place, and time of sampling or measurements;*
- *The individual(s) who performed the sampling or measurements;*
- *The date(s) analyses were performed;*

- *The individual(s) who performed the analyses;*
- *The analytical techniques or methods used; and*
- *The results of such analyses.*

Thereafter, you must conduct maintenance sampling and analysis at least quarterly (4 times per year) of the vessel ballast water discharge in order to demonstrate continued compliance with the standards in Part 5.8.1.1. If any of the initial or maintenance samples exceed the standards specified in Part 5.8.1.1, then the owner/operator must immediately undertake steps necessary to achieve compliance and take and submit samples demonstrating such compliance or cease discharging and seek coverage under an individual permit under Part 1.8 of this permit.

Whole Effluent Toxicity (WET) monitoring

For vessels subject to 5.8.1.2, above: you must initially conduct whole effluent toxicity (WET) testing consistent with Part 15 (Appendix J) of this permit using samples from the ballast water treatment system at the end of pipe for assessing the environmental safety of the resulting ballast water discharges. Two sets of WET tests must be done as set forth in Part 15 of this permit (Appendix E) using different ballast water discharge events separated by at least no less than 14 days, for initial testing followed by annual verification testing for each year of permit coverage. Initial WET testing must be done in the first 90 days of permit coverage or the first 90 days of using the ballast water treatment system after permit issuance.

Thereafter, you must conduct maintenance sampling and analysis at least once per year of the vessel ballast water discharge in order to demonstrate continued compliance with the standards in Part 5.8.1.2. If any of the initial or maintenance samples exceed the standards specified in Part 5.8.1.2, then the owner/operator must immediately undertake steps necessary to achieve compliance and take and submit samples demonstrating such compliance.

Additional Recordkeeping and reporting requirements

Records of the sampling and testing results must be retained onboard for a period of 3 years in the vessel's recordkeeping documentation.

You must submit your monitoring data to EPA HQ, Attn: Ballast Water Treatment System Test Results -Mail Code 4203M, 1200 Pennsylvania Ave., Washington DC 20460 at least once per year. For systems already in use as of the effective date of this permit, initial sampling data must be submitted within 6 months of this permit's effective date. For systems which are not already in use as of the effective date of this permit, initial sampling data must be submitted within 6 months of the system's first use. Maintenance monitoring data must be submitted at least once per year within 30 days of the final sample collection. Data must be submitted on Discharge Monitoring Reports available in Appendix I of this permit or submitted to EPA's e-reporting system available at www.epa.gov/npdes/vessels/eNOI, which will be available within two years of finalization of this permit.

Estimates of Cost

EPA is uncertain how many vessels may seek permit coverage under this provision. However, due to the expectation that some vessels will be employing these systems in the future, some preliminary estimates of the number of vessels that expect to use ballast water treatment systems were gathered and a sensitivity analysis was performed. The costs are reflected in the high end cost estimate detailed below. Since the population of vessels that currently use ballast water treatment systems applicable to this section is currently zero, the low end cost estimate is estimated to be zero.

Sensitivity Analysis

Depending upon the type of biocides used in the vessel's experimental ballast water treatment system, vessels are required to perform either WET testing, TRC sampling, or sampling for parameters that have acute water quality criteria.

Communication with an analytical laboratory that does marine WET testing indicated that a test for acute toxicity costs $450 and a test for chronic toxicity costs between $675 and $775[28]. EPA also assumed that an additional $100 would be required for the administration of the WET test (i.e. sending the sample to the lab, etc.), totaling $550 per acute toxicity testing event and $825 per chronic toxicity testing event. All vessels that discharge treated ballast water containing a residual biocide are required to perform chronic toxicity WET testing on certain species. EPA determined that three of the four vessels with applications pending admission to the USCG's STEP are required to perform chronic toxicity WET testing. However, it is unknown what percentage of the additional 20 vessels per year will be required to perform chronic testing. Therefore, EPA assumed equal probability of the two types of costs and averaged the cost of the acute toxicity and chronic toxicity WET tests to derive an estimate of $688 per testing. Two sets of WET tests must initially be done using different ballast water discharge events, followed thereafter by annual verification testing during the permit period. Therefore, the average annual number of samples tested is 1.2 (6 tests/5 years) and the average annual cost for WET testing is $825.

Cost estimates for sampling TRC or any other parameters with acute water quality criteria were derived based on prior EPA estimates of the Cost Impact Analysis for the 2006 Multi-Sector General Permit (MSGP). The MSGP assumed that it would take 90 minutes to monitor the first parameter and an additional 15 minutes for each of the next three parameters. Since sampling onboard a vessel generally requires more time than onshore sampling, EPA has assumed that it would take 4 labor hours to perform sampling for TRC or any other parameter with acute water quality criteria. EPA assumes the same average labor rate of $31.61 (calculated from all the industry responses) to derive a labor cost of $126. The MSGP also provides average cost estimates for conducting analyses for different sampling parameters. These estimates range between $5 and $40 per parameter. Based on these ranges, EPA assumed that analytical costs (not including labor costs) will total $100. Therefore, the total cost for an acute water quality criteria sampling event is estimated to be $226. Initially, the vessel operator must take at least five samples on different days over a 90-day period. Thereafter, the vessel operator must conduct maintenance sampling and analysis at least quarterly of the vessel ballast water discharge in order to demonstrate continued compliance. Therefore, the average annual number of testing samples is 4.8 (24 tests/5 years) and the average annual cost for testing parameters with acute water quality criteria is $1,087.

Since it is unknown which vessels will perform WET testing and which will perform sampling for TRC or any other parameter with acute water quality criteria, EPA assumed equal probability for the two types of costs and calculated an average of $956 per test/sampling event. This cost was applied to the average annual population of vessels (over the 5-year permit period) that may employ ballast water treatment systems (42 vessels) to derive a total annual incremental cost of $40,150. *Table 6-35* details the high end cost estimates.

[28] The authors note that the permit requirements for WET testing changed slightly from the time the analysis was done to time of permit finalization. EPA does not expect the slight change in requirements to significantly impact these cost estimates.

Table 6-35: WET Testing/Water Quality Sampling Analysis for Vessels Employing Experimental Ballast Water Treatment Systems

Vessel Class	Vessels	% Vessels Applicable to BMP	Annual Cost per Vessel	Total Annual Cost
		High End Estimate		
Freight Barges	22	0.07%	$955.96	$21,031
Freight Ships	1	0.14%	$955.96	$956
Passenger Vessels	8	0.07%	$955.96	$7,648
Tank Barges	3	0.06%	$955.96	$2,868
Tank Ships	1	0.68%	$955.96	$956
Utility Vessels	7	0.07%	$955.96	$6,692
Perform testing/sampling, High End TOTAL	**42**			**$40,150**

6.3.8 Cost Estimates for Other Requirements

The final Permit states that "discharges of tetrachloroethylene degreasers or other products containing tetrachloroethylene are not eligible for coverage under this permit." To evaluate the impacts of this requirement, EPA researched the costs of tetrachloroethylene (TCE) degreasers and cleaners, as compared to the costs of non-TCE containing degreasers and cleaners. Degreasers and cleaners that do not contain TCE are available in a wide price range. All-purpose cleaners and detergents may be purchased for less than $15 per gallon, while the costs of more specialized industrial degreasers and aerosols can range from $15 to $50 per gallon. An Internet search indicated that TCE-containing degreasers are not widely available for purchase; but, for example, laboratory-grade TCE can cost between $138 and $500 per gallon.

Based on this research, EPA determined that there is enough price variability among the multitude of available products for a vessel to opt for a non-TCE degreaser at no incremental cost as compared to a TCE-containing degreaser.

6.3.9 Uncertainties and Limitations

This analysis relies heavily on data provided by industry representatives in estimating the percentage of vessels that are practicing the BMPs required by the Permit under the baseline scenario and in estimating costs of individual BMPs. Although EPA believes that the industry representatives provided good faith estimates, their responses are based on either expert judgment or communication with selected firms within the industry and thus are subject to uncertainty. In addition, there is some incentive for representatives of industry to overstate costs.

Additional information was obtained from personal communications with the industry experts (e.g., David Peters), manufacturers (e.g., Dawg, Inc.) and a diving company (Seacor International). Because EPA made a limited number of contacts, the relevant estimates are likely to be subject to uncertainty.

In estimating the annual cost of ballast water exchange, this analysis assumes that the unit cost of ballast water exchange for the vessels with empty ballast tanks and the practices associated with developing a Ballast Water Management Plan are no different for the vessels for which it was applied within the USCG analysis. However, there may be considerable uncertainty associated with each cost component due to some differences in vessel characteristics to which these estimates applied (e.g., oceangoing vessels vs. Pacific nearshore vessels or vessels in ballast vs. vessels with empty tanks).

6.4 Permit Paperwork Burden

The permit paperwork burden is comprised of six potential cost inputs. Recordkeeping, routine inspections, and annual inspections are already required for these vessels. However, based on the introduction of the Permit best management practices, additional time for these tasks may be required. Furthermore, drydock inspections, including the report preparation, are commonly performed by the industry. However, EPA is assuming that, due to the Permit, some vessels may require additional time for inspection and/or report preparation. Therefore, for the high end estimates, EPA has estimated an additional amount of time required for these vessels for recordkeeping, routine inspections, drydock inspections, and annual inspections. The low end estimates assume that no additional time is required for these four practices. The two other components of the permit paperwork burden are the Notice of Intent filing (for a subset of vessels) and the one-time report requirement for all vessels. The time required for these practices is the same for both the high end and low end estimate since they are new requirements and will introduce costs to applicable vessels.

The additional time required for recordkeeping, routine inspections, drydock inspections, and annual inspections varies according to vessel class. EPA is assuming that certain vessel classes are more likely to have a higher number of applicable discharge categories, and thus, a potentially higher number of Permit BMPs to perform. Thus, in *Table 6-36* EPA has assumed that the following are "large" and "small" vessels. For these three practices, large vessels have a greater time requirement than do small vessels. Furthermore, to calculate the total annual cost per vessel, EPA used the average labor rate provided by the industry survey responses of $31.61.

Table 6-36: Vessel Class Breakdown

Large Vessels	Small Vessels
Cruise Ships	Freight Barges
Freight Ships	Passenger Vessels
Tank Ships	Utility Vessels
	Tank Barges

- ***Recordkeeping***: Vessels are already required to keep extensive records. Since there are very few additional requirements that vessels must record, EPA is assuming a small incremental number of hours required for this practice. For the high end estimate, EPA assumes that 0.5 additional hours is annually required of small vessels, and 1 additional hour is annually required of large vessels. This practice is performed for five years. The detailed high end cost estimates are shown in *Table 6-37*. The low end total cost estimates are null.

Table 6-37: Recordkeeping Burden

Vessel Class	Vessel Count	Total Burden Hours	Total Annual Cost[a]
Large Vessels - 1 Burden Hour			
Cruise Ships	175	175	$5,532
Freight Ships	697	697	$22,032
Tank Ships	147	147	$4,647
Large Vessels TOTAL	**1,019**	**1,019**	**$32,211**
Small Vessels - 0.5 Burden Hours			
Freight Barges	32,842	16,421	$519,068
Passenger Vessels[b]	11,346	5,673	$179,324
Utility Vessels	10,892	5,446	$172,148
Tank Barges	4,944	2,472	$78,140
Small Vessels TOTAL	**60,024**	**30,012**	**$948,679**
TOTAL	**61,043**	**31,031**	**$980,890**

a Incurred every year for the first five years.
b Cruise ships are in the passenger vessels category. Thus, the 175 cruise ship count was subtracted from the normal passenger vessel count of 11,521.

- ***NOI***: The NOI filing requirement is only applicable to vessels that are greater than or equal to 300 gross tons or vessels that have the capacity to hold or discharge more than 8 cubic meters (2113 gallons) of ballast water. Based on the Information Collection Request for NPDES Permits and the Sewage Sludge Management Permits (US EPA, 2006), EPA has found that 1 hour is required to file an NOI for a general permit. This is a one-time requirement and does not carry through over multiple years. This cost is annualized over five years at a 7 percent discount rate. The detailed low and high end cost estimates are shown in *Table 6-38*.

Table 6-38: NOI Burden

Vessel Class	Vessel Count[a]	Total Burden Hours	Total Cost	Total Annual Cost[b]
All Vessels - 1 Burden Hour				
Cruise Ships	175	175	$5,532	$1,349
Freight Ships	469	469	$14,825	$3,616
Tank Ships	117	117	$3,698	$902
Commercial Fishing	26	26	$822	$200
Freight Barges	30,961	30,961	$978,677	$238,690
Passenger Vessels[c]	1,095	1,095	$34,613	$8,442
Utility Vessels	4,255	4,255	$134,501	$32,803
Tank Barges	4,808	4,808	$151,981	$37,067
TOTAL	**41,906**	**41,906**	**$1,324,649**	**$323,069**

a The count of vessels required to submit an NOI is a conservative estimate since data on gross tonnage are not complete. Thus, this count is based on the number of vessels that are either ≥79' in length or ≥300 gross tons.

b Total cost annualized over five years at a 7% discount rate.
c Cruise Ships are within the Passenger Vessels category. Thus, the 175 cruise ship count was subtracted from the normal Passenger Vessel count of 1,270.

- ***Routine Inspections***: Vessels are already performing these routine inspections. However, additional time may be required based on the introduction of the Permit BMPs. For the high end estimate, EPA assumes that 0.5 additional hours are annually required of small vessels and 2 additional hours are annually required of large vessels. This practice is performed for five years. The detailed high end cost estimates are shown in *Table 6-39*. The low end total cost estimates are null.

Table 6-39: Routine Inspection Burden

Vessel Class	Vessel Count	Total Burden Hours	Total Annual Cost[a]
Large Vessels - 2 Burden Hours			
Cruise Ships	175	350	$11,064
Freight Ships	697	1,394	$44,064
Tank Ships	147	294	$9,293
Large Vessels TOTAL	**1,019**	**2,038**	**$64,421**
Small Vessels - 0.5 Burden Hours			
Freight Barges	32,842	16,421	$519,068
Passenger Vessels[b]	11,346	5,673	$179,324
Utility Vessels	10,892	5,446	$172,148
Tank Barges	4,944	2,472	$78,140
Small Vessels TOTAL	**60,024**	**30,012**	**$948,679**
TOTAL	**61,043**	**32,050**	**$1,013,101**

a Incurred every year for the first five years.
b Cruise ships are in the passenger vessels category. Thus, the 175 cruise ship count was subtracted from the normal passenger vessel count of 11,521.

- ***Drydock Inspections***: Vessels are already performing drydock inspections. However, additional time may be required due to the introduction of the Permit BMPs for inspection and/or report preparation. For the high end estimate, EPA assumes that 2 additional hours are annually required for small vessels and 4 additional hours are annually required for large vessels. Drydock inspections are assumed to be performed once every five years. This cost is annualized over five years at a 7 percent discount rate. The detailed high end cost estimates are shown in *Table 6-39*. The low end total cost estimates are null.

Table 6-40: Drydock Inspection Burden

Vessel Class	Vessel Count	Total Burden Hours	Total Cost	Total Annual Cost[a]
Large Vessels - 4 Burden Hours				
Cruise Ships	175	700	$22,127	$5,397
Freight Ships	697	2,788	$88,129	$21,494
Tank Ships	147	588	$18,587	$4,533
Large Vessels TOTAL	**1,019**	**4,076**	**$128,842**	**$31,423**
Small Vessels - 2 Burden Hours				
Freight Barges	32,842	65,684	$2,076,271	$506,383
Passenger Vessels[b]	11,346	22,692	$717,294	$174,941
Utility Vessels	10,892	21,784	$688,592	$167,941
Tank Barges	4,944	9,888	$312,560	$76,230
Small Vessels TOTAL	**60,024**	**120,048**	**$3,794,717**	**$925,496**
TOTAL	**61,043**	**124,124**	**$3,923,560**	**$956,920**

a Total cost annualized over five years at a 7% discount rate.
b Cruise ships are in the passenger vessels category. Thus, the 175 cruise ship count was subtracted from the normal passenger vessel count of 11,521.

- ***Annual Inspection***: Vessels are already performing annual inspections. However, additional time may be required based on the introduction of the Permit BMPs. For the high end estimate, EPA is assuming that 0.5 additional hours is annually required of small vessels and 2 additional hours are annually required of large vessels. This practice is performed for five years. The detailed high end cost estimates are shown in *Table 6-41*. The low end total cost estimates are null.

Table 6-41: Annual Inspection Burden

Vessel Class	Vessel Count	Total Burden Hours	Total Annual Cost[a]
Large Vessels - 2 Burden Hours			
Cruise Ships	175	350	$11,064
Freight Ships	697	1,394	$44,064
Tank Ships	147	294	$9,293
Large Vessels TOTAL	**1,019**	**2,038**	**$64,421**
Small Vessels - 0.5 Burden Hours			
Freight Barges	32,842	16,421	$519,068
Passenger Vessels[b]	11,346	5,673	$179,324
Utility Vessels	10,892	5,446	$172,148
Tank Barges	4,944	2,472	$78,140
Small Vessels TOTAL	**60,024**	**30,012**	**$948,679**
TOTAL	**61,043**	**32,050**	**$1,013,101**

a Incurred every year for the first five years.
b Cruise ships are in the passenger vessels category. Thus, the 175 cruise ship count was subtracted from the normal passenger vessel count of 11,521.

- ***One-time Report***: Since this is a new Permit requirement, EPA assumes that, for both the low and high end estimate, 0.5 hours is required for small and large vessels. This is a one-time requirement and does not carry through over multiple years. This cost is annualized over five years at a 7 percent discount rate. The detailed low and high end cost estimates are shown in *Table 6-42*.

Table 6-42: One-Time Report Burden

Vessel Class	Vessel Count	Total Burden Hours	Total Cost	Total Annual Cost[a]
All Vessels - 0.5 Burden Hours				
Cruise Ships	175	88	$2,766	$675
Freight Ships	697	349	$11,016	$2,687
Tank Ships	147	74	$2,323	$567
Freight Barges	32,842	16,421	$519,068	$126,596
Passenger Vessels[b]	11,346	5,673	$179,324	$43,735
Utility Vessels	10,892	5,446	$172,148	$41,985
Tank Barges	4,944	2,472	$78,140	$19,058
TOTAL	**61,043**	**30,522**	**$964,785**	**$235,302**

a Total cost annualized over five years at a 7% discount rate.
b Cruise ships are in the passenger vessels category. Thus, the 175 cruise ship count was subtracted from the normal passenger vessel count of 11,521.

6.5 Analysis of Total National Costs

The estimated total compliance costs for all BMPs are provided in *Table 6-43*. The estimated VGP compliance costs, including the $468,248 and $1,138,867 annual incremental costs for ballast water practices for domestic and foreign vessels, respectively, vary because of the different assumptions made regarding the populations and the number of instances for which incremental costs will be incurred. The total low end estimate is approximately $6.6 million, whereas the total high end estimate is approximately $16.7 million.

Table 6-43: Total Annual Compliance Costs for All BMPs by Vessel Type

Vessel Type	Total Cost		
	Domestic	Foreign[a]	Total
Low End Estimates			
Commercial Fishing	$27,641	$0	$27,641
Freight Barges	$3,179,041	$367	$3,179,408
Freight Ships	$160,679	$711,189	$871,867
Passenger Vessels	$78,387	$69,617	$148,004
Tank Barges	$562,408	$730	$563,138
Tank Ships	$233,689	$352,662	$586,350
Utility Vessels	$1,184,501	$4,302	$1,188,804
Low End TOTAL	**$5,426,345**	**$1,138,867**	**$6,565,212**
High End Estimates			
Commercial Fishing	$27,641	$0	$27,641
Freight Barges	$9,714,226	$367	$9,714,593
Freight Ships	$308,315	$711,189	$1,019,503
Passenger Vessels	$156,535	$69,617	$226,153
Tank Barges	$1,606,030	$730	$1,606,760
Tank Ships	$268,554	$352,662	$621,216
Utility Vessels	$3,510,277	$4,302	$3,514,579
High End TOTAL	**$15,591,578**	**$1,138,867**	**$16,730,445**

The total costs to cruise ships are provided in *Table 6-44*. These ships are in the passenger vessel category. Thus, this cost is allocated within the totals for the passenger vessel class. These costs are currently based on assumptions made regarding the population of ships that would need to purchase a graywater treatment system and those that would need to undergo sampling practices.

Table 6-44: Total Annual Incremental Cost for Cruise Ships	
Vessel Type[a]	**Total Domestic Cost**
Large Cruise Ships	$1,504,186
Medium Cruise Ships	$251,177
TOTAL	**$1,755,364**

a Cruise ships are in the passenger vessels category.

The total high end cost estimates to vessels expected to employ experimental ballast water treatment systems are provided in *Table 6-45*.

Table 6-45: WET Testing/Water Quality Sampling Analysis for Vessels Employing Experimental Ballast Water Treatment Systems	
Vessel Class	**Total Annual Cost**
High End Estimate	
Freight Barges	$21,031
Freight Ships	$956
Passenger Vessels	$7,648
Tank Barges	$2,868
Tank Ships	$956
Utility Vessels	$6,692
High End TOTAL	**$40,150**

Total paperwork costs are provided within *Table 6-46*. The low end estimate total is approximately $560,000, whereas the high end estimate is approximately $4.5 million.

Table 6-46: Total Permit Recordkeeping Burden Cost	
Vessel Type	**Total Cost to Domestic Vessels**
Low End Estimate	
Cruise Ships	$2,024
Commercial Fishing	$200
Freight Barges	$365,286
Freight Ships	$6,302
Passenger Vessels	$52,177
Tank Barges	$56,124
Tank Ships	$1,469
Utility Vessels	$74,789
Low End TOTAL	**$558,371**
High End Estimate	
Cruise Ships	$35,079
Commercial Fishing	$200
Freight Barges	$2,428,873
Freight Ships	$137,957
Passenger Vessels	$765,089
Tank Barges	$366,774
Tank Ships	$29,235
Utility Vessels	$759,174
High End TOTAL	**$4,522,382**

The total annual incremental costs are provided in *Table 6-47*. This includes the paperwork cost estimates from *Table 6-46*, the sum of the ballast water cost analysis and the sensitivity analysis costs for all other individual

BMPs (*Table 6-43*), the costs to cruise ships (*Table 6-44*), and the high end cost estimates for vessels expected to employ ballast water treatment systems which discharge residual biocides or derivatives. The total low end estimate is approximately $8.9 million, including a $7.7 million cost to domestic flagged vessels and a $1.1 million cost for ballast water requirements to foreign flagged vessels. The total high end estimate is approximately $23 million, including a $21.9 million cost to domestic flagged vessels and a $1.1 million cost for ballast water requirements to foreign flagged vessels.

Table 6-47: Total Annual Incremental Cost

Vessel Type	Total Cost		
	Domestic	**Foreign[a]**	**Total**
Low End Estimates			
Commercial Fishing	$27,841	$0	$27,841
Freight Barges	$3,544,327	$367	$3,544,694
Freight Ships	$166,981	$711,189	$878,170
Passenger Vessels	$1,887,951	$69,617	$1,957,569
Tank Barges	$618,533	$730	$619,262
Tank Ships	$235,157	$352,662	$587,819
Utility Vessels	$1,259,290	$4,302	$1,263,592
Low End TOTAL	**$7,740,080**	**$1,138,867**	**$8,878,947**
High End Estimates			
Commercial Fishing	$27,841	$0	$27,841
Freight Barges	$12,164,130	$367	$12,164,497
Freight Ships	$447,228	$711,189	$1,158,416
Passenger Vessels	$2,719,715	$69,617	$2,789,332
Tank Barges	$1,975,672	$730	$1,976,402
Tank Ships	$298,745	$352,662	$651,407
Utility Vessels	$4,276,143	$4,302	$4,280,445
High End TOTAL	**$21,909,474**	**$1,138,867**	**$23,048,341**

a Only includes ballast water exchange/flushing costs.

7 Analysis of Impacts on Firm Revenues and Financial Performance

The previous chapters assessed total compliance costs to the water transportation and fishing industries, and to the drilling oil and gas wells sector of the mining industry. The firm-level analysis examines the impact of the introduced BMP costs per vessel on model firms that represent the financial conditions of "typical" businesses in each of the 11 examined NAICS codes. Since approximately 95 percent of the firms in the water transportation, and fishing industries, and in the drilling oil and gas wells sector are small (see *Section 5.4.2: Small Businesses),* it is unlikely that firm-level impacts would be material among large firms in these industries. Therefore, the firm-level analysis focuses on assessing impacts on small businesses, as required by the Regulatory Flexibility Act (RFA) and the Small Business Regulatory Enforcement and Fairness Act (SBREFA).

7.1 Methodology

The analysis establishes baseline financial conditions of the model firms, which are used in combination with the introduced BMP costs to examine the firm financial impact. Model-firm impacts provide the basis for estimating the number of firms expected to experience financial stress at the national/total industry level. After identifying the post-compliance cost-to-revenue ratio, the analysis estimates the total number of firms expected to experience potential financial stress. Financial stress may be indicated by a lack of profitability, cash deficiencies, or even bankruptcy. Firms expected to experience financial stress may need to change their business operations, including potentially downsizing or closing operations.

The key steps of the analysis involve: (1) assigning each vessel in the vessel database to a North American Industry Classification System (NAICS) code, (2) estimating the number of vessels per firm, (3) estimating the distribution of costs per vessel, and (4) comparing the costs to the revenues.

7.1.1 Assign Each Vessel to a NAICS Code

The framework for the model firms reflects the range of firm types across the major industry groups. Financial data for each major industry groups are available in the Economic Census while SBA provides firm data by revenue bracket. Since the Economic Census does not have the same vessel categories as compared to other data sources (VESDOC/WTLUS, which contain more complete numbers of all potentially regulated vessels and firms), each of the vessels and firms from the vessel database was assigned to a NAICS code to correspond to the Economic Census industry categories.

The number of firms likely to incur costs as a result of the Permit was identified using the VESDOC and WTLUS databases (and, for the MODU population, from the IADC comment submission, which also identified these vessels as within NAICS 213111). Firms identified in the vessel databases were assigned a NAICS code in order to determine the number of firms subject to permit requirements for each NAICS code. Industry classification information for individual firms listed in the vessel databases was obtained primarily from ReferenceUSA's Business Database (ReferenceUSA, 2006) and Dun & Bradstreet's Million Dollar Database (Dun & Bradstreet, 2006), supplemented by company Web sites and industry publications. Both ReferenceUSA and Dun & Bradstreet link subsidiaries and branch offices to company headquarters, allowing for an identification of domestic parent entities. Dun & Bradstreet's Million Dollar Database classifies businesses based on eight-digit Standard Industrial Classification (SIC) codes. Since both the Census and SBA base their data on NAICS codes, EPA matched the first four digits of the SIC codes provided in Dun & Bradstreet to corresponding six-digit NAICS codes using the U.S. Census Bureau's bridge between 1987 SIC and 2002 NAICS codes (U.S. Census

Bureau, 2002b). The Dun & Bradstreet company names were matched to the vessel owner/operator names in the VESDOC/WTLUS database to provide a NAICS code classification for most vessels in the vessel database.[29]

Once the number of firms with vessel permits was estimated for each NAICS code, EPA distributed these firms across revenue size categories proportionally to the distribution of firms by revenue size category indicated in Economic Census data. This estimated distribution of firms by revenue size category is assumed to be more accurate than estimates that could be derived solely from the Economic Census, since the Economic Census includes firms that are not expected to be affected by the rule. These totals were used to determine the number and percentage of firms experiencing economic impacts.

7.1.2 Estimate the Number of Vessels per Firm

To establish the baseline and post-cost financials for each model firm, the per-vessel BMP costs developed from *Chapter 6* are applied to the firm level. To determine the total BMP costs that a firm could incur, EPA first estimated the average number of vessels owned and operated by firms in each NAICS sector using information from the VESDOC and WTLUS databases. For each NAICS code, EPA determined the number of vessels that were listed with a firm name as well as the number of firms corresponding to these vessels. Based upon the total number of firms and vessels within the subset in each NAICS code, the average number of vessels per firm was determined for each NAICS code. However, since this value is expected to vary among the different firm sizes, this average value was adjusted for each revenue size category so that the average number of vessels in each revenue size range is proportional to the midpoint of revenue in a revenue size category. This calculation is described in more detail below.

Data were available from the Economic Census and from the SBA's Statistics of U.S. Businesses on the total number of firms by revenue size. No data were available on the number of vessels by revenue size; however, data on the average number of vessels per firm per NAICS sector across all revenue sizes were available from the VESDOC and WTLUS databases. Multiplying the number of firms in each NAICS sector by the average number of vessels per firm yields an estimate of the number of vessels in the NAICS sector overall. The number of vessels in each NAICS sector was then distributed over revenue size categories in such a way that the average number of vessels in each revenue size range is proportional to the midpoint of revenue in a revenue size category. This calculation maintains the overall estimated average and total number of vessels in each NAICS sector but recognizes that the number of vessels owned by firms is likely to be approximately proportional to the revenue size of the firm. For example, for an industry with two revenue brackets, $0–$100,000 and $100,000–$200,000, two firms in each bracket, and six vessels per firm on average across all brackets, EPA would assume that there were three vessels per firm in the first bracket and nine vessels per firm in the second bracket. Thus, since the midpoint revenue is three times as high in the second revenue bracket as the midpoint revenue in the first bracket, the number of vessels per firm is also assumed to be three times as high in the second revenue bracket. Note that EPA did not allow the average number of vessels per firm to be less than one for any revenue bracket.

7.1.3 Estimate the Distribution of Costs per Vessel

For each vessel type and BMP, EPA has already estimated in *Section 6.20:* (1) the total number of vessels, (2) the probability of a vessel incurring incremental costs, and (3) the incremental cost of each BMP. By assuming that the probability of incurring an incremental cost for a given BMP is independent of incurring costs for any of the other BMPs, EPA can estimate the probabilities of incurring costs for all possible combinations of BMPs.

In the analysis, the low end cost estimate includes 16 possible BMPs, and the high end cost estimate includes 21 possible BMPs. Treating each BMP cost as an independent, binary "on/off" cost event, this means that there are

[29] Of the total 61,069 vessels in the database that are estimated to be potentially subject to VGP, 340 vessels could not be assigned a NAICS code.

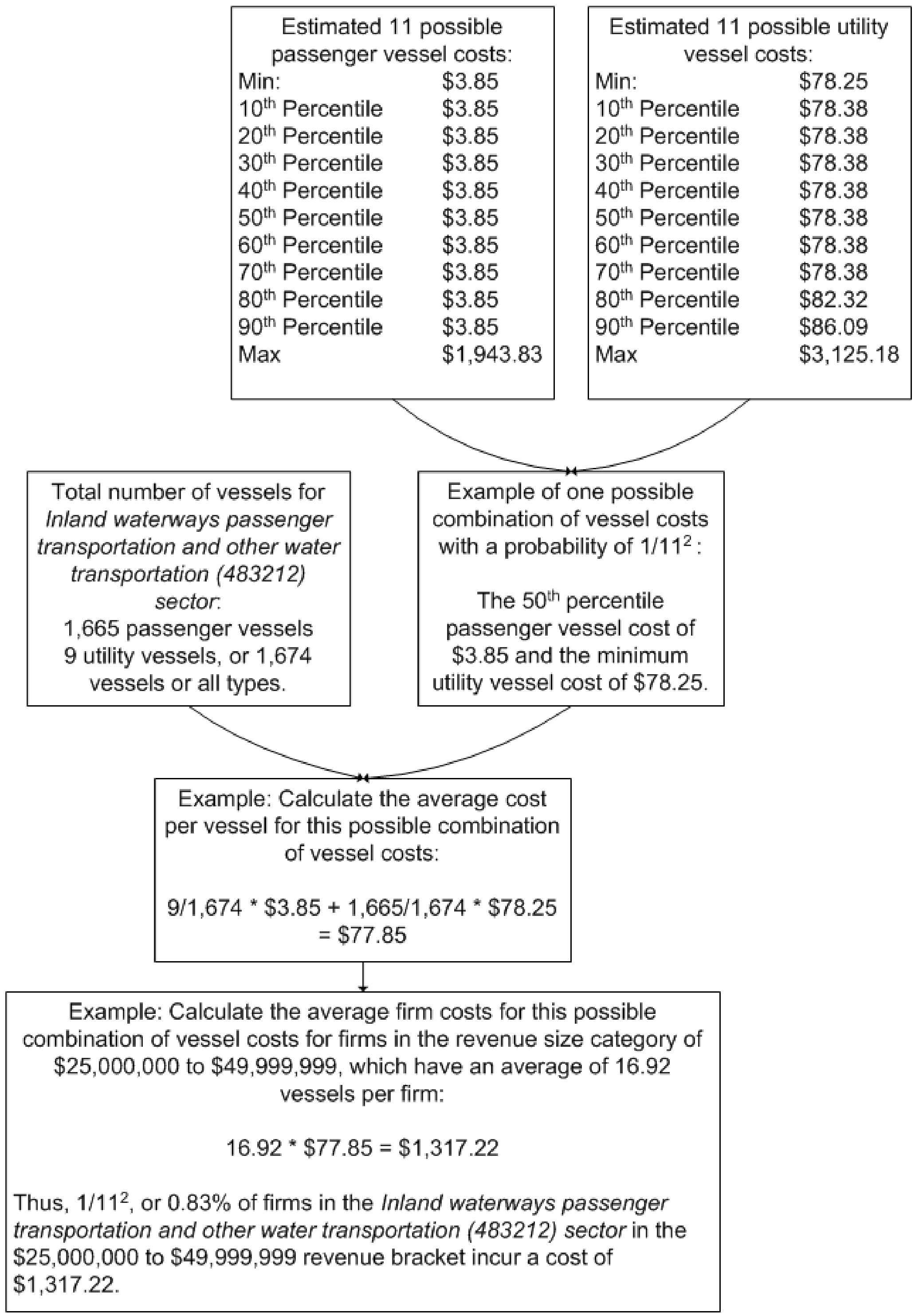
theoretically 2^{16} and 2^{21} possible combinations of BMP cost events for the low end and high end cost estimate, respectively. Each combination BMP cost event is defined on the basis of whether or not each of the specific BMPs is "on" or "off" (and resulting costs) together with the probability of each specific BMP being "on" or "off." Each BMP is assigned a probability of occurrence for each vessel class by dividing the number of vessels estimated to incur a given BMP cost by the total number of vessels, and therefore this is the probability for the individual BMP to be "on." Conversely, the probability of the individual BMP being "off," is equal to one *minus* the probability of the BMPs occurrence. The overall probability of occurrence for a given BMP combination is the product of these individual probabilities. As a result, most of the BMP cost combinations are not meaningful for the impact analysis because one or more of the BMP "on/off" instances in the combination event have a zero probability of occurrence, and thus the overall probability of that particular event, which is calculated as the product of the individual "on" or "off" BMP probabilities, is zero. The high occurrence of zero probability *combination* BMP events results from the presence of BMP costs that are always assumed to be incurred, or have one hundred percent probability of occurrence. The maximum number of observed BMP combinations for a vessel type is therefore only 2,048, which is substantially smaller than the theoretical 2,097,152 possibilities ($2,097,152 = 2^{21}$).

For each of the possible BMP combinations, EPA multiplied the total number of vessels by vessel class by the calculated probability of the combination BMP event to estimate the number of vessels incurring costs for a given combination of BMPs. Finally, EPA calculated the per-vessel cost by vessel class associated with each combination of BMPs by summing the costs of the individual BMPs where costs are incurred. This calculation provided the distribution of per-vessel costs. The distribution shows a high probability of occurrence for very low cost combination BMP events. The probability of occurrence declines rapidly as the cost of the combination BMP events increases. The higher cost combination BMP events—which require a combination of all or nearly all of the individual BMPs—have a very low probability of occurrence.

EPA estimated the distribution of per-firm costs from the distribution of per-vessel costs using the following approach. For firms in industries with more than one vessel class, EPA estimated vessel costs corresponding to the minimum, maximum and each 10 percentile increment in between these extremes – thereby yielding 11 possible vessel costs, which are assumed to be equally likely. For firms in industries with two vessel types, EPA evaluated the firm costs for 11^2 possible combinations of costs. For firms in industries with N vessel types, EPA evaluated the firm costs for 11^N possible combinations of costs – 11 possible costs for each vessel class. For each industry, EPA calculated an average per-vessel cost from the vessel class-specific costs for all 11^N possible combinations based on the relative number of vessels in each class. This average cost per vessel was then multiplied by the number of vessels per firm in each industry for a given revenue size category (see *Section 7.1.2*). Thus, for industries with more than one vessel class, EPA estimated a distribution of costs per firm with 11^N equally likely possibilities, where N is the number of vessel classes observed for the industry.[30] There were three sectors with only one vessel class, three sectors with six vessel classes, and one sector each with two, three, four, and five and seven vessel classes., Figure 7-1 illustrates how the firm cost impact is calculated for one possible combination of vessel costs and one revenue size bracket in a sector with two vessel classes.

[30] For NAICS 483112/483114, EPA performed the analysis using 101 different cost possibilities to account for the small percentage of vessels that are expected to incur these costs.

Figure 7-1: Illustration - Calculation of one firm cost possibility for the *Inland waterways passenger transportation and other water transportation (483212) sector*, which includes two vessel types (passenger and utility vessels).



For firms in industries with only one vessel class, such as commercial fishing, port and harbor operations industries, or the drilling oil and gas wells sector, EPA estimated the total vessel costs for all possible combinations of the individual practice costs. The likelihood of each possible combination is estimated from the likelihoods of incurring each individual practice cost, as described above, which are assumed to be independent. The costs per vessel are multiplied by the number of vessels per firm in each industry to estimate all the possible firm costs. Thus, for industries with only one vessel class, EPA estimated a distribution of costs per firm with 8, 2,049, and 2,049 possibilities for the commercial fishing, port and harbor operations, and drilling oil and gas wells sectors, respectively. [31]

7.1.4 Compare Costs to Revenues

Data from the Economic Census as well as from the SBA's Statistics of U.S. Businesses were used to determine the firm-level financial data. These sources provided the distribution of firms across several revenue brackets as well as the average revenue value in each revenue bracket.

To evaluate the potential impact of the Vessel General Permit on small entities, EPA used a cost-to-revenue test to evaluate the potential severity of economic impact on vessels and facilities owned by small entities. The test calculates annualized pre-tax compliance cost as a percentage of total revenues and uses a threshold of 1 and 3 percent to identify facilities that would be significantly impacted as a result of this Permit.

The cost values equivalent to the 1 and 3 percent thresholds were estimated from the average revenue in each revenue bracket, or the midpoint of the revenue bracket when average revenue was not reported. Each possibility from the distribution of firm costs, described in *Section 7.1.3,* was compared to the 1 and 3 percent thresholds. EPA estimated the percentage of firms that would be significantly impacted as a result of this Permit as the percentage of cost possibilities where the firm costs exceeded the revenue thresholds.

7.2 Small Entity Analysis

Consistent with the framework and requirements of the Regulatory Flexibility Act, EPA prepared a screening analysis that examines the impacts of this Permit on small entities. A small entity may be:

- A small business according to SBA size standards
- A small governmental jurisdiction that is a government of a city, county, town, school district, or special district with a population of less than 50,000
- A small organization that is a not-for-profit enterprise that is independently owned and operated and is not dominant in its field.

The SBA defines small businesses based on NAICS codes and size standards expressed by the number of employees or annual receipts (13 CFR §121.20). For the water transportation, fishing, and drilling oil and gas wells sectors, SBA's business size standards are based on annual revenues as well as employee size. If the revenues or employment were smaller than the corresponding thresholds, EPA classified the entities as small. *Section 5.4.2: Small Businesses* presents the small business thresholds used in this analysis and the number of small businesses in each sector of the water transportation and fishing industries, and of the drilling oil and gas wells sector within the mining industry. On the whole, the affected industries contain more than 90 percent small businesses. Based on data from the U.S. Census Bureau and the SBA, of the 5,037 firms in the water transportation industries, 4,770 (94.3 percent) are small. In the fishing industry, 1,843 (96.2 percent) of the 1,916 firms are small. In the drilling oil and gas wells sector, 1,470 (97.7 percent) of the 1,504 firms are small.

[31] The drilling oil and gas wells sector has the same distribution of costs (thus, the same number of cost combinations) as the port and harbor operations sector since both only contain utility vessels.

After calculating the distribution of per-firm costs, the number and percentage of firms where costs exceed 1 percent and 3 percent of revenue was estimated (by NAICS sector and revenue bracket).

The costs used in the RFA analysis are annualized costs, which reflect the annual equivalent value of first-year (one-time) costs and recurring costs. The resulting 2007 annualized costs range from $0 to $61,531per vessel in the water transportation industry, from $0 to $1,570 per vessel in the fishing industry, and from $0 to $4,470 per vessel in the drilling oil and gas wells sector.

Table 7-1 lists the median, 5th, 95th, and 99th percentile firm-level costs across all NAICS codes. For NAICS category 483112/483114, the 95th percentile of the firm cost is $7.31 and $88.38 per year for the low and high end estimates, respectively. EPA analyses, however, show that a very small proportion of firms (e.g., less than one percent of cruise ship firms) will have much higher costs, as high as $67,361 and $88,298 for the low and high end estimates, respectively, while the next highest percentile of firms (e.g., less than two percent of cruise ship firms) have annual costs estimated at $1,906 and $2,015 (low and high end estimates).

Table 7-1: Estimated Median, 5th, 95th, and 99th Percentile Firm Costs by NAICS Code

		5th Percentile	Median	95th Percentile	99th Percentile
Low End Cost Estimate					
11411	Finfishing, shellfishing, and other commercial fishing	$0	$0	$1,570	$3,921
483111/483113	Deep sea/coastal and Great Lakes freight	$80	$146	$3,662	$17,086
483112/483114	Deep sea/coastal and Great Lakes passenger	$4	$4	$7	$1,906
483211	Inland waterways freight transportation and towing transportation	$82	$393	$13,048	$62,544
483212	Inland waterways passenger transportation and other water transportation	$4	$4	$1,934	$1,950
487210	Scenic and sightseeing transportation, water	$10	$23	$1,956	$9,474
488310	Port and harbor operations	$78	$78	$3,125	$20,310
488320	Marine cargo handling	$82	$795	$20,355	$68,481
488330	Navigational services to shipping and salvage	$77	$81	$3,006	$10,781
488390	Other support activities for water transportation	$1	$1	$136	$148
213111	Drilling oil and gas wells	$78	$78	$3,125	$20,310
High End Cost Estimate					
11411	Finfishing, shellfishing, and other commercial fishing	$0	$0	$1,570	$3,921
483111/483113	Deep sea/coastal and Great Lakes freight	$315	$540	$5,548	$25,792
483112/483114	Deep sea/coastal and Great Lakes passenger	$54	$54	$88	$2,015
483211	Inland waterways freight transportation and towing transportation	$306	$1,445	$22,410	$94,731
483212	Inland waterways passenger transportation and other water transportation	$53	$53	$2,933	$2,955
487210	Scenic and sightseeing transportation, water	$74	$107	$2,965	$14,451
488310	Port and harbor operations	$307	$311	$4,606	$29,094
488320	Marine cargo handling	$306	$1,967	$35,190	$112,349
488330	Navigational services to shipping and salvage	$301	$309	$5,039	$15,456
488390	Other support activities for water transportation	$5	$5	$206	$223
213111	Drilling oil and gas wells	$307	$311	$4,606	$29,094

a Since NAICS 483211 and 488320 both have a high number of vessels per firm (approximately 26 vessels per firm), the 99th percentile firm cost is higher than for other NAICS.

Figure 7-2 through *Figure 7-3* depicts the percentage of firms exceeding specified cost thresholds for two sectors: deep sea/coastal and great lakes passenger transportation, and marine cargo handling. *Figure 7-2* depicts the percentage of firms exceeding specified cost thresholds for the deep sea/coastal and great lakes passenger category. As shown in *Figure 7-2,* the majority of these firms are also expected not to exceed $100 both for the low and high end cost estimate.

Figure 7-2: Percentage of Firms Exceeding Low End and High End Cost Thresholds, NAICS 483112/483114 - Deep sea/coastal and Great Lakes passenger

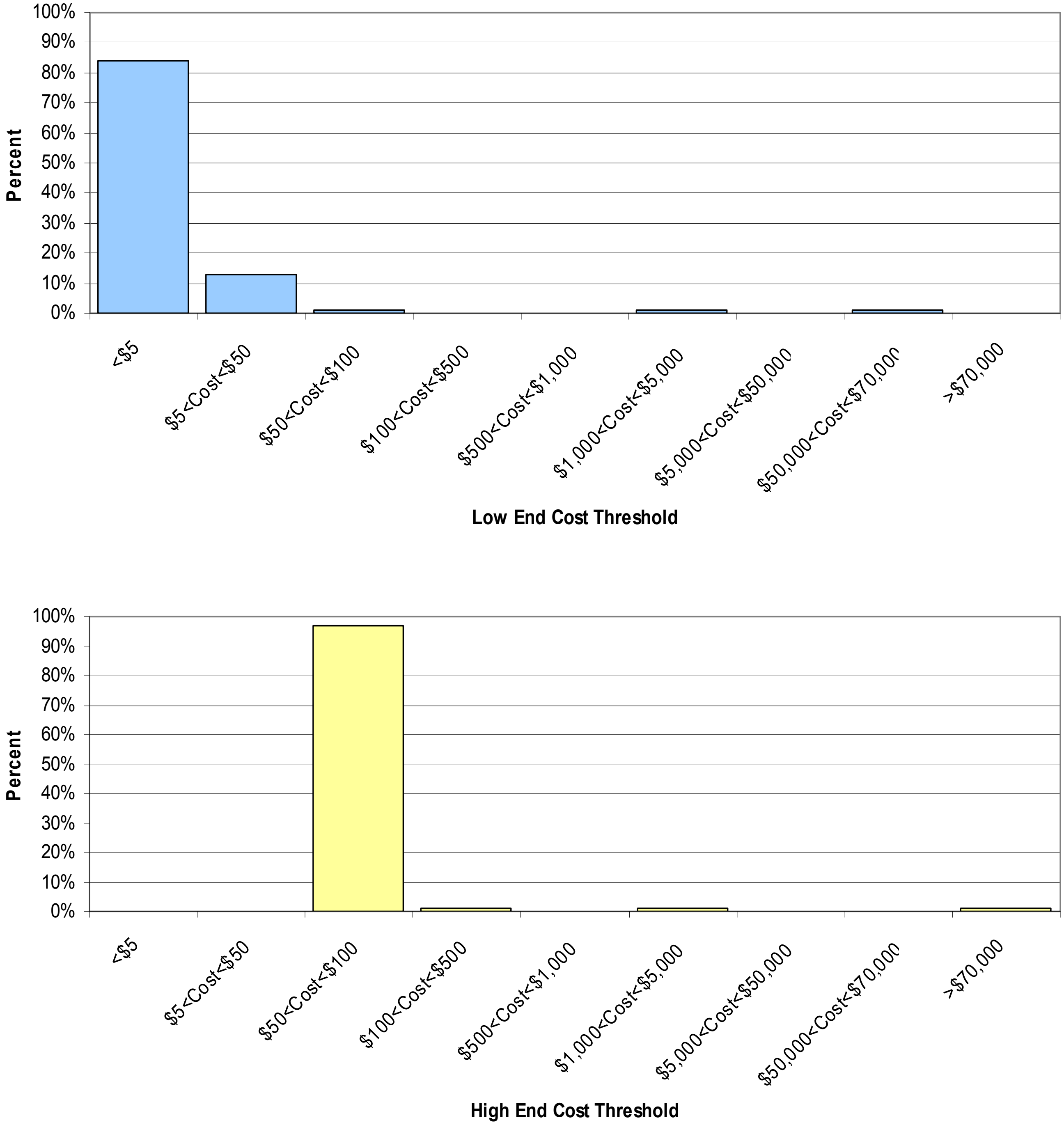


Figure 7-3 depicts the percentage of firms exceeding specified cost thresholds for the marine cargo handling category. As shown in *Figure 7-3,* the majority of these firms are expected not to exceed $5,000, both for the low and high end cost estimate. This category experiences higher firm level costs since the overall average number of vessels per firm is much higher.

Figure 7-3: Percentage of Firms Exceeding Low End and High End Cost Thresholds, NAICS 488320- Marine Cargo Handling

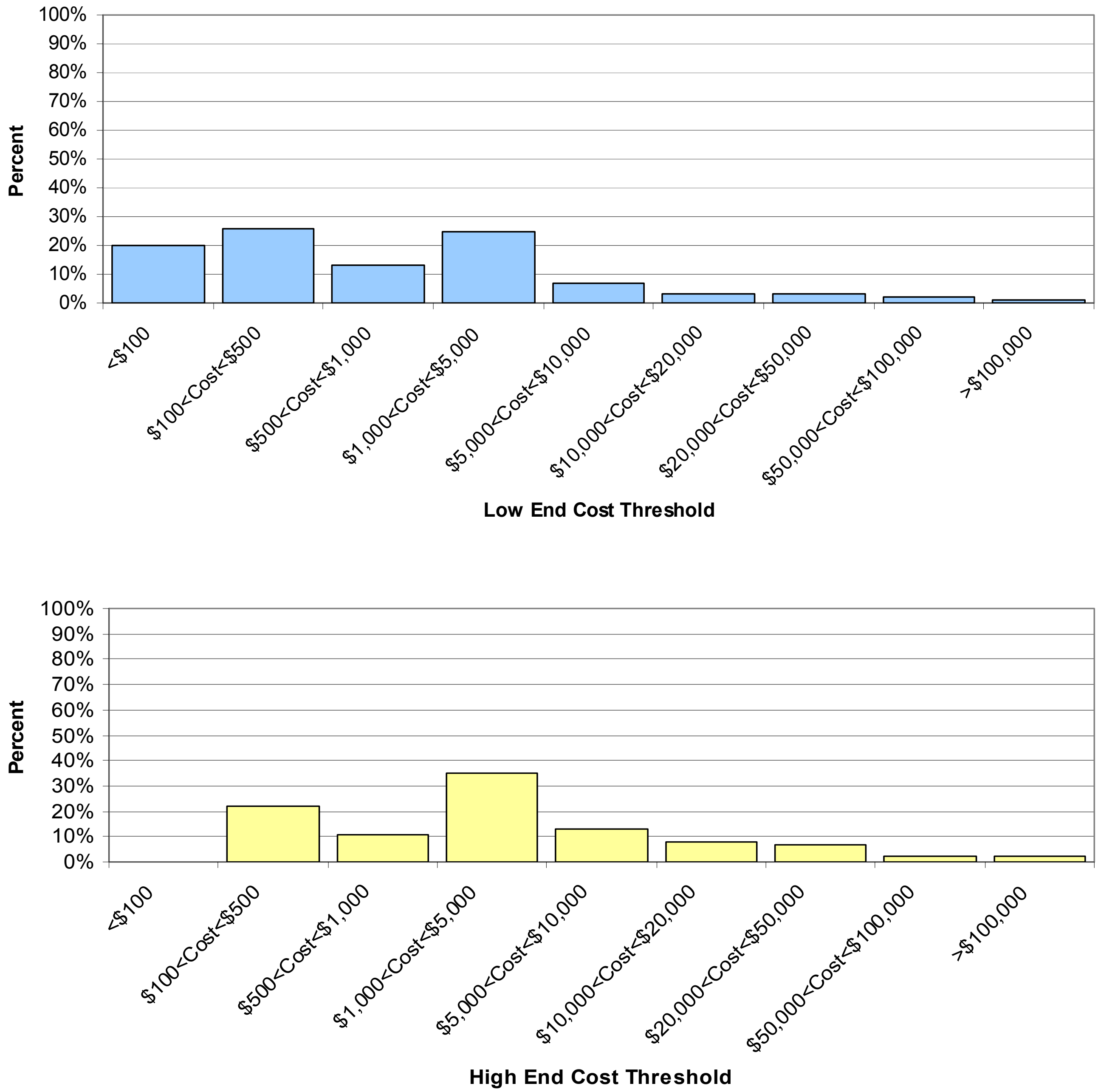


Table 7-2 presents the distribution of the entities' cost-to-revenue ratios. As shown in *Table 7-2*, the total number of small entities in the *fishing industry* that are expected to exceed the 1 percent cost-to-revenue threshold is 3 for the low end and high end cost assumptions. The total number of small entities in the *water transportation industry* that are expected to exceed the 1 percent cost-to-revenue threshold ranges from 209 to 304 under the low and high end cost assumptions, respectively. The total number of small entities in the *drilling oil and gas wells sector* that are expected to exceed the 1 percent cost-to-revenue threshold is 1 under both the low and high end cost assumptions, respectively. The three industries/sectors combined constitute 213 and 308 entities that are expected

to exceed the 1 percent cost-to-revenue threshold under the low and high end cost assumptions, respectively. This represents less than 1 percent of the total number of firms in the water transportation and fishing industries, and the drilling oil and gas wells sector, under both analytic scenarios.

The critical cost thresholds range depending on revenue range and NAICS code. For example, a fishing firm within the revenue range of $0-$100,000 (with an average revenue for firms within the bracket of $54,610) would have a 1 percent critical cost threshold of $546. On the other hand, a firm within the marine cargo handling industry, within the revenue range of $100 million or more (with an average revenue of over $235 million) would have a 1 percent critical cost threshold of nearly $2.4 million. The majority of firms in the fishing industry and the drilling oil and gas wells sector fall within the revenue range from $100,000 to $499,999. The majority of firms in the water transportation industry fall within the revenue range from $100,000 to $249,999. As shown in *Table 7-2,* the percentage of firms expected to exceed the 1 percent threshold under both the low and high end cost assumptions ranges from 0 to 4.93 percent depending on the NAICS code. In examining the percentage of entities affected, the most impacted entities fall within the inland waterways freight transportation and towing transportation, inland waterways passenger transportation and other water transportation, scenic and sightseeing transportation, navigational services to shipping and salvage, deep sea coastal and great lakes freight, and marine cargo handling sectors. These six sectors all have approximately 2 percent or more entities that exceed the 1 percent threshold under both the low and high end cost assumptions.

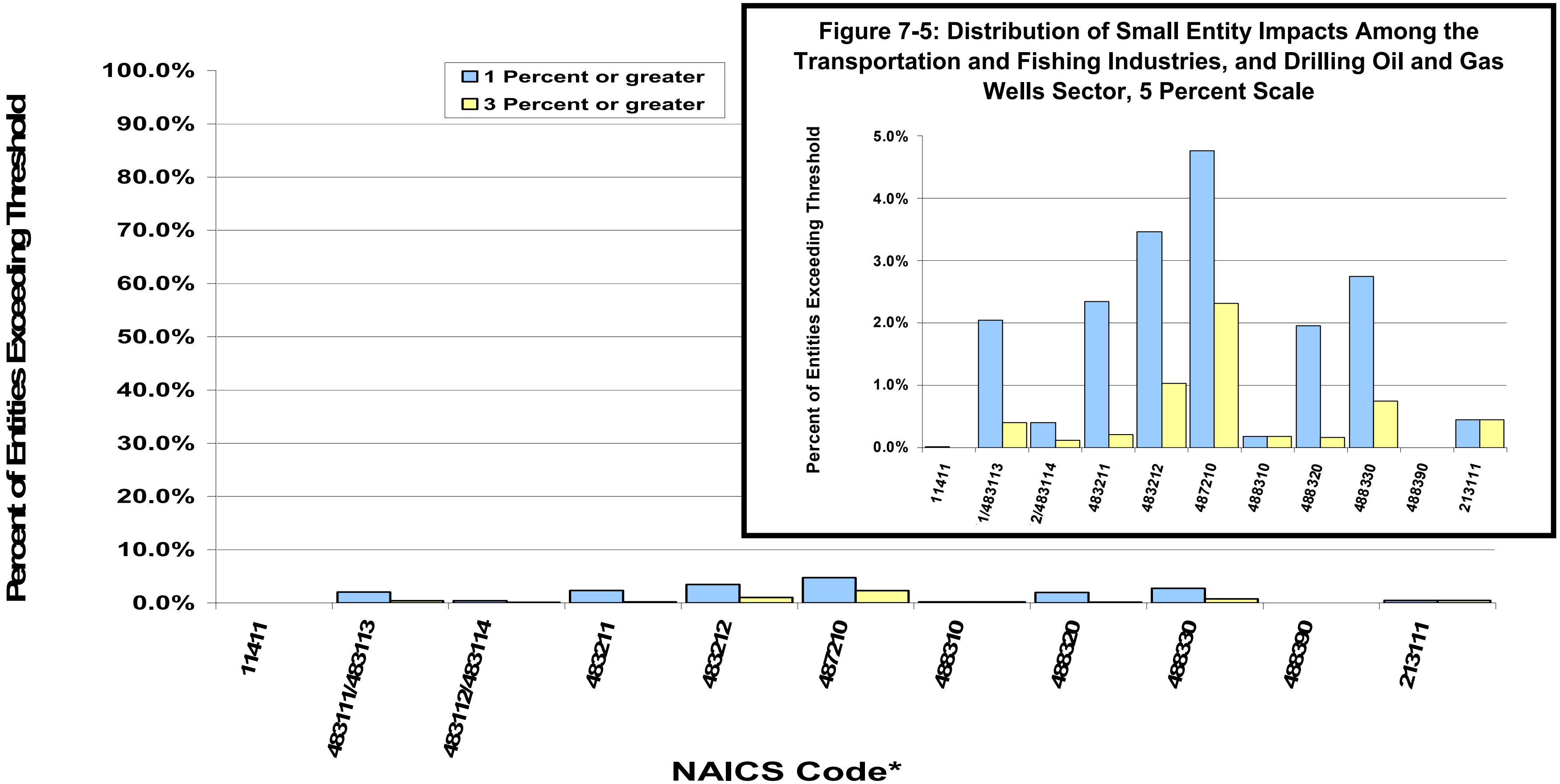
Table 7-2: Results of the Small Entity Impact Analysis

NAICS Code	NAICS Description	1 Percent or greater		Between 1 Percent and 3 Percent		3 Percent or greater	
Low End Cost Estimate							
11411	Finfishing, shellfishing, and other commercial fishing	3	0.01%	3	0.01%	0	0.00%
483111/483113	Deep sea/coastal and Great Lakes freight	29	2.04%	23	1.64%	6	0.41%
483112/483114	Deep sea/coastal and Great Lakes passenger	30	0.41%	21	0.29%	9	0.12%
483211	Inland waterways freight transportation and towing transportation	27	2.34%	25	2.14%	2	0.20%
483212	Inland waterways passenger transportation and other water transportation	42	3.46%	29	2.43%	12	1.03%
487210	Scenic and sightseeing transportation, water	9	4.76%	5	2.45%	4	2.31%
488310	Port and harbor operations	2	0.18%	0	0.00%	2	0.18%
488320	Marine cargo handling	0	1.96%	0	1.80%	0	0.16%
488330	Navigational services to shipping and salvage	70	2.74%	51	1.99%	19	0.75%
488390	Other support activities for water transportation	0	0.00%	0	0.00%	0	0.00%
213111	Drilling oil and gas wells	1	0.44%	0	0.00%	1	0.44%
	TOTAL	**213**	**0.52%**	**157**	**0.38%**	**55**	**0.13%**
High End Cost Estimate							
11411	Finfishing, shellfishing, and other commercial fishing	3	0.01%	3	0.01%	0	0.00%
483111/483113	Deep sea/coastal and Great Lakes freight	39	2.75%	33	2.34%	6	0.41%
483112/483114	Deep sea/coastal and Great Lakes passenger	30	0.41%	21	0.29%	9	0.12%
483211	Inland waterways freight transportation and towing transportation	51	4.45%	34	2.98%	17	1.47%
483212	Inland waterways passenger transportation and other water transportation	42	3.46%	29	2.43%	12	1.03%
487210	Scenic and sightseeing transportation, water	9	4.93%	5	2.62%	4	2.31%
488310	Port and harbor operations	8	0.72%	4	0.36%	4	0.36%
488320	Marine cargo handling	0	4.46%	0	3.30%	0	1.16%
488330	Navigational services to shipping and salvage	123	4.82%	104	4.07%	19	0.75%
488390	Other support activities for water transportation	0	0.00%	0	0.00%	0	0.00%
213111	Drilling oil and gas wells	1	0.88%	0	0.00%	1	0.88%
	TOTAL	**308**	**0.75%**	**235**	**0.57%**	**73**	**0.18%**

Figures do not necessarily add to totals due to rounding.

The graphs in *Figure 7-4* and *Figure 7-5* demonstrate the percentage of entities exceeding the 1 percent and 3 percent cost-to-revenue threshold for the low end cost estimate. The number and percentage of entities exceeding the thresholds for the high end estimate are in line with the figures below. *Figure 7-4* presents the percentage of entities at the 100 percent scale, demonstrating the overall low percentage of entities affected. *Figure 7-5* is a small scaled version of *Figure 7-4,* detailing the percentage of entities affected across each NAICS code.

Figure 7-4: Distribution of Small Entity Impacts Among the Transportation and Fishing Industries, and Drilling Oil and Gas Wells Sector, 100 Percent Scale



* The industries/sectors that are attributed to each NAICS code are as follows: 11411 – Fin fishing, shell fishing, and other commercial fishing; 483111/483113 – Deep sea/coastal and Great Lakes freight; 483112/483114 – Deep sea/coastal and Great Lakes passenger; 483211 – Inland waterways freight transportation and towing transportation; 483212 – Inland waterways passenger transportation and other water transportation; 487210 – Scenic and sightseeing transportation, water; 488310 – Port and harbor operations; 488320 – Marine cargo handling; 488330 – Navigational services to shipping and salvage; 488390 – Other support activities for water transportation; 213111 – Drilling oil and gas wells

7.3 Issues and Uncertainties

The number and percentage of firms estimated to incur economic impacts is based upon the firm number estimated based on from the VESDOC and WTLUS databases. EPA assumes that the Economic Census distribution of firms by revenue size is the same as the VESDOC/WTLUS distribution of firms by revenue size. These assumptions may result in a distribution that differs from the actual distribution of affected firms.

There is uncertainty surrounding EPA's assumption that the average number of vessels per firm is proportional to the midpoint of the revenue bracket. In addition, the constraint that there must be at least one vessel per firm was binding for the lower revenue brackets. These assumptions may result in underestimation or overestimation of the number of vessels per firm, and the underestimation or overestimation may vary by revenue size category. In instances where EPA underestimates the number of vessels per firm, in the aggregate or by revenue size category, market impacts may be underestimated. In instances where EPA overestimates the number of vessels per firm, market impacts may be overestimated. There is uncertainty surrounding the choice of using only 11 possible costs for each vessel class (minimum, maximum, and by 10 percentile increments) and more accurate estimates could be obtained by using a greater number of cost possibilities. However, since industries can have up to seven vessel types, the number of sampled vessel costs is limited by computational feasibility - with 11 possible vessel-class costs and 7 vessel types there are 11^7 possible firm costs. In the case of passenger vessels and cruise ships where only a small percentage of vessels incur costs, EPA limited the uncertainty in the estimates by using 101 different cost possibilities. Because industries with fewer vessel classes are more likely to be sensitive to the sample size, EPA evaluated all possible costs for industries with only one vessel class (i.e., all possible combinations of the estimated individual practice costs).

After simulating a sample of vessel class costs, EPA calculated an average cost per vessel across all vessel classes within each industry sector. For example, NAICS 483212 include both passenger vessels and utility vessels, and on average, firms in the lowest revenue bracket have one vessel. Since 99.5 percent of the firms' vessels are passenger vessels, the firm cost is estimated as the weighted average of vessel costs (99.5% * [Passenger Vessel Cost] + 0.5% * [Utility Vessel Cost]) * 1, where the Passenger Vessel Cost and Utility Vessel Cost are sampled as described in *Section 7.1.3.* There is uncertainty associated with this simplifying assumption, because calculating a weighted average vessel cost results in less cost variation compared to an alternative approach that simulates a distribution of vessel classes for firms.

For each revenue bracket EPA assumed that firm revenues were equal to the average revenue in the bracket (or the midpoint when the average was not available). There is uncertainty associated with this simplifying assumption, because calculating an average firm cost results in less variation compared to an alternative approach that simulates a distribution of firm revenues within revenue size ranges.

8 Benefits Analysis

EPA expects that reductions in vessel discharges will benefit society in two broad categories: (1) reduced risk of invasive species introduction and (2) enhanced environmental quality from reduced pollutant discharges. *Section 8.1.2: Benefits Analysis* provides a qualitative assessment of the ecological and economic impacts of invasive species introductions and the benefits of reducing the occurrence of invasive species. *Section 8.2* discusses pollutants of concern (POCs) found in vessel discharges, their environmental effects, and the benefits likely to be achieved by the requirements of the Vessel General Permit.

8.1 Ballast Water Exchange and Invasive Species Impacts

8.1.1 Introduction and Background

Introductions of non-indigenous species have occurred in the United States for centuries, with more than 50,000 total non-native species thought to be successfully established with reproducing populations in U.S. territory (Pimentel et al., 2005). Scientists and governments have long recognized the economic and ecological damages associated with land-based invaders, but attention has only turned toward aquatic non-indigenous species (ANS) since the 1980s, when the extent of the zebra mussel invasions in the Great Lakes region first became a serious problem (Ruiz and Reid, 2007). ANS invasions have caused tremendous economic and ecological damages to critical coastal and inland waters throughout the United States.

ANS may be introduced through a variety of vectors, including intentional introductions, escape from a confined environment, or ballast water and sediment from ballast tanks. One of the major known vectors for ANS introduction is through the ballast water tanks of commercial vessels. Ballast water is taken on in or near port to provide stability to ships that are not fully loaded. Often, aquatic invertebrates, plants, or microorganisms, as well as suspended sediments that may contain invasive species, are unintentionally taken in along with the ballast water.

Two recent studies conducted by NOAA's Great Lakes Environmental Research Laboratory (GLERL) found that a majority of ships and a near-majority of 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. Glassner-Shwayder refers to ships with ballast water as "biological islands" because they carry such a wide variety of organisms in their ballasts (1999). According to some studies, as many as 4,000 species can be found in a typical ship's ballast water at one time.

When this ballast water is discharged in another port, or when sediments in the ballast tank are mixed with new ballast water, these species can be introduced into an exotic environment, and may become established under some conditions (Ruiz and Reid, 2007). Several of the most harmful invasive species currently known to exist in the United States, including the zebra mussel, the green crab, and the Asian clam, are all thought to have been introduced via ballast water. Researchers hypothesize that as international trade, and therefore shipping traffic, increases, so does the threat of more ANS introductions (Glassner-Shwayder, 1999).

The U.S. Coast Guard's 2004 Rulemaking for Mandatory Ballast Water Management (codified in 33 CFR 151) mandated open ocean ballast water exchange for ships traveling outside the 200-nautical mile exclusive economic zone (EEZ) of the United States. While promulgation of this Permit is reducing the probability of new introductions, it covers neither vessels traveling within the U.S. EEZ nor vessels with empty ballast tanks, both of which are potential sources of ANS introductions.

The ballast water provisions of EPA's new Vessel General Permit will help to address these gaps, further reducing the possibility of ANS introductions. Specifically, the Permit requires ballast water exchanges at least 50 nm from shore for vessels engaged in Pacific nearshore voyages, which were previously exempted from mandatory exchange procedures. It also requires saltwater flushing for vessels declaring no ballast on board (NoBOB) or for vessels with some proportion of their ballast tanks empty.

8.1.2 ANS Impacts

ANS invasions are a persistent problem in U.S. coastal and inland waters. ANS invade U.S. waters through a number of dispersal mechanisms including releases from fisheries; research and education facilities; restoration efforts; public aquaria and the aquarium pet industry; and by being attached to or within ships, drydocks, amphibious planes, floating marine debris, drilling platforms, navigation buoys and marine floats, canals, and recreational equipment (Carlton et al., 2003). Each vector has been associated with introductions of highly damaging species in the past, although this analysis will focus primarily on the ballast vector described in the previous section.

Though no reliable and comprehensive estimates of total ANS introductions nationwide exist, case studies of several major bodies of water across the country, as summarized in *Table 8-1,* provide a sense of the extent of the problem.

Table 8-1: Estimates of Invasive Species in Several Major Water Systems

Region	Estimated Rate of Invasion[a]	Estimated Total Invasions to Date[b]
Great Lakes	Once every 28 weeks[c]	162
Mississippi River System	Unknown	100
San Francisco Bay	Once every 24 weeks[d]	212
Lower Columbia River Basin	Once every 5 months[e]	81
Gulf of Mexico	Unknown	579

a Ruiz and Reid (2007) suggest that these figures may not reliably represent the true rate of introduction, as they are based on discovery data, which may not always track with the underlying rate of introduction.
b All figures in this column are taken from USCG (2004b).
c NOAA (2007).
d Cohen and Carlton (1995).
e Sytsma et al. (2004).

The total costs associated with ANS in the United States are staggering. A recent study suggests that expenditures on control alone for ANS in the United States total approximately $9 billion annually (Pimentel et al., 2005). A broad range of damages are associated with any introduction of a given type of species, summarized in *Table 8-2.* Although some species cause no economic damage, others may cause hundreds of millions of dollars in damages. The majority of these damages may be broken down into six broad categories of impacts, which are described in the subsequent subsections.[32]

[32] Portions of a previous analysis of benefits associated with ANS introduction reductions are incorporated into this analysis (Abt Associates Inc., 2005).

Table 8-2: Estimates of Invasive Species Damages by Type of Species

Type of Species	Range of Potential Damages per Invasion per Year (Million 2007$)
Fish	0 – 153[a]
Mollusks	0 – 6,100[b]
Non-Mollusk Invertebrates	0 – 22.6[c]
Plants	0 – 35.1[d]
Pathogens	0 – 0.726[e]

a Based on Ruffe (Leigh, 1998), adjusted to 2007$ using CPI.
b Based on Zebra Mussel (Pimentel et al., 1999), adjusted to 2007$ using CPI.
c Based on European Green Crab (EPA, 2008a).
d Based on hydrilla (OTA, 1993), adjusted to 2007$ using CPI.
e Based on an outbreak of epidemic cholera (Lovell and Drake, 2007), adjusted to 2007$ using CPI.

Commercial and Recreational Fisheries

As noted above, the introduction of ANS can cause the imbalance of native ecosystems. ANS pose an especially serious risk to commercial and recreational fisheries, which like other aquatic resources could be devastated by ANS (IDNR, 2003). Several examples of ANS impacts on fisheries are provided below.

- ***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 introduced 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. If sea lamprey control measures were eliminated, the resulting lost value to fisheries would be approximately $500 million annually, according to one estimate (OTA, 1993). Control measures that have been introduced 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). Other possible pathways of introduction include ballast water and solid ballast. Grosholz (2006) and Cohen (1997) believe that incidental transport with commercial fishery products is the most likely vector for the initial introduction of C. maenas to the West Coast. 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, 2008a).
- ***Round Goby:*** The round goby, native to Eurasia and likely introduced via ballast water, 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. Fishermen report that they are sometimes able to catch only gobies when fishing for the more desirable walleye (Marsden and Jude, 1995). No attempts to quantify the value of these impacts have been made to date.
- ***Zebra Mussel:*** An invasion of zebra mussels, which are native to the Caspian Sea and were introduced to U.S. waters in ballast water, has led to a halt in the $3 billion dollar Mississippi River shelling industry (Randall, 2001).
- ***Pathogens:*** Pathogens transported in ballast water can also have significant adverse impacts on fisheries. infectious salmon anemia (ISA) has been a persistent problem in U.S. Atlantic fisheries' stocks since 2001. The original source and vector of this pathogen is unknown. Though there has been no attempt to quantify damages to the U.S. economy specifically from ISA, it is estimated that the annual cost in 1999 was $11 million in Norway, $14 million in Canada and $32 million in Scotland (Cipriano and Miller, 2002).

Another recent fish pathogen of concern has been viral hemorrhagic septicemia (VHS). VHS has been known to exist in the coastal regions since the late 1980s, but only recently migrated into the Great Lakes through an unknown vector (USDA, 2006). An unpublished study found that VHS has impacted 6 of 23 fish species caught commercially in the Great Lakes, including two that account for 76 percent of the entire $13.5 million dollar harvest (Lovell and Drake, 2007). In 1991, an exotic strain of *Vibrio cholerae* (epidemic cholera) was identified in oysters in Mobile Bay on the Gulf Coast. The estimated economic losses due to the closure of oyster harvesting in Mobile Bay for five months in 1991 as a response to concerns about epidemic cholera contamination were $726,000 (2007$) (Lovell and Drake, 2007).

Two non-native pathogens, MSX (*Haplosporidium nelsoni*) and Dermo (*Perkinsus marinus)* have caused substantial damages to native oyster populations in several U.S. coastal regions. Though the original vector of introduction is unknown for both pathogens, ballast water is considered to be one potential source of MSX, and Dermo is known to transmit relatively easily between infected and uninfected oysters (McKnight, 2007; Ewart and Ford, 1993).

Other Water-Based Recreation and Tourism

ANS have also had adverse impacts on recreation and tourism nationwide by damaging water quality and flow. Two invasive plants, hydrilla and water lettuce, have caused significant damages in U.S. waters. Both clog the water's surface, blocking boating and swimming, impeding water flow, and disrupting plant and animal communities. Florida spends an estimated $1 million or more annually to control water lettuce, and the rest of the Eastern U.S. states spend approximately $100,000 annually (Van Driesche et al., 2002). Studies of two lakes in Florida affected by hydrilla found that degradation caused by the hydrilla cost the state $11 million in lost recreation expenditures (Pimentel et al., 1999).[33]

Invasive mollusks such as zebra mussels can also adversely affect a number of recreational activities, including boating and swimming. Zebra mussels often cover shorelines with sharp-edged shells and rotting mussel flesh, which can diminish interest in visiting infested beaches. Biofouling can also be a deterrent to recreational boaters who would rather avoid zebra mussel fouling and the resulting necessity of extensive vessel cleaning (USACE, 2002). A study by Vilaplana and Hushak (1994) estimated that incremental annual costs to boat owners in the Great Lakes related to the mussel included $94 for protective anti-fouling paints, $171 for additional maintenance, and $207 for insurance.

Biodiversity and Ecosystems

Introductions of ANS can 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). Ecosystems provide a variety of services, including water quality maintenance, detoxification and decomposition of waste, climate stabilization, mitigation of natural disaster impacts, and a source of income. Several significant instances of adverse ecosystem impact include:

- ***Zebra Mussel:*** Zebra mussels have had some of the most dramatic impacts observed to date on ecosystems, particularly in the Great Lakes region. The mussels achieved densities as high as 700,000 per square meter, which led to a much greater filtration rate of particulate matter, resulting in much lower turbidity (Griffiths et al., 1991; MacIsaac et al., 1995). This in turn led to much greater filtration of light through the water column, which affected plant viability and substantially increased competition for food for indigenous mollusks.

[33] This cost may have an adverse impact locally, but because the money is still available to be spent elsewhere, this adverse impact does not represent a true net welfare loss.

- ***Round Goby:*** The round goby was first introduced into the Great Lakes region via ballast water. The goby preys on benthic fauna competing with species native to the Great Lakes and takes over prime spawning sites of native species, which is changing the balance of the ecosystem. Introduction of the round goby adversely affected a number of native species, including mottled sculpin, logperch, and darters. Because of this threat, the U.S. Army Corps of Engineers and U.S. EPA have spent $1.2 million to erect a dispersal barrier to prevent its further spread down the Chicago Sanitary and Ship Canal to the Mississippi River (Glassner-Shwayder, 1999).
- ***European Ruffe:*** The European ruffe preys on native fish and competes with them for habitat. It was introduced into the Great Lakes via ballast water and poses a serious threat to species like the walleye, yellow perch, and whitefish (Leigh, 1998). Populations of spawning European ruffe in the St. Louis River went from 200,000 in 1989 to 1.8 million in 1991. At the same time, populations of yellow perch, troutperch, emerald shiners, and spottail shiners decreased by 75 percent (RTF, 1992). The expected reduction in value of sport and commercial fisheries in the Great Lakes region due to the ruffe invasion is $119 million (ANSTF, 2007).
- ***Snowflake Coral:*** *Carijoa riisei*, or snowflake coral, an invasive coral species, is threatening the ecosystem stability of the ecologically sensitive Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve (NOAA, 2004a; Toonen, 2005). It is also a threat to the native black coral, which a local industry valued at $30 million harvests and uses to make jewelry.

Threatened and Endangered Species

Invasions have had especially adverse impacts on threatened and endangered species by predation, alteration of habitat, or further competition for limited resources. It is estimated that non-indigenous species are a contributing factor to the endangered status of 70 percent of listed fish species, and more than half of combined endangered and threatened listings (OTA, 1993). They are also estimated to have contributed to 68 percent of fish extinctions in the last 100 years (Larson and Sytsma, 2006).

Damage to Infrastructure

Industrial facilities, such as those that purify water, generate electricity, and manufacture goods, depend on water intake structures to perform their services. These structures can often be adversely affected by ANS.

So far, zebra mussels have been the most damaging ANS introduced into U.S. fresh waters, causing particularly severe problems with water intake structures (USACE, 2002). Zebra mussels attach to surfaces of water intake structures, navigation dams, pumping stations, and gears, often making them inoperable, which inconveniences the public and costs industry significant financial losses and damages (USACE, 2002).

Hushak (1996) reports on the results of 398 surveys of Great Lakes users with lake water intake structures from 1989 to 1994 for private and public utilities, municipal water facilities, and industrial users. Extrapolating the results of this survey to all facilities in the Great Lakes yielded total monitoring and control costs of $120 million from 1989 to 1994 with an average cost of $30 million annually (Park and Hushak, 1998). Another study done in 1995 of the economic impact of zebra mussels (O'Neill, 1997) found that the total costs of zebra mussels control and monitoring were $69 million, with a mean cost of $205,570 per facility. The study results also showed that total annual expenses rose from $234,140 in 1989 to $17,751,000 in 1995 as the range of mussels increased (O'Neill, 1997).

Another invasive bivalve species, the Asian clam, is estimated to have caused fouling damage that cost the nuclear industry about $1 billion per year in the early 1980s (OTA, 1993). Two other invasive bivalves, the brown mussel and the green mussel, have also caused fouling damages in the Gulf Coast region and Tampa Bay, respectively, where each has become established, although the total economic value of the damages is not known (Benson et al., 2002; GSMFC, 2003).

Finally, invasive plant species such as hydrilla and water hyacinth can disrupt water flow in irrigation canals and in utility cooling reservoirs. Annual expenditures on aquatic weed control in the United States, much of which is spent on ANS weeds specifically, are estimated at $110 million (Pimentel et al., 2005).

Human Health Impacts

Most new human pathogens arise by the introduction of organisms from outside the country. Although a comprehensive estimate of the monetary cost of exotic pathogens to Americans is not available, but it is certain to be considerable. Examples of exotic pathogens that pose a threat to human health in the United States include West Nile virus, avian influenza, and human immunodeficiency virus (USDA, 2007). The expansion of trade and globalization and human mobility are significant factors in the spread of human pathogens.

Though the exact nature of the link between human health impacts and ANS invasions through ballast water is poorly understood, studies have established that pathogenic invasive species can be transported in ballast water (Ruiz and Reid, 2007). Moreover, in the case of epidemic cholera, a serious human pathogen, the presence of non-native strains has already been confirmed in U.S. waters (CDC, 1993). The potential human health impacts associated with ballast water transport are an object of increasing concern. Some pathogenic bacteria identified in ballast water known to be associated with adverse human health impacts include *E. coli*, enterococci, *Vibrio cholerae*, *Clostridium perfingens*, *Salmonella spp*. *Cryptosporidium spp*., and *Giardia spp.*, as well as a variety of viruses (Knight et al., 1999; Reynolds et al., 1999; Zo et al., 1999).

In July 1991, a strain of *Vibrio cholerae* was identified in oysters in Mobile Bay on the Gulf Coast that was indistinguishable from a Latin American strain not endemic to the United States. An investigation indicated that the pathogen was most probably introduced from the discharge of contaminated ballast water (CDC, 1993). Because oysters are often eaten raw, this is a potential human health threat. Of the 61 cases of cholera in the United States between 1995 and 2000, 14 were caused by the consumption of undercooked seafood (Steinberg, 2001). Though it is unclear whether any of these cases were caused by exotic strains of *Vibrio cholerae*, this evidence clearly indicates that the potential exists for the transport of harmful non-native pathogens in ballast water.

As mentioned in the introduction to this section, a study by NOAA also showed the potential for pathogens to be transported in ballast water tanks, even when they are not filled. The study found that virus-like particle concentrations in sampled ballast tanks ranged from 10^7 to 10^9 per ml in residual unpumpable ballast water and from 10^7 to 10^{11} per ml in sediment porewater. Bacteria concentrations under the same conditions were 10^5 to 10^9 per ml and 10^4 to 10^8 per ml, respectively (Johengen et al., 2005). Since a critical component of the new Permit is its provisions for saltwater flushing in vessels with empty ballast tanks, removing sediments may reduce the potential for pathogen contamination.

Ballast water is also a vector for the microorganisms associated with the "red tide" or harmful algal bloom phenomenon. This phenomenon occurs 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 (WHOI, 2007). Although current USCG mandatory BMPs for all vessels with ballast tanks, codified in 33 CFR 151, require vessels not to take up ballast water in areas known to be contaminated with such organisms, the new Permit's requirements governing ballast exchange may further reduce the spread and impact of these organisms.

8.1.3 Efficacy of Ballast Water Exchange and Saltwater Flushing

Studies have found that ballast water exchange and saltwater flushing generally reduce the quantity of ANS discharged into U.S. waters and therefore the risk of potential invasions (Johengen et al., 2005; Reid et al., 2007).

Dye tests found that 300 percent flow through exchange and empty tank refill exchange successfully displaced 80–99 percent of initial water in ballast tanks (Reid et al., 2007).

A NOAA study of saltwater exchange efficacy found that saltwater flushing results in the resuspension of 30–80 percent of sediment deposits in a given vessel (Reid et al., 2007). As sediments are one potential vector for introductions, reducing sediments in tanks can in turn reduce ANS discharges. One piece of the study found that salinity alone reduces populations of several types of potential invaders, including most phytoplankton species, rotifers, cladocerans, and some copepods and flatworms. Results were less conclusive for several other important types of potential invasive species, including pathogens, bivalves, crabs, barnacles and shrimp (Reid et al., 2007).

All available studies conclude that mandatory ballast water management practices are a valuable tool in combating invasions, and should be extended to vessels with empty tanks and vessels not departing the EEZ, as the new EPA Permit will do in some cases.

8.1.4 Benefits of Reducing ANS Introductions

The evidence presented in *Section 8.1.2: ANS Impacts* demonstrates that introductions of ANS through ballast water are associated with significant detrimental impacts throughout the United States. The ballast water provisions of EPA's final Vessel General Permit, to the degree that they fill a gap in the existing ballast water management practices, can therefore be expected to generate benefits by reducing the risk of such damages in the future. Benefits would include the prevention of damages to fisheries, tourism, and recreation, of damages to infrastructure, and of adverse human health impacts, as well as prevention of further stresses on native biodiversity and ecosystems.

The issue of ANS invasions and their impacts presents unique challenges for the estimation of the benefits associated with this Permit. Although ballast water is one of the major pathways of invasive species introduction, estimating changes in risk of introduction of invasive species from the Permit requirements is not feasible due to the lack of data on rates of invasive species introduction associated with ballast water releases. Moreover, because the type of species introduced in the future is unknown and the range of potential economic impacts associated with each species type is very large, estimating the monetary value of benefits from preventing future invasions with a reasonable degree of certainty would not be possible.

Commercial and Recreational Fisheries

A reduction in the number of ANS introductions due to the final ballast management requirements and other Permit requirements may prevent significant future damages to commercial and recreational fisheries that play a critical role in the U.S. economy. In 2006, 9.5 billion pounds of commercial landings were made by U.S. fishermen at U.S. ports, and were valued at $4 billion (NMFS, 2007). An additional 29.9 million anglers aged 16 and older spent an average of 17 days fishing in 2006, spending more than $40 billion dollars on trips, equipment, licenses, and other costs (USDOI, 2007). Leigh (1998) estimated the annual reduction in value of yellow perch, walleye, and whitefish fisheries due to ruffe invasion under moderate scenario assumptions to be $119 million (in 1998 dollars; $153 million (2007$) inflated using the Consumer Price Index (CPI)).

Other Water-Based Recreation and Tourism

Another source of potential benefits from the reduction of ANS introductions under the Permit will be the prevention of damages to valuable recreation and tourism sites. A report by NOAA (2004b) estimated the annual revenue associated with coastal tourism in the United States to be $54 billion, and found that beaches are the most popular tourist destinations in the United States. One invasive plant species alone, hydrilla, is associated with $14.5 million annually in control costs, and reduces lake recreation on two Florida lakes alone by $11 million in years when hydrilla covers the lakes (Pimentel et al., 1999). Since data are limited on the impacts of invasive species on recreation and tourism in ecosystems for which estimated rates of invasion exist, it is not possible to calculate the level of expected benefits for other water-based recreation and tourism. However, EPA projects that there will be some incremental benefits.

Biodiversity and Ecosystems

Additional significant benefits from the Permit will accrue to biodiversity and ecosystems. As detailed in *Section 8.1.2: ANS Impacts,* ANS are associated with substantial adverse impacts on the composition of ecosystems and the biodiversity therein. The quantification of biodiversity benefits will not be attempted in this analysis due to the great deal of uncertainty surrounding the impact of a single ANS introduction on a given ecosystem relative to other factors, as well as the difficulty. However, potential benefits in the form of preservation of habitat and species are likely.

Threatened and Endangered Species

The Permit requirements for ballast water management, by reducing the impacts of invasive species introductions on threatened and endangered species, will have benefits in terms of prevention of reduction in species population and species extinction. Total federal spending nationwide on programs related to the Endangered Species Act for 2004, the most recent year for which data are available, was more than $1.2 billion, and state spending was more than $200 million (USFWS, 2005).

As mentioned above, ANS are considered likely contributors to the threatened or endangered status of 70 percent of listed fish species (Larson and Sytsma, 2006). Combined federal and state expenditures per listed species of fish in 2004 ranged from $25,000 to $1.09 million (USFWS, 2005). It is not possible to calculate a range of benefits to threatened and endangered species associated with EPA's Permit requirements, due to the lack of research linking specific invasions with quantifiable impacts on particular species. However, it is likely that some proportion of potential future expenditures on endangered and threatened fish, as well as expenditures on other aquatic endangered species, would be averted by reduced ANS introductions under the Permit requirements.

Damage to Infrastructure

Another benefit of the Permit requirements for ballast management will result from averting damages to infrastructure by invasive species of plants and mollusks. Fouling by species such as the Asian clam, zebra mussel, and hydrilla has caused substantial economic damage to a variety of municipal and industrial entities in the past. Most of this damage takes the form of clogging water intake structures and disrupting the flow of water. One study estimated fouling damage to water intake infrastructure by zebra mussels for the year 2000 to be $5 billion (Khalanski (1997), and cited in Pimentel et al. (1999); $6.1 billion in 2007$ using CPI).

Human Health

Estimating expected human health benefits of EPA's Permit is not feasible due to very limited data on the rates of non-endemic pathogen invasions and the human health effects of these pathogens. Nevertheless, the Permit provisions are likely to reduce the probability of introduction of harmful exotic pathogens and thus are expected to benefit human health.

Summary of Benefits

The ballast water management practices established in this Vessel General Permit are designed to directly address the likelihood of future ANS invasions. The categories of potential damages from such ANS invasions have been discussed above, and studies referenced as to the potential magnitude of these damages for each. To the degree that these damage estimates provide an indicator of the likely payback that can be anticipated from reducing ANS invasions, EPA believes the benefits of this Permit can be expected to be very significant. However, the complexity of the ANS issue, the wide range and varied nature of impacts these invasions can cause, and the great breadth of the scope of this Permit prohibit EPA from developing a quantified estimate of these benefits.

8.2 Benefits of Reduced Pollutant Discharges from Vessels

8.2.1 Introduction and Background

The Clean Water Act and its associated regulations have greatly improved the quality of the nation's waters over the past 35 years. Nevertheless, large portions of the United States' fresh and saline waters remain degraded by elevated concentrations of harmful pollutants. EPA's 2007 National Water Quality Inventory Report to Congress found that 45 percent of assessed rivers and streams; 47 percent of assessed lakes, ponds, and reservoirs; and 32 percent of assessed bays and estuaries were classified as impaired for at least one of their designated uses (EPA, 2007c).[34] These impairments are associated with a variety of economic and ecological damages throughout the country.

Many of the discharges regulated by EPA's Vessel General Permit (2008b) were previously regulated under select circumstances. Several discharges are associated with a wide variety of harmful pollutants in substantial concentrations. For example, untreated graywater may contain pathogenic bacteria, toxic and carcinogenic organic and inorganic compounds, nutrients, and metals (EPA, 2007a).

The Permit covers many discharges and contains special provisions for numerous vessel types (see EPA (2008b) for information on the affected discharges and provisions by vessel type). Because of the breadth of coverage and provisions in the Permit, the following discussion does not address all of these provisions individually, but focuses on the more important changes in Permit coverage for certain types of vessel discharges. Previous sections of this analysis address its most critical provisions, which will close a number of gaps in existing coverage of pollutant discharges and will generate significant potential benefits for aquatic ecosystems. These benefits will be likely to occur mostly in waterways receiving the greatest amount of vessel traffic.

8.2.2 Pollutants Commonly Found in Vessel Discharges

The numerous individual harmful constituents of vessel discharges may be grouped into six broad categories: nutrients, pathogens, oil and grease, metals, other pollutants with toxic effects, and other non-toxic pollutants. Many of the 26 types of discharges covered by EPA's Permit are associated with one of these six types of pollution. *Table 8-3* summarizes pollutant types potentially reduced by Permit requirements.[35]

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[34] States are responsible for assessing impairment of water bodies. States assessed 19 percent of rivers and streams; 37 percent of lakes, ponds, and reservoirs; and 35 percent of bays and estuaries in the reporting cycle summarized in this report.

[35] The effect of ballast water provisions on risk of introduction of ANS is discussed in the preceding section.

Table 8-3: Pollutants Found in Vessel Discharges[a]

Type of Discharge	Nutrients	Pathogens	Oil & Grease	Metals	Other Toxics	Other Non-Toxics
Deck Runoff	x		x	x	x	x
Bilgewater	x		x	x	x	
Anti-fouling Hull Coating				x	x	
AFFF					x	
Boiler Blowdown					x	x
Cathodic Protection				x		
Chain Locker Effluent			x	x		
Controllable Pitch Propeller Hydraulic Fluid			x	x		
Elevator Pit Effluent	x			x	x	
Firemain Systems	x			x	x	x
Freshwater Layup					x	
Gas Turbine Wash Water			x		x	
Graywater	x	x	x	x	x	x
Motor Gasoline and Compensating Discharge				x	x	
Non-Oily Machinery Wastewater			x	x	x	
Refrigeration and Air Condensate Discharge			x		x	
Rudder Bearing Lubrication Discharge			x			
Seawater Cooling Overboard Discharge				x		x
Seawater Piping Biofouling Prevention					x	
Small Boat Engine Wet Exhaust			x		x	
Sonar Dome Discharge				x	x	
Underwater Ship Husbandry				x		
Welldeck Discharges	x	x	x	x	x	x

Source: Battelle (2007)
a: Other Permit requirements that could not be firmly linked to one of these six categories of pollutants are excluded from the table.

Several types of discharges covered by EPA's Permit have particularly significant pollutant constituents and therefore also may be associated with substantial incremental benefits. They are described in more detail below.

Graywater

Untreated graywater, as defined in *Section 4.2: Graywater,* contains multiple constituents of concern, including pathogenic bacteria, toxic and carcinogenic organic and inorganic compounds, nutrients, and metals (EPA, 2007a). *Table 8-4* summarizes the rates of discharge for major pollutants found in graywater in an EPA survey of cruise ships. The same survey found that total graywater discharge volumes ranged from 36 to 119 gallons/day/person, with a mean value of 67 gallons/day/person.

Table 8-4: Types of Pollutants Found in Graywater Discharges

Type of Discharge	Average Concentration of Pollutants[a]	EPA NRWQC Standard[b]
Ammonia – Nitrogen	2130-2210 μg N/L	2140-15,600 μg N/L CMC, 321-2960 μg N/L CCC
Nitrate	0.009-0.0872 mg/L	------
Total Kjeldahl Nitrogen	11.1-26.2 mg/L	------
Total Phosphorus	3.34-10.1 mg/L	------
Fecal Coliform	2,950,000 MPN/100 mL	43 MPN/100 mL
Enterococci	8920 MPN/100 mL	35 MPN/100 mL
Hexane Extractable Material[c]	78-149 mg/L	------
Arsenic	1.22-2.25 μg/L	0.14 μg/L
Copper[d]	483-510 μg/L total, 195 μg/L dissolved	74 μg/L CMC, 8.2 μg/L CCC
Nickel	29.7-48.7 μg/L total, 18.2 μg/L dissolved	4.8 μg/L CMC, 3.1 μg/L CCC
Thallium	0.93 μg/L total, 0.403 μg/L dissolved	0.47 μg/L (in shellfish)
Zinc	790-2540 μg/L total, 1610 μg/L dissolved	90 μg/L CMC, 81 μg/L CCC
Bis(2-ethylhexyl) phthalate	22.4-71.9 μg/L	2.2 μg/L
Tetrachloroethylene	10.7-11.4 μg/L	3.3 μg/L
Phenol	1.16-52.5 μg/L	------
Total Residual Chlorine[e]	372 μg/L	13 μg/L CMC, 7.5 μg/L CCC
Chlorides	125 mg/L	------

Source: EPA (2007a)
Note: Because of the quantity of metals and toxics detected, only pollutants exceeding EPA's national recommended water quality criteria (NRWQC) or pollutants discussed elsewhere in this analysis are listed here.
a Ranges presented in this table represent differences in reported concentrations between data from the Alaska Cruise Ship Initiative of the Alaska Department of Environmental Conservation (ACSI/ADEC), and EPA's own data, both presented in EPA (2007a).
b EPA has not set NRWQC for all pollutants of interest. CCC is an abbreviation for Criterion Continuous Concentration, a long-term measure of pollutant loading. CMC is Criterion Maximum Concentration, a short-term measure.
c Hexane extractable material is considered an indicator of level of oil and grease contamination.
d ACSI/ADEC did not conduct separate sampling for dissolved metals, so a range is not listed for dissolved metals.
e EPA did not sample total residual chlorine; ACSI/ADEC did not sample chloride.

Previously, discharges of graywater have been largely unregulated at the federal level in the territorial waters of the United States, with two exceptions: the Great Lakes, where graywater discharges must be treated similarly to sewage discharges under the Clean Water Act; and the territorial waters of Alaska, where graywater discharges by cruise ships within the territorial waters are subject to discharge standards. Maine, Washington, Hawaii, and Florida also have state-level programs to reduce the impacts of graywater discharges from cruise ships. (See *Chapter 4: Permit Overlap with Existing Regulations* for a detailed breakdown of these requirements.)

Under the new Permit, all vessels must minimize discharges of graywater in port, and large oceangoing vessels must not discharge graywater within 1 nm of shore if they have the capacity to store it. Vessel operators should also use biodegradable detergents, and must use non-toxic and phosphate-free soaps and detergents, which will reduce harmful constituents of discharges. Phosphate-based soaps and detergents are a source of phosphorus, which is a limiting nutrient in freshwater systems. Finally, medium- and large-sized cruise ships, as well as large ferries, will be subject to stricter requirements, including effluent standards for discharges within 1 nm of shore and requirements to discharge while underway at a speed of 6 knots or greater between 1 and 3 nm from shore. Because cruise ships and ferries have the largest numbers of passengers and crew, these requirements will have a particularly significant positive impact on receiving waters.

Bilgewater

Bilgewater is water from a variety of sources, including wastewater and leakage, which drains into a compartment in a vessel's inner hull. Known pollutant constituents of bilgewater include nutrients, pathogens, oil and grease, metals, and toxic and/or carcinogenic compounds (EPA and DOD, 1999). It is difficult to assess an average rate of bilgewater production, as rates of generation vary widely by vessel size and type.

The constituents of bilgewater that are of greatest concern from an environmental perspective are oil and grease. Current regulations require the use of oily-water separators prior to discharging bilgewater for all vessels weighing more than 400 tons. However, this practice does not eliminate all oil and grease from discharges, but merely reduces it to a level below 15 ppm (EPA and DOD, 1999). Furthermore, the use of oily-water separators does not have any significant impact on concentrations of other pollutants found in bilgewater.

EPA's Permit addresses this problem by retaining existing requirements governing untreated bilgewater, and adds requirements that "MARPOL" vessels weighing more than 400 tons not discharge any bilgewater within 1 nm of shore, and only discharge treated bilgewater between 1 and 3 nm from shore if underway at a speed of at least 6 knots. It also requires that all vessels reduce bilgewater discharges to the minimum levels required to operate the vessel safely (EPA, 2008b). Though these requirements will not eliminate all discharges of harmful pollutants via bilgewater, they will reduce the loads in areas with heavy vessel traffic that are in nearshore environments.

Aqueous Film-Forming Foam

Aqueous film-forming foam (AFFF) is a relatively rare type of discharge compared to many of the discharges covered by EPA's Permit, but it is associated with potentially substantial adverse impacts to human health and ecosystems due to the toxic and carcinogenic constituents of some formulations. The primary constituents of concern are perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), although AFFF discharges may be mixed with firemain water, which can contain bis(2-ethylhexyl) phthalate, nutrients, and metals (EPA and DOD, 1999; Scheffey and Hanauska, 2002).[36]

3M Inc., the largest U.S. manufacturer of PFOS-based AFFF, voluntarily began to phase out production in 2000 due to suspicion of toxicity and carcinogenicity, and had ceased production altogether by fall 2001 (Scheffey and Hanauska, 2002). EPA then published a rule that requires companies to file notice if they intend to manufacture or import any of the PFOS-based substances that 3M phased out, effectively ending all manufacture. However, remaining stocks of PFOS-based AFFF may still be in use.

There is still a lack of understanding as to the extent to which PFOA and its telomers enter the environment through various discharges, so these chemicals remain legal to manufacture and distribute in the United States, including in AFFF. EPA has nonetheless encouraged participation of U.S. businesses in its voluntary 2010/15 PFOA Stewardship Program, in which businesses agree to eliminate 95 percent of PFOA use by 2010 and 100 percent by 2015 (EPA, 2007d).

AFFF discharges were previously not regulated, but under EPA's Permit, they are heavily restricted. Vessels that regularly sail outside the U.S. EEZ may not discharge AFFF within the EEZ except in emergencies, and vessels that do not sail outside the EEZ must collect all discharged AFFF and dispose of it onshore. Additionally, non-fluorinated firefighting foams are recommended for use in all vessels.

8.2.3 Pollutant Impacts

Vessel discharges contain a wide variety of pollutants with the potential to cause ecological and economic harm to aquatic species and their habitat. The relationship between types of pollutants and associated discharges is summarized in *Table 8-4: Types of Pollutants Found in Graywater Discharges,* above.

[36] Scheffey and Hanauska's report discusses AFFF with respect to the aviation industry; however, similar formulations are used onboard vessels.

Nutrients

Nutrient pollution, including nitrogen and phosphorus, is a component of vessel discharges and a major source of water quality degradation throughout the United States (USGS, 1999). Though traditionally associated with agricultural runoff from fertilizer, sewage treatment facilities, and urban stormwater, a variety of other sources do exist, including graywater and bilgewater discharges from ships.

Nutrient pollution is associated with a variety of negative environmental impacts, the most notable of which is eutrophication, which can lead to reduced levels of dissolved oxygen due to increased demand (sometimes to the extremes of hypoxia), reduced levels of light penetration and turbidity, and changes in the composition of aquatic flora and fauna (National Research Council, 2000). It also helps to fuel the harmful algal blooms described in *Section 8.1.2: ANS Impacts,* which can have devastating impacts on both aquatic life and human health, if affected organisms are consumed (WHOI, 2007). The impacts of these water quality reductions on recreation and fishing can be significant, particularly in estuaries. For example, a 1989 study found that a hypothetical 20 percent reduction in nitrogen and phosphorus loading in the Chesapeake Bay would result in an increase in recreation worth $34.6 million (in 1984 dollars) from increased public beach usage (National Research Council, 2000). Nutrient pollution has also contributed to the decline of the Chesapeake crab fishery, due to its role in degrading underwater vegetation, which serves as an important habitat for post-larval crabs (Maryland DLS, 2005).

Pathogens

Pathogens are another important constituent of discharges from vessels, particularly in graywater. EPA's study of graywater discharges from cruise ships found that levels of pathogen indicator bacteria exceeded enterococci standards for marine water bathing and fecal coliform standards for harvesting shellfish 66 percent and over 80 percent of the time, respectively (EPA, 2007a). Specific pathogens of concern found in graywater include *Salmonella*, *E. coli*, enteroviruses, hepatitis, and pathogenic protists (National Research Council, 1993). Elevated levels of these pathogens have increasingly resulted in beach closures in recent years, which in turn have reduced the recreational value of impacted beaches (NRDC, 2005).

Though it is difficult to determine the precise contribution of vessel discharges to infections by these organisms, epidemiologists have attempted to quantify the proportion of total infections that are waterborne. For example, waterborne infection may account for as many as 60 percent of *Giardia* infections and 75 percent of pathogenic *E. coli* infections (National Research Council, 1993). Graywater discharges are a significant source of pathogenic microorganisms within the regulated waters, and reducing them would likely be associated with non-negligible human health benefits.

Oil and Grease

Oil and grease are another known component of vessel discharges with potentially harmful impacts to humans and to aquatic life. Oil in vessel discharges is required to be discharged in concentrations that may not be harmful, consistent with existing regulation. The Group of Experts on the Scientific Aspects of Marine Environmental Protection (GESAMP), a United Nations body, found that voluntary vessel discharges account for less than 1 percent of vessel oil discharges into the marine environment (GESAMP, 2007). However, vessel discharges may still contain enough oil to do ecological damage, even if they meet existing concentration requirements and account for a small percentage of total oil discharges worldwide. Oils are highly toxic and carcinogenic, and may inhibit reproduction and cause organ damage or even mortality (AMSA, 2003). Additionally, oil can taint organisms that are consumed by humans, which is a potential source of adverse health impacts.

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, EPA's study of cruise ship graywater found a total of 13 different metals in at least 10 percent of samples, with copper, nickel, and zinc detected in 100 percent of samples (EPA, 2007a). Bilgewater also contains these constituents and likely others (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. Even essential metals can do serious damage to organism function in sufficiently elevated concentrations. Adverse impacts can include impaired organ function; impaired reproduction and birth defects; and, at extreme concentrations, acute mortality. Additionally, through a process known as bioaccumulation, metals may not be fully eliminated removed from blood and tissues by natural processes, and may accumulate in predator organisms further up the food chain (EPA, 2007b). This process can result in adverse health impacts for humans, who may consume contaminated fish and mollusks.

However, the impacts of metals on any given ecosystem are difficult to predict, due to the relatively complicated circumstances by which they are available to organisms. Bioavailability of metals, and therefore impacts, varies by species of organism, as well as by climate and chemistry of a water body (John and Leventhal, 1996). Moreover, background levels of metals can vary substantially by location (EPA, 2007b).

Other Pollutants with Toxic Effects

The term "other 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. For example, EPA's study of cruise ship graywater found a total of 16 different volatile and semi-volatile organic compounds in at least 10 percent of samples, for which the most significant rates and levels of detection were phthalates, phenol, and tetrachloroethylene. Other notable pollutants with toxic effects detected included free residual chlorine and chlorides.

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, 2007a).

PFOS and PFOA, potentially found in AFFF discharges, are persistent, bioaccumulative chemical compounds. A United Kingdom study found that PFOS is toxic to humans and wildlife, and carcinogenic in humans (Footitt et al., 2004). 3M, the only U.S. manufacturer of PFOS-based AFFF, voluntarily ceased production in 2002, and EPA enacted an effective ban on the substance due to concerns about its impacts on human health and wildlife. However, existing stocks may still be in use (EPA, 2007d). The health impacts of PFOA and its telomers are not as well understood, particularly in aquatic environments, but EPA's Science Advisory Board has concluded that PFOA "is likely to be carcinogenic in humans" (SAB, 2006).

Other Non-Toxic Pollutants

The category "other non-toxic pollutants" includes all non-conventional pollutants except fecal coliform (discussed in pathogens) as applied to vessel discharges also consists of multiple pollutants with disparate impacts. The most important types are pH pollution and thermal pollution, which can be found in several of the covered discharges, including graywater and bilgewater.

Some vessel discharges are more acidic or basic than the receiving waters, which 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, extensive literature on the impacts of pH changes in the contexts of aquaculture and acid rain does exist. For nearly all fish populations, pH more acidic than 5 or more basic than 10 will cause rapid mortality, and many individual species are sensitive to more moderate changes in pH (EPA, 2007e; Wurts and Durborrow, 1992).

Some vessel discharges may also be warmer or colder than the ambient temperature of the receiving water, which 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, due to scale. However, even small temperature changes can impact some sensitive organisms' growth, reproduction, and even survival, which implies that some vessel discharges may have adverse impacts on aquatic ecosystems, and also fisheries (Abbaspour et al., 2005; Cairns, 1972; Govorushko, 2007).

8.2.4 Benefits of Reducing Pollutant Discharges

Many of the nation's busiest ports are considered to be impaired by a variety of pollutants found in vessel discharges, as is summarized in *Table 8-5.* The Permit is expected to reduce discharges of nutrients, metals, oil, grease, toxics, and other pollutants in waters with high levels of vessel traffic.

Table 8-5: 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.

These impacts will be particularly significant in those nutrient-impaired areas frequented by cruise ships (e.g., San Francisco Bay and Chesapeake Bay), which can discharge large volumes of graywater and are subject to stringent discharge requirements under the Permit. For example, phosphorus loading could be reduced by 6 lbs to 18.1 lbs, and zinc loading could be reduced by 1.42 lbs to 4.56 lbs per day. *Table 8-6* summarizes the daily pollutant loadings likely to be prevented for an average large cruise ship, as the term is defined in the Permit language.[37,38]

[37] Daily loadings are calculated by taking average passenger capacity for a large cruise ship and multiplying by the average per-person discharge rate found in EPA (2007b). This assumes that some vessels currently remain in waters subject to the Permit requirements for

Table 8-6: Potential Daily Reduction in Loadings of Pollutants from Graywater Discharges by a Large Cruise Ship in U.S. Territorial Waters			
Pollutant	**Average Graywater Generated per Day (L)[a]**	**Average Pollutant Concentration in Untreated Graywater**	**Reduction in Pollutant Loading per Day (g)**
Ammonia - Nitrogen	814,382	2,130-2,210 µg N/L	1,734-1,800
Nitrate	814,382	0.009-0.0872 mg/L	7.33-71.01
Total Kjeldahl Nitrogen	814,382	11.1-26.2 mg/L	9,040-21,337
Total Phosphorus	814,382	3.34-10.1 mg/L	2,720-8,225
Hexane Extractable Material	814,382	78-149 mg/L	63,522-121,343
Arsenic	814,382	1.22-2.25 µg/L	0.994-1.83
Copper	814,382	483-510 µg/L	393-415
Nickel	814,382	29.7-48.7 µg/L	24.2-39.7
Thallium	814,382	0.93 µg/L	0.757
Zinc	814,382	790-2540 µg/L	643-2,069
Bis(2-ethylhexyl) phthalate	814,382	22.4-71.9 µg/L	18.2-58.6
Tetrachloroethylene	814,382	10.7-11.4 µg/L	8.71-9.28
Phenol	814,382	1.16-52.5 µg/L	0.945-42.8
Total Residual Chlorine	814,382	372 µg/L	303
Chlorides	814,382	125 mg/L	102

Sources: EPA (2007a)
a EPA (2007a) estimates average graywater generated per person per day onboard cruise ships to be 67 gallons, which was multiplied by 3,211 (the average passenger capacity for the "large cruise ship" Permit category) and converted to liters for compatibility with pollutant concentration data. Since crews also generate graywater, this number may underestimate actual graywater generation rates.

The evidence presented in the pollutant impacts section demonstrates that vessel discharges, particularly ANS spread by ballast water, are associated with significant detrimental impacts throughout the United States. Controls on specific discharges, as well as general housekeeping requirements of the Permit, can be expected to generate benefits through reducing the risk of damages in the future and making water quality improvements in already-impaired waters. Monetized benefits will include the prevention of fishery closures and of adverse human health impacts, as well as increased opportunities for recreation. Non-monetized benefits will include prevention of further stresses on biodiversity and ecosystems. Though the magnitude of benefits is not calculable, *Table 8-7* presents a summary of potential benefits resulting from the Permit requirements.

multiple days, and thus discharge graywater equivalent to the generation rate on each subsequent day after maximum storage capacity is reached.

[38] *E. Coli* and enterococci, which are found in *Table 8-4,* were excluded from *Table 8-6* because concentration, rather than total loading, is the primary metric of interest for pathogens.

Table 8-7: Benefits of Reducing Pollutants Found in Vessel Discharges

Type of Benefit	Nutrients	Pathogens	Oil & Grease	Metals	Other Toxics	Other Non-Toxics
Human Health	x	x	x	x	x	
Biodiversity	x		x	x	x	x
Ecosystem Function	x		x	x	x	x
Improved Fishery Conditions	x	x		x	x	x
Increased Opportunities for Recreation	x	x			x	

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Appendix A: Survey Questionnaires

Individual BMP Survey

Why Does EPA need this information?

The Agency is evaluating the impacts of instituting a General Permit for practices associated with discharges incidental to normal operation of cruise ships as part of developing a permitting framework for commercial vessels. The Agency will use your responses to estimate any incremental costs that would result from implementing best management practices required under this Permit. The discharges that are applicable, unless noted otherwise, are those that take place within U.S. waters, i.e. within 12 nm.

Survey Instructions:

Please fill out all pieces of information that are relevant and obtainable. Include any comments if any of the requested information is not available and/or not relevant. If you are unable to estimate the cost for a piece of information in the manner requested but are **able** to estimate the cost in a separate manner, please do so and mark accordingly.

If any of these discharge categories do not apply to your vessel types, please mark "N/A" within the specific section and list which vessel types to which the discharge category **does not** apply. If a straightforward response is not possible, please explain the variances in responses as best as possible.

Primary contact person:

Last Name ____________________ First Name _____________________ Title _______
Company _______________________________________
Telephone Number _________________________________
Email _________________________________
Date _________________________________

1. Please provide a general, average labor rate that would be applicable to practices associated with the 9 discharge categories listed above ________$ per hour.[39]

2. Please list the total number of vessels that your company has within each vessel category and, if possible, how many vessels sail outside of the territorial sea (outside 12 nm) more than once per month (herein referred to as "ocean going vessels") and how many vessels ***do not*** sail outside of the territorial sea (outside 12 nm) more than once per month (herein referred to as "non-ocean going vessels").

Vessel ID	Vessel Category	Total Number of Vessels	Ocean Going Vessels	Non-Ocean Going Vessels
Example	*Example Vessel Category*	*10*	*7*	*3*
1	General Cargo Freighter (Includes (a) freight ships, and (b) public freight ships			
2	Break Bulk/RO-RO Carrier			
3	RO-RO Vessel			
4	Bulk Carrier			
5	Containership			
6	Partial Containership			
7	Container/Vehicle/Trailer (RO-RO)			
8	Vehicle Carrier			
9	Passenger Vessel[40]			
10	Commercial Fishing			
11	Petroleum/Chemical Carrier			
12	Chemical Carrier			
13	Liquid Bulk Tanker			
14	Other Tanker			
15	Push Boat			
16	Tugboat/Towing Vessel			
17	Open Hopper Barge			
18	Covered Hopper Barge			
19	Car Float (Railroad Car Barge)			
20	Flat/Deck Barge			
21	Pontoon Barge			
22	Open Dry Cargo Barge			
23	Covered Dry Cargo Barge			
24	RO-RO Barge			
25	Container Barge			
26	Lash/Seabee Barge			
27	Liquid Cargo Barge			
28	Other Liquid Cargo Barge, Not Elsewhere Included (Includes tank barge)			
29	Convertible Barge			
30	Passenger Barge			
31	Other Dry Cargo Barge (Includes freight			

(Proceed to the relevant sections.)

[39] The average labor cost includes the base rate, fringe benefits such as vacation, sick leave, insurance, and allowance for overhead and other agency indirect burden.

[40] Includes excursion/sightseeing vessels, ferries, and combined passenger and cargo vessels.

1) DECK RUNOFF

1. Indicate how many times per month a vessel performs deck cleanup (i.e. removing debris, garbage, and other loose materials) prior to conducting **deck washdowns or prior to departing from port**: ___times per month

   a. Estimate the cost involved with performing deck cleanup prior to conducting **deck washdowns or prior to departing from port**:

      - *Labor Hours* typically required to perform deck cleanup: _______ hours
      OR
      - *Total Cost*: $____ per cleanup.
      OR
      - Check this box if this cost is negligible ☐

   b. Indicate how many deck washdowns a vessel performs per month: _____times per month

   c. Indicate how many times a vessel departs from port per month: _____times per month

   Question d. is specific to Commercial Fishing vessels:

   d. How often do you perform deck cleanup after moving fish to the fish hold?

   *Always*_____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* ______

2. Indicate the percentage of vessels that have coamings or drip pans to collect any oily water from machinery and to prevent spills for all machinery on deck: ______________% of vessels

   e. Estimate a cost of installing these coamings or drip pans for every piece of machinery on deck:

      - *Total Cost*: $____ per installation.

   f. Estimate how many times per year you need to install these coamings or drip pans for every piece of machinery on deck: _______ times per year

3. Estimate the number of times a vessel's drip pans/coamings become full, per month: ___times per month

   When drip pans become full from runoff, estimate how often a vessel drains or wipes and cleans the drip pans: *Always*_____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* ______

   g. Estimate the cost involved with performing this task:

      - *Labor Hours* typically required to drain/wipe and clean drip pans: _______ hours
      - *Additional Cost and Fees*: $____ per instance of draining/wiping and cleaning drip pans.
      OR
      - *Total Cost*: $____ per instance of draining/wiping and cleaning drip pans.
      OR
      - Check this box if this cost is negligible ☐

4. Indicate the percentage of vessels that use non-toxic or other environmentally preferable cleaners (i.e. low or no phosphorus content or biodegradable) for the washdown: __________% of vessels

h. Estimate how many gallons of cleaner are used per month:

_______per vessel, gallons per month **OR** ______per company, gallons per month

2) AQUEOUS FILM FORMING FOAM (AFFF)

OCEAN GOING VESSELS

5. Indicate the number of times per year a vessel discharges AFFF for maintenance and/or training purposes:...for certification purposes:

   *(Maintenance/Training)*____________times per year
   *(Certification)*____________________times per year

6. Indicate the percentage of your vessels that use a non-fluorinated foaming agent:_________% of vessels

   i. Estimate the number of gallons of foam a vessel purchases a year: ______ gallons of foam purchased per year

NON-OCEAN GOING VESSELS

7. Indicate the number of times per year a vessel discharges AFFF for maintenance and/or training purposes: _________ times per year

8. Indicate how often a vessel collects and stores this discharge of AFFF for onshore disposal:

   *Always*_____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* ______

   j. Estimate the cost involved with collecting and storing the AFFF discharge for onshore disposal:

      - *Labor Hours* typically required to collect and store AFFF for onshore disposal: _______ hours
      - *Additional Cost and Fees: $*____ per instance of collecting and storing AFFF for onshore disposal.

        OR
      - *Total Cost: $*____ per instance of collecting and storing AFFF for onshore disposal.

        OR
      - Check this box if this cost is negligible ☐

9. Indicate the percentage of your vessels use a non-fluorinated foaming agent: ______% of vessels

   k. Estimate the number of gallons of foam a vessel purchases a year: _________ gallons of foam purchased per year

ALL VESSELS

10. Unless 1) for emergency purposes, 2) for discharge by rescue vessels (such as fireboats for firefighting purposes), or 3) for vessels owned or under contract to do business exclusively in or within 1 nm of those protected areas by the US government or state or local governments, estimate how many of your vessels discharge AFFF in or within 1 nm of waters of exceptional value: ___________ vessels

l. Indicate the number of times per year AFFF discharges occur within those waters for **emergency purposes**: ____ times per year.

i. Indicate how often, on average, a vessel documents the discharge:

*Always*_____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* ______

ii. Estimate the typical cost of documenting this discharge:

1. *Labor Hours* typically required to document this discharge: _______ hours

OR

2. *Total Cost: $*____ per instance of documenting this discharge.

m. Not including the above mentioned exceptions, indicate the number of times per year a vessel operating within 1 nm of water of exceptional value performs this discharge: ___ times per year

3) GRAYWATER

OCEAN GOING VESSELS

11. Indicate what percentage of your ocean going vessels are able to store graywater in order to reach a distance greater than 1 nm to discharge: ____________% of vessels

a. For those vessels that are underway and are able to store graywater by these specifications, estimate how often a vessel discharges graywater greater than 1 nm from shore:

*Always*_____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* _______

n. Estimate the cost involved (for those ocean going vessels able to store graywater) with needing to discharge graywater greater than 1 nm from shore:

- *Labor Hours* typically required to discharge greater than 1 nm from shore: _______ hours

OR

- Check this box if this cost is negligible ☐

o. Indicate how often a vessel (for those ocean going vessels able to store graywater) that is underway needs to discharge graywater:___times per month.

NON-OCEAN GOING VESSELS

12. Estimate how many times per month a vessel needs to dispose of graywater:_________ times per month

p. Estimate how many times per year, on average, a vessel disposes of graywater on shore at the appropriate facilities: ______________________ times per year

a. Estimate the cost involved with disposing of graywater on shore:
- *Labor Hours* typically required to dispose of graywater on shore: _______ hours
- *Additional Cost and Fees: $*____ per instance of disposing graywater onshore.

OR

- *Total Cost: $*____ per instance of disposing graywater onshore.

q. Estimate the number of times per year appropriate facilities are **not** available and the vessel needs to dispose of graywater: ____________ times per year

13. If appropriate facilities are not available, estimate how often a vessel discharges graywater into waters with an ability to dilute concentrations of detergents, soaps, and pathogens:... discharges graywater while the vessel is underway:

    (Certain Waters) *Always*____ *Most of the time* _____ *Sometimes* _____ *Rarely* _____ *Never* _____

    (Underway) *Always*____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* ______

    a. Estimate the additional cost of needing to discharge graywater into waters with an ability to dilute concentrations of detergents, soaps, and pathogens:…of needing to discharge graywater while the vessel is underway:

       Certain Waters
       - *Total Cost: $*____ per instance of discharging graywater into waters with an ability to dilute concentrations of detergents, soaps, and pathogens.

         OR
       - Check this box if this cost is negligible ☐

       Vessel Underway
       - *Total Cost: $*____ per instance of discharging graywater while the vessel is underway.

         OR
       - Check this box if this cost is negligible ☐

ALL VESSELS

14. Estimate the percentage of your vessels that are able to store graywater: ___________ % of vessels

    a. For those vessels **able** to store graywater, while a vessel is underway, how often does a vessel avoid discharging graywater in "waters of exceptional value":

       *Always*_____ *Most of the time* _____ *Sometimes* ______ *Rarely* ______ *Never* ______

15. Estimate the percentage of vessels that use non-toxic soaps:...non-toxic detergents:

    *(Soaps)*_________________________________ % of vessels
    *(Detergents)*_____________________________ % of vessels

    a. Estimate the number of gallons of soap/detergent used per year, per vessel:

       *(Soaps)*______________________________ gallons per year
       *(Detergents)*__________________________ gallons per year

4) UNDERWATER SHIP HUSBANDRY

16. Indicate the number of times per year a vessel cleans the hull **underwater**: ___________ times per year

    a. Estimate how often a vessel cleans the hull by methods that minimize the discharge of fouling organisms and antifouling hull coatings:

       *Always*_____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* ______

b. Estimate the cost involved with cleaning the hull:

- *Labor Hours* typically required to clean the hull: _______ hours
- *Additional Cost and Fees: $*____ per instance of cleaning the hull.

OR

- *Total Cost: $*____ per instance of cleaning the hull.

17. Estimate how often a vessel disposes of removed substances in accordance with local, State, and Federal regulations: *Always*____ *Most of the time* ___ *Sometimes* _____ *Rarely* ____ *Never* ______

a. Estimate the cost involved, if any, with disposal of any removed substances from the hull:

- *Labor Hours* typically required to dispose of removed substances: _______ hours
- *Additional Cost and Fees: $*____ per instance of disposing of the removed substances.

OR

- *Total Cost: $*____ per instance of disposing of removed substances.

OR

- Check this box if this cost is negligible ☐

18. When performing mechanical underwater scrubbing, indicate the percentage of vessels that use vacuum control technologies to remove the addition of biocide paints and detached living organisms from the waters: _____________ % of vessels

a. Estimate the cost of purchasing vacuum control technologies: $______________

b. Indicate how many times per year a vessel performs mechanical underwater scrubbing: _____________ times per year

5) CATHODIC PROTECTION

19. Indicate the percentage of your vessels that use ICCP (Impressed Current Cathodic Protection) as the method of Cathodic Protection:...sacrificial electrodes as the method of Cathodic Protection:

*(ICCP)*__________________________________ % of vessels
*(Sacrificial Electrodes)*_____________________ % of vessels

*(If **all** vessels use ICCP, skip question 3)*

20. Indicate how many times per year a vessel performs maintenance ________ times per year

r. Indicate how often cleaning the anodes, including minimizing the flaking of the large, corroded portions of the anodes is done during maintenance periods:

*Always*_____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* ______

s. Estimate the cost of performing maintenance (i.e. cleaning) to the anodes:

- *Labor Hours* typically required to perform maintenance to the anodes: _______ hours
- *Additional Cost and Fees: $*____ per instance of performing maintenance to the anodes.

OR

- *Total Cost: $*____ per instance of performing maintenance to the anodes.

21. (With awareness that magnesium is less toxic than aluminum which is less toxic than zinc), when economically and physically feasible, estimate the percent of vessels that use the metals that are less toxic for sacrificial electrodes: ___________________ % of vessels

    a. Estimate the additional cost per vessel of purchasing these specific types of less toxic metals: $_______________________

22. Estimate the cost per vessel of installing sacrificial electrodes as the method of Cathodic Protection:

    - *Total Cost: $____* per instance of installing sacrificial electrodes as the method of Cathodic Protection.

23. Estimate the cost per vessel of installing ICCP as the method of Cathodic Protection:

    - *Total Cost: $____* per instance of installing ICCP as the method of Cathodic Protection.

6) CHAIN LOCKER EFFLUENT

24. Estimate how often a vessel carefully and thoroughly washes down the anchor chain as it is being hauled out of the water to remove sediment and marine organisms:

    Always_____ Most of the time _____ Sometimes _______ Rarely ______ Never ______

    t. Estimate the cost involved with this task:

    - *Labor Hours* typically required to wash down the anchor chain: ____hours
    - *Additional Cost and Fees: $____* per instance of washing down the anchor chain.

    OR

    - *Total Cost: $____* per instance of washing down the anchor chain.

    OR

    - Check this box if this cost is negligible ☐

    u. Indicate how many times per year a vessel hauls the anchor chain out of the water:

    ____times per year

25. During dry docks, how often does a vessel thoroughly clean chain lockers to eliminate accumulated sediments and any potential accompanying pollutants:

    Always_____ Most of the time _____ Sometimes _______ Rarely ______ Never ______

    a. Estimate the cost involved with this task:

    - *Labor Hours* typically required to clean chain lockers: ____hours
    - *Additional Cost and Fees: $____* per instance of cleaning chain lockers.

    OR

    - *Total Cost: $____* per instance of cleaning the chain lockers.

    OR

    - Check this box if this cost is negligible ☐

    b. Indicate how many times per year a vessel dry docks: _______________ times per year

26. Estimate how often a vessel inspects, cleans, and pumps out the space beneath the chain locker prior to entering nearshore waters:

*Always*___ *Most of the time* ___ *Sometimes* ___ *Rarely* ___ *Never* ___

a. Estimate the cost involved with this task:

- *Labor Hours* typically required to inspect, clean, and pump out the space beneath the chain locker: ____hours
- *Additional Cost and Fees: $*____ per instance of inspecting, cleaning, and pumping out the space beneath the chain locker.

OR

- *Total Cost: $*____ per instance to inspect, clean, and pump out this space.

OR

- Check this box if this cost is negligible ☐

b. Estimate the number of times per year a vessel enters nearshore waters: _____________ times per year

27. Unless rinsing/pumping within 3 nm from shore is necessary for safety purposes, how often does a vessel rinse or pump this space greater than 3 nm from shore:

*Always*_____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* ______

v. If rinsing/pumping within 3 nm from shore is necessary, how often is the safety claim is documented: *Always*_____ *Most of the time* ____ *Sometimes* ______ *Rarely* ______ *Never* ___

i. Estimate the cost involved with the documentation:

- *Labor Hours* typically required to document the safety claim: ____hours

OR

- *Total Cost: $*____ per instance to document the safety claim.

ii. Estimate how many times per year a vessel rinses/pumps within 3 nm from shore if necessary for safety purposes: ____________ times per year

7) CONTROLLABLE PITCH PROPELLER HYDRAULIC FLUID

28. During dry docks, how often does a vessel perform maintenance activities on controllable pitch propellers: *Always*_____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* _______

a. Estimate the cost involved with this task:

- *Labor Hours* typically required to perform maintenance activities on controllable pitch propellers: ____hours
- *Additional Cost and Fees: $*____ per instance of performing maintenance activities on controllable pitch propellers.

OR

- *Total Cost: $*____ per instance to perform maintenance on controllable pitch propellers.

OR

- Check this box if this cost is negligible ☐

b. Indicate how many times per year a vessel dry docks: _______________ times per year

29. During instances of maintenance when the vessel is in the water, how often does a vessel use an oil boom to contain any hydraulic oil leakage:

*Always*_____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* ______

a. Estimate the cost involved with using an oil boom to contain any hydraulic oil leakage:

- *Labor Hours* typically required to use an oil boom to contain any hydraulic oil leakage: ____hours
- *Additional Cost and Fees: $*____ per instance of using an oil boom to contain any hydraulic oil leakage.

OR

- *Total Cost: $*____ per instance to use an oil boom.

OR

- Check this box if this cost is negligible ☐

b. Estimate how many times per year a vessel performs this type of maintenance while the vessel is in the water: _____________ times per year

c. Estimate the percentage of vessel operators that have appropriate equipment such as oil absorbent pads to clean any potential oil spills: _____________ % of vessel operators

i. Estimate the additional cost per individual vessel of purchasing the appropriate equipment to clean any potential oil spills: $___________________________

8) ELEVATOR PIT EFFLUENT

30. In cases of **non-emergency**, estimate how many times per year a vessel discharges elevator pit effluent:

____________________ times per year

a. Estimate the cost involved, if any, to dispose of this effluent onshore:

- *Labor Hours* typically required to dispose this effluent onshore: ____hours
- *Additional Cost and Fees: $*____ per instance of disposing this effluent onshore.

OR

- *Total Cost: $*____ per instance to dispose of effluent onshore.

OR

- Check this box if this cost is negligible ☐

31. In cases of **emergency**, how often does a vessel discharge elevator pit effluent with an oil content below 15 ppm: *Always*_____ *Most of the time* _____ *Sometimes* _______ *Rarely* ______ *Never* ______

a. Estimate the cost involved, if any, to ensure that the elevator pit effluent has an oil content below 15 ppm:

- *Labor Hours* typically required to ensure that the elevator pit effluent has an oil content below 15 ppm: ____hours
- *Additional Cost and Fees: $*____ per instance of ensuring that the elevator pit effluent has an oil content below 15 ppm.

OR

- *Total Cost: $*____ per instance to ensure the oil level.

OR

- Check this box if this cost is negligible ☐

b. In cases of emergency, estimate how many times per year a vessel discharges elevator pit effluent:__________________ times per year

9) FIREMAIN SYSTEMS

32. Except in emergency situations or when washing down the anchor chain to comply with anchor wash down when pulling the anchor and anchor chain from waters, estimate how many times per year a vessel discharges from firemain systems into "waters of exceptional value": __________ times per year

    w. Estimate the cost involved, if any, to dispose of the firemain system discharge onshore:

    - *Labor Hours* typically required to dispose of the firemain system discharge onshore: ____hours
    - *Additional Cost and Fees: $*____ per instance of disposing of the firemain system discharge onshore.

    OR

    - *Total Cost: $*____ per instance to dispose of the discharge onshore.

    OR

    - Check this box if this cost is negligible ☐

DEFINITIONS OF DISCHARGE CATEGORIES

33. **Deck Runoff**: the precipitation, washdowns, and seawater falling on the weather deck of a vessel and discharged overboard through deck openings. Primarily, we are referring to the runoff caused by deck washdowns (unless the question specifies otherwise).
34. **Aqueous Film-Forming Foam**: the firefighting foam and seawater mixture discharged during training, testing, or maintenance operations.
35. **Graywater**: galley, bath, and shower water, as well as wastewater from lavatory sinks, laundry, interior deck drains, water fountains, and shop sinks where vapors could accumulate.
36. **Underwater Ship Husbandry**: the materials discharged during the inspection, maintenance, cleaning, and repair of hulls performed while the vessel is waterborne.
37. **Cathodic Protection**: the constituents released into surrounding water from sacrificial anode or impressed current cathodic hull corrosion protection systems.
38. **Chain Locker Effluent**: the accumulated precipitation and seawater that is emptied from the compartment used to store the vessel's anchor chain.
39. **Controllable Pitch Propeller Hydraulic Fluid**: the hydraulic fluid that discharges into the surrounding seawater from propeller seals as part of normal operation, and the hydraulic fluid released during routine maintenance of the propellers.
40. **Elevator Pit Effluent**: the liquid that accumulates in, and is discharged from, the sumps of elevator wells on vessels.
41. **Firemain Systems**: the seawater pumped through the firemain system for firemain testing, maintenance, and training, and to supply water for the operation of certain vessel systems.

Cruise Ship Survey

WHY DOES EPA NEED THIS INFORMATION?

The Agency is evaluating the impacts of instituting a General Permit for practices associated with discharges incidental to normal operation of cruise ships as part of developing a permitting framework for commercial vessels. The Agency will use your responses to estimate any incremental costs that would result from implementing best management practices required under this Permit.

SURVEY INSTRUCTIONS

Please fill out all pieces of information that are relevant and obtainable. Include any comments if any of the requested information is not available and/or not relevant. If you are unable to estimate the cost for a piece of information in the manner requested but are **able** to estimate the cost in a separate manner, please do so and mark accordingly.

Please either fill out the survey and email the electronic version to Steve Collins at scollins@cruising.org **or** print out the survey and scan/email and/or fax the hard copy survey to Steve at (fax) 754-224-2250.

PRIMARY CONTACT PERSON:

Last Name ____________________ First Name _____________________ Title _______
Company _______________________________________

QUESTIONS:

1. **HOW MANY VESSELS ARE IN YOUR COMPANY?**
   ____

2. **HOW MANY VESSELS ARE:**
   a. Large cruise ships authorized to carry 500 or more passengers? _________
   b. Medium cruise ships authorized to carry 250 to 499 passengers? _________
   c. Medium cruise ships authorized to carry 100 to 249 passengers? _________

Unless otherwise noted, when asking for information regarding medium cruise ships, please include information for both medium cruise ship classifications, i.e. those authorized to carry 250-499 passengers and those authorized to carry 100-249 passengers.

3. **INDICATE THE NUMBER OF YOUR CRUISE SHIPS THAT HAVE AN ADVANCED WASTEWATER PURIFICATION (OR TREATMENT) SYSTEM FOR TREATING BLACKWATER THAT ARE ALSO CONFIGURED TO TREAT GRAYWATER THAT MEET THE FOLLOWING DISCHARGE STANDARDS:**

   (1) The discharge must satisfy the minimum level of effluent quality specified in 40 CFR 133.102;

(2) The geometric mean of the samples from the discharge during any 30-day period may not exceed 20 fecal coliform/100 milliliters (ml) and not more than 10 percent of the samples exceed 40 fecal coliform/100 ml; and/or
(3) Concentrations of total residual chlorine may not exceed 10.0 micrograms per liter (µg/l);

____ large cruise ships _____ medium cruise ships

4. **DESCRIBE DISCHARGE SAMPLING ACTIVITIES**

   a. How many of your cruise ships are certified for use in Alaska?
   ____ large cruise ships _____ medium cruise ships

   b. Indicate the number of samples all other cruise ships take (not including those cruise ships authorized to operate in Alaska)take over a 30 day period:
   ___ samples from large cruise ships
   ___ samples from medium cruise ships

   c. Please indicate if test samples are typically taken:

      1. Biological oxygen demand (BOD): ____yes ____ no
      2. Suspended solids: ____yes ____ no
      3. pH: ____yes ____ no
      4. Total residual chlorine: ____yes ____ no

   d. Estimate typical **total** cost of analyzing water samples: $____

*(If **all** cruise ships have graywater treatment systems to meet the standards within question 1 (Alaskan standards), skip questions 5, 6, and 7).*

5. **INDICATE THE NUMBER OF CRUISE SHIPS THAT DO NOT HAVE A STANDARD GRAYWATER TREATMENT SYSTEM AND DO NOT HAVE HOLDING CAPACITY TO DISCHARGE IN WATERS GREATER THAN 1 NM FROM SHORE**:
____ large cruise ships _____ medium cruise ships

*(If **all** cruise ships have sufficient holding capacity, skip questions 6 and 7)*

6. **INDICATE THE NUMBER OF CRUISE SHIPS THAT DO NOT HAVE SUFFICIENT HOLDING CAPACITY AND THUS NEED TO DISCHARGE WHILE PIERSIDE:**
____ large cruise ships _____ medium cruise ships

*(If **0**, skip all of question 6.)*

   a. Estimate the average number of days per year that a cruise ship is pierside:
   ______ days for large cruise ships _____ day for medium cruise ships

   b. Estimate what percentage of time discharge is necessary while pierside and appropriate reception facilities for graywater are **available**?
   ____ % for large cruise ships _____ % for medium cruise ships

c. Estimate what percentage of time discharge is necessary while pierside and appropriate reception facilities for graywater are **used**?
____ % for large cruise ships _____ % for medium cruise ships

d. Estimate the average amount of labor hours required of discharging graywater at appropriate reception facilities, **per instance**:
____ labor hours per large cruise ships _____ labor hours per medium cruise ships

7. UNTREATED GRAYWATER DISCHARGES

a. On average, how many times per year do untreated graywater discharges occur?
_____ times per year per large cruise ship

_____ times per year per medium cruise ship

b. How often do vessel operators thoroughly document untreated graywater discharges within their recordkeeping books?
Large Cruise Ships: *Always* ___ *Most of the time* ___*Sometimes*___ *Rarely* ___

Medium Cruise Ships: *Always* ___*Most of the time* ___*Sometimes*__ *Rarely* ___

c. Estimate the average amount of labor hours required for documenting untreated graywater discharges **per instance**:
____ labor hours per large cruise ships ___ labor hours per medium cruise ships

*Number of **not** documented discharges per year:*

____large cruise ships ____ medium cruise ships

8. CRUISE SHIPS OPERATING IN UNITED STATES NUTRIENT IMPAIRED WATERS

a. How many of your cruise ships operate in nutrient impaired waters (including, but not limited to, Chesapeake Bay, San Francisco Bay, Puget Sound, and the territorial sea surrounding the mouth of the Mississippi River in the Gulf of Mexico)?
___large cruise ships ___ medium cruise ships
___*unsure if cruise ships operate in nutrient impaired waters*

*(If **0 or unsure**, skip all of question 8)*

b. How many of these cruise ships have a standard graywater treatment system as noted within question 3 (same as Alaskan standards)?
___large cruise ships ___ medium cruise ships

c. How many of the cruise ships with no standard graywater treatment system have sufficient holding capacity for graywater in order to not discharge within these waters? ___large cruise ships ___ medium cruise ships

9. **DUE TO THE PENDING PERMIT REQUIREMENT, HOW MANY OF YOUR CRUISE SHIPS ARE LIKELY TO CONTINUE TO HOLD AND DISCHARGE GRAYWATER ACCORDING TO THE PERMIT STANDARDS VERSUS PURCHASING/UPGRADING THE GRAYWATER TREATMENT SYSTEM ACCORDING TO THE STANDARDS WITHIN QUESTION 3 (SAME AS ALASKAN STANDARDS) *(SEE ATTACHMENT FOR A SUMMARY OF DISCHARGE AND TREATMENT STANDARDS)*?**
___large cruise ships ___ medium cruise ships

10. **USE OF SOAPS AND DETERGENTS**

a. Please indicate the number of gallons of soap/degreaser or number of cruise ships that are associated with each section:

	Number of Gallons purchased of *all* types of soaps/degreasers, per fleet per year			**Number of Cruise Ships Using *Phosphate Free* Soaps or *Non-Toxic* Degreasers**		
	Large Cruise Ships	Medium Cruise Ships	Total	Large Cruise Ships	Medium Cruise Ships	Total
Soaps[41]						
Degreasers						

b. Estimate the incremental cost of purchasing phosphate free soaps and non-toxic degreasers:

	Incremental Cost per Gallon	**Incremental Cost per Fleet**
Soaps[42]		
Degreasers		

11. **DESCRIBE MANAGEMENT PRACTICES TO PREVENT WASTEWATER DISCHARGES**

a. What practices does a cruise ship typically perform to prevent unintended waste discharge from these sources? Check all that apply. *Please note if there are any significant differences among large and medium cruise ships.*

[41] I.E. shower and hand soaps, laundry detergents, and dishwashing soaps.

[42] I.E. shower and hand soaps, laundry detergents, and dishwashing soaps.

	Practice		
Waste discharge	Plug area drains that flow to graywater, blackwater, or bilge systems	Create alternative waste receptacles	Replumbing drains to appropriate holding tanks and then disposing of these wastes
Medical sinks or floor drains			
Salon/ day spa sinks and floor drains			
Chemical storage areas			

b. Please estimate ***incremental*** installation, maintenance, and labor hours that are associated with each of these practices:

	Practice		
Cost	Plug drains	Waste receptacles	Replumbing
Installation Cost			
Maintenance Cost			
Total Labor Hours:			

ATTACHMENT:

PERMIT SPECIFICATIONS REGARDING DISCHARGE STANDARDS AND GRAYWATER TREATMENT STANDARDS

DISCHARGE STANDARDS:

Pierside Limits:
1) While pierside, appropriate reception facilities for Graywater must be used, if reasonably available.

Operational Limits:
1) While operating within 1 nm of shore for *large cruise ships* or 1000 feet of shore for *medium cruise ships*, discharges of graywater are prohibited.
3) If you operate within 3 nm of shore, discharges of graywater must either be released while the Cruise Ship is sailing at a speed of at least 6 knots and is not in a water of exceptional value.

Nutrient Impaired Water Limits:
1) *Large Cruise Ships*: If you are operating in nutrient impaired waters including, but not limited to, such as the Chesapeake Bay or the territorial Sea surrounding the mouth of the Mississippi River in the Gulf of Mexico, you must not discharge graywater.
2) *Medium Cruise Ships*: If you are operating in nutrient impaired waters including, but not limited to, such as the Chesapeake Bay or the territorial Sea surrounding the mouth of the Mississippi River in the Gulf of Mexico, you must discharge the Graywater while the Cruise Ship is sailing at a speed of at least 6 knots or dispose of graywater properly on shore.

Monitoring Requirements:
1) The owner/operator must maintain records estimating all discharges of untreated graywater into waters subject to this permit, including date, location and volume discharged in their recordkeeping documentation. These records can be maintained as part of the vessel's sewage and graywater discharge record book

TREATMENT STANDARDS:

Treatment System Standard:

The discharge of treated Graywater must meet the following standards:

(1) The discharge must satisfy the minimum level of effluent quality specified in 40 CFR 133.102;
(2) The geometric mean of the samples from the discharge during any 30-day period may not exceed 20 fecal coliform/100 milliliters (ml) and not more than 10 percent of the samples exceed 40 fecal coliform/100 ml; and
(3) Concentrations of total residual chlorine may not exceed 10.0 micrograms per liter (µg/l);

(Based on 33 CFR 159.309 – Alaskan Cruise Ship Regulation)

Monitoring Requirements:
1) In order to demonstrate the effectiveness of the treatment system, the vessel operator must take at least five samples taken from the vessel on different days over a 30-day period that are representative of the treated effluent to be discharged. Samples must be taken for BOD, suspended solids, pH, and total residual chlorine. Sampling and testing shall be conducted according to 40 CFR Part 136.

2) After demonstrating the effectiveness of their system, vessel owner/operators must conduct the same sampling and analysis twice each year to demonstrate treatment equipment maintenance and compliance. Records of the sampling and testing results must be retained onboard for a period of 3 years in the vessels recordkeeping documentation.

Appendix B: Summary of Survey Responses

Individual BMP Survey

The following tables summarize the industry responses to the questionnaires in Appendix A. The Individual BMP Questionnaire regarding typical practices and cost estimates was sent to three different industry representatives who represent: (1) passenger vessels, (2) towing vessels and barges, and (3) freight and tank ships. The industry representatives sent this questionnaire to their member companies to obtain information. The passenger vessel industry received one response from its member companies, which was sent directly to Abt Associates for review. The towing vessels and barges industry received nine responses from five different companies. One company among these nine respondents provided information on behalf of four different operational areas. These surveys were also sent directly to Abt Associates for review. Member companies in the freight and tank ships industry did not respond to the full questionnaire. However, the industry representative provided information on more general questions that were answered by the member companies.

The Cruise Ship Questionnaire was sent to one industry representative, who sent the survey to member cruise lines. The industry representative provided a summary of the responses and has provided further information on request as a supplement to these responses.

Survey Responses Regarding Labor Rates[a]	
Passenger Vessel Company	Provided an average labor rate of $35.
Towing Vessel and Barge Companies	Five companies with a very small number of vessels provided an average labor rate of $75. Two other companies with a slightly larger number of vessels provided rates of $32 and $60 per hour. Two other companies with the largest number of vessels provided rates of $14 and $15 per hour.
Freight and Tank Ship Industry	Has not yet provided labor rate information.

a Based upon these average labor rates and the corresponding number of vessels associated with each industry response, an average labor rate of $31.61 was calculated among all these industries. The weighted average labor rate used for deck runoff practice cost estimates is $16.53. This labor rate remains lower than the overall average since this calculation does not include the responses from the passenger vessel company.

Survey Responses Regarding Deck Runoff				
	Deck Cleanup	**Drip Pan Installation**	**Drip Pan Cleaning**	**Deck Washdown Cleaners**
Passenger Vessel Company	Deck cleanup is regularly performed prior to washdown/departing from port.			
Towing Vessel and Barge Companies	Three of the nine respondents stated that their vessels do not perform deck washdowns or deck cleanups. The other six respondents provided a range of the number of times that a vessel performs deck cleanup and deck washdown and the number of times a vessel departs from port, per month. The number of times a vessel performs deck cleanup ranges from one to 15 times per month, the number of times a vessel performs deck washdown ranges from one to 20 times per month, and the number of times a vessel departs from port ranges from four to 30 times per month. The respondents provided a range of 1 to 6 hours required per cleanup.	Eight of the nine respondents stated their vessels had drip pans installed. One of the nine respondents stated that drip pans were not installed. The respondents estimated a cost ranging from $2,000 to $8,000 for the one-time installation.	Seven of the nine respondents stated that they regularly clean drip pans when necessary. The respondents provided a range of the frequency that the drip pans need to be cleaned/drained of once per month to four times per month. They also provided a range of the cost of disposal of $200 to $1,200 per cleaning. The other two respondents did not respond to this question.	Eight of the nine respondents stated that their vessels use environmentally friendly cleaners for the deck washdown. Five of the eight respondents provided the number of gallons of cleaner purchased per vessel, per month: ranging from 10 to 833 gallons. The other respondent did not respond to this question.
Freight and Tank Ship Industry	Deck cleanup is an ongoing activity on all ship types. Ships do not generally perform deck washdowns. The exception is that inland vessels and dry bulk cargo vessels collect cargo residues and may perform a washdown.			

Survey Responses Regarding AFFF	
Passenger Vessel Company	AFFF is not an applicable discharge to passenger vessels.
Towing Vessel and Barge Companies	AFFF is not an applicable discharge to these vessels.
Freight and Tank Ship Industry	Foams are typically not changed out of ships more frequently than every 5 years. Respondents provided a range of 5 to 25 years in which foams may need to be replaced. AFFF is by far the most frequent foam used by vessels, while some vessels also use protein and polar solvent foams. The type of foam that is carried onboard is dependent on the type of cargo. The amount of foam in the tanks ranges from 300 to 6,000 gallons, dependent on ship type. It is not standard to have the technology to collect and store maintenance/training discharges of foams. It is common practice to wash the foam over the side of the ship. It is uncommon to perform these maintenance/training discharges while in inland waters. Most vessels perform these discharges while at sea.

Survey Responses Regarding Graywater		
	Graywater Discharge	**Soaps and Detergents**
Passenger Vessel Company	Graywater is always disposed of onshore at appropriate facilities. The respondent cited a cost of $0.18 per gallon to dispose onshore. 100% of vessels can store graywater in holding tanks.	The respondent uses non-toxic detergents; purchases approximately 5 gallons per year.
Towing Vessel and Barge Companies	Six of the nine respondents stated that 0% of their vessels are able to store graywater. One of the other respondents stated that 100% of oceangoing vessels are able to store graywater in order to reach a distance of greater than 1 nm to discharge and, most of the time, they discharge in waters greater than 1 nm from shore. Another of the other respondents stated that 50% of oceangoing vessels are able to store graywater in order to reach a distance of greater than 1 nm to discharge, and they always discharge in waters greater than 1 nm from shore. These vessels need to discharge approximately 10 times per month. Both of these respondents stated that all vessels that are able to store graywater avoid discharging in waters of exceptional value and that there is no additional cost of discharging in waters greater than 1 nm from shore. The remaining respondent did not respond to this question.	Five of the nine respondents stated that 100% of their vessels use environmentally friendly soaps and detergents. The number of gallons purchased per vessel ranges from 24 to 125 gallons of soap and 12 to 200 gallons of detergent per year. The other four respondents did not respond to this question.
Freight and Tank Ship Industry	Some vessels are able to retain graywater and some are not.	

Survey Responses Regarding Underwater Hull Husbandry	
Passenger Vessel Company	Does not clean hull underwater.
Towing Vessel and Barge Companies	Eight of the nine respondents stated that the hull is always cleaned during drydocks, not while underwater. The other respondent stated that the hull is cleaned during drydock or while underwater every 30 months. If cleaning is performed underwater, the hull is always cleaned by methods that minimize the discharge of fouling organisms and anti-fouling hull coatings. Estimates a cost of $70,000 per cleaning. Always disposes of removed substances in accordance with local, state, and federal regulations.
Freight and Tank Ship Industry	Hull cleaning is performed based on need.

Survey Responses Regarding Cathodic Protection			
	Cathodic Protection System	**Metals Used**	**Maintenance/Replacement**
Passenger Vessel Company	Use sacrificial electrodes (magnesium) as the method of cathodic protection.		
Towing Vessel and Barge Companies	Seven of the nine respondents stated that 100% of their vessels use sacrificial electrodes as the method of cathodic protection. One of the other respondents stated that 100% of its vessels use an impressed current system as the method of cathodic protection. The other respondent stated that 30% of its vessels use sacrificial electrodes as the method of cathodic protection. Estimates a cost ranging from $4,500 to $30,000 to install a cathodic protection system.	Two of the nine respondents stated that none of their vessels have magnesium or aluminum anodes. Four of the nine respondents stated that 100% of their vessels use the less toxic metals. The other three respondents did not respond to this question.	Four of the nine respondents stated that maintenance to the cathodic protection system is performed during regular periods of maintenance. The respondents provided a range of the maintenance timeline: maintenance is performed every 30 months to once in five years. One of the four respondents stated that anodes are simply replaced, not cleaned. The other five respondents did not respond to this question.
Freight and Tank Ship Industry	The majority of ships have impressed current systems installed, and some have sacrificial anodes added for increased protection.		

Survey Responses Regarding Chain Locker Effluent				
	Wash Anchor Chain as Hauled Out of Water	**Clean Chain Lockers in Drydock**	**Clean Space Beneath Chain Locker Prior to Entering Nearshore Water**	**Document Safety Claim if Space Rinsed within 3nm from Shore**
Passenger Vessel Company	Chain locker effluent does not apply to these vessels.			
Towing Vessel and Barge Companies	Three of the nine respondents stated that this practice is not applicable to their vessels. Four of the other six respondents stated that the anchor chain is always washed down as it is being hauled out of the water. Two of the other six respondents stated that the anchor chain is rarely washed down as it is being hauled out of the water. These six respondents stated that the number of times that an anchor is hauled out of the water varies depending on the type of vessels. Most provided an average between 12 and 50 times per year and an estimate of 0.5 to 1 hour to perform this cleaning. The other two respondents did not respond to this question.	Two of the nine respondents stated that this practice is not applicable to their vessels. Six of the other seven respondents stated that, during drydocks, a vessel always thoroughly cleans chain lockers. One of the seven respondents stated that this was done most of the time. These seven respondents estimated a cost ranging from $2,000 to $15,000 per cleaning and that a vessel is drydocked from twice every five years to twice every three years.	Two of the nine respondents stated that this practice is not applicable to their vessels. The other seven respondents stated that the space beneath the chain locker is rarely inspected, cleaned, and pumped out prior to entering nearshore waters. These seven respondents provided a range of the number of times that a vessel enters nearshore waters ranging from 50 times per year to daily. One of the seven respondents estimated a cost of $2,000 per instance, and another estimated that 40 labor hours are required per instance.	Two of the nine respondents stated that this practice is not applicable to their vessels. The other seven respondents stated that this discharge does not take place within 3 nm from shore.
Freight and Tank Ship Industry	It is normal practice to rig a fire hose and wash down the anchor as it is being heaved. Additionally, most new ships have several high-pressure freshwater spray nozzles installed in the hawsepipes that spray the chain and anchor as it is being heaved and thus wash seafloor sediment back into the water.	Chain lockers are typically cleaned during normal shipyard periods and *not* during normal underway operations (since the lockers are full of anchor chain) whether on the deep sea or in nearshore waters.		

Survey Responses Regarding Controllable Pitch Propeller Hydraulic Fluid			
	Maintenance During Dry Dock	**Use of Oil Boom for Underwater Maintenance**	**Oil Spill Equipment Onboard**
Passenger Vessel Company	Controllable pitch propeller hydraulic fluid is not applicable to these vessels.		
Towing Vessel and Barge Companies	Seven out of the nine respondents stated that controllable pitch propeller hydraulic fluid is not applicable to these vessels. The other two respondents stated that, during drydocks, a vessel always performs maintenance on controllable pitch propellers. One of the respondents estimated a $15,000 cost per instance and stated that a vessel drydocks 0.67 times per year.	The two respondents to whom this question was applicable stated that these vessels never perform this maintenance in the water. One respondent stated that if the maintenance was done in the water, an oil boom would be rigged. The other respondent stated that an oil boom would not be rigged.	The two respondents to whom this question was applicable stated that 100% of vessel operators have oil spill equipment on hand. Estimates a cost of $1,000 to $2,000 to purchase the equipment.
Freight and Tank Ship Industry	Routine maintenance of the controllable pitch propeller occurs during drydocks.	It is not common to rig an oil boom because the vessel is drydocked. If any maintenance is to be done with the vessel in the water it would be boomed.	All ships have some supply of absorbent pads and other equipment aboard ship.

Survey Responses Regarding Elevator Pit Effluent	
Passenger Vessel Company	Elevator pit effluent is not applicable to these vessels.
Towing Vessel and Barge Companies	Eight respondents stated that this discharge is not applicable to these vessels. Another respondent stated that vessels never discharge elevator pit effluent. Estimates a cost of $2,000 per instance to dispose of the effluent onshore. In cases of emergency, a vessel never discharges this effluent with an oil content >15 ppm. However, this emergency discharge never occurs.
Freight and Tank Ship Industry	Elevator pit effluent would be pumped to an oily waste tank and either transferred to a slop tank for disposal ashore, or burned in the incinerator.

Survey Responses Regarding Firemain Discharges	
Passenger Vessel Company	Firemain discharge is not applicable to these vessels.
Towing Vessel and Barge Companies	Three out of the nine respondents stated that firemain discharge is not applicable to these vessels. Another four respondents stated that a vessel never discharges from firemain systems into waters of exceptional value. The last two respondents stated that a vessel may discharge from firemain systems into waters of exceptional value from 12 to 52 times per year.
Freight and Tank Ship Industry	Unless in emergency situations, legally required drills and system activation are conducted out of port. Firemain discharges are charged with freshwater, operated with the effluent going over the side through normal deck drainage ports.

Cruise Ship Survey

Survey Responses Regarding Cruise Ships	
Pierside and Operational Limits	Both large and medium cruise ships have sufficient holding capacity to avoid discharging within 1 nm from shore. Discharges within 3 nm from shore currently undergo graywater treatment or are discharged while the ship is sailing at a speed of at least 6 knots. Furthermore, regarding the Permit specifications, according to an industry representative, reception facilities for graywater are very rare and are not commonplace even at major ports.
Limits Applicable to Operation in Nutrient Impaired Waters	If necessary to discharge, medium cruise ships discharge graywater in these waters while sailing at a speed of at least 6 knots. There is a subset of large cruise ships that operate in these waters whose graywater holding capacity is exceeded due to the voyage length.
Sculleries and Galleys	The industry representative was not able to provide the percentage of large or medium ships that use these phosphate free/non-toxic products or the annual average number of gallons that are purchased by a ship.
Hazardous Waste	Source drains are currently either replumbed to appropriate holding tanks or are plugged and alternative waste receptacles are used.
Untreated Graywater Documentation	Documentation of these discharges is common practice.
Monitoring	The cost associated with one sampling event is approximately $1,000 per ship. Sampling is not a current practice for the majority of cruise ships.