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Cost-Effectiveness Analysis Of Final Effluent Limitations Guidelines And Standards For The Offshore Oil And Gas Industry

COST-EFFECTIVENESS ANALYSIS OF FINAL EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS OF PERFORMANCE FOR THE OFFSHORE OIL AND GAS INDUSTRY

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SECTION ONE

INTRODUCTION

The EPA proposed effluent limitations guidelines and standards for the offshore segment of the oil and gas industry on August 26, 1985. The proposed regulations covered produced water, drilling fluids, drill cuttings, produced sand, deck drainage, and well treatment fluids, as well as sanitary and domestic wastes discharges. A Notice of Data Availability and Request for Comments relating to the discharge of drilling fluids and drill cuttings was published on October 21, 1988. On November 26, 1990, and March 13, 1991, the Agency reproposed effluent limitations guidelines and standards for both drilling and production wastes.

This cost-effectiveness analysis (ce) is in support of the promulgation of final effluent limitations guidelines and standards for the offshore oil and gas industry. Incremental pollution control options are considered for several waste streams:

- Drilling fluids and drill cuttings. Drilling fluids are liquids used to lubricate the drill bit and carry away cut rock to the surface in a well drilling operation. Drill cuttings are fragments of the host rock removed by the drilling operation.
- Produced water. The production of oil and gas results in the generation, separation, and discharge of waters and sand associated with hydrocarbons in the subsea reservoirs (i.e., produced waters and produced sand, respectively).
- Produced sand.[1]

These options include effluent limitations guidelines and standards based on BAT (Best Available control Technology economically achievable) and NSPS (New Source Performance Standards), that are being considered under authority of the Federal Water Pollution Control Act, as amended (the Clean Water Act). EPA has identified several pollution control options,

[1]Other effluents are included in the rulemaking, e.g., domestic wastes, sanitary wastes, deck drainage, and treatment, workover and completion fluids. No toxic pollutant removals were quantified for incremental pollution controls on these waste streams; therefore they do not appear in the cost-effectiveness analysis.

each with different levels of pollution abatement and compliance cost. The ce analysis is a useful tool for comparing the costs of the regulatory options with their relative ability to remove toxic pollutants. EPA's cost-effectiveness methodology is not intended to analyze the removal of conventional pollutants (oil and grease, BOD, TSS, fecal coliform, and pH). The removal of conventional pollutants is not addressed in this report.

This report is primarily concerned with the total annualized cost incurred by the offshore oil and gas industry in complying with the regulations. The effectiveness measure used is pounds of pollutant removed weighted by an estimate of their relative toxicity. The rationale for this measure, referred to as "pound equivalents (pe) removed," is described later in this report.

Section Two discusses the background of the cost-effectiveness methodology employed in this report. Section Three describes the alternative options under consideration, explains how the ce was calculated, and lists the pollutants included in the analysis. Section Four presents the findings. Appendices A through C contain tables of pollutants removed (in pounds and pound-equivalents) for drilling fluids and drill cuttings, BAT produced water, and NSPS produced water options, respectively.

SECTION TWO

BACKGROUND METHODOLOGY

Cost-effectiveness (ce) is defined as the incremental annualized cost of a pollution control option in an industry or industry subcategory per incremental pound equivalent of pollutant removed annually by that control option.

Cost-effectiveness analyses account for differences in toxicity among the pollutants with toxic weighting factors. These factors are necessary because different pollutants have different potential effects on human and aquatic life. For example, a pound of zinc in an effluent stream has a significantly different potential effect than a pound of PCBs. Toxic weighting factors for pollutants are derived using ambient water quality criteria and toxicity values. For most industries, toxic weighting factors are derived from chronic freshwater aquatic criteria. In cases where a human health criterion has also been established for the consumption of fish, then the sum of both the human and aquatic criteria are used in deriving toxic weighting factors. However, in this study of an industry that discharges into the ocean, chronic saltwater aquatic criteria are used wherever available. Chronic saltwater aquatic criteria are available for most of the pollutants considered in the analysis (see Tables 2-1 and 2-2). These toxic weighting factors are then standardized by relating them to a particular pollutant.

Copper was selected as the standard pollutant for developing weighting factors since it is a toxic metal pollutant and is commonly detected and removed from industrial effluents.[1] Some examples of the effect of different aquatic and human health criteria on weighting factors are shown in Table 2-3.

As indicated in Table 2-3, 1 pound of copper poses the same relative hazard as 2.9 pounds of nickel in the marine environment, since copper has a salt water toxic weight

[1]EPA uses the old freshwater quality criterion for copper (5.6 ug/l) as the standardization factor to retain comparability of the new ce results with values derived for previously regulated industries. The toxic weighing factor for copper itself reflects the newer water quality criterion for this pollutant.

TABLE 2-1

LIST OF POLLUTANTS CONSIDERED AND TOXIC WEIGHTING FACTORS
RISK LEVEL AT 10^-5
DRILLING FLUIDS AND DRILL CUTTINGS

Pollutant	Toxic Weighting Factor	Saltwater/ Freshwater Criteria
DIRECT REMOVALS:		
Benzene	0.0298	Salt
Napthalene	0.6597	Salt
Fluorene	0.5604	Salt
Phenanthrene	1.3211	Salt
Phenol	0.0193	Salt
Cadmium	0.6351	Salt
Mercury	262.3562	Salt
INCIDENTAL REMOVALS:		
Antimony	0.0125	Salt
Arsenic	4.1556	Salt
Beryllium	4.2424	Salt
Chromium	0.0109	Salt
Copper	1.9310	Salt
Lead	0.6588	Salt
Nickel	0.6759	Salt
Selenium	0.0797	Salt
Silver	6.0871	Salt
Thallium	1.1518	Salt
Zinc	0.0651	Salt
Aluminum	0.0644	Fresh
Barium	0.0020	Fresh
Iron	0.0170	Salt
Tin	0.3011	Fresh
Titanium	0.0293	Fresh
Organics (Alkylated Benzenes)	0.3025	Salt

Source: Versar, 1992. "Toxic Weighting Factors for Offshore Oil and Gas Extraction Industry Pollutants," Submitted to Alexandra Tarney, U.S. EPA, 15 October.

TABLE 2-2

LIST OF POLLUTANTS CONSIDERED AND TOXIC WEIGHTING FACTORS
PRODUCED WATER

Risk Level is 10-5

Pollutant	Toxic Weighting Factor	Saltwater/ Freshwater Criteria
2-Butanone	0.0001	Salt
2-4-Dimethylphenol	0.0024	Salt
Anthracene	0.3510	Salt
Benzene	0.0298	Salt
Benzo(a)pyrene	18.5600	Salt
Chlorobenzene	0.0110	Salt
Di-N-Butylpthalate	0.0663	Salt
Ethylbenzene	0.2607	Salt
N-Alkanes	0.0740	Fresh
Napthalene	0.6597	Salt
P-Chloro-M-Cresol	3.7300	Fresh
Phenol	0.0193	Salt
Steranes	0.0741	Fresh
Toluene	0.0018	Salt
Triterpanes	0.0741	Fresh
Total Xylenes	1.1429	Salt
Aluminum	0.0644	Fresh
Arsenic	4.1556	Salt
Barium	0.0020	Fresh
Boron	0.1770	Fresh
Cadmium	0.6351	Salt
Copper	1.9310	Salt
Iron	0.0170	Salt
Lead	0.6588	Salt
Manganese	0.0560	Salt
Nickel	0.6759	Salt
Titanium	0.0293	Fresh
Zinc	0.0651	Salt
Radium-226	1.3E+06	Salt
Radium-228	1.3E+06	Salt

Source: Versar, 1992. "Toxic Weighting Factors for Offshore Oil and Gas Extraction Industry Pollutants," Submitted to Alexandra Tarney, U.S. EPA, 15 October.

TABLE 2-3

WEIGHTING FACTORS BASED ON COPPER FRESHWATER CHRONIC CRITERIA
10-5 RISK LEVEL

Pollutant	Human Health Criteria (ug/l)	Aquatic Chronic Saltwater Criteria (ug/l)	Aquatic Chronic Freshwater Criteria (ug/l)	Weighting Calculation	Final Weight
Copper	--	2.9	12	5.6/2.9	1.9310
Zinc	--	86	110	5.6/86	0.0651
Nickel	4600	8.3	160	(5.6/4,600)+(5.6/8.3)	0.6759
Cadmium	170	9.3	1.1	(5.6/170)+(5.6/9.3)	0.6351
Benzene	710	255	265	(5.6/710)+(5.6/255)	0.0298
Titanium	--	--	191	5.6/191	0.0293

Note: Based on ingestion of 6.5 grams of fish products per day.
-- Not available.

approximately 2.9 times as large as the toxic weight of nickel (i.e., 1.931 ÷ .6759). As shown in Tables 2-1 and 2-2, mercury, arsenic, beryllium, silver, benzo(a)pyrene, p-chloro-m-cresol, and radium have toxic weighting factors larger than that of copper.

The final weights are used to calculate the "pound equivalent" unit -- a standard measure of toxicity. Pound equivalents are calculated as the number of pounds of pollutant multiplied by the weighting factor. Thus, in ce analysis, the amount of pollutant removed by a control option is weighted by its relative toxicity. Cost-effectiveness is calculated as the ratio of incremental annual cost of an option to the incremental pound equivalents removed by that option.

The pollutants included in ce analysis are the regulated pollutants and selected non-regulated ones. Non-regulated pollutants are included because they can be removed incidentally as a result of a particular treatment technology, even though they are not specifically limited. (For example, when drilling fluids and drill cuttings are barged and disposed in an onshore landfill, some toxic metals such as arsenic are removed from the marine environment, even though there is no specific limitation on arsenic; the cost-effectiveness reflects the removal of arsenic.) Some of the factors considered in selecting non-regulated pollutants include toxicity, frequency of occurrence, and amount of pollutant in the waste stream.

The data set for an industry-specific ce analysis contains the following information:

- Wastewater pollutants;
- The pollution control approaches identified by the Office of Science and Technology, Engineering and Analysis Division;
- Annual volume of loadings by pollutant -- currently, and at each BAT/NSPS control level;
- Toxic weighting factor for each pollutant;
- Annualized costs for each control option (where results are adjusted to 1981 dollars to enable comparison among all industries).

Criteria or toxicity values have been developed for the priority pollutants and were taken from data in the 1980 Ambient Water Quality Criteria Document (EPA 440/5-80 Series), and

updated criteria documents in the EPA 440/5-85 and EPA 440/5-87 series. Criteria for a few of the nonconventional pollutants were taken from the 1976 Quality Criteria for Water, EPA-440/9-76-023.

SECTION THREE

COST-EFFECTIVENESS ANALYSIS METHODOLOGY FOR THE OFFSHORE OIL AND GAS INDUSTRY

3.1 REGULATORY OPTIONS

The cost-effectiveness report for the March 1991 reproposal of effluent guidelines and standards of performance for the offshore oil and gas industry investigated three oil price scenarios and two development scenarios for NSPS projections. In order to focus on the new information for estimating the costs and associated pollutant removals, only one development scenario is analyzed in this report. This is the $21/bbl restricted, or constrained, development scenario presented in the proposal. Given the long time frame for the projections (15 years), recent oil prices, and the volatility of oil prices, the $21/bbl oil price assumption was the most reasonable of the three possibilities. Given current Presidential and State restrictions on offshore activity, the restricted, or constrained, development scenario was chosen.

3.1.1 Drilling Fluids and Drill Cuttings

Four options for BAT and NSPS were developed for the control of drilling fluids and drill cuttings. The following requirements are included in some combination in the various options:

- No discharge of diesel oil.
- No discharge of "free oil" as measured by the static sheen test.
- Toxicity limitation as measured by a 96-hour LC50 test.
- Limitations on cadmium and mercury in the stock barite.
- Zero discharge of drilling fluids and drill cuttings based on distance from shore. The technology basis for the zero discharge requirement is onshore treatment and/or disposal.

These requirements have been combined into four options:

- **3 Mile Gulf/California** — For all regions except Alaska, drilling wastes from wells located within three miles of shore must meet zero discharge requirements. In these regions, the disposal of drilling wastes from wells located beyond three miles of shore must meet limitations on toxicity, no discharge of diesel oil, no discharge of free oil as determined by the static sheen test, and limitations on mercury (1 mg/kg) and cadmium (3 mg/kg) content in the stock barite. Alaska is excluded from the zero discharge requirement, but all discharges must meet the requirements for toxicity, free oil, diesel oil, cadmium, and mercury.

- **8 Mile Gulf/ 3 Mile California** — Zero discharge for all wells in the Gulf of Mexico located within eight miles from shore and zero discharge for all wells offshore California located within three miles of shore. All wells located beyond eight miles of shore in the Gulf of Mexico, beyond three miles of shore off California, and all wells drilled offshore Alaska permitted to discharge drilling fluids and drill cuttings that are in compliance with the requirements for toxicity, free oil, diesel oil, cadmium, and mercury.

- **Zero Discharge Gulf/California** — Zero discharge for all wells located in the Gulf of Mexico and offshore California. All wells being drilled offshore Alaska permitted to discharge drilling fluids and drill cuttings that are in compliance with the requirements for toxicity, free oil, diesel oil, cadmium, and mercury.

- **4 Mile Gulf/California** — The requirements are the same as in the 3 Mile Gulf/California option, except that the boundary determining the zero discharge requirement is set at 4 miles from shore. This option is comparable to the preferred option in the March 1991 proposal.

3.1.2 Produced Water

Three disposal technologies are considered for produced water:

- Zero discharge of produced water (technologically based on reinjection).

- Filtration of produced water prior to discharge. The costs and removals for this alternative are based on updated information for granular filtration.

- Improved performance of gas flotation.

Five disposal options are considered in the economic impact for BAT and NSPS produced water regulations. The options for BAT are summarized in Table 3-1, while those for NSPS are listed in Table 3-2. BAT options are distinguished by the exclusion of existing Gulf of Mexico single-well structures with their own production equipment from zero discharge requirements; these structures must meet flotation limitations. No exclusion from zero discharge requirements is made under NSPS for these structures. The BAT Flotation All option includes costs for two years of monitoring for radium in produced water, however, no monitoring requirement is included in the BAT limitation; the NSPS Flotation All option includes no costs for radium monitoring. BAT and NSPS options for Alaska are distinguished in the costing efforts because existing offshore Alaskan structures (BAT) are already required to meet zero discharge requirements by State permit conditions (so they will incur no BAT costs), but costs for projected structures in Alaskan waters are included in the calculation of NSPS costs. The limitations for Alaska, however, are the same under BAT and NSPS. All existing structures off California (BAT) are excluded from meeting zero discharge requirements and instead must comply with improved gas flotation limitations.

3.1.3 Produced Sand

Produced sand consists of the slurried particles used in hydraulic fracturing and the accumulated formation sands and other particles (including scale) generated during production. This waste stream also includes sludges generated in the produced water system, such as tank bottoms from oil/water separators and solids removed in filtration. The option considered in this analysis is zero discharge of all produced sand.

3.2 ANALYTICAL APPROACH

For each of the options considered here, the pound equivalents of pollutants removed were obtained by multiplying the pounds of each pollutant removed annually by that pollutant's toxic weighting factor and summing the pound equivalents for each approach. Regional totals were then summed to obtain the national totals. Removals were calculated relative to the

TABLE 3-1

PRODUCED WATER
BAT REGULATORY OPTIONS

Regulatory Option	Short Form of Title
BPT - All Structures	BPT All
Improved Gas Flotation - All Structures	Flotation All
Filter (Granular) and Discharge - All Structures Within 4 Miles BPT - All Structures Beyond 4 Miles	Filter 4 Miles
Gulf of Mexico Zero Discharge Within 3 Miles (Gulf lb Structures = Flotation) Flotation Beyond 3 Miles California: Flotation - All Structures	Zero 3 Miles Gulf and Alaska
Gulf of Mexico Zero Discharge (Gulf lb Structures = Flotation) California: Flotation - All Structures	Zero Discharge Gulf and Alaska

TABLE 3-2

PRODUCED WATER
NSPS REGULATORY OPTIONS

Regulatory Option	Short Form of Title
BPT - All Structures	BPT All
Improved Gas Flotation - All Structures	Flotation All
Filter (Granular) and Discharge All Structures Within 4 Miles BPT - All Structures Beyond 4 Miles	Filter 4 Miles
Gulf of Mexico and Alaska Zero Discharge Within 3 Miles Flotation Beyond 3 Miles California: Flotation - All Structures	Zero 3 Miles Gulf and Alaska
Gulf of Mexico and Alaska Zero Discharge - All Structures California: Flotation - All Structures	Zero Discharge Gulf and Alaska

baseline defined by current practices, i.e. they represent the incremental quantities of pollutants which would be removed as a result of this rule.

Table 3-3 shows the removals for the zero discharge option for drilling fluids and drill cuttings from the Gulf of Mexico. Appendix A contains the tables showing pounds and pound-equivalents removed for drilling fluids and drill cuttings; Appendix B contains the tables for the BAT produced water options; and tables for NSPS produced water options are given in Appendix C. To enable comparisons between industries, these costs were converted to 1981 dollars by dividing by a factor of 1.21 (based on the change in the Construction Cost Index from 1981 to 1986; see Engineering News Record, March 17, 1988).

Following standard procedures for the Agency's cost-effectiveness analyses, the options were ranked in order of increasing stringency (i.e., increasing pound equivalents removed). The incremental cost-effectiveness of each option was calculated by the following equation:

$$ce_k = \frac{ATC_k - ATC_{k-1}}{pe_k - pe_{k-1}}$$

where:

ce_k	=	cost-effectiveness of Option K;
ATC_k	=	annualized treatment cost of Option K;
pe_k	=	pound equivalent removed at Option K.

TABLE 3-3

ANNUAL POLLUTANT REMOVALS (UNWEIGHTED AND WEIGHTED)
DRILLING FLUIDS AND DRILL CUTTINGS
ZERO DISCHARGE

GULF OF MEXICO

Pollutant	Pounds Removed			Toxic Weighting Factor (10^-5)	Pounds Equivalent Removed		
	Muds	Cuttings	Total Removals		Muds	Cuttings	Total Removals
DIRECT REMOVALS:							
Benzene	0	0	0	0.0298	0	0	0
Napthalene	565	233	798	0.6597	373	154	526
Fluorene	0	0	0	0.5604	0	0	0
Phenanthrene	0	0	0	1.3211	0	0	0
Phenol	0	0	0	0.0193	0	0	0
Cadmium	1,795	107	1,902	0.6351	1,140	68	1,208
Mercury	546	32	578	262.3562	143,246	8,395	151,642
INCIDENTAL REMOVALS:							
Antimony	4,447	254	4,701	0.0125	56	3	59
Arsenic	9,364	555	9,919	4.1556	38,913	2,306	41,219
Beryllium	546	32	578	4.2424	2,316	136	2,452
Chromium	438,044	25,974	464,018	0.0109	4,767	283	5,050
Copper	31,133	1,846	32,979	1.9310	60,119	3,565	63,684
Lead	52,044	3,086	55,130	0.6588	34,288	2,033	36,321
Nickel	10,533	624	11,157	0.6759	7,119	422	7,541
Selenium	858	51	909	0.0797	68	4	72
Silver	546	32	578	6.0871	3,324	195	3,518
Thallium	937	56	993	1.1518	1,079	65	1,144
Zinc	156,444	9,276	165,720	0.0651	10,187	604	10,791
Aluminum	7,076,979	421,278	7,498,257	0.0644	455,530	27,117	482,646
Barium	280,700,100	16,709,487	297,409,587	0.0020	558,806	33,265	592,070
Iron	11,972,710	712,711	12,685,421	0.0170	203,173	12,094	215,268
Tin	11,392	678	12,070	0.3011	3,430	204	3,634
Titanium	68,274	4,058	72,332	0.0293	2,000	119	2,119
Organics	344,643	142,031	486,674	0.3025	104,269	42,970	147,239
TOTALS	300,881,900	18,032,401	318,914,301		1,634,202	134,001	1,768,203

Sources: Pounds Removed: EPA, EAD.
Toxic Weighting Factors: Versar, 1992 (See Tables 2-1 and 2-2).

SECTION FOUR

COST-EFFECTIVENESS RESULTS

Cost-effectiveness (ce) analysis was performed for each of the incremental pollution control options for each waste stream. Section 4.1 discusses ce for drilling fluids and drill cuttings. Section 4.2 discusses ce for BAT produced water while Section 4.3 considers ce for NSPS produced water. The cost-effectiveness of the regulatory option for produced sand is discussed in Section 4.4.

4.1 COST-EFFECTIVENESS FOR DRILLING FLUIDS AND DRILL CUTTINGS

Table 4-1 and Figure 4-1 show the cost-effectiveness analysis for drilling fluids and drill cuttings. The costs and removals are based on the $21/bbl oil price, restricted development scenario. The ce report for the March 1991 proposal investigates the sensitivity of the ce analysis for this waste stream to changes in oil price and development assumptions.

Cost-effectiveness for the 3 Mile Gulf/California option is $44 per pound equivalent (pe) removed. The incremental ce for the other options is approximately $72-$73 per pound equivalent. Appendix A contains the tables for the pounds and pound equivalents removed for the drilling waste options.

4.2 COST-EFFECTIVENESS FOR BAT PRODUCED WATER

Cost-effectiveness analysis was performed for each of the five options for BAT produced water. Table 4-2 and Figure 4-2 summarize the results of this analysis. The BPT All option is the same as current practices; there are no costs or removals associated with this option. Incremental cost-effectiveness ranges from $33/pe for the Flotation All option to $653/pe for the Filter 4 Miles option. The incremental cost-effectiveness for the two options where the Gulf 1b projects are excluded from the Zero Discharge requirement ranges from $244/pe to $573/pe.

TABLE 4-1

COST-EFFECTIVENESS FOR OFFSHORE OIL AND GAS
DRILLING FLUIDS AND DRILL CUTTINGS

Option	Total Annual PE Removed	Total Annual Cost (1986 $) ($000)	Total Annual Cost (1981 $) ($000)	Incremental PE Removed	Incremental Cost (1981 $) ($000)	Incremental Cost-Effectiveness $/PE (1981 $)
Current	0	$0	$0	--	--	--
3 Mile Gulf/ California	357,955	$18,954	$15,664	357,955	$15,664	$43.76
4 Mile Gulf/ California	383,702	$21,217	$17,535	25,747	$1,870	$72.64
8 Mile Gulf/ 3 Mile California	521,490	$33,291	$27,513	137,789	$9,979	$72.42
Zero Discharge Gulf/ California	1,822,906	$148,421	$122,662	1,301,415	$95,149	$73.11

Note: Factor for converting 1986 dollars to 1981 dollar 1.21 .
The cost-effectiveness is standardized in 1981 dollars to facilitate comparsion among numerous regulated industries.
Projects in Alaska are excluded from the zero discharge limitation.

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FIGURE 4-1
COST-EFFECTIVENESS
DRILLING FLUIDS AND DRILL CUTTINGS

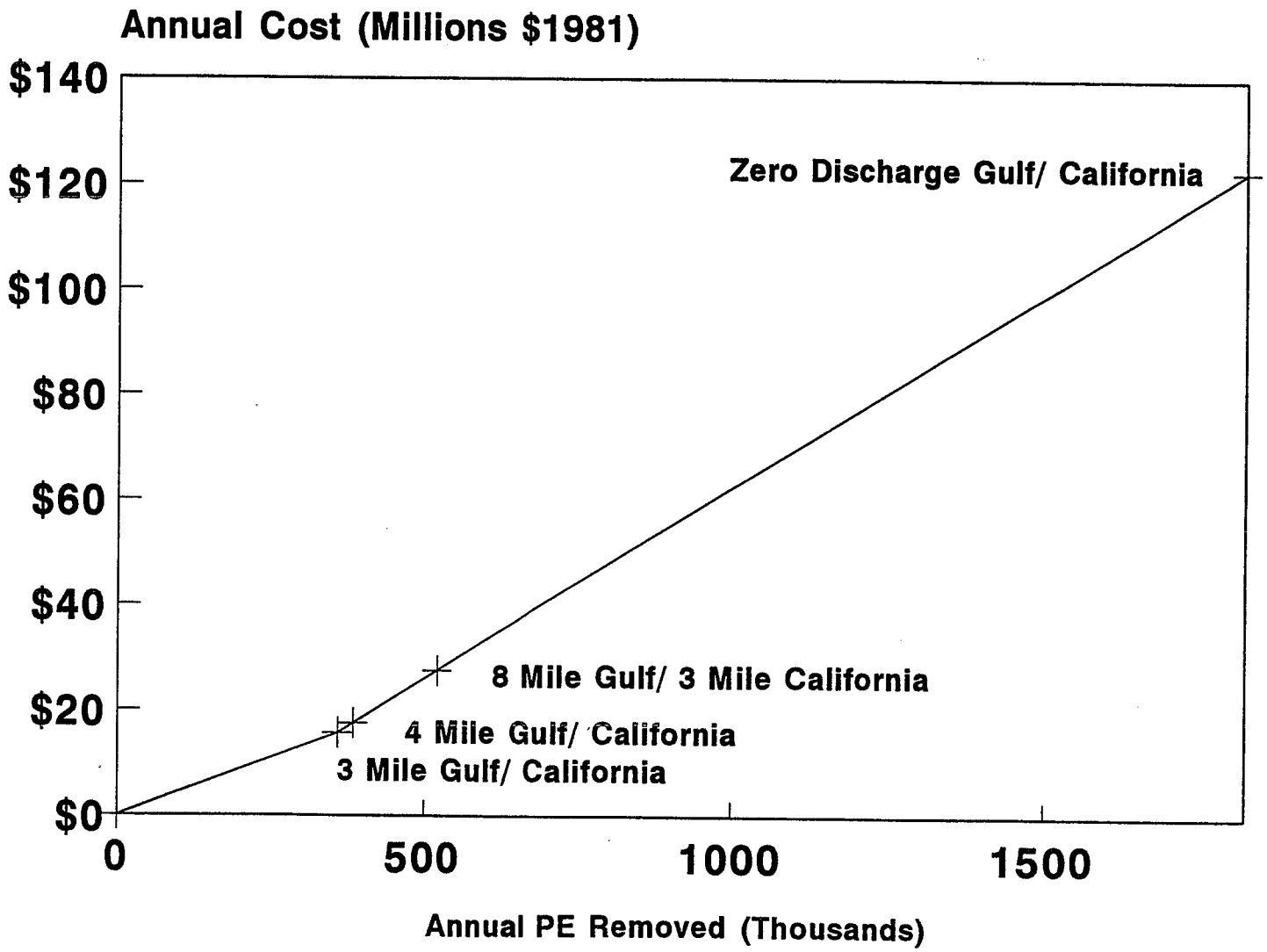

TABLE 4-2

COST-EFFECTIVENESS FOR OFFSHORE OIL AND GAS
BAT PRODUCED WATER

Option	Total Annual PE Removed	Total Annual Cost (1986 $) ($000)	Total Annual Cost (1981 $) ($000)	Incremental PE Removed	Incremental Cost (1981 $) ($000)	Incremental Cost-Effectiveness $/PE (1981 $)
Current (BPT All)	0	0	$0	--	--	--
Filter 4 Miles	48,887	$38,635	$31,930	48,887	$31,930	$653.13
Flotation All	1,480,176	$96,290	$79,578	1,431,289	$47,649	$33.29
Zero 3 Miles Gulf (Gulf 1b = Flotation)	1,507,861	$115,474	$95,433	27,685	$15,855	$572.67
Zero Discharge Gulf (Gulf 1b = Flotation)	3,334,240	$654,217	$540,675	1,826,379	$445,242	$243.78

Notes: Factor for converting 1986 dollars to 1981 dollars is $1.21 .

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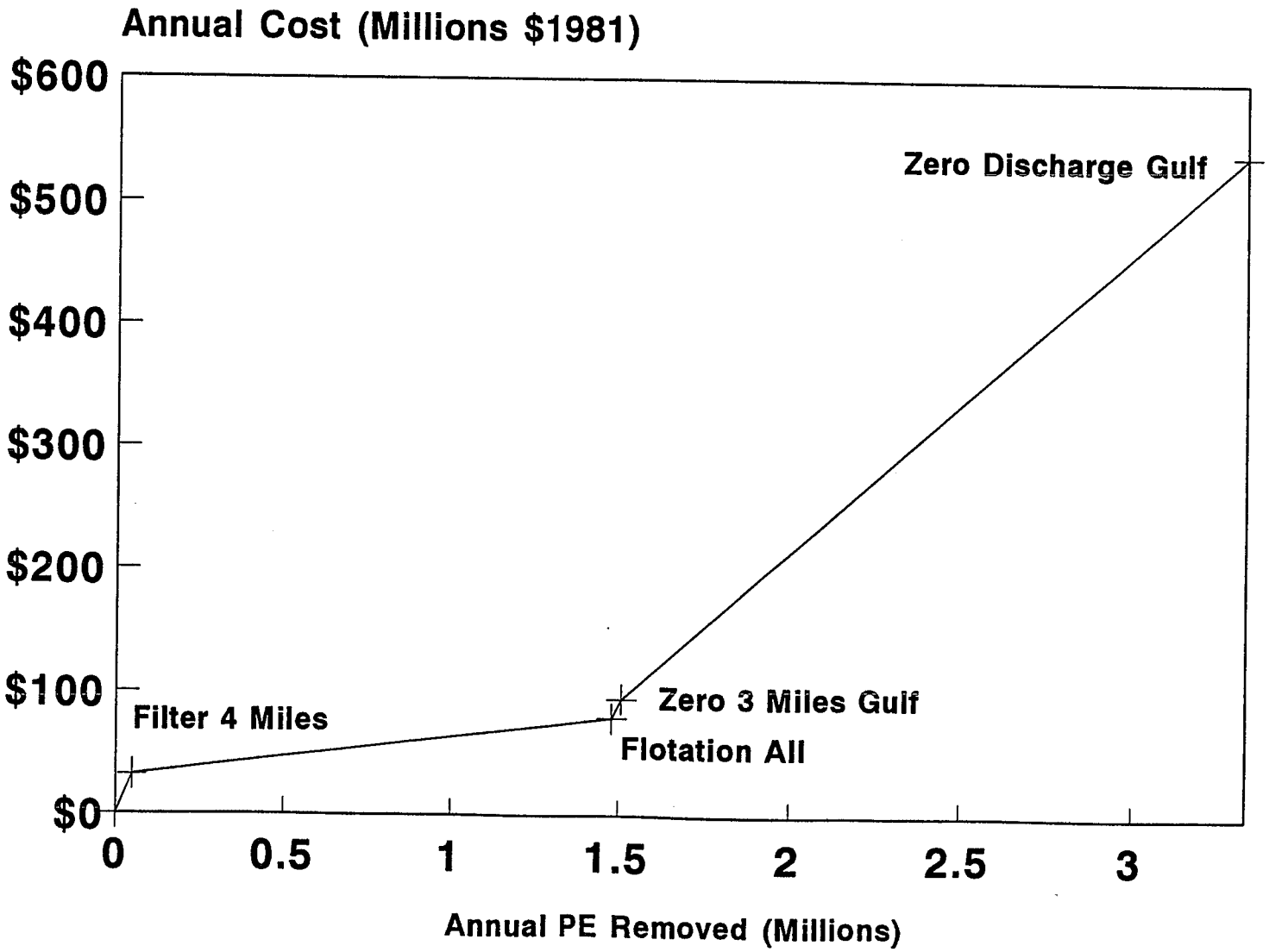
FIGURE 4-2
COST-EFFECTIVENESS
BAT PRODUCED WATER



4.3 COST-EFFECTIVENESS FOR NSPS PRODUCED WATER

The cost-effectiveness information for NSPS produced water is summarized in Table 4-3 and Figure 4-3. As with BAT produced water, the BPT All option under NSPS has no costs or removals associated with it. The Filter 4 Miles option does not appear because it has lower removals and higher costs than the Flotation All option. Under these circumstances, the Filter 4 Miles option is considered dominated by the Flotation All option, and is removed from the analysis. The cost-effectiveness of the remaining options range from $17/pe for the Flotation All option to $295/pe for the Zero Discharge Gulf and Alaska option.

4.4 PRODUCED SAND

Zero discharge of produced sand is estimated to remove 3.8 million microcuries (3.8 grams) of Radium-226 and Radium-228 (see Development Document for details). Given a conversion factor of 453.6 grams to a pound, and a toxic weighting factor of 1,300,000 for radium, an estimated 10,842 pound-equivalents of radium are removed by the zero discharge requirement. Toxic removals associated with other pollutants, such as organics, were not quantified for this waste stream.

The cost associated with the zero discharge requirement for produced sand is $3.814 million dollars (1986 dollars; $3.152 million in 1981 dollars). Hence, the cost-effectiveness for the zero discharge requirement for produced sand is $291/pe.

4.5 SUMMARY

Table 4-4 summarizes the range in cost-effectiveness for the offshore oil and gas industry effluent controls to the cost-effectiveness of BAT regulations for other industries. Table 4-5 summarizes the same information for NSPS regulations. All costs are shown in 1981 dollars. The effect of combined costs on the regulated industry has been examined in the economic impact analysis.

TABLE 4-3

COST-EFFECTIVENESS FOR OFFSHORE OIL AND GAS
NSPS PRODUCED WATER

Option	Total Annual PE Removed	Total Annual Cost (1986 $) ($000)	Total Annual Cost (1981 $) ($000)	Incremental PE Removed	Incremental Cost (1981 $) ($000)	Incremental Cost-Effectiveness $/PE (1981 $)
Current (BPT All)	0	0	$0	--	--	--
Flotation All	601,169	$12,085	$9,987	601,169	$9,987	$16.61
Zero 3 Miles Gulf and Alaska	747,489	$61,893	$51,151	146,320	$41,163	$281.32
Zero Discharge Gulf and Alaska	1,546,775	$346,974	$286,756	799,286	$235,605	$294.77

Notes: Factor for converting 1986 dollars to 1981 dollars is $1.21 .

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FIGURE 4-3
COST-EFFECTIVENESS
NSPS PRODUCED WATER

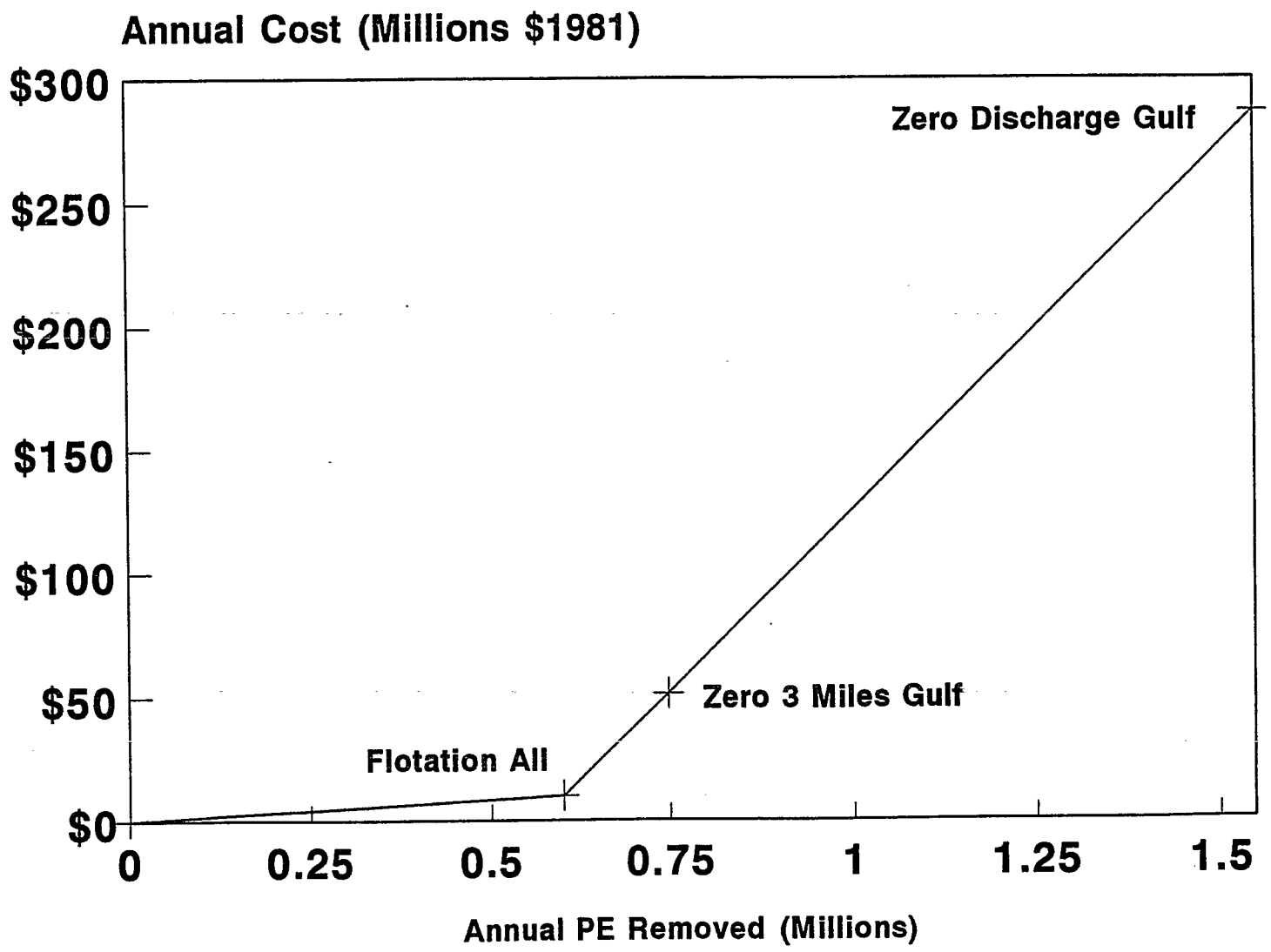

TABLE 4-4

INDUSTRY COMPARISON OF COST-EFFECTIVENESS FOR DIRECT DISCHARGERS
TOXIC AND NONCONVENTIONAL POLLUTANTS ONLY
COPPER-BASED WEIGHTS
1981 DOLLARS

INDUSTRY	POUNDS EQUIVALENT CURRENTLY DISCHARGED (000's)	POUNDS EQUIVALENT REMAINING AT SELECTED OPTION 000's)	COST-EFFECTIVENESS OF SELECTED OPTION(S) ($/POUND EQUIVALENT)
Aluminum Forming	1,340	90	121
Battery Manufacturing	4,126	5	2
Canmaking	12	0.2	10
Coal Mining	BAT=BPT	BAT=BPT	BAT=BPT
Coil Coating	2,289	9	49
Copper Forming	70	8	27
Electronics I	9	3	404
Electronics II	NA	NA	NA
Foundries	2,308	39	84
Inorganic Chemicals II	32,503	1,290	[a]
Inorganic Chemicals II	605	27	6
Iron and Steel	40,746	1,040	2
Leather Tanning	259	112	BAT=BPT
Metal Finishing	3,305	3,268	12
Nonferrous Metals Forming	34	2	69
Nonferrous Metals Manufacturing I	6,653	313	4
Nonferrous Metals Manufacturing II	1,004	12	6
Offshore Oil and Gas			
- Drilling Fluids and Drill Cuttings	--	--	BAT=NSPS[d]
- Produced Water	3,808	2,328	33
- Produced Sand	--	--	BAT=NSPS[d]
Organic Chemicals, and Plastics and Synthetics[b]	54,225	9,735	5
Pesticides	2,461	371	15
Pharmaceuticals	208	4	1
Plastics Molding and Forming	44	41	BAT=BPT
Porcelain Enameling	1,086	63	6
Petroleum Refining	BAT=BPT	BAT=BPT	BAT=BPT
Pulp and Paper[c]	1,330	748	18
Steam Electric			
Textile Mills	BAT=BPT	BAT=BPT	BAT=BPT
Timber			

[a] Less than a dollar.
[b] Reflects costs and removals of both air and water pollutants.
[c] PCB control for Deink subcategory only.
[d] The major impact of the regulation on drilling fluids and drill cuttings will occur under NSPS. Impacts for produced sand are also estimated on a combined BAT/NSPS basis.

TABLE 4-5

INDUSTRY COMPARISON OF COST-EFFECTIVENESS FOR NEW SOURCE PERFORMANCE STANDARDS TOXIC AND NONCONVENTIONAL POLLUTANTS ONLY COPPER-BASED WEIGHTS 1981 DOLLARS

INDUSTRY	INCREMENTAL[a] POUNDS EQUIVALENT REMOVED	COST-EFFECTIVENESS OF SELECTED OPTION ($/POUND EQUIVALENT)
Aluminum Forming	509	190
Battery Manufacturing	1,612	47
Canmaking	NA	NA
Coal Mining		
Coil Coating	5,004	13
Copper Forming	216	132
Electronics I	NA	NA
Electronics II	427	183
Foundries		
Inorganic Chemicals I		
Inorganic Chemicals II	NA	NA
Iron and Steel		
Leather Tanning		b
Metal Finishing	26,208	
Nonferrous Metals Manufacturing I	NA	NA
Nonferrous Metals Manufacturing II	32,570	9
Offshore Oil and Gas		
- Drilling Fluids and Drill Cuttings	357,955	44
- Produced Water	601,169	17
- Produced Sand	10,842	291
Organic Chemicals, Plastics and Synthetics	NA	NA
Pesticides	NA	NA
Petroleum Refining		
Pharmaceuticals	NA	NA
Plastics Molding and Forming	NA	NA
Porcelain Enameling	2,500	38
Pulp and Paper[c]	NA	NA
Steam Electric		
Textile Mills[c]	NA	NA
Timber		

[a] Incremental pound equivalent removed from next less stringent option considered.
[b] Less than a dollar
[c] Incremental treatment required for conventional pollutants only.

NA NSPS not promulgated or NSPS equal to BAT.

APPENDIX A

POLLUTANT REMOVAL CALCULATIONS
DRILLING FLUIDS AND DRILL CUTTINGS

TABLE A-1

ANNUAL REGIONALIZED POLLUTANT REMOVALS
DRILLING FLUIDS & DRILL CUTTINGS
3 MILE GULF/ CALIFORNIA

UNWEIGHTED REMOVALS (POUNDS)

POLLUTANT	GULF OF MEXICO			PACIFIC			ALASKA			ALL REGIONS		
	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total
DIRECT REMOVALS:												
Benzene	0	0	0	0	0	0	0	0	0	0	0	0
Napthalene	47	107	154	0	1	1	0	1	1	47	109	156
Fluorene	0	0	0	0	0	0	0	0	0	0	0	0
Phenanthrene	0	0	0	0	0	0	0	0	0	0	0	0
Phenol	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	1,009	65	1,074	0	0	0	0	1	1	1,009	66	1,075
Mercury	475	28	503	0	0	0	0	0	0	475	28	503
INCIDENTAL REMOVALS:												
Antimony	372	45	417	0	0	0	0	0	0	372	45	417
Arsenic	4,289	287	4,576	0	0	0	0	1	1	4,289	288	4,577
Beryllium	46	6	52	0	1	1	0	0	0	46	7	53
Chromium	266,493	16,917	283,410	0	23	23	0	22	22	266,493	16,962	283,455
Copper	17,766	1,141	18,907	0	1	1	0	2	2	17,766	1,144	18,910
Lead	26,955	1,761	28,716	0	3	3	0	2	2	26,955	1,766	28,721
Nickel	883	114	997	0	2	2	0	2	2	883	118	1,001
Selenium	72	9	81	0	0	0	0	1	1	72	10	82
Silver	46	6	52	0	1	1	0	0	0	46	7	53
Thallium	79	11	90	0	0	0	0	0	0	79	11	90
Zinc	13,128	1,709	14,837	0	19	19	0	18	18	13,128	1,746	14,874
Aluminum	593,872	78,350	672,222	0	869	869	0	809	809	593,872	80,028	673,900
Barium	23,555,644	3,107,645	26,663,289	0	34,476	34,476	0	32,116	32,116	23,555,644	3,174,237	26,729,881
Iron	1,004,703	132,552	1,137,255	0	1,471	1,471	0	1,370	1,370	1,004,703	135,393	1,140,096
Tin	956	126	1,082	0	2	2	0	1	1	956	129	1,085
Titanium	5,700	752	6,452	0	8	8	0	8	8	5,700	768	6,468
Organics	28,922	64,864	93,786	0	695	695	0	1,044	1,044	28,922	66,603	95,525
TOTALS	25,521,457	3,406,495	28,927,952	0	37,572	37,572	0	35,398	35,398	25,521,457	3,479,465	29,000,922

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TABLE A-2

ANNUAL REGIONALIZED POLLUTANT REMOVALS
DRILLING FLUIDS & DRILL CUTTINGS
4 MILE GULF/ CALIFORNIA

UNWEIGHTED REMOVALS (POUNDS)

POLLUTANT	GULF OF MEXICO			PACIFIC			ALASKA			ALL REGIONS		
	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total
DIRECT REMOVALS:												
Benzene	0	0	0	0	0	0	0	0	0	0	0	0
Napthalene	56	109	165	0	1	1	0	1	1	56	111	167
Fluorene	0	0	0	0	0	0	0	0	0	0	0	0
Phenanthrene	0	0	0	0	0	0	0	0	0	0	0	0
Phenol	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	1,023	67	1,090	0	0	0	0	1	1	1,023	68	1,091
Mercury	476	28	504	0	0	0	0	0	0	476	28	504
INCIDENTAL REMOVALS:												
Antimony	447	49	496	0	0	0	0	0	0	447	49	496
Arsenic	4,382	292	4,674	0	0	0	0	1	1	4,382	293	4,675
Beryllium	55	6	61	0	1	1	0	0	0	55	7	62
Chromium	269,637	17,083	286,720	0	23	23	0	22	22	269,637	17,128	286,765
Copper	18,011	1,153	19,164	0	1	1	0	2	2	18,011	1,156	19,167
Lead	27,414	1,785	29,199	0	3	3	0	2	2	27,414	1,790	29,204
Nickel	1,060	124	1,184	0	2	2	0	2	2	1,060	128	1,188
Selenium	86	11	97	0	0	0	0	1	1	86	12	98
Silver	55	6	61	0	1	1	0	0	0	55	7	62
Thallium	95	12	107	0	0	0	0	0	0	95	12	107
Zinc	15,753	1,849	17,602	0	19	19	0	18	18	15,753	1,886	17,639
Aluminum	712,648	84,633	797,281	0	869	869	0	809	809	712,648	86,311	798,959
Barium	28,266,687	3,356,839	31,623,526	0	34,476	34,476	0	32,116	32,116	28,266,687	3,423,431	31,690,118
Iron	1,205,644	143,180	1,348,824	0	1,471	1,471	0	1,370	1,370	1,205,644	146,021	1,351,665
Tin	1,147	136	1,283	0	2	2	0	1	1	1,147	139	1,286
Titanium	6,846	813	7,659	0	8	8	0	8	8	6,846	829	7,675
Organics	34,706	66,277	100,983	0	695	695	0	1,044	1,044	34,706	68,016	102,722
TOTALS	30,566,228	3,674,452	34,240,680	0	37,572	37,572	0	35,398	35,398	30,566,228	3,747,422	34,313,650

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TABLE A-3

ANNUAL REGIONALIZED POLLUTANT REMOVALS
DRILLING FLUIDS & DRILL CUTTINGS
8 MILE GULF/ 3 MILE CALIFORNIA

UNWEIGHTED REMOVALS (POUNDS)

POLLUTANT	GULF OF MEXICO			PACIFIC			ALASKA			ALL REGIONS		
	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total
DIRECT REMOVALS:												
Benzene	0	0	0	0	0	0	0	0	0	0	0	0
Napthalene	107	121	228	0	1	1	0	1	1	107	123	230
Fluorene	0	0	0	0	0	0	0	0	0	0	0	0
Phenanthrene	0	0	0	0	0	0	0	0	0	0	0	0
Phenol	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	1,100	70	1,170	0	0	0	0	1	1	1,100	71	1,171
Mercury	483	28	511	0	0	0	0	0	0	483	28	511
INCIDENTAL REMOVALS:												
Antimony	845	69	914	0	0	0	0	0	0	845	69	914
Arsenic	4,878	318	5,196	0	0	0	0	1	1	4,878	319	5,197
Beryllium	104	8	112	0	1	1	0	0	0	104	9	113
Chromium	286,398	17,968	304,366	0	23	23	0	22	22	286,398	18,013	304,411
Copper	19,317	1,223	20,540	0	1	1	0	2	2	19,317	1,226	20,543
Lead	29,866	1,915	31,781	0	3	3	0	2	2	29,866	1,920	31,786
Nickel	2,003	174	2,177	0	2	2	0	2	2	2,003	178	2,181
Selenium	163	14	177	0	0	0	0	1	1	163	15	178
Silver	104	8	112	0	1	1	0	0	0	104	9	113
Thallium	178	16	194	0	0	0	0	0	0	178	16	194
Zinc	29,757	2,588	32,345	0	19	19	0	18	18	29,757	2,625	32,382
Aluminum	1,346,111	118,140	1,464,251	0	869	869	0	809	809	1,346,111	119,818	1,465,929
Barium	53,392,252	4,685,873	58,078,125	0	34,476	34,476	0	32,116	32,116	53,392,252	4,752,465	58,144,717
Iron	2,277,326	199,868	2,477,194	0	1,471	1,471	0	1,370	1,370	2,277,326	202,709	2,480,035
Tin	2,167	190	2,357	0	2	2	0	1	1	2,167	193	2,360
Titanium	12,960	1,135	14,095	0	8	8	0	8	8	12,960	1,151	14,111
Organics	65,555	73,818	139,373	0	695	695	0	1,044	1,044	65,555	75,557	141,112
TOTALS	57,471,674	5,103,544	62,575,218	0	37,572	37,572	0	35,398	35,398	57,471,674	5,176,514	62,648,188

TABLE A-4

ANNUAL REGIONALIZED POLLUTANT REMOVALS
DRILLING FLUIDS & DRILL CUTTINGS
ZERO DISCHARGE GULF/ CALIFORNIA

UNWEIGHTED REMOVALS (POUNDS)

POLLUTANT	GULF OF MEXICO			PACIFIC			ALASKA			ALL REGIONS		
	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total
DIRECT REMOVALS:												
Benzene	0	0	0	0	0	0	0	0	0	0	0	0
Napthalene	565	233	798	9	3	12	0	1	1	574	237	811
Fluorene	0	0	0	0	0	0	0	0	0	0	0	0
Phenanthrene	0	0	0	0	0	0	0	0	0	0	0	0
Phenol	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	1,795	107	1,902	31	2	33	0	1	1	1,826	110	1,936
Mercury	546	32	578	3	0	3	0	0	0	549	32	581
INCIDENTAL REMOVALS:												
Antimony	4,447	254	4,701	163	8	171	0	0	0	4,610	262	4,872
Arsenic	9,364	555	9,919	203	11	214	0	1	1	9,567	567	10,134
Beryllium	546	32	578	20	2	22	0	0	0	566	34	600
Chromium	438,044	25,974	464,018	6,865	384	7,249	0	22	22	444,909	26,380	471,289
Copper	31,133	1,846	32,979	535	30	565	0	2	2	31,668	1,878	33,546
Lead	52,044	3,086	55,130	1,004	56	1,060	0	2	2	53,048	3,144	56,192
Nickel	10,533	624	11,157	387	22	409	0	2	2	10,920	648	11,568
Selenium	858	51	909	31	2	33	0	1	1	889	54	943
Silver	546	32	578	20	2	22	0	0	0	566	34	600
Thallium	937	56	993	34	2	36	0	0	0	971	58	1,029
Zinc	156,444	9,276	165,720	5,735	321	6,056	0	18	18	162,179	9,615	171,794
Aluminum	7,076,979	421,278	7,498,257	259,421	14,523	273,944	0	809	809	7,336,400	436,610	7,773,010
Barium	280,700,100	16,709,487	297,409,587	10,289,642	576,036	10,865,678	0	32,116	32,116	290,989,742	17,317,639	308,307,381
Iron	11,972,710	712,711	12,685,421	438,885	24,570	463,455	0	1,370	1,370	12,411,595	738,651	13,150,246
Tin	11,392	678	12,070	418	24	442	0	1	1	11,810	703	12,513
Titanium	68,274	4,058	72,332	2,502	140	2,642	0	8	8	70,776	4,206	74,982
Organics	344,643	142,031	486,674	5,888	1,966	7,854	0	1,044	1,044	350,531	145,041	495,572
TOTALS	300,881,900	18,032,401	318,914,301	11,011,796	618,104	11,629,900	0	35,398	35,398	311,893,696	18,685,903	330,579,599

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TABLE A-5

ANNUAL REGIONALIZED POLLUTANT REMOVALS
DRILLING FLUIDS & DRILL CUTTINGS
3 MILE GULF/ CALIFORNIA

WEIGHTED REMOVALS (POUND EQUIVALENTS)

POLLUTANT	GULF OF MEXICO			PACIFIC			ALASKA			ALL REGIONS		
	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total
DIRECT REMOVALS:												
Benzene	0	0	0	0	0	0	0	0	0	0	0	0
Napthalene	31	71	102	0	1	1	0	1	1	31	72	103
Fluorene	0	0	0	0	0	0	0	0	0	0	0	0
Phenanthrene	0	0	0	0	0	0	0	0	0	0	0	0
Phenol	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	641	41	682	0	0	0	0	1	1	641	42	683
Mercury	124,619	7,346	131,965	0	0	0	0	0	0	124,619	7,346	131,965
	0	0		0	0		0	0				
INCIDENTAL REMOVALS:	0	0		0	0		0	0				
Antimony	5	1	5	0	0	0	0	0	0	5	1	5
Arsenic	17,823	1,193	19,016	0	0	0	0	4	4	17,823	1,197	19,020
Beryllium	195	25	221	0	4	4	0	0	0	195	30	225
Chromium	2,900	184	3,084	0	0	0	0	0	0	2,900	185	3,085
Copper	34,307	2,203	36,510	0	2	2	0	4	4	34,307	2,209	36,516
Lead	17,759	1,160	18,919	0	2	2	0	1	1	17,759	1,163	18,922
Nickel	597	77	674	0	1	1	0	1	1	597	80	677
Selenium	6	1	6	0	0	0	0	0	0	6	1	7
Silver	280	37	317	0	6	6	0	0	0	280	43	323
Thallium	91	13	104	0	0	0	0	0	0	91	13	104
Zinc	855	111	966	0	1	1	0	1	1	855	114	969
Aluminum	38,226	5,043	43,269	0	56	56	0	52	52	38,226	5,151	43,377
Barium	46,894	6,187	53,080	0	69	69	0	64	64	46,894	6,319	53,213
Iron	17,050	2,249	19,299	0	25	25	0	23	23	17,050	2,298	19,347
Tin	288	38	326	0	1	1	0	0	0	288	39	327
Titanium	167	22	189	0	0	0	0	0	0	167	23	190
Organics	8,750	19,624	28,374	0	210	210	0	316	316	8,750	20,150	28,900
TOTALS	311,482	45,625	357,107	0	378	378	0	469	469	311,482	46,473	357,955

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ANNUAL REGIONALIZED POLLUTANT REMOVALS
DRILLING FLUIDS & DRILL CUTTINGS
4 MILE GULF/ CALIFORNIA

WEIGHTED REMOVALS (POUND EQUIVALENTS)

POLLUTANT	GULF OF MEXICO			PACIFIC			ALASKA			ALL REGIONS		
	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total
DIRECT REMOVALS:												
Benzene	0	0	0	0	0	0	0	0	0	0	0	0
Napthalene	37	72	109	0	1	1	0	1	1	37	73	110
Fluorene	0	0	0	0	0	0	0	0	0	0	0	0
Phenanthrene	0	0	0	0	0	0	0	0	0	0	0	0
Phenol	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	650	43	692	0	0	0	0	1	1	650	43	693
Mercury	124,882	7,346	132,228	0	0	0	0	0	0	124,882	7,346	132,228
	0	0		0	0		0	0				
INCIDENTAL REMOVALS:	0	0		0	0		0	0				
Antimony	6	1	6	0	0	0	0	0	0	6	1	6
Arsenic	18,210	1,213	19,423	0	0	0	0	4	4	18,210	1,218	19,427
Beryllium	233	25	259	0	4	4	0	0	0	233	30	263
Chromium	2,934	186	3,120	0	0	0	0	0	0	2,934	186	3,121
Copper	34,780	2,226	37,006	0	2	2	0	4	4	34,780	2,232	37,012
Lead	18,061	1,176	19,237	0	2	2	0	1	1	18,061	1,179	19,240
Nickel	716	84	800	0	1	1	0	1	1	716	87	803
Selenium	7	1	8	0	0	0	0	0	0	7	1	8
Silver	335	37	371	0	6	6	0	0	0	335	43	377
Thallium	109	14	123	0	0	0	0	0	0	109	14	123
Zinc	1,026	120	1,146	0	1	1	0	1	1	1,026	123	1,149
Aluminum	45,872	5,448	51,319	0	56	56	0	52	52	45,872	5,556	51,427
Barium	56,272	6,683	62,955	0	69	69	0	64	64	56,272	6,815	63,087
Iron	20,459	2,430	22,889	0	25	25	0	23	23	20,459	2,478	22,937
Tin	345	41	386	0	1	1	0	0	0	345	42	387
Titanium	201	24	224	0	0	0	0	0	0	201	24	225
Organics	10,500	20,051	30,551	0	210	210	0	316	316	10,500	20,578	31,078
TOTALS	335,634	47,220	382,854	0	378	378	0	469	469	335,634	48,067	383,702

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TABLE A-7

ANNUAL REGIONALIZED POLLUTANT REMOVALS
DRILLING FLUIDS & DRILL CUTTINGS
8 MILE GULF/ 3 MILE CALIFORNIA

WEIGHTED REMOVALS (POUND EQUIVALENTS)

POLLUTANT	GULF OF MEXICO			PACIFIC			ALASKA			ALL REGIONS		
	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total
DIRECT REMOVALS:												
Benzene	0	0	0	0	0	0	0	0	0	0	0	0
Napthalene	71	80	150	0	1	1	0	1	1	71	81	152
Fluorene	0	0	0	0	0	0	0	0	0	0	0	0
Phenanthrene	0	0	0	0	0	0	0	0	0	0	0	0
Phenol	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	699	44	743	0	0	0	0	1	1	699	45	744
Mercury	126,718	7,346	134,064	0	0	0	0	0	0	126,718	7,346	134,064
	0	0		0	0		0	0				
INCIDENTAL REMOVALS:	0	0		0	0		0	0				
Antimony	11	1	11	0	0	0	0	0	0	11	1	11
Arsenic	20,271	1,321	21,592	0	0	0	0	4	4	20,271	1,326	21,596
Beryllium	441	34	475	0	4	4	0	0	0	441	38	479
Chromium	3,117	196	3,312	0	0	0	0	0	0	3,117	196	3,313
Copper	37,302	2,362	39,663	0	2	2	0	4	4	37,302	2,367	39,669
Lead	19,676	1,262	20,938	0	2	2	0	1	1	19,676	1,265	20,941
Nickel	1,354	118	1,471	0	1	1	0	1	1	1,354	120	1,474
Selenium	13	1	14	0	0	0	0	0	0	13	1	14
Silver	633	49	682	0	6	6	0	0	0	633	55	688
Thallium	205	18	223	0	0	0	0	0	0	205	18	223
Zinc	1,938	169	2,106	0	1	1	0	1	1	1,938	171	2,109
Aluminum	86,646	7,604	94,251	0	56	56	0	52	52	86,646	7,712	94,359
Barium	106,291	9,328	115,619	0	69	69	0	64	64	106,291	9,461	115,752
Iron	38,646	3,392	42,037	0	25	25	0	23	23	38,646	3,440	42,085
Tin	652	57	710	0	1	1	0	0	0	652	58	711
Titanium	380	33	413	0	0	0	0	0	0	380	34	413
Organics	19,833	22,333	42,166	0	210	210	0	316	316	19,833	22,859	42,692
TOTALS	464,895	55,748	520,643	0	378	378	0	469	469	464,895	56,595	521,490

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TABLE A-8

ANNUAL REGIONALIZED POLLUTANT REMOVALS
DRILLING FLUIDS & DRILL CUTTINGS
ZERO DISCHARGE GULF/ CALIFORNIA

WEIGHTED REMOVALS (POUND EQUIVALENTS)

	GULF OF MEXICO			PACIFIC			ALASKA			ALL REGIONS		
POLLUTANT	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total	Muds	Cuttings	Total
DIRECT REMOVALS:												
Benzene	0	0	0	0	0	0	0	0	0	0	0	0
Napthalene	373	154	526	6	2	8	0	1	1	379	156	535
Fluorene	0	0	0	0	0	0	0	0	0	0	0	0
Phenanthrene	0	0	0	0	0	0	0	0	0	0	0	0
Phenol	0	0	0	0	0	0	0	0	0	0	0	0
Cadmium	1,140	68	1,208	20	1	21	0	1	1	1,160	70	1,230
Mercury	143,246	8,395	151,642	787	0	787	0	0	0	144,034	8,395	152,429
	0	0		0	0		0	0				
INCIDENTAL REMOVALS:	0	0		0	0		0	0				
Antimony	56	3	59	2	0	2	0	0	0	58	3	61
Arsenic	38,913	2,306	41,219	844	46	889	0	4	4	39,756	2,356	42,112
Beryllium	2,316	136	2,452	85	8	93	0	0	0	2,401	144	2,545
Chromium	4,767	283	5,050	75	4	79	0	0	0	4,842	287	5,129
Copper	60,119	3,565	63,684	1,033	58	1,091	0	4	4	61,152	3,626	64,778
Lead	34,288	2,033	36,321	661	37	698	0	1	1	34,949	2,071	37,021
Nickel	7,119	422	7,541	262	15	276	0	1	1	7,381	438	7,819
Selenium	68	4	72	2	0	3	0	0	0	71	4	75
Silver	3,324	195	3,518	122	12	134	0	0	0	3,445	207	3,652
Thallium	1,079	65	1,144	39	2	41	0	0	0	1,118	67	1,185
Zinc	10,187	604	10,791	373	21	394	0	1	1	10,560	626	11,187
Aluminum	455,530	27,117	482,646	16,698	935	17,633	0	52	52	472,228	28,104	500,332
Barium	558,806	33,265	592,070	20,484	1,147	21,631	0	64	64	579,290	34,475	613,765
Iron	203,173	12,094	215,268	7,448	417	7,865	0	23	23	210,621	12,535	223,156
Tin	3,430	204	3,634	126	7	133	0	0	0	3,556	212	3,767
Titanium	2,000	119	2,119	73	4	77	0	0	0	2,074	123	2,197
Organics	104,269	42,970	147,239	1,781	595	2,376	0	316	316	106,050	43,881	149,931
TOTALS	1,634,202	134,001	1,768,203	50,922	3,312	54,233	0	469	469	1,685,124	137,782	1,822,906

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APPENDIX B

POLLUTANT REMOVAL CALCULATIONS
BAT PRODUCED WATER

TABLE B-1

Annual Regionalized Pollutant Removals
BAT Produced Water
Flotation All

Unweighted Removals (pounds)

Pollutant	Facilities Located Within 3 Miles of Shore				Facilities Located Beyond 3 Miles of Shore				Total Removal
	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	
2-BUTANONE	3,182	12,638	0	15,820	192,291	33,421	0	225,712	241,532
2-4-DIMETHYLPHENOL	346	1,374	0	1,720	20,908	3,634	0	24,542	26,262
ANTHRACENE	57	227	0	285	3,459	601	0	4,060	4,345
BENZENE	9,034	35,881	0	44,915	545,930	94,885	0	640,815	685,730
BENZO(A)PYRENE	36	142	0	178	2,168	377	0	2,545	2,723
CHLOROBENZENE	60	239	0	299	3,639	632	0	4,272	4,571
DI-N-BUTYLPTHALATE	50	198	0	247	3,006	522	0	3,528	3,775
ETHYLBENZENE	1,348	5,352	0	6,699	81,430	14,153	0	95,582	102,282
N-ALKANES	5,076	20,162	0	25,238	306,762	53,316	0	360,079	385,317
NAPTHALENE	781	3,102	0	3,884	47,205	8,204	0	55,409	59,293
P-CHLORO-M-CRESOL	78	310	0	388	4,717	820	0	5,536	5,924
PHENOL	5,166	20,517	0	25,683	312,176	54,257	0	366,433	392,116
STERANES	240	952	0	1,192	14,483	2,517	0	17,000	18,192
TOLUENE	5,512	21,890	0	27,401	333,055	57,886	0	390,941	418,342
TRITERPANES	241	958	0	1,199	14,577	2,533	0	17,110	18,309
TOTAL XYLENES	2,149	8,537	0	10,686	129,886	22,575	0	152,461	163,147
ALUMINUM	145	575	0	720	8,747	1,520	0	10,268	10,987
ARSENIC	212	841	0	1,053	12,803	2,225	0	15,029	16,082
BARIUM	103,101	409,474	0	512,575	6,230,233	1,082,838	0	7,313,071	7,825,646
BORON	47,762	189,691	0	237,453	2,886,191	501,631	0	3,387,822	3,625,275
CADMIUM	42	167	0	209	2,538	441	0	2,980	3,188
COPPER	825	3,277	0	4,102	49,859	8,666	0	58,525	62,627
IRON	9,122	36,227	0	45,349	551,207	95,802	0	647,008	692,357
LEAD	362	1,438	0	1,800	21,874	3,802	0	25,676	27,476
MANGANESE	215	854	0	1,069	12,991	2,258	0	15,249	16,318
NICKEL	3,165	12,568	0	15,733	191,230	33,237	0	224,467	240,200
TITANIUM	13	52	0	65	785	136	0	921	986
ZINC	5,444	21,623	0	27,067	328,995	57,180	0	386,175	413,242
RADIUM-226	0.0001	0.0005	0.0000	0.0006	0.0070	0.0012	0.0000	0.0083	0.0089
RADIUM-228	0.0001	0.0006	0.0000	0.0007	0.0086	0.0015	0.0000	0.0101	0.0108
Total	203,764	809,265	0	1,013,029	12,313,146	2,140,070	0	14,453,216	15,466,245

TABLE B-2

Annual Regionalized Pollutant Removals
BAT Produced Water
Zero 3 Miles Gulf (Pacific and Gulf 1b = Flotation All)

Unweighted Removals (pounds)

	Facilities Located Within 3 Miles of Shore				Facilities Located Beyond 3 Miles of Shore				
Pollutant	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	Total Removal
2-BUTANONE	5,097	12,638	0	17,735	192,291	33,421	0	225,712	243,447
2-4-DIMETHYLPHENOL	1,509	1,374	0	2,883	20,908	3,634	0	24,542	27,425
ANTHRACENE	92	227	0	319	3,459	601	0	4,060	4,379
BENZENE	14,737	35,881	0	50,618	545,930	94,885	0	640,815	691,433
BENZO(A)PYRENE	58	142	0	200	2,168	377	0	2,545	2,745
CHLOROBENZENE	96	239	0	336	3,639	632	0	4,272	4,607
DI-N-BUTYLPTHALATE	80	198	0	277	3,006	522	0	3,528	3,805
ETHYLBENZENE	1,637	5,352	0	6,989	81,430	14,153	0	95,582	102,571
N-ALKANES	8,131	20,162	0	28,293	306,762	53,316	0	360,079	388,371
NAPTHALENE	1,209	3,102	0	4,312	47,205	8,204	0	55,409	59,721
P-CHLORO-M-CRESOL	125	310	0	435	4,717	820	0	5,536	5,971
PHENOL	7,660	20,517	0	28,177	312,176	54,257	0	366,433	394,610
STERANES	384	952	0	1,336	14,483	2,517	0	17,000	18,336
TOLUENE	9,363	21,890	0	31,252	333,055	57,886	0	390,941	422,193
TRITERPANES	386	958	0	1,344	14,577	2,533	0	17,110	18,454
TOTAL XYLENES	3,443	8,537	0	11,979	129,886	22,575	0	152,461	164,440
ALUMINUM	377	575	0	952	8,747	1,520	0	10,268	11,220
ARSENIC	552	841	0	1,393	12,803	2,225	0	15,029	16,422
BARIUM	268,533	409,474	0	678,006	6,230,233	1,082,838	0	7,313,071	7,991,077
BORON	124,399	189,691	0	314,090	2,886,191	501,631	0	3,387,822	3,701,912
CADMIUM	109	167	0	276	2,538	441	0	2,980	3,256
COPPER	2,149	3,277	0	5,426	49,859	8,666	0	58,525	63,951
IRON	23,758	36,227	0	59,985	551,207	95,802	0	647,008	706,993
LEAD	943	1,438	0	2,380	21,874	3,802	0	25,676	28,057
MANGANESE	560	854	0	1,414	12,991	2,258	0	15,249	16,663
NICKEL	8,242	12,568	0	20,811	191,230	33,237	0	224,467	245,278
TITANIUM	34	52	0	85	785	136	0	921	1,007
ZINC	6,067	21,623	0	27,690	328,995	57,180	0	386,175	413,865
RADIUM-226	0.0011	0.0005	0.0000	0.0015	0.0070	0.0012	0.0000	0.0083	0.0098
RADIUM-228	0.0013	0.0006	0.0000	0.0019	0.0086	0.0015	0.0000	0.0101	0.0120
Total	489,728	809,265	0	1,298,993	12,313,146	2,140,070	0	14,453,216	15,752,209

TABLE B-3

Annual Regionalized Pollutant Removals
BAT Produced Water
Zero Discharge Gulf (Pacific and Gulf 1b = Flotation All)

Unweighted Removals (pounds)

	Facilities Located Within 3 Miles of Shore				Facilities Located Beyond 3 Miles of Shore				
Pollutant	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	Total Removal
2-BUTANONE	5,097	12,638	0	17,735	318,604	33,421	0	352,025	369,760
2-4-DIMETHYLPHENOL	1,509	1,374	0	2,883	97,631	3,634	0	101,265	104,148
ANTHRACENE	92	227	0	319	5,731	601	0	6,333	6,652
BENZENE	14,737	35,881	0	50,618	922,156	94,885	0	1,017,040	1,067,658
BENZO(A)PYRENE	58	142	0	200	3,595	377	0	3,972	4,172
CHLOROBENZENE	96	239	0	336	6,029	632	0	6,661	6,997
DI-N-BUTYLPTHALATE	80	198	0	277	4,979	522	0	5,501	5,779
ETHYLBENZENE	1,637	5,352	0	6,989	100,512	14,153	0	114,665	121,654
N-ALKANES	8,131	20,162	0	28,293	508,269	53,316	0	561,586	589,878
NAPTHALENE	1,209	3,102	0	4,312	75,445	8,204	0	83,650	87,961
P-CHLORO-M-CRESOL	125	310	0	435	7,815	820	0	8,635	9,070
PHENOL	7,660	20,517	0	28,177	476,671	54,257	0	530,928	559,105
STERANES	384	952	0	1,336	23,997	2,517	0	26,514	27,850
TOLUENE	9,363	21,890	0	31,252	587,102	57,886	0	644,988	676,240
TRITERPANES	386	958	0	1,344	24,152	2,533	0	26,685	28,030
TOTAL XYLENES	3,443	8,537	0	11,979	215,206	22,575	0	237,781	249,760
ALUMINUM	377	575	0	952	24,070	1,520	0	25,591	26,543
ARSENIC	552	841	0	1,393	35,231	2,225	0	37,456	38,850
BARIUM	268,533	409,474	0	678,006	17,143,664	1,082,838	0	18,226,501	18,904,508
BORON	124,399	189,691	0	314,090	7,941,900	501,631	0	8,443,531	8,757,621
CADMIUM	109	167	0	276	6,979	441	0	7,420	7,697
COPPER	2,149	3,277	0	5,426	137,195	8,666	0	145,861	151,287
IRON	23,758	36,227	0	59,985	1,516,743	95,802	0	1,612,545	1,672,530
LEAD	943	1,438	0	2,380	60,193	3,802	0	63,995	66,375
MANGANESE	560	854	0	1,414	35,751	2,258	0	38,008	39,422
NICKEL	8,242	12,568	0	20,811	526,203	33,237	0	559,439	580,250
TITANIUM	34	52	0	85	2,160	136	0	2,296	2,382
ZINC	6,067	21,623	0	27,690	370,073	57,180	0	427,253	454,943
RADIUM-226	0.0011	0.0005	0.0000	0.0015	0.0695	0.0012	0.0000	0.0708	0.0723
RADIUM-228	0.0013	0.0006	0.0000	0.0019	0.0850	0.0015	0.0000	0.0865	0.0884
Total	489,728	809,265	0	1,298,993	31,178,057	2,140,070	0	33,318,127	34,617,120

TABLE B-4

Annual Regionalized Pollutant Removals
BAT Produced Water
Filter 4 Miles

Unweighted Removals (pounds)

Pollutant	Facilities Located Within 4 Miles of Shore				Facilities Located Beyond 4 Miles of Shore				Total Removal
	Gulf	Pacific	Alaska	<= 4 Mile Subtotal	Gulf	Pacific	Alaska	> 4 Mile Subtotal	
2-BUTANONE	2,058	2,949	0	5,007	0	0	0	0	5,007
2-4-DIMETHYLPHENOL	634	909	0	1,543	0	0	0	0	1,543
ANTHRACENE	37	53	0	90	0	0	0	0	90
BENZENE	2,056	2,945	0	5,001	0	0	0	0	5,001
BENZO(A)PYRENE	23	33	0	56	0	0	0	0	56
CHLOROBENZENE	39	56	0	95	0	0	0	0	95
DI-N-BUTYLPTHALATE	32	46	0	78	0	0	0	0	78
ETHYLBENZENE	532	762	0	1,294	0	0	0	0	1,294
N-ALKANES	3,284	4,704	0	7,988	0	0	0	0	7,988
NAPTHALENE	1,336	1,913	0	3,249	0	0	0	0	3,249
P-CHLORO-M-CRESOL	58	83	0	141	0	0	0	0	141
PHENOL	3,077	4,408	0	7,486	0	0	0	0	7,486
STERANES	155	222	0	377	0	0	0	0	377
TOLUENE	2,960	4,241	0	7,201	0	0	0	0	7,201
TRITERPANES	156	224	0	380	0	0	0	0	380
TOTAL XYLENES	612	876	0	1,488	0	0	0	0	1,488
ALUMINUM	874	1,253	0	2,127	0	0	0	0	2,127
ARSENIC	1,968	2,819	0	4,787	0	0	0	0	4,787
BARIUM	78,811	112,901	0	191,712	0	0	0	0	191,712
BORON	2,935	4,205	0	7,140	0	0	0	0	7,140
CADMIUM	91	130	0	220	0	0	0	0	220
COPPER	520	745	0	1,266	0	0	0	0	1,266
IRON	25,953	37,179	0	63,132	0	0	0	0	63,132
LEAD	781	1,118	0	1,899	0	0	0	0	1,899
MANGANESE	114	163	0	276	0	0	0	0	276
NICKEL	6,824	9,775	0	16,599	0	0	0	0	16,599
TITANIUM	23	34	0	57	0	0	0	0	57
ZINC	7,157	10,253	0	17,410	0	0	0	0	17,410
RADIUM-226	0.0005	0.0006	0.0000	0.0011	0.0000	0	0.0000	0.0000	0.0011
RADIUM-228	0.0006	0.0008	0.0000	0.0013	0.0000	0	0.0000	0.0000	0.0013
Total	143,102	205,001	0	348,103	0	0	0	0	348,103

TABLE B-5

Annual Regionalized Pollutant Removals
BAT Produced Water
Flotation All

Pound Equivalents Removed

Pollutant	Facilities Located Within 3 Miles of Shore				Facilities Located Beyond 3 Miles of Shore				Total Removal
	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	
2-BUTANONE	0	1	0	1	13	2	0	16	17
2-4-DIMETHYLPHENOL	1	3	0	4	51	9	0	60	64
ANTHRACENE	20	80	0	100	1,214	211	0	1,425	1,525
BENZENE	270	1,071	0	1,341	16,295	2,832	0	19,127	20,468
BENZO(A)PYRENE	666	2,644	0	3,310	40,234	6,993	0	47,227	50,537
CHLOROBENZENE	1	3	0	3	40	7	0	47	50
DI-N-BUTYLPTHALATE	3	13	0	16	199	35	0	234	250
ETHYLBENZENE	351	1,395	0	1,746	21,225	3,689	0	24,914	26,661
N-ALKANES	376	1,492	0	1,868	22,705	3,946	0	26,651	28,519
NAPTHALENE	515	2,047	0	2,562	31,140	5,412	0	36,553	39,115
P-CHLORO-M-CRESOL	291	1,156	0	1,447	17,593	3,058	0	20,650	22,098
PHENOL	100	396	0	496	6,029	1,048	0	7,076	7,572
STERANES	18	71	0	88	1,073	187	0	1,260	1,348
TOLUENE	10	39	0	49	592	103	0	695	744
TRITERPANES	18	71	0	89	1,080	188	0	1,268	1,357
TOTAL XYLENES	2,457	9,757	0	12,213	148,448	25,801	0	174,249	186,462
ALUMINUM	9	37	0	46	563	98	0	661	707
ARSENIC	880	3,497	0	4,377	53,206	9,247	0	62,453	66,830
BARIUM	205	815	0	1,020	12,403	2,156	0	14,559	15,579
BORON	8,454	33,575	0	42,029	510,856	88,789	0	599,644	641,674
CADMIUM	27	106	0	133	1,612	280	0	1,892	2,025
COPPER	1,593	6,328	0	7,921	96,280	16,734	0	113,014	120,935
IRON	155	615	0	770	9,354	1,626	0	10,980	11,749
LEAD	238	947	0	1,186	14,411	2,505	0	16,916	18,102
MANGANESE	12	48	0	60	728	126	0	854	914
NICKEL	2,139	8,495	0	10,634	129,256	22,465	0	151,721	162,355
TITANIUM	0	2	0	2	23	4	0	27	29
ZINC	355	1,408	0	1,763	21,423	3,723	0	25,146	26,909
RADIUM-226	152	602	0	754	9,162	1,592	0	10,755	11,508
RADIUM-228	185	736	0	922	11,204	1,947	0	13,151	14,073
Total	19,501	77,450	0	96,951	1,178,413	204,813	0	1,383,226	1,480,176

TABLE B-6

Annual Regionalized Pollutant Removals
BAT Produced Water
Zero 3 Miles Gulf (Pacific and Gulf 1b = Flotation All)

Pound Equivalents Removed

	Facilities Located Within 3 Miles of Shore				Facilities Located Beyond 3 Miles of Shore				
Pollutant	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	Total Removal
2-BUTANONE	0	1	0	1	13	2	0	16	17
2-4-DIMETHYLPHENOL	4	3	0	7	51	9	0	60	67
ANTHRACENE	32	80	0	112	1,214	211	0	1,425	1,537
BENZENE	440	1,071	0	1,511	16,295	2,832	0	19,127	20,638
BENZO(A)PYRENE	1,067	2,644	0	3,712	40,234	6,993	0	47,227	50,939
CHLOROBENZENE	1	3	0	4	40	7	0	47	51
DI-N-BUTYLPTHALATE	5	13	0	18	199	35	0	234	252
ETHYLBENZENE	427	1,395	0	1,822	21,225	3,689	0	24,914	26,736
N-ALKANES	602	1,492	0	2,094	22,705	3,946	0	26,651	28,745
NAPTHALENE	798	2,047	0	2,844	31,140	5,412	0	36,553	39,397
P-CHLORO-M-CRESOL	466	1,156	0	1,623	17,593	3,058	0	20,650	22,273
PHENOL	148	396	0	544	6,029	1,048	0	7,076	7,621
STERANES	28	71	0	99	1,073	187	0	1,260	1,359
TOLUENE	17	39	0	56	592	103	0	695	751
TRITERPANES	29	71	0	100	1,080	188	0	1,268	1,367
TOTAL XYLENES	3,935	9,757	0	13,691	148,448	25,801	0	174,249	187,940
ALUMINUM	24	37	0	61	563	98	0	661	722
ARSENIC	2,293	3,497	0	5,790	53,206	9,247	0	62,453	68,243
BARIUM	535	815	0	1,350	12,403	2,156	0	14,559	15,908
BORON	22,019	33,575	0	55,594	510,856	88,789	0	599,644	655,238
CADMIUM	69	106	0	175	1,612	280	0	1,892	2,068
COPPER	4,150	6,328	0	10,478	96,280	16,734	0	113,014	123,492
IRON	403	615	0	1,018	9,354	1,626	0	10,980	11,997
LEAD	621	947	0	1,568	14,411	2,505	0	16,916	18,484
MANGANESE	31	48	0	79	728	126	0	854	933
NICKEL	5,571	8,495	0	14,066	129,256	22,465	0	151,721	165,787
TITANIUM	1	2	0	3	23	4	0	27	29
ZINC	395	1,408	0	1,803	21,423	3,723	0	25,146	26,949
RADIUM-226	1,383	602	0	1,985	9,162	1,592	0	10,755	12,740
RADIUM-228	1,692	736	0	2,428	11,204	1,947	0	13,151	15,579
Total	47,186	77,450	0	124,636	1,178,413	204,813	0	1,383,226	1,507,861

TABLE B-7

Annual Regionalized Pollutant Removals
BAT Produced Water
Zero Discharge Gulf (Pacific and Gulf 1b = Flotation All)

Pound Equivalents Removed

	Facilities Located Within 3 Miles of Shore				Facilities Located Beyond 3 Miles of Shore				
Pollutant	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	Total Removal
2-BUTANONE	0	1	0	1	22	2	0	24	26
2-4-DIMETHYLPHENOL	4	3	0	7	238	9	0	247	254
ANTHRACENE	32	80	0	112	2,012	211	0	2,223	2,335
BENZENE	440	1,071	0	1,511	27,525	2,832	0	30,357	31,868
BENZO(A)PYRENE	1,067	2,644	0	3,712	66,721	6,993	0	73,713	77,425
CHLOROBENZENE	1	3	0	4	66	7	0	73	77
DI-N-BUTYLPTHALATE	5	13	0	18	330	35	0	365	383
ETHYLBENZENE	427	1,395	0	1,822	26,199	3,689	0	29,888	31,710
N-ALKANES	602	1,492	0	2,094	37,620	3,946	0	41,566	43,660
NAPTHALENE	798	2,047	0	2,844	49,770	5,412	0	55,182	58,027
P-CHLORO-M-CRESOL	466	1,156	0	1,623	29,149	3,058	0	32,207	33,829
PHENOL	148	396	0	544	9,205	1,048	0	10,253	10,797
STERANES	28	71	0	99	1,778	187	0	1,965	2,064
TOLUENE	17	39	0	56	1,044	103	0	1,147	1,202
TRITERPANES	29	71	0	100	1,790	188	0	1,977	2,077
TOTAL XYLENES	3,935	9,757	0	13,691	245,961	25,801	0	271,762	285,453
ALUMINUM	24	37	0	61	1,549	98	0	1,647	1,708
ARSENIC	2,293	3,497	0	5,790	146,405	9,247	0	155,652	161,443
BARIUM	535	815	0	1,350	34,129	2,156	0	36,285	37,634
BORON	22,019	33,575	0	55,594	1,405,716	88,789	0	1,494,505	1,550,099
CADMIUM	69	106	0	175	4,432	280	0	4,713	4,888
COPPER	4,150	6,328	0	10,478	264,929	16,734	0	281,663	292,141
IRON	403	615	0	1,018	25,739	1,626	0	27,364	28,382
LEAD	621	947	0	1,568	39,657	2,505	0	42,161	43,730
MANGANESE	31	48	0	79	2,002	126	0	2,128	2,208
NICKEL	5,571	8,495	0	14,066	355,669	22,465	0	378,134	392,200
TITANIUM	1	2	0	3	63	4	0	67	70
ZINC	395	1,408	0	1,803	24,098	3,723	0	27,821	29,624
RADIUM-226	1,383	602	0	1,985	90,412	1,592	0	92,004	93,990
RADIUM-228	1,692	736	0	2,428	110,561	1,947	0	112,509	114,937
Total	47,186	77,450	0	124,636	3,004,792	204,813	0	3,209,604	3,334,240

TABLE B-8

Annual Regionalized Pollutant Removals
BAT Produced Water
Filter 4 Miles

Pound Equivalents Removed

Pollutant	Facilities Located Within 4 Miles of Shore				Facilities Located Beyond 4 Miles of Shore				Total Removal
	Gulf	Pacific	Alaska	<= 4 Mile Subtotal	Gulf	Pacific	Alaska	> 4 Mile Subtotal	
2-BUTANONE	0	0	0	0	0	0	0	0	0
2-4-DIMETHYLPHENOL	2	2	0	4	0	0	0	0	4
ANTHRACENE	13	19	0	32	0	0	0	0	32
BENZENE	61	88	0	149	0	0	0	0	149
BENZO(A)PYRENE	431	617	0	1,048	0	0	0	0	1,048
CHLOROBENZENE	0	1	0	1	0	0	0	0	1
DI-N-BUTYLPTHALATE	2	3	0	5	0	0	0	0	5
ETHYLBENZENE	139	199	0	337	0	0	0	0	337
N-ALKANES	243	348	0	591	0	0	0	0	591
NAPTHALENE	881	1,262	0	2,143	0	0	0	0	2,143
P-CHLORO-M-CRESOL	217	310	0	527	0	0	0	0	527
PHENOL	59	85	0	145	0	0	0	0	145
STERANES	11	16	0	28	0	0	0	0	28
TOLUENE	5	8	0	13	0	0	0	0	13
TRITERPANES	12	17	0	28	0	0	0	0	28
TOTAL XYLENES	699	1,002	0	1,701	0	0	0	0	1,701
ALUMINUM	56	81	0	137	0	0	0	0	137
ARSENIC	8,178	11,715	0	19,894	0	0	0	0	19,894
BARIUM	157	225	0	382	0	0	0	0	382
BORON	520	744	0	1,264	0	0	0	0	1,264
CADMIUM	58	82	0	140	0	0	0	0	140
COPPER	1,005	1,439	0	2,444	0	0	0	0	2,444
IRON	440	631	0	1,071	0	0	0	0	1,071
LEAD	514	737	0	1,251	0	0	0	0	1,251
MANGANESE	6	9	0	15	0	0	0	0	15
NICKEL	4,612	6,607	0	11,220	0	0	0	0	11,220
TITANIUM	1	1	0	2	0	0	0	0	2
ZINC	466	668	0	1,134	0	0	0	0	1,134
RADIUM-226	588	843	0	1,432	0	0	0	0	1,432
RADIUM-228	720	1,031	0	1,751	0	0	0	0	1,751
Total	20,097	28,790	0	48,887	0	0	0	0	48,887

APPENDIX C

POLLUTANT REMOVAL CALCULATIONS
NSPS PRODUCED WATER

TABLE C-1

Annual Regionalized Pollutant Removals
NSPS Produced Water
Flotation All

Unweighted Removals (pounds)

Pollutant	Facilities Located Within 3 Miles Of Shore				Facilities Located More Than 3 Miles From Shore				Total Removal
	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	
2-BUTANONE	7,491	0	7,688	15,179	80,909	0	2,009	82,918	98,098
2-4-DIMETHYLPHENOL	815	0	836	1,650	8,797	0	218	9,016	10,666
ANTHRACENE	135	0	138	273	1,455	0	36	1,492	1,765
BENZENE	21,268	0	21,827	43,095	229,707	0	5,705	235,412	278,507
BENZO(A)PYRENE	84	0	87	171	912	0	23	935	1,106
CHLOROBENZENE	142	0	145	287	1,531	0	38	1,569	1,856
DI-N-BUTYLPTHALATE	117	0	120	237	1,265	0	31	1,296	1,533
ETHYLBENZENE	3,172	0	3,256	6,428	34,262	0	851	35,113	41,541
N-ALKANES	11,951	0	12,265	24,216	129,074	0	3,206	132,280	156,495
NAPTHALENE	1,839	0	1,887	3,726	19,862	0	493	20,355	24,082
P-CHLORO-M-CRESOL	184	0	189	372	1,985	0	49	2,034	2,406
PHENOL	12,162	0	12,481	24,643	131,352	0	3,262	134,614	159,257
STERANES	564	0	579	1,143	6,094	0	151	6,245	7,389
TOLUENE	12,975	0	13,316	26,291	140,137	0	3,480	143,617	169,908
TRITERPANES	568	0	583	1,151	6,133	0	152	6,286	7,436
TOTAL XYLENES	5,060	0	5,193	10,253	54,651	0	1,357	56,008	66,261
ALUMINUM	341	0	350	691	3,681	0	91	3,772	4,463
ARSENIC	499	0	512	1,011	5,387	0	134	5,521	6,532
BARIUM	242,719	0	249,091	491,810	2,621,445	0	65,105	2,686,550	3,178,360
BORON	112,441	0	115,393	227,834	1,214,400	0	30,160	1,244,560	1,472,394
CADMIUM	99	0	101	200	1,068	0	27	1,095	1,295
COPPER	1,942	0	1,993	3,936	20,979	0	521	21,500	25,436
IRON	21,474	0	22,038	43,512	231,927	0	5,760	237,687	281,199
LEAD	852	0	875	1,727	9,204	0	229	9,432	11,159
MANGANESE	506	0	519	1,026	5,466	0	136	5,602	6,627
NICKEL	7,450	0	7,646	15,096	80,462	0	1,998	82,461	97,556
TITANIUM	31	0	31	62	330	0	8	338	400
ZINC	12,817	0	13,154	25,971	138,428	0	3,438	141,866	167,837
RADIUM-226	0.0003	0.0000	0.0003	0.0006	0.0030	0	0.0001	0.0030	0.0036
RADIUM-228	0.0003	0.0000	0.0003	0.0007	0.0036	0	0.0001	0.0037	0.0044
Total	479,698	0	492,293	971,991	5,180,903	0	128,671	5,309,574	6,281,565

Note: Columns may not sum due to independent rounding.

TABLE C-2

Annual Regionalized Pollutant Removals
NSPS Produced Water
Zero 3 Miles Gulf and Alaska (Pacific = Flotation All)

Unweighted Removals (pounds)

	Facilities Located Within 3 Miles Of Shore				Facilities Located More Than 3 Miles From Shore				
Pollutant	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	Total Removal
2-BUTANONE	12,486	0	12,813	25,299	80,909	0	2,009	82,918	108,217
2-4-DIMETHYLPHENOL	3,848	0	3,949	7,797	8,797	0	218	9,016	16,813
ANTHRACENE	225	0	230	455	1,455	0	36	1,492	1,947
BENZENE	36,144	0	37,093	73,237	229,707	0	5,705	235,412	308,648
BENZO(A)PYRENE	141	0	145	285	912	0	23	935	1,220
CHLOROBENZENE	236	0	242	479	1,531	0	38	1,569	2,048
DI-N-BUTYLPTHALATE	195	0	200	395	1,265	0	31	1,296	1,691
ETHYLBENZENE	3,927	0	4,030	7,957	34,262	0	851	35,113	43,070
N-ALKANES	19,918	0	20,441	40,359	129,074	0	3,206	132,280	172,639
NAPTHALENE	2,956	0	3,033	5,989	19,862	0	493	20,355	26,344
P-CHLORO-M-CRESOL	306	0	314	621	1,985	0	49	2,034	2,654
PHENOL	18,666	0	19,156	37,821	131,352	0	3,262	134,614	172,435
STERANES	940	0	965	1,905	6,094	0	151	6,245	8,151
TOLUENE	23,020	0	23,624	46,644	140,137	0	3,480	143,617	190,261
TRITERPANES	946	0	971	1,918	6,133	0	152	6,286	8,203
TOTAL XYLENES	8,434	0	8,655	17,089	54,651	0	1,357	56,008	73,097
ALUMINUM	947	0	971	1,918	3,681	0	91	3,772	5,690
ARSENIC	1,386	0	1,422	2,807	5,387	0	134	5,521	8,328
BARIUM	674,219	0	691,920	1,366,139	2,621,445	0	65,105	2,686,550	4,052,690
BORON	312,336	0	320,536	632,872	1,214,400	0	30,160	1,244,560	1,877,432
CADMIUM	274	0	282	556	1,068	0	27	1,095	1,651
COPPER	5,396	0	5,537	10,933	20,979	0	521	21,500	32,433
IRON	59,650	0	61,216	120,866	231,927	0	5,760	237,687	358,553
LEAD	2,367	0	2,429	4,797	9,204	0	229	9,432	14,229
MANGANESE	1,406	0	1,443	2,849	5,466	0	136	5,602	8,451
NICKEL	20,694	0	21,238	41,932	80,462	0	1,998	82,461	124,393
TITANIUM	85	0	87	172	330	0	8	338	511
ZINC	14,441	0	14,820	29,262	138,428	0	3,438	141,866	171,128
RADIUM-226	0.0027	0.0000	0.0028	0.0056	0.0030	0	0.0001	0.0030	0.0086
RADIUM-228	0.0034	0.0000	0.0034	0.0068	0.0036	0	0.0001	0.0037	0.0105
Total	1,225,588	0	1,257,765	2,483,353	5,180,903	0	128,671	5,309,574	7,792,927

Note: Columns may not sum due to independent rounding.

TABLE C-3

Annual Regionalized Pollutant Removals
NSPS Produced Water
Zero Discharge Gulf and Alaska (Pacific = Flotation All)

Unweighted Removals (pounds)

	Facilities Located Within 3 Miles Of Shore				Facilities Located More Than 3 Miles From Shore				
Pollutant	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	Total Removal
2-BUTANONE	12,486	0	12,813	25,299	134,848	0	3,349	138,197	163,496
2-4-DIMETHYLPHENOL	3,848	0	3,949	7,797	41,560	0	1,032	42,593	50,390
ANTHRACENE	225	0	230	455	2,426	0	60	2,486	2,941
BENZENE	36,144	0	37,093	73,237	390,366	0	9,695	400,061	473,297
BENZO(A)PYRENE	141	0	145	285	1,522	0	38	1,559	1,845
CHLOROBENZENE	236	0	242	479	2,552	0	63	2,615	3,094
DI-N-BUTYLPTHALATE	195	0	200	395	2,107	0	52	2,160	2,555
ETHYLBENZENE	3,927	0	4,030	7,957	42,411	0	1,053	43,465	51,421
N-ALKANES	19,918	0	20,441	40,359	215,123	0	5,343	220,466	260,825
NAPTHALENE	2,956	0	3,033	5,989	31,921	0	793	32,714	38,703
P-CHLORO-M-CRESOL	306	0	314	621	3,308	0	82	3,390	4,010
PHENOL	18,666	0	19,156	37,821	201,596	0	5,007	206,603	244,424
STERANES	940	0	965	1,905	10,157	0	252	10,409	12,314
TOLUENE	23,020	0	23,624	46,644	248,622	0	6,175	254,797	301,441
TRITERPANES	946	0	971	1,918	10,222	0	254	10,476	12,394
TOTAL XYLENES	8,434	0	8,655	17,089	91,085	0	2,262	93,347	110,436
ALUMINUM	947	0	971	1,918	10,224	0	254	10,478	12,396
ARSENIC	1,386	0	1,422	2,807	14,964	0	372	15,336	18,144
BARIUM	674,219	0	691,920	1,366,139	7,281,792	0	180,847	7,462,640	8,828,779
BORON	312,336	0	320,536	632,872	3,373,332	0	83,779	3,457,111	4,089,982
CADMIUM	274	0	282	556	2,964	0	74	3,038	3,594
COPPER	5,396	0	5,537	10,933	58,274	0	1,447	59,721	70,654
IRON	59,650	0	61,216	120,866	644,239	0	16,000	660,239	781,104
LEAD	2,367	0	2,429	4,797	25,567	0	635	26,202	30,999
MANGANESE	1,406	0	1,443	2,849	15,185	0	377	15,562	18,411
NICKEL	20,694	0	21,238	41,932	223,505	0	5,551	229,056	270,988
TITANIUM	85	0	87	172	917	0	23	940	1,112
ZINC	14,441	0	14,820	29,262	155,970	0	3,874	159,843	189,105
RADIUM-226	0.0027	0.0000	0.0028	0.0056	0.0297	0	0.0007	0.0304	0.0360
RADIUM-228	0.0034	0.0000	0.0034	0.0068	0.0363	0	0.0009	0.0372	0.0440
Total	1,225,588	0	1,257,765	2,483,353	13,236,760	0	328,742	13,565,503	16,048,855

Note: Columns may not sum due to independent rounding.

TABLE C-4

Annual Regionalized Pollutant Removals
NSPS Produced Water
Filter 4 Miles

Unweighted Removals (pounds)

Pollutant	Facilities Located Within 4 Miles of Shore				Facilities Located Beyond 4 Miles of Shore				Total Removal
	Gulf	Pacific	Alaska	<= 4 Mile Subtotal	Gulf	Pacific	Alaska	> 4 Mile Subtotal	
2-BUTANONE	1,468	0	1,281	2,749	0	0	0	0	2,749
2-4-DIMETHYLPHENOL	452	0	395	847	0	0	0	0	847
ANTHRACENE	26	0	23	49	0	0	0	0	49
BENZENE	1,466	0	1,280	2,745	0	0	0	0	2,745
BENZO(A)PYRENE	17	0	14	31	0	0	0	0	31
CHLOROBENZENE	28	0	24	52	0	0	0	0	52
DI-N-BUTYLPTHALATE	23	0	20	43	0	0	0	0	43
ETHYLBENZENE	379	0	331	711	0	0	0	0	711
N-ALKANES	2,341	0	2,044	4,385	0	0	0	0	4,385
NAPTHALENE	952	0	831	1,784	0	0	0	0	1,784
P-CHLORO-M-CRESOL	41	0	36	78	0	0	0	0	78
PHENOL	2,194	0	1,915	4,109	0	0	0	0	4,109
STERANES	111	0	97	207	0	0	0	0	207
TOLUENE	2,110	0	1,843	3,953	0	0	0	0	3,953
TRITERPANES	111	0	97	208	0	0	0	0	208
TOTAL XYLENES	436	0	381	817	0	0	0	0	817
ALUMINUM	623	0	544	1,168	0	0	0	0	1,168
ARSENIC	1,403	0	1,225	2,628	0	0	0	0	2,628
BARIUM	56,185	0	49,057	105,243	0	0	0	0	105,243
BORON	2,093	0	1,827	3,920	0	0	0	0	3,920
CADMIUM	65	0	56	121	0	0	0	0	121
COPPER	371	0	324	695	0	0	0	0	695
IRON	18,502	0	16,155	34,657	0	0	0	0	34,657
LEAD	557	0	486	1,042	0	0	0	0	1,042
MANGANESE	81	0	71	152	0	0	0	0	152
NICKEL	4,865	0	4,247	9,112	0	0	0	0	9,112
TITANIUM	17	0	15	31	0	0	0	0	31
ZINC	5,102	0	4,455	9,557	0	0	0	0	9,557
RADIUM-226	0.0003	0.0000	0.0003	0.0006	0.0000	0.0000	0.0000	0.0000	0.0006
RADIUM-228	0.0004	0.0000	0.0003	0.0007	0.0000	0.0000	0.0000	0.0000	0.0007
Total	102,019	0	89,076	191,095	0	0	0	0	191,095

Note: Columns may not sum due to independent rounding.

TABLE C-5

Annual Regionalized Pollutant Removals
NSPS Produced Water
Flotation All

Pound Equivalent Removals

Pollutant	Facilities Located Within 3 Miles Of Shore				Facilities Located More Than 3 Miles From Shore				Total Removal
	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	
2-BUTANONE	1	0	1	1	6	0	0	6	7
2-4-DIMETHYLPHENOL	2	0	2	4	21	0	1	22	26
ANTHRACENE	47	0	49	96	511	0	13	524	619
BENZENE	635	0	651	1,286	6,856	0	170	7,027	8,313
BENZO(A)PYRENE	1,567	0	1,609	3,176	16,929	0	420	17,350	20,526
CHLOROBENZENE	2	0	2	3	17	0	0	17	20
DI-N-BUTYLPTHALATE	8	0	8	16	84	0	2	86	102
ETHYLBENZENE	827	0	849	1,676	8,931	0	222	9,153	10,828
N-ALKANES	885	0	908	1,792	9,553	0	237	9,791	11,583
NAPTHALENE	1,213	0	1,245	2,458	13,103	0	325	13,428	15,886
P-CHLORO-M-CRESOL	685	0	703	1,389	7,402	0	184	7,586	8,975
PHENOL	235	0	241	476	2,537	0	63	2,600	3,075
STERANES	42	0	43	85	452	0	11	463	547
TOLUENE	23	0	24	47	249	0	6	255	302
TRITERPANES	42	0	43	85	454	0	11	466	551
TOTAL XYLENES	5,783	0	5,935	11,718	62,461	0	1,551	64,013	75,731
ALUMINUM	22	0	23	44	237	0	6	243	287
ARSENIC	2,073	0	2,127	4,200	22,387	0	556	22,943	27,143
BARIUM	483	0	496	979	5,219	0	130	5,348	6,327
BORON	19,902	0	20,425	40,327	214,949	0	5,338	220,287	260,614
CADMIUM	63	0	64	127	678	0	17	695	822
COPPER	3,751	0	3,849	7,600	40,511	0	1,006	41,517	49,117
IRON	364	0	374	738	3,936	0	98	4,033	4,772
LEAD	561	0	576	1,138	6,064	0	151	6,214	7,352
MANGANESE	28	0	29	57	306	0	8	314	371
NICKEL	5,036	0	5,168	10,203	54,386	0	1,351	55,737	65,940
TITANIUM	1	0	1	2	10	0	0	10	12
ZINC	835	0	857	1,691	9,014	0	224	9,238	10,929
RADIUM-226	357	0	366	723	3,855	0	96	3,951	4,674
RADIUM-228	436	0	448	884	4,714	0	117	4,831	5,716
Total	45,909	0	47,114	93,023	495,831	0	12,314	508,146	601,169

Note: Columns may not sum due to independent rounding.

TABLE C-6

Annual Regionalized Pollutant Removals
NSPS Produced Water
Zero 3 Miles Gulf and Alaska (Pacific = Flotation All)

Pound Equivalent Removals

	Facilities Located Within 3 Miles Of Shore				Facilities Located More Than 3 Miles From Shore				
Pollutant	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	Total Removal
2-BUTANONE	1	0	1	2	6	0	0	6	8
2-4-DIMETHYLPHENOL	9	0	10	19	21	0	1	22	41
ANTHRACENE	79	0	81	160	511	0	13	524	683
BENZENE	1,079	0	1,107	2,186	6,856	0	170	7,027	9,213
BENZO(A)PYRENE	2,615	0	2,683	5,298	16,929	0	420	17,350	22,648
CHLOROBENZENE	3	0	3	5	17	0	0	17	23
DI-N-BUTYLPTHALATE	13	0	13	26	84	0	2	86	112
ETHYLBENZENE	1,024	0	1,050	2,074	8,931	0	222	9,153	11,227
N-ALKANES	1,474	0	1,513	2,987	9,553	0	237	9,791	12,778
NAPTHALENE	1,950	0	2,001	3,951	13,103	0	325	13,428	17,379
P-CHLORO-M-CRESOL	1,142	0	1,172	2,315	7,402	0	184	7,586	9,901
PHENOL	360	0	370	730	2,537	0	63	2,600	3,330
STERANES	70	0	72	141	452	0	11	463	604
TOLUENE	41	0	42	83	249	0	6	255	338
TRITERPANES	70	0	72	142	454	0	11	466	608
TOTAL XYLENES	9,639	0	9,892	19,531	62,461	0	1,551	64,013	83,543
ALUMINUM	61	0	63	123	237	0	6	243	366
ARSENIC	5,758	0	5,909	11,667	22,387	0	556	22,943	34,610
BARIUM	1,342	0	1,377	2,720	5,219	0	130	5,348	8,068
BORON	55,283	0	56,735	112,018	214,949	0	5,338	220,287	332,305
CADMIUM	174	0	179	353	678	0	17	695	1,048
COPPER	10,419	0	10,693	21,112	40,511	0	1,006	41,517	62,629
IRON	1,012	0	1,039	2,051	3,936	0	98	4,033	6,085
LEAD	1,560	0	1,601	3,160	6,064	0	151	6,214	9,374
MANGANESE	79	0	81	160	306	0	8	314	473
NICKEL	13,988	0	14,355	28,342	54,386	0	1,351	55,737	84,079
TITANIUM	2	0	3	5	10	0	0	10	15
ZINC	940	0	965	1,905	9,014	0	224	9,238	11,143
RADIUM-226	3,569	0	3,663	7,233	3,855	0	96	3,951	11,183
RADIUM-228	4,365	0	4,480	8,844	4,714	0	117	4,831	13,676
Total	118,121	0	121,222	239,343	495,831	0	12,314	508,146	747,489

Note: Columns may not sum due to independent rounding.

TABLE C-7

Annual Regionalized Pollutant Removals
NSPS Produced Water
Zero Discharge Gulf and Alaska (Pacific = Flotation All)

Pound Equivalent Removals

	Facilities Located Within 3 Miles Of Shore				Facilities Located More Than 3 Miles From Shore				
Pollutant	Gulf	Pacific	Alaska	<= 3 Mile Subtotal	Gulf	Pacific	Alaska	> 3 Mile Subtotal	Total Removal
2-BUTANONE	1	0	1	2	9	0	0	10	11
2-4-DIMETHYLPHENOL	9	0	10	19	101	0	3	104	123
ANTHRACENE	79	0	81	160	851	0	21	873	1,032
BENZENE	1,079	0	1,107	2,186	11,652	0	289	11,941	14,127
BENZO(A)PYRENE	2,615	0	2,683	5,298	28,239	0	701	28,941	34,239
CHLOROBENZENE	3	0	3	5	28	0	1	29	34
DI-N-BUTYLPTHALATE	13	0	13	26	140	0	3	143	170
ETHYLBENZENE	1,024	0	1,050	2,074	11,055	0	275	11,329	13,403
N-ALKANES	1,474	0	1,513	2,987	15,922	0	395	16,318	19,305
NAPTHALENE	1,950	0	2,001	3,951	21,058	0	523	21,581	25,532
P-CHLORO-M-CRESOL	1,142	0	1,172	2,315	12,337	0	306	12,644	14,958
PHENOL	360	0	370	730	3,893	0	97	3,990	4,720
STERANES	70	0	72	141	753	0	19	771	912
TOLUENE	41	0	42	83	442	0	11	453	536
TRITERPANES	70	0	72	142	757	0	19	776	918
TOTAL XYLENES	9,639	0	9,892	19,531	104,102	0	2,585	106,688	126,218
ALUMINUM	61	0	63	123	658	0	16	674	798
ARSENIC	5,758	0	5,909	11,667	62,186	0	1,544	63,730	75,397
BARIUM	1,342	0	1,377	2,720	14,496	0	360	14,856	17,576
BORON	55,283	0	56,735	112,018	597,080	0	14,829	611,909	723,927
CADMIUM	174	0	179	353	1,883	0	47	1,929	2,283
COPPER	10,419	0	10,693	21,112	112,529	0	2,795	115,324	136,435
IRON	1,012	0	1,039	2,051	10,933	0	272	11,204	13,255
LEAD	1,560	0	1,601	3,160	16,844	0	418	17,263	20,423
MANGANESE	79	0	81	160	850	0	21	871	1,031
NICKEL	13,988	0	14,355	28,342	151,071	0	3,752	154,823	183,165
TITANIUM	2	0	3	5	27	0	1	28	33
ZINC	940	0	965	1,905	10,156	0	252	10,408	12,314
RADIUM-226	3,569	0	3,663	7,233	38,551	0	957	39,508	46,741
RADIUM-228	4,365	0	4,480	8,844	47,143	0	1,171	48,314	57,158
Total	118,121	0	121,222	239,343 0	1,275,747	0	31,684	1,307,431	1,546,775

Note: Columns may not sum due to independent rounding.

TABLE C-8

Annual Regionalized Pollutant Removals
NSPS Produced Water
Filter 4 Miles

Pound Equivalent Removals

Pollutant	Facilities Located Within 4 Miles of Shore				Facilities Located Beyond 4 Miles of Shore				Total Removal
	Gulf	Pacific	Alaska	<= 4 Mile Subtotal	Gulf	Pacific	Alaska	> 4 Mile Subtotal	
2-BUTANONE	0	0	0	0	0	0	0	0	0
2-4-DIMETHYLPHENOL	1	0	1	2	0	0	0	0	2
ANTHRACENE	9	0	8	17	0	0	0	0	17
BENZENE	44	0	38	82	0	0	0	0	82
BENZO(A)PYRENE	307	0	268	575	0	0	0	0	575
CHLOROBENZENE	0	0	0	1	0	0	0	0	1
DI-N-BUTYLPTHALATE	2	0	1	3	0	0	0	0	3
ETHYLBENZENE	99	0	86	185	0	0	0	0	185
N-ALKANES	173	0	151	325	0	0	0	0	325
NAPTHALENE	628	0	548	1,177	0	0	0	0	1,177
P-CHLORO-M-CRESOL	154	0	135	289	0	0	0	0	289
PHENOL	42	0	37	79	0	0	0	0	79
STERANES	8	0	7	15	0	0	0	0	15
TOLUENE	4	0	3	7	0	0	0	0	7
TRITERPANES	8	0	7	15	0	0	0	0	15
TOTAL XYLENES	498	0	435	934	0	0	0	0	934
ALUMINUM	40	0	35	75	0	0	0	0	75
ARSENIC	5,830	0	5,091	10,921	0	0	0	0	10,921
BARIUM	112	0	98	210	0	0	0	0	210
BORON	370	0	323	694	0	0	0	0	694
CADMIUM	41	0	36	77	0	0	0	0	77
COPPER	716	0	625	1,342	0	0	0	0	1,342
IRON	314	0	274	588	0	0	0	0	588
LEAD	367	0	320	687	0	0	0	0	687
MANGANESE	5	0	4	8	0	0	0	0	8
NICKEL	3,288	0	2,871	6,159	0	0	0	0	6,159
TITANIUM	0	0	0	1	0	0	0	0	1
ZINC	332	0	290	622	0	0	0	0	622
RADIUM-226	420	0	366	786	0	0	0	0	786
RADIUM-228	513	0	448	961	0	0	0	0	961
Total	14,327	0	12,510	26,837	0	0	0	0	26,837

Note: Columns may not sum due to independent rounding.

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