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Cost-Effectiveness Analysis Of Proposed Effluent Limitations Guidelines And Standards For The Pesticide Formulating, Packaging, And Repackaging Industry

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Section 1
Introduction

This analysis is submitted in support of the proposed effluent limitations guidelines and standards for the Pesticide Formulating, Packaging, and Repackaging (PFPR) Industry. The report analyzes the cost-effectiveness of six alternative Pretreatment Standards for Existing Sources (PSES) regulatory options for Subcategory C facilities based on the original 272 pesticide active ingredients (PAIs) studied for regulation. An additional Subcategory C PSES option covering all PAIs (except sodium hypochlorite) is analyzed. Also, two PSES regulatory options for Subcategory E facilities are evaluated.

Section 2 of the report defines cost-effectiveness, discusses the cost-effectiveness methodology, and describes the relevant regulatory options. Section 3 presents the findings of the analysis covering only the original 272 PAIs. Section 4 provides the results of the analysis of the option including non-272 PAIs. In Section 5, the cost-effectiveness values are compared to cost-effectiveness values for other promulgated rules. Four appendices are also included. Appendix A lists the original 272 pesticide active ingredients on which this analysis is based. Appendix B lists the toxic weighting factors for these 272 PAIs. Appendix C describes the cost-effectiveness results for direct discharging facilities to comply with the existing Best Practicable Control Technology Currently Available (BPT) regulation. Finally, Appendix D provides a sensitivity analysis of POTW removal efficiencies for PAIs.

Section 2
Methodology

This section defines cost-effectiveness, describes the steps taken in the cost-effectiveness analysis, and characterizes the regulatory options considered in the analysis.

Cost-effectiveness calculations are used in setting effluent limitations guidelines to compare the efficiency of one regulatory option in removing pollutants to another regulatory option. Cost-effectiveness is defined as the incremental annual cost of a pollution control option in an industry or industry subcategory per incremental pollutant removal. The increments considered are relative to another option or to a benchmark, such as existing treatment. Pollutant removals are measured in copper-based "pounds-equivalent." The cost-effectiveness value, therefore, represents the unit cost of removing the next pound-equivalent of pollutant. While not required by the Clean Water Act, cost-effectiveness analysis is a useful tool for evaluating regulatory options for the removal of toxic pollutants. Cost-effectiveness analysis is not intended to analyze the removal of conventional pollutants (oil and grease, biological oxygen demand, and total suspended solids). The removal of conventional pollutants is therefore not addressed in this report.

Three factors are of particular importance in cost-effectiveness calculations: (1) the normalization of pounds of pollutant removed to copper-based pounds-equivalent; (2) the incremental nature of cost-effectiveness, and (3) the fact that cost-effectiveness results are used for comparison purposes rather than on an absolute basis. First, the analysis is based on removals of pounds-equivalent - a term used to describe a pound of pollutant weighted by its toxicity relative to copper. These weights are known as toxic weighting factors. Copper is used as the standard pollutant for developing toxic weighting factors because it is a toxic metal commonly released in industrial effluent and removed from that effluent. The use of pounds-equivalent reflects the fact that some pollutants are more toxic than others. Also, by expressing removals in common terms, the removals can be summed across pollutants to give a meaningful basis for comparing cost-effectiveness results among alternative regulatory options or different regulations.

Second, cost-effectiveness analysis is done on an incremental basis to compare the incremental or marginal cost and removals of one control option to another control option or to existing treatment.

The third point is that no absolute scales exist for judging cost-effectiveness values. The values are considered high or low only within a given context, such as similar discharge status or compared to effluent limitations guidelines for other industries.

Cost-effectiveness analysis involves a number of steps, which may be summarized as follows:

- Determine the relevant wastewater pollutants;
- Estimate the relative toxic weights of priority and other pollutants;
- Define the pollution control approaches;
- Calculate pollutant removals for each control option;
- Determine the annualized cost of each control option;
- Rank the control options by increasing stringency and cost;
- Calculate incremental cost-effectiveness values; and
- Compare cost-effectiveness values.

These steps are discussed below.

Pollutant Discharges Considered in the Cost-Effectiveness Analysis

Some of the factors considered in selecting pollutants for regulation include toxicity, frequency of occurrence, and amount of pollutant in the wastestream. The cost-effectiveness of the Pesticide Formulator, Packager, and Repackager (PFPR) effluent limitations guidelines is based on 272 pesticide active ingredients (PAIs). A list of these pollutants is shown in Appendix A. Because priority pollutants generally do not appear in PFPR wastewater, no priority pollutants are included in the analysis.

Relative Toxic Weights of Pollutants

Cost-effectiveness analyses account for differences in toxicity among the regulated pollutants by using toxic weighting factors (TWFs). These factors are necessary because different pollutants have different potential effects on human and aquatic life. For example, a pound of nickel (TWF=0.036) in an effluent stream has significantly less potential effect than a pound of cadmium (TWF=5.12). The toxic weighting factors are used to calculate the pound-equivalent unit - a standardized measure of toxicity.

In the majority of cases, toxic weighting factors are derived from both chronic freshwater aquatic criteria (or toxic effect levels) and human health criteria (or toxic effect levels) established for the consumption of fish.[1] These factors are then standardized by relating them to copper.[2] The resulting toxic weighting factors for each PAI are provided in Appendix B. Some examples of the effects of different aquatic and human health criteria on weighting factors are shown in Table 1.

Table 1
Weighting Factors Based on Copper Freshwater Chronic Criteria

Pollutant	Human Health Criteria* (μg/l)	Aquatic Chronic Criteria (μg/l)	Weighting Calculation	Toxic Weighting Factor
Copper**	--	12.0	5.6/12.0	0.467
Hexavalent Chromium	3,400	11.0	5.6/3,400 + 5.6/11	0.511
Nickel	4,600	160.0	5.6/4,600 + 5.6/160	0.036
Cadmium	170	1.1	5.6/170 + 5.6/1.1	5.12
Benzene	12	265.0	5.6/12 + 5.6/265	0.488

Criteria are maximum contamination thresholds. Using the above calculation, the greater the values for the criteria used, the lower the toxic weighting factor. Units for criteria are micrograms of pollutant per liter of water.

* Based on ingestion of 6.5 grams of fish per day.

** While the water quality criterion for copper has been revised (to 12.0 μg/l), the cost-effectiveness analysis uses the old criterion (5.6 μg/l) to facilitate comparisons with cost-effectiveness values for other effluent limitations guidelines. The revised higher criteria for copper results in a toxic weighting factor for copper not equal to 1.0 but equal to 0.467.

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[1] A complete discussion of the development of the toxic weighting factors can be found in *Toxic Weighting Factors for Pesticide Active Ingredients and Priority Pollutants* Final Report, July 13, 1993, located in the Administrative Record.

[2] While the water quality criterion for copper has been revised (to 12.0 μg/l), the cost-effectiveness analysis uses the old criterion (5.6 μg/l) to facilitate comparisons with cost-effectiveness values for other effluent limitations guidelines. The revised higher criterion for copper results in a toxic weighting factor for copper equal to 0.467, not 1.0.

As indicated in Table 1, the toxic weighting factor is the sum of two criteria-weighted ratios: the "old" copper criterion divided by the human health criterion for the particular pollutant, and the "old" copper criterion divided by the aquatic chronic criterion. For example, using the values reported in Table 1, 10.96 pounds of copper pose the same relative hazard in surface waters as one pound of cadmium, since cadmium has a toxic weight 10.96 times (5.12/0.467 = 10.96) as large as the toxic weight of copper.

Pollution Control Options

This analysis considers the cost-effectiveness of a Pretreatment Standard for Existing Sources (PSES) regulation applicable to indirect discharging facilities. Two Subcategories of facilities are examined: Subcategory C (Pesticide Formulating, Packaging, and Repackaging Facilities), and Subcategory E (Refilling Establishments). Six PSES regulatory options are evaluated for Subcategory C facilities, and two PSES options are evaluated for Subcategory E facilities. The six options examined for Subcategory C facilities are as follows:

- **Option 1** consists of end-of-pipe treatment for the entire wastewater volume now generated by PFPR facilities through the Universal Treatment System[3] and discharge to POTWs.

- **Option 2** adds pollution prevention by recycling wastewaters generated from cleaning the interiors of formulating and packaging equipment and raw material and shipping containers into the product to recover product value in the wastewaters. Other wastewaters are still expected to be treated through the Universal Treatment System and discharged to POTWs.

- **Option 3** employs the same technology and pollution prevention practices as Option 2 but achieves zero discharge of all process wastewater by recycling the wastewater back to the facility after treatment through the Universal Treatment System.

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[3]The Universal Treatment System consists of chemical emulsion breaking, hydrolysis, chemical oxidation, sulfide precipitation and activated carbon filtration treatment technologies.

- **Option 3/S** corresponds to Option 3 except that certain non-interior source wastewater streams are exempted from the regulatory requirements. Specifically, for facilities that process sanitizer chemicals, *the zero discharge requirement would not apply to physically separate, non-interior wastewater streams that contain only six sanitizer chemicals.* These non-interior wastewater streams include exterior equipment and floor wash, leak and spill cleanup, safety equipment rinsate, contaminated precipitation run-off, laboratory wastewater, air pollution control wastewater, and DOT test bath water. The *zero discharge requirement would apply to the interior wastewater streams of these facilities including discharge from cleaning the interiors of drum/shipping containers, bulk containers, and other equipment.*

- **Option 4** incorporates the pollution prevention aspects of Options 2 and 3, but instead of treatment, adds off-site disposal to an incinerator of the rest of the wastewater.

- **Option 5** disposes of all wastewater through off-site incineration.

The two options considered for Subcategory E facilities are:

- **Option 1** assumes that contaminated wastewater is used as make-up water in the application of pesticide chemicals to the field.

- **Option 2** disposes of wastewater through off-site incineration.

Calculation of Pollutant Removals

The reductions in pollutant loadings to the receiving water body were calculated for each control option. At-stream and end-of-pipe pollutant removals may differ because a portion of the end-of-pipe loadings for indirect dischargers may be removed by the POTW. As a result, the at-stream removal of pollutants due to PSES regulations are considered to be less than end-of-pipe removals. The cost-effectiveness analysis is based upon removals at-stream.

For example, if a facility is discharging 100 pounds of cadmium in its effluent stream to a POTW and the POTW has a removal efficiency for cadmium of 38 percent, then the cadmium discharged to surface waters is only 62 pounds. If a regulation results in a reduction of cadmium in the effluent stream to 50 pounds, then the amount discharged to surface waters is calculated as 50 pounds multiplied by the POTW removal efficiency factor (1 - 0.38, or 0.62). Cost-effectiveness calculations reflect the fact that the actual reduction of pollutant discharge to surface waters is not 50 pounds (the change in the amount discharged to the POTW), but 31 pounds (= 62 - 31), the change in the amount ultimately discharged to surface waters.[4]

Annualized Costs for Each Control Option

Full details of the methods by which the costs of complying with the regulatory options were estimated can be found in the Technical Development Document. A brief summary of the compliance cost analysis is provided below.

Two categories of compliance costs were analyzed: (1) capital costs, and (2) operating and maintenance costs (including sludge disposal and self-monitoring costs). Although capital costs are one-time "lump sum" costs, operating and maintenance costs occur annually. The capital equipment is conservatively estimated to have a productive life of ten years. Using a real weighted average cost of capital, the capital costs are amortized to account for the cost of financing the investment (through equity and debt) over the ten-year period.[5] Total annualized costs are equal to annualized capital costs plus operating and maintenance costs. For ease of estimating costs, EPA assumed that non-manufacturing PFPR facilities have no treatment in place. For the PFPR/manufacturing facilities, it is assumed that, if possible, the facilities will build on existing treatment. The reported costs are the full costs of compliance to society, some of which will be borne by the government in the form of decreased tax receipts. The analysis therefore overstates the burden of the regulations on industry.

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[4]POTW removal efficiencies are not available for PAIs and are assumed to be zero. A laboratory study of the PAI removal performance that would be achieved by biotreatment at well-operated POTWs applying secondary treatment is reported in the Domestic Sewage Study (see the Technical Development Document). However, the data used for that analysis were derived under laboratory conditions, and therefore tend to overestimate POTW removal efficiencies and are considered to be inappropriate for the cost-effectiveness analysis. A sensitivity analysis based on 50 percent POTW removal efficiency for all PAIs is considered in Appendix D.

[5]For details on the real weighted average cost of capital, see the discussion of the facility impact analysis in *Economic Impact Analysis of Proposed Effluent Limitations Guidelines and Standards for the Pesticide Formulating, Packaging, and Repackaging Industry* (hereafter the Proposed EIA).

Compliance costs were estimated in terms of 1988 dollars. For the purpose of comparing cost-effectiveness values of the options under review to those of other promulgated rules, the compliance costs used in the cost-effectiveness analysis are deflated from to 1981 dollars using Engineering News Record's Construction Cost Index (CCI). This adjustment factor is:

$$\textit{Adjustment factor} = \frac{1981\ CCI}{1988\ CCI} = \frac{3535}{4519} = 0.7823$$

Stringency and Cost Ranking

The regulatory options are ranked to determine relative cost-effectiveness. Options are first ranked in increasing order of stringency, where stringency is aggregate pollutant removals, measured in pounds-equivalent. If two or more options remove equal amounts of pollutants, these options are then ranked in increasing order of cost. For example, if two or more options specify zero discharge, the removals under each option would be equal. The options would then be ranked from least expensive to most expensive.

Calculation of Incremental Cost-Effectiveness Values

After the options have been ranked by stringency and cost, the incremental cost-effectiveness values can be calculated. Cost-effectiveness values are calculated separately for Subcategories C and E. For a given subcategory, the cost-effectiveness value of a particular option is calculated as the incremental annual cost of that option divided by the incremental pounds-equivalent removed by that option. Algebraically, this equation is:

$$CE_k = \frac{ATC_k - ATC_{k-1}}{PE_k - PE_{k-1}}$$

where:

CE_k	=	Cost-effectiveness of Option k;
ATC_k	=	Total annualized compliance cost under Option k; and
PE_k	=	Removals in pounds-equivalent under Option k.

The numerator of the equation is the incremental cost in going from Option k-1 to Option k. Similarly, the denominator is the incremental removals associated with the move from Option k-1 to Option k. Thus, cost-effectiveness values are measured in dollars per pound-equivalent of pollutant removed. The incremental change can be from another regulatory option or from a baseline scenario.

Comparisons of Cost-Effectiveness Values

Two types of comparisons are typically done using cost-effectiveness values. First, compliance costs and pollutant removals may be plotted to derive a marginal cost curve to determine which options offer the most cost-effective regulatory control. The cost-effectiveness value calculated in the move from one option to another represents such a marginal cost curve. Second, the cost-effectiveness of regulatory options incremental to the baseline scenario can be used to assess the cost-effectiveness of controls relative to previously promulgated effluent limitations guidelines for other industries.

Section 3
Results Using Original 272 PAIs

The cost-effectiveness analysis is based on EPA's estimates of the full societal cost of compliance and wastewater pollutant removals associated with six Pretreatment Standards for Existing Sources (PSES) options for indirect discharging Subcategory C (Pesticide Formulating, Packaging, Repackaging Facilities) and two PSES options for Subcategory E (Refilling Establishments).

Subcategory C

Table 2 presents the estimated total annualized costs, total pounds and total pounds-equivalent of pollutants removed for the six options.

Table 2
National Estimate of Annualized Costs and Removals Under PSES
SUBCATEGORY C FACILITIES

Option	Annualized Cost, MM $ (1981 dollars)	Pound Removals	Pound-Equivalent Removals
Option 1	$25.4	111,653	12,127,075
Option 2	$21.8	111,683	12,127,666
Option 3/S	$20.4	111,793	12,134,031
Option 3	$21.8	111,996	12,134,051
Option 4*	$224.1	111,996	12,134,051
Option 5*	$281.8	111,996	12,134,051

*These options result in additional costs with no additional removals.

Table 3 presents the incremental cost-effectiveness values for the six options considered for Subcategory C. As the table shows, the cost-effectiveness of Option 1 is $2.10 per pound-equivalent of pollutant removed. Option 1 is very cost-effective when compared to the cost-effectiveness values of other effluent limitations guidelines. Movement from Option 1 to Option 2 and from Option 2 to Option 3/S is cost-effective relative to Option 1 because costs are reduced while removals increase. Movement from Option 3/S to Option 3 is substantially less efficient than movement from Option 1 to Option 2 or from Option 2 to Option 3/S. The average cost-effectiveness of Option 3 is $1.79 per pound-equivalent and for Option 3/S is $1.68. Options 4 and 5 are not cost-effective as they result in additional costs with no additional removals relative to Option 3. Option 3/S is the most cost-effective option. Successive improvements in weighted removals are achieved at progressively lower costs by moving from Option 1 through Option 2 to Option 3/S. Further movement from Option 3/S to Options 3, 4 or 5 provides minor additional removals at substantially higher marginal cost.

Table 3
Estimated Industry Incremental Cost-Effectiveness Under PSES
SUBCATEGORY C FACILITIES

Option	Cost-Effectiveness, $/lb.	Cost-Effectiveness, $/lb-eq.
Incremental from Baseline to Option 1	$227.87	$2.10
Incremental from Option 1 to Option 2	-$121,746*	-$6,232*
Incremental from Option 2 to Option 3/S	-$12,513*	-$215.86*
Incremental from Option 3/S to Option 3	$6,790	$71,252
Incremental from Option 3 to Option 4	undefined**	undefined**
Incremental from Option 4 to Option 5	undefined**	undefined**

Dollar values are in constant 1981 dollars.

* Options are ranked by increasing levels of pollutant removals. Negative cost-effectiveness numbers mean that costs have decreased from the previous option, while removals have increased, improving cost-effectiveness.

** These options result in additional costs with no additional removals. Therefore, the incremental cost-effectiveness ratio (incremental cost/incremental removals) is undefined.

EPA is not able to estimate cost-effectiveness values for the regulatory options by PAIs or groups of PAIs for several reasons. First, wastestreams containing multiple PAIs are often commingled at PFPR facilities. This commingling occurs because of the physical set-up of the PFPR lines and because products are often made with more than one PAI. EPA estimated compliance costs on a facility-specific basis, in part due to this commingling, therefore costs are not available at a PAI-specific level within a facility.

EPA is able, however, to estimate cost-effectiveness values classifying facilities by their primary markets. Question 19 of the Survey Introduction asked respondents to report the percentage of pesticide revenue obtained from nine specific markets: agricultural, institutional/commercial, industrial, wood preservatives, intermediate products, professional use, consumer home/lawn/garden, government use, and additives. The analysis assumed that the market from which a facility received at least 50 percent of its pesticide revenue is the primary market for that facility. The primary market a facility reports does not necessarily relate to the PAIs used by that facility. Many PAIs appear in products that have several uses, and those products may be used in more than one market. Table 4 provides the estimated industry incremental cost-effectiveness disaggregated by primary market. As the table illustrates, Option 3/S is cost-effective when considered relative to other effluent guidelines.

Table 4
Estimated Industry Incremental Cost-Effectiveness Under PSES, Disaggregated by Primary Market
SUBCATEGORY C FACILITIES
($ / lb-eq)

Option	Agricultural Market	Institutional / Commercial Market	Industrial Market	Wood Preserv. Market	Intermed. Market	Profess. Use Market	Cons. Home / Lawn / Garden Market	Govt Use Market	Additives Market
Incremental from Baseline to Option 1	inefficient*	inefficient*	inefficient*	inefficient*	inefficient*	inefficient*	inefficient*	inefficient*	inefficient*
Incremental from Option 1 to Option 2	inefficient*	inefficient*	inefficient*	inefficient*	inefficient*	inefficient*	inefficient*	inefficient*	inefficient*
Incremental from Baseline to Option 3/S	$3.61	$1.64	$27.88	$0.62	$8.34	$113.76	$0.39	$28.32	$6.51
Incremental from Option 3/S to Option 3	**	$77,785	$2,279	$24,621	**	**	$59,990	**	$285 MM
Incremental from Option 3 to Option 4	**	**	**	**	**	**	**	**	**
Incremental from Option 4 to Option 5	**	**	**	**	**	**	**	**	**

Dollar values are in constant 1981 dollars.

* Options are ranked by increasing levels of pollutant removals. Options labelled as "inefficient" achieve lower removals, or have higher costs, or both, relative to Option 3/S.

** These options result in additional costs with no additional removals. Therefore, the incremental cost-effectiveness ratio (incremental cost/incremental removals) is undefined.

Subcategory E

Table 5 presents the estimated total annualized costs, total pounds, and total pounds-equivalent of pollutants removed for the two options considered for Subcategory E facilities. Option 1, the proposed option, is expected to be achieved with zero additional costs.

Table 5 National Estimate of Annualized Costs and Removals Under PSES SUBCATEGORY E FACILITIES			
Option	**Annualized Cost, (1981 dollars)**	**Pound Removals**	**Pound-Equivalent Removals**
Option 1	$0	1.0	1.3
Option 2*	$1,507	1.0	1.3
*This option results in additional costs with no additional removals.			

Because Option 1 is expected to be met with no additional compliance costs, its cost-effectiveness is zero. Option 2 requires additional costs but results in no additional removals, so its cost-effectiveness value is undefined. Therefore, Option 1 is the more cost-effective option.

Section 4
Results Using Additional Non-272 PAIs

EPA also estimated the cost-effectiveness of including under the proposed option all other PAIs not on the list of 272 PAIs studied in detail. This section presents the estimated cost-effectiveness of including these additional PAIs under the proposed PSES regulation for Subcategory C facilities. The regulatory option considered in this section is the same as Option 3/S discussed in the preceding section, with the exception that its regulatory coverage is broadened to include the additional non-272 PAIs. To distinguish the analysis of the proposed regulation including the non-272 PAIs from the preceding analysis based only on the 272 PAIs, the following discussion refers to the regulation *including coverage of the additional non-272 PAIs* as Option 3/S′.

Because toxic weighting factors are not available for the non-272 PAIs, two separate cost-effectiveness analyses of Option 3/S′ were performed. The first analysis assumes that no non-272 PAIs are removed from the wastestreams. This is a highly conservative approach, because costs to treat the non-272 PAIs are included, but credit is not taken for removal of those PAIs.[6] The second analysis estimates an average toxic weighting factor for the non-272 PAIs based on the toxic weighting factors of the original 272 PAIs. These analyses and results are discussed below.

<u>Without Considering Non-272 PAI Removals</u>

To conservatively estimate the cost-effectiveness of Option 3/S′, EPA calculated the cost-effectiveness of the option accounting for costs to remove non-272 PAIs but without considering the additional removals of non-272 PAIs. Table 6 presents the total annualized compliance costs and removals under this assumption.

Table 6
National Estimate of Annualized Costs and Removals Under PSES of Option 3/S′, Considering Non-272 PAI Costs but not Non-272 PAI Removals
SUBCATEGORY C FACILITIES

Option	Annualized Cost, MM $ (1981 dollars)	Pound Removals	Pound-Equivalent Removals
Option 3/S′	$43.9	111,793	12,134,031

[6]For a discussion of the compliance cost estimates under Option 3/S′, see Chapter 12 of the EIA.

Under this conservative assumption, the average cost-effectiveness of Option 3/S′ is $3.62 per pound-equivalent. Thus, Option 3/S′ is very cost-effective when compared to the cost-effectiveness values of other effluent limitations guidelines.

Considering Non-272 PAI Removals

A more realistic assessment of the cost-effectiveness of Option 3/S′ would recognize the additional pollutant removals achieved by the inclusion of the non-272 PAIs. Toxic weighting factors (TWFs) for these additional PAIs are not available, however. To provide a surrogate for the TWFs for these PAIs, EPA assumed that the weighted average toxicity of the pre-compliance loadings of non-272 PAIs is the same as that for pre-compliance loadings of the original 272 PAIs. Specifically, EPA estimated an weighted average TWF for the non-272 PAIs by dividing the pre-compliance pound-equivalent loadings of 272 PAIs by the pre-compliance loadings in pounds. This ratio yielded a weighted average TWF of 108.3436. The estimated pre-compliance loadings in pounds of non-272 PAIs was multiplied by this average TWF to provide pre-compliance pound-equivalent loadings.

For the post-compliance analysis, all loadings are among the designated sanitizer PAIs, because Option 3/S′ specifies zero discharge of all PAIs other than the designated sanitizer PAIs. To estimate the toxic-weighted loadings of the non-272 sanitizer PAIs in post-compliance discharge, EPA assumed that the weighted average toxicity of these loadings would be the same as the simple average of TWFs for the sanitizer PAIs among the original 272 PAIs. Specifically, EPA multiplied the average TWF for 272 sanitizer PAIs (0.1953) by the post-compliance loadings of non-272 sanitizer PAIs to estimate the pound-equivalent loadings of these PAIs. The quantity of pollutant removals due to Option 3/S′ was then calculated as the difference between the pre-compliance and post-compliance loadings. Table 7 presents the total and incremental estimates of compliance costs, pollutant removals, and cost-effectiveness, using these average TWFs for non-272 PAIs.

Table 7 National Estimate of Annualized Costs and Removals Under PSES of Option 3/S′, Considering Non-272 PAI Costs and Removals SUBCATEGORY C FACILITIES				
Option	**Annualized Cost, MM $ (1981 dollars)**	**Pound Removals**	**Pound-Equivalent Removals**	**Cost-Effectiveness, $ / lb-eq.**
Option 3/S	$20.4	111,793	12,134,031	$1.68
Incremental from Option 3/S to Option 3/S′	$23.5	198,662	21,613,832	$1.09
Option 3/S′	$43.9	310,455	33,747,863	$1.30
Note: Toxicity of the non-272 PAIs is estimated as the average pre-compliance loading-weighted average toxicity of the 272 PAIs.				

As Table 6 indicates, Option 3/S′ is very cost-effective when compared to the cost-effectiveness values of other effluent limitations guidelines. Movement from Option 3/S to Option 3/S′ is cost-effective; the incremental cost-effectiveness value is $1.09 per pound-equivalent. The average cost-effectiveness of Option 3/S′ is $1.30 per pound-equivalent.

Section 5
Comparision of Cost-Effectiveness Values with Promulgated Rules

Table 8 illustrates the cost-effectiveness values for effluent limitations guidelines issued for indirect dischargers in other industries. The proposed PSES rule for pesticide formulating, packaging, repackaging facilities is cost-effective when compared to the cost-effectiveness values for other effluent limitations guidelines.

Table 8
Industry Comparison of Cost-Effectiveness for Indirect Dischargers (Toxic and Nonconventional Pollutants Only) Copper Based Weights (1981 Dollars)*

Industry	Pounds Equivalent Currently Discharged (To Surface Waters) (000's)	Pounds Equivalent Remaining at Selected Option (To Surface Waters) (000's)	Cost Effectiveness Selected Option Beyond BPT** ($/lb-eq. removed)
Aluminum Forming	1,602	18	155
Battery Manufacturing	1,152	5	15
Can Making	252	5	38
Coal Mining***	N/A	N/A	N/A**
Coil Coating	2,503	10	10
Copper Forming	34	4	10
Electronics I	75	35	14
Electronics II	260	24	14
Foundries	2,136	18	116
Inorganic Chemicals I	3,971	3,004	9
Inorganic Chemicals II	4,760	6	****
Iron & Steel	5,599	1,404	6
Leather Tanning	16,830	1,899	111
Metal Finishing	11,680	755	10
Nonferrous Metals Forming	89	5	90
Nonferrous Metals Mfg I	3,187	19	15
Nonferrous Metals Mfg II	38	0.41	12
OCPSF	5,210	72	34
Pesticide Manufacturing	257	19	18
Pharmaceuticals	340	63	1
Plast. Molding & Forming	N/A	N/A	N/A
Porcelain Enameling	1,565	96	14
Pulp & Paper *****	9,539	103	65

* Although toxic weighting factors for priority pollutants varied across these rules, this table reflects the cost-effectiveness at the time of regulation.
** N/A: Pretreatment Standards not promulgated, or no incremental costs will be incurred.
*** Reflects costs and removals of both air and water pollutants
**** Less than a dollar.
***** Results shown for proposed rules, December 1993.

Appendix A

Original 272 Pesticide Active Ingredients Considered for Regulation

This appendix provides the original 272 pesticide active ingredients considered for regulation.

Pesticide Number	Pesticide Name	CAS Number
1	Dicofol [1,1-Bis(chlorophenyl)-2,2,2-trichloroethanol]	00115-32-2
2	Maleic Hydrazide	00123-33-1
3	EDB [1,2-Ethylene dibromide]	00106-93-4
4	Vancide TH [1,3,5-Triethylhexahydro-s-triazine]	07779-27-3
5	Dichloropropene	00542-75-6
6	Oxybiphenoarsine	00058-36-6
7	Dowicil 75 [1-(3-Chloroallyl)-3,5,7-triaza-1-azoniaadamantanechloride]	04080-31-3
8	Triadimefon	43121-43-3
9	Hexachlorophene (nabac)	00070-30-4
10	Tetrachlorophene	01940-43-8
11	Dichlorophene	00097-23-4
12	Dichlorvos	00062-73-7
13	Landrin-2 [2,3,5-trimethylphenylmethylcarbamate]	02686-99-9
14	Fenac [2,3,6-Trichlorophenylacetic acid] or any salt or ester	00085-34-7
15	2,4,5-T [2,4,5-Trichlorophenoxyacetic acid] or any salt or ester	00093-76-5
16	2,4-D [2,4-Dichlorophenoxyacetic acid] or any salt or ester	00094-75-7
17	2,4-DB [2,4-Dichlorophenoxybutyric acid] or any salt or ester	00094-82-6
18	Anilazine [2,4-Dichloro-6-(o-chloroanilino)-s-triazine]	00101-05-3
19	Dinocap	39300-45-3
20	Dichloran (2,6-dichloro-4-nitroaniline)	00099-30-9
21	Busan 90 [2-Bromo-4-hydroxyacetophenone]	02491-38-5
22	Mevinphos	07786-34-7
23	Sulfallate [2-chloroallyldiethyldithiocarbamate]	00095-06-7
24	Chlorfenvinphos	00470-90-6
25	Cyanazine	21725-46-2
26	Propachlor	01918-16-7
27	MCPA [2-Methyl-4-chlorophenoxyacetic acid] or any salt or ester	00094-74-6
28	Octhilinone	26530-20-1
29	Pindone	00083-26-1
30	Dichlorprop [2-(2,4-Dichlorophenoxy) propionic acid] or any salt or ester	00120-36-5
31	MCPP [2-(2-Methyl-4-chlorophenoxy)propionic acid] or any salt or ester	00093-65-2
32	Thiabendazole	00148-79-8
33	Belclene 310 [2-(methylthio)-4-(ethylamino)-6-(1,2-dimethylamino)-s-triazine]	22936-75-0
34	Cloprop [2-(m-Chlorophenoxy)propionic acid] or any salt or ester	00101-10-0
35	TCMTB [2-(Thiocyanomethylthio)benzothiazole]	21564-17-0

Pesticide Number	Pesticide Name	CAS Number
36	HAE [2-((Hydroxymethyl)amino) ethanol	34375-28-5
37	Chlorophacinone	03691-35-8
38	Landrin-1 [3,4,5-trimethylphenylmethylcarbamate]	02686-99-9
39	Pronamide	23950-58-5
40	Methiocarb	02032-65-7
41	Propanil	00709-98-8
42	Polyphase antimildew [3-Iodo-2-propynyl butylcarbamate]	55406-53-6
43	3-(a-Acetonylfurfuryl)-4-hydroxycoumarin [Coumafuryl] or any salt or ester	00117-52-2
44	DNOC (4,6-dinitro-o-cresol)	00534-52-1
45	Metribuzin	21087-64-9
46	CPA (4-chlorophenoxyacetic acid) or any salt or ester	00122-88-3
47	MCPB [4-(2-Methyl-4-chlorophenoxy)butyric acid] or any salt or ester	00094-81-5
48	Aminocarb [4-(dimethylamino)-m-tolylmethylcarbamate]	02032-59-9
49	Etridiazole	02593-15-9
50	Ethoxyquin	00091-53-2
51	Quinoliol sulfate (8-Quinoliol sulfate)	00134-31-6
52	Acephate	30560-19-1
53	Acifluorfen or any salt or ester	50594-66-6
54	Alachlor	15972-60-8
55	Aldicarb	00116-06-3
56	Hyamine 3500 [Alkyl* dimethyl benzyl ammonium chloride * (50% C14, 40% C12, 10% C16)]	68424-85-1
57	Allethrin (all isomers and allethrin coil)	00584-79-2
58	Ametryn	00834-12-8
59	Amitraz	33089-61-1
60	Atrazine	01912-24-9
61	Bendiocarb	22781-23-3
62	Benomyl and Carbendazim	17804-35-2
63	Benzene Hexachloride	00608-73-1
64	Benzyl benzoate	00120-51-4
65	Lethane 384 [Beta-Thiocyanoethyl esters of mixed fatty acids containing from 10-18 carbons]	00301-11-1
66	Bifenox	42576-02-3
67	Biphenyl	00092-52-4
68	Bromacil or any salt or ester	00314-40-9
69	Bromoxynil or any salt or ester	01689-84-5
70	Butachlor	23184-66-9

Pesticide Number	Pesticide Name	CAS Number
71	Giv-gard [β-Bromo-β-nitrostyrene]	07166-19-0
72	Cacodylic acid or any salt or ester	00075-60-5
73	Captafol	02425-06-1
74	Captan	00133-06-2
75	Carbaryl [Sevin]	00063-25-2
76	Carbofuran	01563-66-2
77	Carbosulfan	55285-14-8
78	Chloramben or any salt or ester	00133-90-4
79	Chlordane	00057-74-9
80	Chloroneb	02675-77-6
81	Chloropicrin	00076-06-2
82	Chlorothalonil	01897-45-6
83	Chloroxuron	01982-47-4
84	Stirofos	00961-11-5
85	Chlorpyrifos methyl	05598-13-0
86	Chlorpyrifos	02921-88-2
87	Mancozeb	08018-01-7
88	Bioquin	10380-28-6
89	Copper EDTA	01495-19-18
90	Fenvalerate	51630-58-1
91	Cycloheximide	00066-81-9
92	Dalapon (2,2-dichloropropionic acid) or any salt or ester	00075-99-0
93	Dienochlor	02227-17-0
94	Demeton [O,O-Diethyl O-(and S-) (2-ethylthio)ethyl) phosphorothioate]	08065-48-3
95	Desmedipham	13684-56-5
96	Diammonium ethylenebisdithiocarbamate	03566-10-7
97	DBCP [Dibromo-3-chloropropane]	00096-12-8
98	Dicamba [3,6-Dichloro-o-anisic acid] or any salt or ester	01918-00-9
99	Dichlone (Phygon)	00117-80-6
100	Thiophanate ethyl	23564-06-9
101	Perthane [Diethyl diphenyl dichloroethane and related compounds]	00072-56-0
102	EXD [Diethyl dithiobis (thionoformate)]	00502-55-6
103	Diazinon	00333-41-5
104	Diflubenzuron	35367-38-5
105	Benzethonium chloride	00121-54-0
106	Dimethoate	00060-51-5

Pesticide Number	Pesticide Name	CAS Number
107	Parathion methyl	00298-00-0
108	Dicrotophos	00141-66-2
109	Crotoxyphos	07700-17-6
110	DCPA [Dimethyl 2,3,5,6-tetrachloroterephthalate]	01861-32-1
111	Trichlorofon	00052-68-6
112	Dinoseb	00088-85-7
113	Dioxathion	00078-34-2
114	Diphacinone	00082-66-6
115	Diphenamid	00957-51-7
116	Diphenylamine	00122-39-4
117	MGK 326 [Dipropyl isocinchomeronate]	00113-48-4
118	Nabonate [Disodium cyanodithioimidocarbonate]	00138-93-2
119	Diuron	00330-54-1
120	Metasol DGH [Dodecylguanidine hydrochloride]	13590-97-1
121	Dodine (dodecylquanidine acetate)	02439-10-3
122	Endosulfan [Hexachlorohexahydromethano-2,4,3-benzodioxathiepin-3-oxide]	00115-29-7
123	Endothall or any salt or ester	00145-73-3
124	Endrin	00072-20-8
125	Ethalfluralin	55283-68-6
126	Ethion	00563-12-2
127	Ethoprop	13194-48-4
128	Fenamiphos	22224-92-6
129	Chlorobenzilate	00510-15-6
130	Butylate	02008-41-5
131	Famphur	00052-85-7
132	Fenarimol	60168-88-9
133	Fenthion	00055-38-9
134	Ferbam	14484-64-1
135	Fluometuron	02164-17-2
136	Fluoroacetamide	00640-19-7
137	Folpet	00133-07-3
138	Glyphosate [N-(Phosphonomethyl) glycine] or any salt or ester	01071-83-6
139	Glyphosine	02439-99-8
140	Heptachlor	00076-44-8
141	Cycloprate	54460-46-7
142	Hexazinone	51235-04-2
143	Isofenphos	25311-71-1

Pesticide Number	Pesticide Name	CAS Number
144	Isopropalin	33820-53-0
145	Propham	00122-42-9
146	Karbutilate	04849-32-5
147	Lindane	00058-89-9
148	Linuron	00330-55-2
149	Malachite green [Ammonium(4-(p-(dimethylamino)-alpha-phenylbenzylidine)-2,5-cyclohexadien-1-ylidene)-dimethyl chloride]	00569-64-2
150	Malathion	00121-75-5
151	Maneb	12427-38-2
152	Manganous dimethyldithiocarbamate	15339-36-3
153	Mefluidide [N-(2,4-dimethyl-5-(((trifluoromethyl) sulfonyl)-amino) phenyl acetamide] or any salt or ester	53780-34-0
154	Methamidophos	10265-92-6
155	Methidathion	00950-37-8
156	Methomyl	16752-77-5
157	Methoprene	40596-69-8
158	Methoxychlor	00072-43-5
159	Methylbenzethonium chloride	15716-02-6
160	Methylbromide	00074-83-9
161	Methylarsonic acid or any salt or ester	00124-58-3
162	Hyamine 2389 [Methyldodecylbenzyl trimethyl ammonium chloride 80% and methyldodecylxylylene bis (trimethylammoniumchloride) 20%]	01399-80-0
163	Methylenebisthiocyanate	06317-18-6
164	Quinmethionate	02439-01-2
165	Metolachlor	51218-45-2
166	Mexacarbate	00315-18-4
167	Metiram	09006-42-2
168	Monuron TCA	00140-41-0
169	Monuron	00150-68-5
170	Napropamide	15299-99-7
171	Deet	00134-62-3
172	Nabam	00142-59-6
173	Naled	00300-76-5
174	Norea	18530-56-8
175	Norflurazon	27314-13-2
176	Naptalam [N-1-Naphthylphthalamic acid] or any salt or ester	00132-66-1
177	MGK 264 [N-2-Ethylhexyl bicycloheptene dicarboximide]	00136-45-8

Pesticide Number	Pesticide Name	CAS Number
178	Benfluralin	01861-40-1
179	Sulfotepp	03689-24-5
180	Aspon	03244-90-4
181	Coumaphos	00056-72-4
182	Fensulfothion	00115-90-2
183	Disulfoton	00298-04-4
184	Fenitrothion	00122-14-5
185	Phosmet	00732-11-6
186	Azinphos Methyl	00086-50-0
187	Oxydemeton methyl	00301-12-2
188	Organo-arsenic pesticides	-----
189	Organo-cadmium pesticides	-----
190	Organo-copper pesticides	-----
191	Organo-mercury pesticides	-----
192	Organo-tin pesticides	-----
193	Orthodichlorobenzene	00095-50-1
194	Oryzalin	19044-88-3
195	Oxamyl	23135-22-0
196	Oxyfluorfen	42874-03-3
197	Bolstar [Sulprofos]	35400-43-2
198	Sulprofos Oxon	38527-90-1
199	Santox (O-Ethyl O-(p-nitrophenyl) phenylphosphonothioate	02104-64-5
200	Fonofos	00944-22-9
201	Propoxur (o-Isopropylphenylmethylcarbamate)	00114-26-1
202	Paradichlorobenzene	00106-46-7
203	Parathion	00056-38-2
204	Pendimethalin	40487-42-1
205	Pentachloronitrobenzene	00082-68-8
206	Pentachlorophenol or any salt or ester	00087-86-5
207	Perfluidone	37924-13-3
208	Permethrin	52645-53-1
209	Phenmedipham	13684-63-4
210	Phenothiazine	00092-84-2
211	Phenylphenol	00090-43-7
212	Phorate	00298-02-2
213	Phosalone	02310-17-0
214	Phosphamidon	13171-21-6
215	Picloram or any salt or ester	01918-02-1

Pesticide Number	Pesticide Name	CAS Number
216	Piperonyl butoxide	00051-03-6
217	PBED (Busan 77) [Poly (oxyethylene (dimethylimino) ethylene (dimethylimino) ethylene dichloride]	31512-74-0
218	Busan 85 [Potassium dimethyldithiocarbamate]	00128-03-0
219	Busan 40 [Potassium N-hydroxymethyl-N-methyldithiocarbamate]	51026-28-9
220	KN Methyl [Potassium N-methyldithiocarbamate]	00137-41-7
221	Metasol J26 [Potassium N-(alpha-(nitroethyl) benzyl)-ethylenediamine]	53404-62-9
222	Profenofos	41198-08-7
223	Prometon	01610-18-0
224	Prometryn	07287-19-6
225	Propargite	02312-35-8
226	Propazine	00139-40-2
227	Propionic acid	00079-09-4
228	Propamocarb and Propamocarb HCL	24579-73-5
229	Pyrethrin coils	-----
230	Pyrethrin I	00121-21-1
231	Pyrethrin II	00121-29-9
232	Pyrethrum (other than pyrethrins)	08003-34-7
233	Resmethrin	10453-86-8
234	Ronnel	00299-84-3
235	Rotenone	00083-79-4
236	DEF [S,S,S-Tributyl phosphorotrithioate]	00078-48-8
237	Siduron	01982-49-6
238	Silvex [2-(2,4,5-Trichlorophenoxypropionic acid)] or any salt or ester	00093-72-1
239	Simazine	00122-34-9
240	Bentazon	25057-89-0
241	Carbam-S [Sodium dimethyldithiocarbanate]	00128-04-1
242	Sodium monofluoroacetate	00062-74-8
243	Vapam [Sodium methyldithiocarbamate]	00137-42-8
244	Sulfoxide	00120-62-7
245	Cycloate	01134-23-2
246	EPTC [S-Ethyl dipropylthiocarbamate]	00759-94-4
247	Molinate	02212-67-1
248	Pebulate	01114-71-2
249	Vernolate	01929-77-7
250	HPTMS [S-(2-Hydroxypropyl) thiomethanesulfonate]	29803-57-4

Pesticide Number	Pesticide Name	CAS Number
251	Bensulide	00741-58-2
252	Tebuthiuron	34014-18-1
253	Temephos	03383-96-8
254	Terbacil	05902-51-2
255	Terbufos	13071-79-9
256	Terbuthylazine	05915-41-3
257	Terbutryn	00886-50-0
258	Tetrachlorophenol or any salt or ester	25167-83-3
259	Dazomet	00533-74-4
260	Thiophanate methyl	23564-05-8
251	Thiram	00137-26-8
262	Toxaphene	08001-35-2
263	Merphos [Tributyl phosphorotrithioate]	00150-50-5
264	Trifluralin	01582-09-8
265	Warfarin [3-(a-Acetonylbenzyl)-4-hydroxycoumarin] or any salt or ester	00081-81-2
266	Zinc MBT [Zinc 2-mercaptobenzothiazolate]	00155-04-4
267	Zineb	12122-67-7
268	Ziram	00137-30-4
269	S-(2,3,3-trichloroallyl) diisopropylthiocarbamate	02303-17-5
270	Phenothrin	26002-80-2
271	Tetramethrin	07696-12-0
272	Chloropropham	00101-21-3

Appendix B
Toxic Weighting Factors for Pesticide Active Ingredients

This appendix provides the toxic weighting factors (TWFs) used in the analysis. Toxic weighting factors for pesticide active ingredients are listed in Table B-1.

TABLE B–1. TOXIC WEIGHTING FACTORS FOR PESTICIDE ACTIVE INGREDIENTS (PAIs)
(CARCINOGENIC HUMAN HEALTH VALUES BASED ON A 10–5 RISK)

EAD PAI No.	CAS No.	Pollutant Name	Aquatic Life Chronic Value (ug/l)	Human Health Ingesting Organisms Only Value (ug/l)	TOXIC WEIGHTING FACTORS (TWFs) Chronic	Human	Total	
A052	30560191	Acephate	320	1,200	0.017	0.005	0.022	
A053	50594664	Acifluorfen \ Blazer	850		0.0066	–	0.0066	
A054	15972608	Alachlor \ Lasso	10	682	0.560	0.0082	0.568	
A055	116063	Aldicarb \ Temik	2.5	1,080	2.24	0.0052	2.25	
A057	584792	Allethrin	0.021		267	–	267	
A058	834128	Ametryn	32	855	0.175	0.0065	0.182	
A048	2032599	Aminocarb \ Matacil	0.60		9.33	–	9.3	
A059	33089612	Amitraz	13	45	0.431	0.124	0.555	
A096	3566107	Amobam	891		0.0063	–	0.0063	
A018	101053	Anilazine \ Dyrene	0.0027	7,700	2,074	0.0007	2,074	
A188	637036	Arsenobenzene			–	–	ND	
A180	3244904	Aspon	3.5		1.60	–	1.60	
A060	1912249	Atrazine	60	730	0.093	0.0077	0.101	
A186	86500	Azinphos methyl \ Guthion, methyl–	0.01	200	560	0.028	560	
A033	22936750	Belclene 310	30		0.187	–	0.187	
A061	22781233	Bendiocarb \ Ficam	23.5	7,200	0.238	0.0008	0.239	
A178	1861401	Benfluralin \ Benefin	3.7	570	1.51	0.0098	1.52	
A062	17804352	Benomyl \ Benlate	0.30	13,100	18.7	0.0004	18.7	
A251	741582	Bensulide \ Betesan	7		0.800	–	0.800	
A240	25057890	Bentazon	193,700	2600	2.89E–05	0.0022	2.18E–03	
A105	121540	Benzethonium chloride	14		0.40	–	0.40	
A064	120514	Benzyl benzoate	233		0.024	–	0.024	
A147	58899	BHC, gamma– \ Lindane	0.08	0.625	70.0	9.0	79	
A063	608731	BHC, technical–	1	0.460	5.6	12.2	17.8	
A066	42576023	Bifenox	23.5		0.238	–	0.238	
A088	380286	Bioquin	12		0.467		0.467	(a)
A067	92524	Biphenyl	15	1,235	0.3733	0.0045	0.378	
A197	35400432	Bolstar \ Sulprofos	52		0.108	–	0.108	
A068	314409	Bromacil	1,000		0.0056	–	0.0056	
A160	74839	Bromomethane	550	57.0 *	0.010	0.098	0.108	
A069	1689845	Bromoxynil	0.5	1,320	11.2	0.0042	11.2	
A259	533744	Busamid \ Dazomet \ Mylone	295		0.019	–	0.019	
A219	51026289	Busan 40	1.4		4.00	–	4.0	(b)
A035	21564170	Busan 72	6		0.933	–	0.933	
A217	31512740	Busan 77 \ PBED	10		0.560	–	0.560	
A218	128030	Busan 85	3		1.87	–	1.87	
A021	2491385	Busan 90	42.2		0.133	–	0.133	
A070	23184669	Butachlor	2.6		2.15	–	2.15	
A130	2008415	Butylate	10.5	32,600	0.533	0.0002	0.534	
A073	2425061	Captafol \ Difolatan	1	8,000	5.60	0.0007	5.6	
A074	133062	Captan	1.7	3,800	3.29	0.0015	3.30	
A241	128041	Carbam–S	34		0.165	–	0.165	
A075	63252	Carbaryl \ Sevin	0.02	4,000	280	0.0014	280	
A076	1563662	Carbofuran \ Furadan	2.4	4,500	2.33	0.0012	2.33	
A077	55285148	Carbosulfan	0.15	110	37.3	0.051	37.4	
A078	133904	Chloramben	500	6,200	0.011	0.0009	0.012	
A079	57749	Chlordane	0.0043	0.0059	1,302	949	2,251	
A024	470906	Chlorfenvinphos \ Supona	10.95	580	0.511	0.0097	0.521	

TABLE B-1. TOXIC WEIGHTING FACTORS FOR PESTICIDE ACTIVE INGREDIENTS (PAIs) (CARCINOGENIC HUMAN HEALTH VALUES BASED ON A 10-5 RISK)

EAD PAI No.	CAS No.	Pollutant Name	Aquatic Life Chronic Value (ug/l)	Human Health Ingesting Organisms Only Value (ug/l)	TOXIC WEIGHTING FACTORS (TWFs) Chronic	Human	Total
A129	510156	Chlorobenzilate	7	103	0.800	0.054	0.854
A080	2675776	Chloroneb	1,200		0.0047	–	0.0047
A037	3691358	Chlorophacinone	150		0.037	–	0.04
A046	122883	Chlorophenoxyacetic acid, 4– (CPA)	6,250		0.001	–	0.001
A081	76062	Chloropicrin	0.95		5.89	–	5.9
A082	1897456	Chlorothalonil	0.076	850	73.68	0.0066	73.69
A083	1982474	Chloroxuron	4.3		1.30	–	1.30
A272	101213	Chlorpropham	324	100,000	0.017	5.60E–05	0.017
A085	5598130	Chlorpyrifos methyl	1	98	5.60	0.057	5.7
A086	2921882	Chlorpyrifos \ Dursban	0.041	11.8	137	0.475	137
A089	14951918	Copper EDTA	12		0.467	–	0.467 (a)
A043	117522	Coumafuryl	0.34	25	16.5	0.224	16.7 (c)
A181	56724	Coumaphos	0.001		5,600	–	5,600
A109	7700176	Crotoxyphos \ Ciodrin	0.55		10.2	–	10.2
A025	21725462	Cyanazine	100	2,900	0.056	0.0019	0.058
A245	1134232	Cycloate	45		0.124	–	0.124
A091	66819	Cycloheximide	70		0.080	–	0.080
A141	54460467	Cycloprate \ Zardex	0.432		13.0	–	13.0
A106	60515	Cygon \ Dimethoate	2.2	27	2.55	0.207	2.75
A092	75990	Dalapon	550	103,000	0.010	5.44E–05	0.010
A017	94826	DB, 2,4– salts and esters	20	740	0.280	0.0076	0.288
A110	1861321	DCPA \ Dacthal	62	11,200	0.090	0.0005	0.091
A171	134623	Deet	3,750		0.0015	–	0.0015
A236	78488	DEF	0.27	0.1	20.7	56.0	76.7
A094	8065483	Demeton \ Systox	0.1	0.95	56.0	5.89	61.9
A187	301122	Demeton–O–methyl	0.4	16,000	14.0	0.0004	14.0
A095	13684565	Desmedipham \ Betanex	6		0.933	–	0.933
A103	333415	Diazinon \ Spectracide	0.009	630	622	0.0089	622
A097	96128	Dibromo–3–chloropropane, 1,2–	810		0.0069	–	0.0069
A098	1918009	Dicamba	195	23,100	0.029	0.0002	0.029
A099	117806	Dichlone \ Phygon	0.14		40.0	–	40.0
A011	97234	Dichlorophen	36		0.156	–	0.156
A016	94757	Dichlorophenoxyacetic acid, 2,4–	80	1,960	0.0700	0.0029	0.073
A005	542756	Dichloropropene, 1,3–	4.5	87 *	1.24	0.064	1.31
A030	120365	Dichlorprop	2,340		0.0024	–	0.0024
A012	62737	Dichlorvos	0.001	12	5,600	0.467	5,600
A020	99309	Dicloran \ Botran	147	7,300	0.038	0.0008	0.039
A001	115322	Dicofol \ Kelthane	0.53	0.0098	10.6	571.429	582.0
A108	141662	Dicrotophos \ Bidrin	21.5	1,080	0.26	0.01	0.27
A093	2227170	Dienochlor \ Pentac	0.002		3,294	–	3,294
A104	35367385	Diflubenzuron	0.16	940	35.0	0.0060	35.0
A044	534521	Dinitro–o–cresol, 4,6–	3.3	765	1.70	0.0073	1.70
A019	39300453	Dinocap \ Karathane	0.15		37.3	–	37.3
A112	88857	Dinoseb \ DNBP	0.32	30	17.5	0.187	17.7
A113	78342	Dioxathion	0.09	150	62.2	0.037	62.3
A114	82666	Diphacinone	105		0.053	–	0.053
A115	957517	Diphenamid	1,600	108,000	0.0035	5.19E–05	0.0036
A116	122394	Diphenylamine	378	1,000	0.015	0.0056	0.020

TABLE B–1. TOXIC WEIGHTING FACTORS FOR PESTICIDE ACTIVE INGREDIENTS (PAIs) (CARCINOGENIC HUMAN HEALTH VALUES BASED ON A 10–5 RISK)

EAD PAI No.	CAS No.	Pollutant Name	Aquatic Life Chronic Value (ug/l)	Human Health Ingesting Organisms Only Value (ug/l)	TOXIC WEIGHTING FACTORS (TWFs)		
					Chronic	Human	Total
A183	298044	Disulfoton	0.05	0.9	112	6.22	118
A119	330541	Diuron \ DCMU	1.6	150	3.50	0.037	3.54
A121	2439103	Dodecylguanidine monoacetate	100	740	0.056	0.0076	0.064
A007	4080313	Dowicil 75	420		0.013	–	0.013
A122	115297	Endosulfan mixed isomers	0.056	2	100	2.800	103
A123	145733	Endothall	7	431,000	0.800	1.30E–05	0.800
A124	72208	Endrin	0.0023	0.81	2,435	6.91	2,442
A199	2104645	EPN \ Santox	0.0056	0.009	1,000	622	1,622
A246	759944	EPTC	575	12,600	0.0097	0.0004	0.010
A125	55283686	Ethalfluralin	0.08		70.0	–	70.0
A126	563122	Ethion \ Bladan	0.02	3.6	280	1.556	282
A127	13194484	Ethoprophos	11.5	15	0.487	0.4	0.860
A050	91532	Ethoxyquin	212		0.026	–	0.026
A003	106934	Ethylene dibromide	608	0.13	0.0092	43.1	43.1
A049	2593159	Etridiazole	12.1		0.463	–	0.463
A102	502556	EXD			–	–	ND
A131	52857	Famphur \ Famophos	48.5		0.12	–	0.12
A014	85347	Fenac \ Chlorfenac	55		0.102	–	0.102
A128	22224926	Fenamiphos	5.5	180	1.02	0.031	1.05
A132	60168889	Fenarimol \ Rubigan	9.1		0.615	–	0.615
A184	122145	Fenitrothion	0.5	330	11	0.017	11
A182	115902	Fensulfothion \ Desanit	0.5	81	11.2	0.069	11.3
A133	55389	Fenthion \ Baytex	0.006	4.7	933	1.19	935
A090	51630581	Fenvalerate \ Pydrin	0.036	680	156	0.0082	156
A134	14484641	Ferbam	4.5	830,000	1.24	6.75E–06	1.24
A135	2164172	Fluometuron	30	3,400	0.187	0.0016	0.188
A136	640197	Fluoroacetamide, 2–	2,000		0.0028	–	0.0028
A137	133073	Folpet	0.39	50	14.4	0.11	14.5
A200	944229	Fonofos	0.07	144	80.0	0.039	80.0
A071	7166190	Giv–gard	0.2		28.0	–	28.0
A138	1071836	Glyphosate \ Roundup	65	34,700	0.086	0.0002	0.086
A139	1333240	Glyphosine			–	–	ND
A036	34375285	HAE	4.27E+07		1.31E–07	–	1.31E–07
A140	76448	Heptachlor	0.0038	0.0021	1,474	2,667	4,140
A009	70304	Hexachlorophene	1.5	0.009	3.73	622	626
A142	51235042	Hexazinone	5,000	3,540,000	0.0011	1.58E–06	0.0011
A250	29803574	HPTMS	486		0.012	–	0.012
A162	1399800	Hyamine 2389	60		0.093	–	0.093
A056	68424851	Hyamine 3500	60		0.093	–	0.093 (d)
A072	75605	Hydroxydimethylarsine oxide		65	–	0.086	0.086
A143	25311711	Isofenphos	400	72	0.014	0.078	0.092
A144	33820530	Isopropalin	1	273	5.60	0.021	5.6
A146	4849325	Karbutilate	3,750		0.0015	–	0.0015
A220	137417	KN Methyl	1.4		4.00	–	4.00 (b)
A038	2686999	Landrin I	50		0.112	–	0.112
A013	2655154	Landrin II	50		0.112	–	0.112
A065	112561	Lethane 384	160		0.03	–	0.03
A148	330552	Linuron	90	300	0.062	0.019	0.081

TABLE B-1. TOXIC WEIGHTING FACTORS FOR PESTICIDE ACTIVE INGREDIENTS (PAIs) (CARCINOGENIC HUMAN HEALTH VALUES BASED ON A 10-5 RISK)

EAD PAI No.	CAS No.	Pollutant Name	Aquatic Life Chronic Value (ug/l)	Human Health Ingesting Organisms Only Value (ug/l)	TOXIC WEIGHTING FACTORS (TWFs) Chronic	Human	Total
A149	569642	Malachite green	0.305		18.4	–	18.4
A150	121755	Malathion	0.100	2,700	56	0.0021	56
A002	123331	Maleic hydrazide	6,250	54,000,000	0.0009	1.04E-07	0.0009
A087	8018017	Mancozeb	23	89,700	0.243	6.24E-05	0.244
A151	12427382	Maneb \ Vancide	17	54,000,000	0.329	1.04E-07	0.329
A027	94746	MCPA	60	380	0.093	0.015	0.108
A047	94815	MCPB	3.5	1,770	1.60	0.0032	1.60
A031	93652	MCPP \ Mecoprop	445	8,970	0.013	0.0006	0.013
A153	53780340	Mefluidide	5,000		0.0011	–	0.0011
A263	150505	Merphos \ Folex	13	0.22	0.431	25.5	25.9
A120	13590971	Metasol DGH	100	740	0.056	0.0076	0.064 (e)
A221	53404629	Metasol J26	60		0.093	–	0.093 (d)
A243	137428	Metham sodium \ Vapam	1.4		4.00	–	4.00
A154	10265926	Methamidophos	2,300	5,980	0.0024	0.0009	0.0034
A155	950378	Methiadathion \ Supracide	0.11	234	50.9	0.024	50.9
A040	2032657	Methiocarb	0.25	120	22.4	0.0467	22.4
A156	16752775	Methomyl \ Lannate	0.05	269,000	112	2.08E-05	112
A157	40596698	Methoprene	15.5	1,300	0.361	0.0043	0.366
A158	72435	Methoxychlor	0.03	6.5	187	0.862	188
A159	15716026	Methyl benzethonium chloride	14		0.40	–	0.40 (f)
A161	124583	Methylarsonic acid	40,500		0.0001	–	0.0001
A167	9006422	Metiram	64		0.088	–	0.088
A165	51218452	Metolachlor	100	23,400	0.056	0.0002	0.06
A045	21087649	Metribuzin	2,100	135,000	0.0027	4.15E-05	0.0027
A022	7786347	Mevinphos \ Phosdrin	0.002	212,000	2,800	2.64E-05	2,800
A166	315184	Mexacarbate \ Mexcarbole \ Zectran	0.5		11.2	–	11.2
A177	113484	MGK 264	130		0.043	–	0.043
A117	136458	MGK 326	666		0.0084	–	0.0084
A247	2212671	Molinate	10.5	360	0.533	0.016	0.549
A169	150685	Monuron	4,455		0.0013	–	0.0013
A168	140410	Monuron TCA	5,000		0.0011	–	0.0011
A172	142596	Nabam	9.8		0.571	–	0.571
A118	138932	Nabonate	1.4		4.00	–	4.0 (b)
A163	6317186	Nalco D-2303	3.5		1.60	–	1.60
A173	300765	Naled \ Dibrom	0.004	3,100	1,400	0.0018	1,400
A170	15299997	Napropamide	400	21,500	0.014	0.0003	0.014
A176	132661	Naptalam	3,800		0.0015	–	0.0015
A152	15339363	Niacide	4.5	820,000	1.24	6.83E-06	1.24 (g)
A174	18530568	Norea \ Noruron	70		0.080	–	0.080
A175	27314132	Norflurazon	10,000		0.0006	–	0.0006
A028	26530201	Octhilinone			–	–	ND
A273		Organo-antimony compounds	30	4,300	0.187	0.0013	0.188 (h)
A189		Organo-cadmium compounds	1.1	170	5.09	0.0329	5.12 (h)
A190		Organo-copper compounds	12		0.467	–	0.467 (h)
A191		Organo-mercury compounds	0.012	0.146	466.7	38	505 (h)
A192		Organo-tin compounds	0.017	0.2	329.4	28	357 (i)
A194	19044883	Oryzalin	9.5	9,100	0.589	0.0006	0.590
A195	23135220	Oxamyl \ Vydate	24	138,000	0.233	4.06E-05	0.233

TABLE B–1. TOXIC WEIGHTING FACTORS FOR PESTICIDE ACTIVE INGREDIENTS (PAIs) (CARCINOGENIC HUMAN HEALTH VALUES BASED ON A 10–5 RISK)

EAD PAI No.	CAS No.	Pollutant Name	Aquatic Life Chronic Value (ug/l)	Human Health Ingesting Organisms Only Value (ug/l)	TOXIC WEIGHTING FACTORS (TWFs) Chronic	Human	Total
A196	42874033	Oxyfluorofen	124	18	0.045	0.311	0.356
A203	56382	Parathion ethyl	0.013	125	431	0.045	431
A107	298000	Parathion methyl	0.007	39	800	0.144	800
A248	1114712	Pebulate \ Tillam	370		0.015	–	0.015
A204	40487421	Pendimethalin \ Prowl	4.20	372	1.33	0.015	1.35
A205	82688	Pentachloronitrobenzene \ Quintozene	6.60	27	0.8	0.211	1.1
A206	87865	Pentachlorophenol	13	29,000	0.431	0.0002	0.431
A207	37924132	Perfluidone	15,600		0.0004	–	0.0004
A208	52645532	Permethrin \ Ambush \ Pounce	0.023	4,300	243.5	0.0013	243.5
A101	72560	Perthane \ Ethylan	0.04		140	–	140
A209	13684634	Phenmedipham \ Bentanal	165		0.034	–	0.034
A210	92842	Phenothiazine	198		0.028	–	0.028
A006	58366	Phenoxarsine, 10,10'–oxydi–	0.018		311	–	311
A211	90437	Phenylphenol, o–	59.9	798	0.093	0.0070	0.101
A212	298022	Phorate \ Famophos \ Thimet	0.006	3.40	933	1.65	935
A213	2310170	Phosalone \ Azofone	1	76	5.60	0.074	5.7
A185	732116	Phosmet \ Imidan	0.1	2,600	56.0	0.0022	56.0
A214	13171216	Phosphamidon \ Dimecron	0.14	2,700	40.0	0.0021	40.0
A215	1918021	Picloram	1.35	1,400,000	4.15	4.00E–06	4.15
A029	83261	Pindone	8,630		0.0006	–	0.0006
A216	51036	Piperonyl butoxide	18.0	120	0.31	0.05	0.36
A244	120627	Piperonyl sulfoxide	17.7		0.316	–	0.316
A042	55406536	Polyphase \ Guardsan 388	7,030		0.0008	–	0.0008
A228	25606411	Previcur N \ Propamocarb HCL	11,750	720,000	0.0005	7.78E–06	0.0005
A222	41198087	Profenofos \ Curacron	0.008		700	–	700
A223	1610180	Prometon \ Pramitol	86	150	0.065	0.037	0.102
A224	7287196	Prometyrn \ Caparol	25	170	0.224	0.033	0.257
A039	23950585	Pronamide	3,600	8,100,000	0.0016	6.91E–07	0.0016
A026	1918167	Propachlor	8.5	10,200	0.659	0.0005	0.659
A041	709988	Propanil	23	485	0.243	0.012	0.255
A227	79094	Propanoic acid	2,500		0.0022	–	0.0022
A225	2312358	Propargite/BPPS	1	7,100	5.60	0.0008	5.6
A226	139402	Propazine	875	1,900	0.0064	0.0029	0.009
A145	122429	Propham	400	3,300	0.014	0.0017	0.016
A034	5825876	Propionamide, 2–(m–Chlorophenoxy)	1,050		0.0053	–	0.0053
A201	114261	Propoxur \ Baygon	0.650	4,600	8.62	0.0012	8.6
A230	121211	Pyrethrin I	0.014	513	400	0.011	400
A231	121299	Pyrethrin II	0.014	3,400	400	0.0016	400
A275	8003347	Pyrethrins	0.014	513	400	0.011	400
A051	134316	Quinolinol sulfate			–	–	ND
A164	2439012	Quinomethionate/Oxythioquinox	0.74		7.57	–	7.6
A233	10453868	Resmethrin	0.0028	436	2,000	0.013	2,000
A234	299843	Ronnel	1		5.60	–	5.6
A235	83794	Rotenone \ Mexide	0.026	226	215	0.025	215
A237	1982496	Siduron	900		0.0062	–	0.0062
A239	122349	Simazine	10		0.560	–	0.560
A242	62748	Sodium fluoroacetate	2,000		0.0028	–	0.0028 (j)
A023	95067	Sulfallate \ CDEC	58		0.097	–	0.097

TABLE B-1. TOXIC WEIGHTING FACTORS FOR PESTICIDE ACTIVE INGREDIENTS (PAIs) (CARCINOGENIC HUMAN HEALTH VALUES BASED ON A 10-5 RISK)

EAD PAI No.	CAS No.	Pollutant Name	Aquatic Life Chronic Value (ug/l)	Human Health Ingesting Organisms Only Value (ug/l)	TOXIC WEIGHTING FACTORS (TWFs)		
					Chronic	Human	Total
A198	38527901	Sulprofos oxon	52		0.108	–	0.108 (k)
A270	26002802	Sumithrin \ Phenothrin	0.17		32.9	–	32.9
A252	34014181	Tebuthiuron	5,600	188,000	0.0010	2.98E-05	0.0010
A253	3383968	Temephos \ Abate	0.5		11.2	–	11.2
A254	5902512	Terbacil	3.5	70,000	1.60	8.00E-05	1.60
A255	13071799	Terbufos \ Counter	0.01	74	560	0.1	560
A256	5915413	Terbuthylazine	46		0.122	–	0.122
A257	886500	Terbutryn	8.2	26	0.683	0.215	0.898
A010	1940438	Tetrachlorophene	18.3		0.306	–	0.306
A258	58902	Tetrachlorophenol, 2,3,4,6-	10	3,000	0.560	0.0019	0.562
A084	961115	Tetrachlorvinphos \ Gardona \ Stirofos	4.3	1,200	1.30	0.0047	1.31
A179	3689245	Tetraethyldithiopyrophosphate	0.08	192	70.0	0.029	70.0
A271	7696120	Tetramethrin \ Neo-pynamin	0.7		8.00	–	8.0
A032	148798	Thiabendazole \ Mertect	365	47,500	0.015	0.0001	0.015
A100	23564069	Thiophanate ethyl	4,950		0.0011	–	0.0011
A260	23564058	Thiophanate methyl	89	2,800	0.063	0.0020	0.065
A261	137268	Thiram	1.05	472	5.33	0.012	5.3
A262	8001352	Toxaphene	0.0002	0.0075	28,000	747	28,747
A008	43121433	Triadimefon	500	36,400	0.011	0.0002	0.011
A269	2303175	Tri-allate \ Far-Go	4.9	171	1.14	0.033	1.18
A111	52686	Trichlorofon \ Dylox	0.265	74,800	21	0.0001	21
A015	93765	Trichlorophenoxyacetic acid, 2,4,5-	7.5	1,657	0.747	0.0034	0.750
A238	93721	Trichlorophenoxypropionic acid, 2,4,5-	6	330	0.933	0.017	0.950
A264	1582098	Trifluralin \ Treflan	1.9	4.1	2.95	1.37	4.3
A266	155044	Vancide 51Z \ Zetax			–	–	ND
A004	7779274	Vancide TH	36.7		0.1526	–	0.153
A249	1929777	Vernolate	11.5	220	0.487	0.025	0.512
A265	81812	Warfarin	0.34	25	16.5	0.224	16.7
A267	12122677	Zineb \ Dithane Z	9.70	3,170	0.5773	1.77E-03	0.579
A268	137304	Ziram \ Cymate	15	2.20E+08	0.373	2.55E-08	0.373

Notes:

* These pollutants are volatile priority pollutants. Therefore, the human health criteria (organisms only) has been replaced with the criteria for (water and organisms). See text for discussion.

a. The TWF for copper is reported for these compounds since the complexes could release copper into the environment
b. The TWF of metham sodium (vapam) is used for these compounds due to structural similarity.
c. The TWF of warfarin is used for this compound due to structural similarity.
d. The TWF of hyamine 2389 is used for these structurally similar quaternary ammonium compounds.
e. The TWF of dodecylguanidine monoacetate is used for this compound due to structural similarity.
f. The TWF of benzethonium chloride is used for this compound due to structural similarity.
g. The TWF of ferbam is used for this compound due to structural similarity.
h. The TWF for the base metals of these compounds is reported assuming the toxicity is mainly due to the bound metal.
i. The TWF for tributyltin oxide is reported for these compounds since it is the most probable PAI related pollutant in wastewaters.
j. The TWF of 2-fluoroacetamide is used for this compound due to structural similarity.

TABLE B−1. TOXIC WEIGHTING FACTORS FOR PESTICIDE ACTIVE INGREDIENTS (PAIs) (CARCINOGENIC HUMAN HEALTH VALUES BASED ON A 10−5 RISK)

EAD PAI No.	CAS No.	Pollutant Name	Aquatic Life Chronic Value (ug/l)	Human Health Ingesting Organisms Only Value (ug/l)	TOXIC WEIGHTING FACTORS (TWFs) Chronic	Human	Total

k. The TWF of bolstar \ sulprofos is used for this compound due to structural similarity.

Appendix C
Results of Compliance with the Existing 1978 BPT Regulation

This appendix describes the results of the cost-effectiveness analysis for direct discharging facilities to comply with the existing 1978 Best Practicable Control Technology Currently Available (BPT) regulation. The analysis is based on EPA's estimates of the full societal cost of compliance and wastewater pollutant removals associated with six BPT options for direct discharging Subcategory C facilities. These options are analogous to the PSES options described in Section 2.

Table C-1 presents the estimated total annualized costs, total pounds and total pounds-equivalent of pollutants removed for the six options.

Table C-1
National Estimate of Annualized Costs and Removals Under BPT
SUBCATEGORY C FACILITIES

Option	Annualized Cost, MM $ (1981)	Pound Removals	Pound-Equivalent Removals
Option 1	$5.9	49,411	72,258,866
Option 2	$5.5	49,415	72,259,368
Option 3/S	$5.5	49,435	72,259,886
Option 3	$5.5	49,435	72,259,886
Option 4*	$103.6	49,435	72,259,886
Option 5*	$107.6	49,435	72,259,886

*These options result in additional costs with no additional removals.

Table C-2 presents the incremental cost-effectiveness values for the six options considered. As the table shows, the cost-effectiveness of Option 1 is $0.08 per pound-equivalent of pollutant removed. That is very cost-effective when compared to the cost-effectiveness of other effluent limitations guidelines. Movement from Option 1 to Option 2 and from Option 2 to Option 3/S is cost-effective relative to Option 1 because costs are reduced while removals increase. Movement from Option 3/S to Option 3 results in no additional costs or removals, so the incremental cost-effectiveness value is undefined. Options 4 and 5 are not cost-effective as they result in additional costs with no additional removals relative to Option 3/S. Option 3/S is the most cost-effective option. Successive improvements in weighted removals are achieved at progressively lower costs by moving from Option 1 through Option 2 to Option 3/S. Further movement from Option 3/S to Options 3, 4 or 5 provides minor additional removals at substantially higher marginal cost.

Table C-2
Estimated Industry Incremental Cost-Effectiveness Under BPT
SUBCATEGORY C FACILITIES

Option	Cost-Effectiveness, $/lb.	Cost-Effectiveness, $/lb-eq.
Incremental from Baseline to Option 1	$120.00	$0.08
Incremental from Option 1 to Option 2	-$90,723*	-$813.34*
Incremental from Option 2 to Option 3/S	$0	$0
Incremental from Option 3/S to Option 3	undefined**	undefined**
Incremental from Option 3 to Option 4	undefined**	undefined**
Incremental from Option 4 to Option 5	undefined**	undefined**

Dollar values are in constant 1981 dollars.

* Options are ranked by increasing levels of pollutant removals. Negative cost-effectiveness numbers mean that costs have decreased from the previous option, while removals have increased, improving cost-effectiveness.

** Option 3 results in the same costs and removals as Option 3/S. Options 4 and 5 result in additional costs with no additional removals. Therefore, the incremental cost-effectiveness ratio (incremental cost/incremental removals) is undefined.

Appendix D
Sensitivity Analysis of POTW Removal Efficiency

This appendix describes a sensitivity analysis applied to the assumption in the PSES cost-effectiveness analysis that pesticide active ingredients (PAIs) are not removed by POTWs. There is very little empirical data on the PAI removals actually achieved by POTWs. The only data available on POTW removal efficiencies for PAIs is from the Domestic Sewage Study (DSS) (Report to Congress on the Discharge of Hazardous Waste to Publicly Owned Treatment Works, February 1986, EPA/530-SW-86-004). The DSS provides laboratory data under ideal conditions to estimate biotreatment removal efficiencies at POTWs for different organic PAI structural groups. These data, however, are not full-scale/in-use POTW data and therefore, are not appropriate for use in the cost-effectiveness analysis.

For the sensitivity analysis it is assumed that POTWs remove 50 percent of the PAIs from the wastestream. The results are discussed below for Subcategory C and Subcategory E facilities.

Subcategory C

Table D-1 presents the estimated total annualized costs, total pounds and total pounds-equivalent of pollutants removed for the six options under the assumption of 50 percent POTW removal efficiency for PAIs.

Table D-1 National Estimate of Annualized Costs and Removals Under PSES SUBCATEGORY C FACILITIES Assuming 50 percent POTW Removal Efficiency for PAIs			
Option	**Annualized Cost, MM $ (1981 dollars)**	**Pound Removals**	**Pound-Equivalent Removals**
Option 1	$25.4	55,827	6,063,537
Option 2	$21.8	55,841	6,063,833
Option 3/S	$20.4	55,897	6,067,016
Option 3	$21.8	55,998	6,067,025
Option 4*	$224.1	55,998	6,067,025
Option 5*	$281.8	55,998	6,067,025
*These options result in additional costs with no additional removals.			

Table D-2 presents the incremental cost-effectiveness values for the six options considered for Subcategory C under the assumption of the sensitivity analysis. As the table shows, the cost-effectiveness of Option 1 is $4.20 per pound-equivalent of pollutant removed. Option 1 is very cost-effective when compared to the cost-effectiveness values of other effluent limitations guidelines. Movement from Option 1 to Option 2 and from Option 2 to Option 3/S is cost-effective relative to Option 1 because costs are reduced while removals increase. Movement from Option 3/S to Option 3 is substantially less efficient than movement from Option 1 to Option 2 or from Option 2 to Option 3/S. The average cost-effectiveness of Option 3 is $3.59 per pound-equivalent and for Option 3/S is $3.36. Options 4 and 5 are not cost-effective as they result in additional costs with no additional removals relative to Option 3. Option 3/S is the most cost-effective option. Successive improvements in weighted removals are achieved at progressively lower costs by moving from Option 1 through Option 2 to Option 3/S. Further movement from Option 3/S to Options 3, 4 or 5 provides minor additional removals at substantially higher marginal cost. Thus, the assumption of 50 percent PAI removal efficiency at POTWs does not alter the result that Option 3/S is the most cost effective option, and is cost-effective relative to promulgated effluent limitations guidelines.

Table D-2 Estimated Industry Incremental Cost-Effectiveness Under PSES SUBCATEGORY C FACILITIES Assuming 50 percent POTW Removal Efficiency for PAIs		
Option	**Cost-Effectiveness, $/lb.**	**Cost-Effectiveness, $/lb-eq.**
Incremental from Baseline to Option 1	$455.73	$4.20
Incremental from Option 1 to Option 2	-$243,491*	-$12,463*
Incremental from Option 2 to Option 3/S	-$25,025*	-$431.72*
Incremental from Option 3/S to Option 3	$13,580	$142,503
Incremental from Option 3 to Option 4	undefined**	undefined**
Incremental from Option 4 to Option 5	undefined**	undefined**

Dollar values are in constant 1981 dollars.

* Options are ranked by increasing levels of pollutant removals. Negative cost-effectiveness numbers mean that costs have decreased from the previous option, while removals have increased, improving cost-effectiveness.

** These options result in additional costs with no additional removals. Therefore, the incremental cost-effectiveness ratio (incremental cost/incremental removals) is undefined.

<u>Subcategory E</u>

Table D-3 presents the estimated total annualized costs, total pounds, and total pounds-equivalent of pollutants removed for the two options considered for Subcategory E facilities under the assumption of 50 percent PAI removal efficiency for POTWs. Option 1, the proposed option, is expected to be achieved with zero additional costs.

Table D-3 National Estimate of Annualized Costs and Removals Under PSES SUBCATEGORY E FACILITIES Assuming 50 percent POTW Removal Efficiency for PAIs			
Option	**Annualized Cost, (1981 dollars)**	**Pound Removals**	**Pound-Equivalent Removals**
Option 1	$0	0.5	0.6
Option 2*	$1,507	0.5	0.6
*This option results in additional costs with no additional removals.			

Because Option 1 is expected to be met with no additional compliance costs, its cost-effectiveness is zero. Option 2 requires additional costs but results in no additional removals, so its cost-effectiveness value is undefined. Therefore, Option 1 is still the more cost-effective option, even assuming POTWs can remove 50 percent of the PAIs in the wastestream.