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Assessment of Compliance Costs Resulting from Implementation of the Final Great Lakes Water Quality Guidance

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EXECUTIVE SUMMARY

On April 16, 1993, the Environmental Protection Agency (EPA) proposed the Great Lakes Water Quality Guidance (58 *FR* 20802) that included minimum water quality criteria, antidegradation provisions, and implementation procedures for the Great Lakes System. In support of the Regulatory Impact Analysis for this proposal, an estimate of the incremental cost to direct dischargers resulting from the implementation of the proposed Guidance was developed. The resulting estimate reflected the incremental cost of complying with prospective permit requirements stemming from compliance with procedures and water quality criteria specified in the proposed Guidance. In addition, because some of the compliance costs may be passed on to users of publicly owned treatment works (POTWs), preliminary cost estimates for indirect dischargers (i.e., dischargers to POTWs) were developed. Preliminary estimates of the reductions of pollutant loadings resulting from implementation of the proposed Guidance were also developed to evaluate the resulting cost-effectiveness.

In response to the public comments received on the proposed Guidance, EPA has revised the proposed Guidance to address many of the issues raised by the public. While revising the proposed Guidance, EPA requested support in evaluating the costs associated with complying with the final Guidance. This report provides compliance cost information for use by EPA in decision-making for the final Guidance. The primary purpose of this study was to develop the cost of control measures (e.g., pollution prevention, end-of-pipe treatment, or other pollutant controls) needed by point sources to meet effluent limitations developed using the final Guidance water quality criteria and implementation procedures. The estimate considers only the <u>incremental</u> cost of complying with the final Guidance.

I. METHODOLOGY FOR ESTIMATING COMPLIANCE COSTS AND POLLUTANT LOADING REDUCTIONS

In general, the basic methodology used to estimate compliance costs and pollutant load reductions attributable to the proposal was employed to estimate costs for the final Guidance. However, the approach was revised based on comments received by EPA to more accurately project the costs to the regulated community and to better account for the pollutant load reductions. Several of the significant revisions are described briefly below.

- Improved Data Collection: For the final Guidance, the current information and data (including permits, fact sheets, permit applications, and other relevant discharge information) were updated and verified, and were used as the basis for comparison to Guidance requirements. In addition, State permitting authorities were requested to review each sample facility and provide recommendations or comments so that the facilities were represented accurately. Comments provided by States in response to the original cost estimates were also considered.

- Consideration of Additional Pollutants: In addition to the 32 pollutants for which numeric criteria are being published as part of the final Guidance, 37 other pollutants were included in the cost analysis. These 37 pollutants were identified at the sample facilities and were determined to have potential impacts on costs and pollutant loadings. This increased the total number of pollutants evaluated to 69.

- Use of Tier I Criteria and Tier II Values: Water quality criteria for the 69 pollutants were developed using the Tier I and Tier II methodologies outlined in Appendices A, B, C, and D of the final Guidance and readily available toxicity data. In addition, EPA revised many of the criteria originally proposed under the Guidance, including promulgating criteria for metals in the dissolved form as opposed to the total form for aquatic life.

- Additivity: The estimate of costs for the sample facilities accounted for additivity of human carcinogenic effects of pollutants contained in a discharge. To estimate costs for the final Guidance, it was assumed that the total carcinogenic risk of the mixture of two or more carcinogens in a discharge would not exceed a lifetime incremental cancer risk equal to one in 100,000 (10^{-5}).

- Intake Credits: The presence of intake water pollutants in establishing water quality-based effluent limits was considered in accordance with the final Guidance.

In general, the assessment of compliance costs was revised to reflect modifications made to the final Guidance to provide increased flexibility for State and Tribal implementation. For purposes of estimating compliance costs, it was assumed that permitting authorities would use the more stringent provisions specified in the final Guidance even when the Guidance provides for less stringent alternatives.

Finally, in an effort to ensure consistency in estimating the general types of controls that would be necessary for a sample facility to comply with the final Guidance, as well as to integrate into the cost analysis the alternatives available through the final Guidance (e.g., phased total maximum daily loads/water quality assessments, site-specific criteria modifications, alternative mixing zones, etc.), a costing decision matrix was used for each sample facility. The underlying assumption of the decision matrix is that facilities would first pursue least-cost controls prior to incurring the costs to install end-of-pipe treatment. As a final step before assuming that treatment would be installed by the facility, the relationship between the cost of adding the treatment and other types of remedies or controls were considered. If it was concluded that other remedies or controls would be more feasible than installing end-of-pipe treatment, then it was assumed that a facility would alternatively pursue some type of regulatory relief from the Guidance water quality-based effluent limit (WQBEL).

Two different cost scenarios were developed for the final Guidance to primarily account for the flexibility provided in the Guidance (i.e., use of regulatory relief). Under the low-end compliance cost scenario, if the estimated annualized cost for removal of a pollutant by a facility exceeded $200 per toxic pounds-equivalent then it was assumed that the facility would explore the use of other remedies or controls. Acknowledging that the use of regulatory relief may be limited depending upon the particular circumstances for a "facility," compliance costs were also estimated under a high-end cost scenario that assumes regulatory relief would be granted only when the cost for the particular "category of dischargers" exceeds $500 per toxic pounds-equivalent. Under the high-end scenario, when the trigger for the category was exceeded, then it was assumed that dischargers within the "category" would be granted regulatory relief.

II. RESULTS

The total annualized cost of the final Guidance will be between $61 million (low-end) and $376 million (high-end). Table ES-1 presents a breakdown of costs for direct and indirect dischargers. Under the low-end estimate, direct dischargers account for 67 percent of the total estimated compliance costs and indirect dischargers account for the remaining 33 percent. Under the high-end estimate, direct dischargers account for 98 percent of the total estimated cost, and indirect dischargers account for 2 percent. The increase in capital costs under the high-end resulted in a greater percentage of the costs associated with direct discharging facilities.

TABLE ES-1 SUMMARY OF ANNUALIZED COMPLIANCE COSTS ATTRIBUTABLE TO THE FINAL GREAT LAKES WATER QUALITY GUIDANCE

Cost Categories	Low-End Cost Scenario		High-End Cost Scenario	
	Estimated Costs*	Group Cost as Percent of Total Cost	Estimated Costs*	Group Cost as Percent of Total Cost
Major Direct Dischargers—Industrial	15.7	25.8%	108.2	28.7%
Major Direct Dischargers—Municipal	23.8	39.0%	259.8	69.1%
Minor Direct Dischargers	1.6	2.6%	1.6	0.4%
Indirect Dischargers	19.9	32.6%	6.6	1.8%
TOTAL	61.0	100.0%	376.2	100.0%

* First Quarter 1994 $, Millions

Low-End Scenario Cost Estimates

Under the low-end cost estimate for the direct dischargers, municipal majors are expected to incur 58 percent of total costs and industrial majors account for 38 percent of total compliance costs. Minor direct dischargers are estimated to incur 4 percent of the total costs for direct dischargers. The two major industrial categories with the largest total annualized cost are the pulp and paper (20 percent of total) and miscellaneous (11 percent) categories. The food and food products, metal finishing, mining, and metals manufacturing categories are estimated to incur less than 1 percent of the total annualized compliance cost.

Although the municipal major category accounts for over 58 percent of the total estimated cost under the low-end, the average annual cost is just over $75,000 per facility. Average annualized costs for industrial majors vary widely across categories, with the highest average cost estimated for the miscellaneous ($168,000 per plant) and pulp and paper ($151,000 per plant) categories. For minor facilities, average costs are negligible at an estimated $500 per facility.

Costs to direct dischargers for developing and implementing pollutant minimization programs (required when WQBELs are below analytical detection levels) account for most of the low-end costs (58 percent of total annual costs). Annualized capital and operation and maintenance (O&M) costs make up just over 21 percent of the total annual costs and waste minimization (i.e., pollution prevention) costs account for just over 11 percent. Under the low-end cost scenario, regulatory relief was assumed when the control costs for a pollutant at a facility exceeded $200 per toxic pounds-equivalent. Based on the analysis of sample facilities, it was estimated that regulatory relief would be required for less than 1 percent of all direct dischargers. For these facilities, cost for controls to comply with the final Guidance (e.g., capital and O&M, pollutant minimization programs, waste minimization, etc.) were shifted to costs related to pursuing regulatory relief. The resulting costs associated with pursuing regulatory relief account for just over 6 percent of the total annual costs.

Controls for mercury account for over 20 percent of annual low-end costs (attributable primarily to pollutant minimization program-related costs). Other pollutants that account for significant costs include methylene chloride, aluminum, benzene, and copper.

<u>High-End Scenario Cost Estimates</u>

Under the high-end scenario, regulatory relief was assumed necessary when the total cost for a category exceeded $500 per toxic pounds-equivalent reduced. Only the steam electric industrial category was estimated to exceed the $500 toxic pounds-equivalent cost trigger. In general, estimated costs for end-of-pipe treatment of significant volumes of non-contact cooling water accounted for the high costs within the steam electric category. As a result of these significant costs, costs for end-of-pipe treatment were shifted to costs to pursue regulatory relief for certain high volume steam electric facilities.

Under the high-end estimate for the direct dischargers, municipal majors are expected to incur just over 69 percent of total costs and industrial majors account for 29 percent of total annual compliance costs. Minor direct dischargers are estimated to incur less than 1 percent of the total costs.

The two major industrial categories with the largest total annualized cost are the pulp and paper (23 percent of total) and miscellaneous (3 percent) categories. Even under the high-end, the food and food products, metal finishing, mining, and metals manufacturing categories are still estimated to incur less than 1 percent of the total annualized compliance cost. In addition, due to the shift from end-of-pipe treatment to regulatory relief, the steam electric category also accounts for less than 1 percent of the total compliance cost.

The municipal major category accounts for just over 69 percent of the total estimated cost, the average annual cost is just over $822,000 per facility. Average annualized costs for industrial majors vary widely across categories, with the highest average cost estimated for pulp and paper ($1,583,000 per plant) and miscellaneous ($433,700 per plant) categories. For minor facilities, average costs are negligible at an estimated $500 per facility.

For the high-end scenario, costs to direct dischargers shifted away from developing and implementing pollutant minimization plans and waste minimization to capital, operating and maintenance costs (over 52 percent of total annual costs) associated with construction and application of end-of-pipe treatment. Annualized costs for developing and implementing pollutant minimization plans make up just over 6 percent of total annual costs and waste minimization costs account for less than 1 percent. Since regulatory relief was assumed for only one category under the high-end, the costs associated with regulatory relief account for less than 1 percent of the total annual compliance cost.

Controls for lead account for over 60 percent of annual costs (attributable primarily to end-of-pipe treatment related controls). Other pollutants that account for significant costs include heptachlor, pentachlorophenol, lindane, and mercury.

Comparison of Estimated Costs for the Final Guidance to Costs of Proposed Guidance

The original proposal estimates were revised to reflect changes made in the approach to estimating costs for the final Guidance. The reevaluated original proposal resulted was about $240 million (low-end scenario) and $265 million (high-end scenario) higher than estimates for the final Guidance.

The annual cost estimate for the final Guidance is significantly lower than the revised estimates for the proposed Guidance. Some of this reduction is attributable to the final Guidance intake credit provisions, which provide relief to several significant dischargers that discharge to non-attained waters, and to the use of dissolved metals criteria, which also tends to lower the costs for the final Guidance.

Common to both the reevaluated proposal and the final Guidance, the lowering of the permit baseline also accounts for an overall decrease in compliance costs and load reduction. The lowering of the permit baseline was expected due to State implementation of the requirements of Section 303(c) of the Clean Water Act, which required all States to promulgate water quality criteria for certain toxic pollutants. To ensure that the requirements of Section 303(c) are met, EPA promulgated the National Toxics Rule (57 *FR* 6084; 12/22/92) to provide water quality criteria for pollutants for which States did not promulgate criteria. More important, each of the Great Lake States has been actively involved in the Great Lakes Water Quality Initiative since 1989, acting as co-partners and major participants in developing the Guidance.

Consequently, most of the Guidance and current State water quality standards have a wide number of similarities. In fact, some States have already elected to promulgate more stringent requirements for a variety of Guidance-related provisions in anticipation of the Guidance. As a result of these and many other efforts by States, the stringency of National

Pollutant Discharge Elimination System (NPDES) permit requirements continues to increase, which decreases the incremental difference between the current State permit limits and Guidance-based WQBELs.

III. POLLUTANT LOADINGS REDUCTIONS AND COST-EFFECTIVENESS

Toxic pounds-equivalent represent a unit of measurement that permit uniform comparison among pollutants based on their relative toxicity. For example, reducing the discharge of aluminum by 10 pounds will have a different effect on the environment as compared to reducing the discharge of mercury by 10 pounds. Normalizing the pollutant loading reductions by using toxic weight factors enables one to compare the relative impacts of these pollutant loading reductions.

For the final Guidance, the toxicity-weighted baseline pollutant loading was projected to be just over 35 million toxic pounds-equivalent per year (lbs-eq/year). This baseline pollutant loading represents almost a 72 percent reduction in the baseline projected by EPA for its original analysis of the proposed Guidance (126 million lbs-eq/year).

This downward shift in the baseline pollutant loadings is particularly significant in light of the fact that over 35 more pollutants were added for the analysis of the final Guidance. This shift is attributable to the fact that the existing permit baseline also moved downward (i.e., existing permit limits for the sample facilities were found to be more stringent). This downward shift in the permit baseline is due, in part, to increased efforts by States to protect water quality. The use of dissolved criteria for metals for the final Guidance, which tended to eliminate metals for the cost and loading analysis also accounted for a shift in the baseline. Finally, in contrast to the cost analysis for the proposed Guidance, where baseline loads were estimated even when all data were reported below analytical detection levels (in the absence of a permit limit), the cost analysis for the final Guidance excluded pollutants that were never detected from further evaluation.

Upon implementation of the final Guidance, the estimated pollutant loadings under the low-end estimate would be reduced by 5.8 million lbs-eq/year, which represents a 16 percent reduction of the baseline pollutant loadings. Under the high-end cost estimate, pollutant loading reductions would increase by 1.8 million lbs-eq/year to a total of 7.6 million lbs-eq/year, which represents a 22 percent reduction of the baseline pollutant loadings.

The percent reductions estimated for the final Guidance are also lower than projected for the proposed Guidance reevaluated using the revised approach for estimating costs and load reductions. Pollutant loadings under the proposed Guidance would be 8.4 million lbs-eq/year (24 percent reduction) and 10.1 million lbs-eq/year (29 percent reduction) for the low- and high-end scenarios, respectively. The drop in estimated pollutant loadings can also be credited to the changes made by EPA to the criteria for the final Guidance (e.g., adjusting bioaccumulation factors, use of dissolved criteria for metals) and the toxic weights. The combined result of these changes was essentially less stringent criteria, which would tend to reduce the difference between existing permit limits and the Guidance-based WQBELs.

Under the low-end estimate for the final Guidance, the largest pollutant load reductions occur for dieldrin and lead, which account for over 50 percent toxic weighted load reduction. Chlordane, heptachlor, and pentachlorobenzene were also reduced by significant amounts from the baseline. Under the high-end estimate, the largest pollutant load reductions occur for heptachlor, dieldrin, and lead which account for about 70 percent of the toxic weighted load reduction.

Approximately 80 percent of the pollutant load reduction for the final Guidance, regardless of the scenario, is attributable to reducing BCCs as a result of pollutant minimization plans and end-of-pipe treatment.

The cost-effectiveness of the final Guidance under the low-end estimate is just under $7.00/lbs-eq for the direct dischargers only; with the cost for indirect dischargers, the cost-effectiveness rises to $10.30/lbs-eq. Under the high-end estimate, the cost-effectiveness increases to just over $49.00/lbs-eq.

The estimates for the final Guidance are considerably more cost-effective than those estimated for the proposed Guidance using the revised approach ($35.96/lbs-eq and $63.83/lbs-eq); low-end and high-end scenarios, respectively). For comparative purposes, cost-effectiveness values for effluent limitations guidelines and standards range from just over $1.00/lbs-eq to over $500/lbs-eq.

IV. EVALUATION OF REGULATORY OPTIONS

The proposed Guidance generated extensive comments related to the potential costs of numerous aspects of the Guidance. In response to the issues raised regarding the cost of various provisions of the Guidance, additional analyses were performed to evaluate the impact of possible regulatory options to address these issues.

Fish Consumption Rates

Many commenters believed that EPA's proposed fish consumption rate of 15 grams per day (grams/day) for establishing human health protection criteria would not be protective of recreational and subsistence anglers such as the Native American anglers and minority anglers, or women of childbearing age and children within the Great Lakes Basin. Further, some commenters suggested that a higher fish consumption rate ranging from 30-60 grams/day would be necessary to protect lower income and minority subpopulations that eat more sport caught fish on average. The cost estimates for the final Guidance were based on a consumption rate of 45 grams/day. Decreasing the consumption rate to 15 grams/day had an insignificant impact on the estimated compliance cost and expected pollutant load reductions. The cost results at the high-end also show relatively insignificant increases in estimated costs and pollutant load reductions. The primary reason that decreasing fish consumption had little impact on costs or load reductions was due to the fact that the resulting difference in criteria using 15 and 45 grams/day assumptions was not significant enough to change the control options selected for a pollutant at a particular facility. This was particularly the case for most BCCs, for which criteria using 15 or 45 grams/day remained below analytical detection levels.

Use of Pollutant Minimization Programs When WQBELs Are Below Analytical Detection Levels

Procedure 8 of the final Guidance requires that the permitting authority require that a pollutant minimization plan be required when a WQBEL is established below analytical detection levels. The intent of the pollutant minimization plan is to reduce all sources of the pollutant to maintain the effluent below analytical detection levels. Although it is acknowledged that some facilities will want to ensure compliance with WQBELs below detection levels through the use of additional or enhanced end-of-pipe treatment, it is likely that an aggressive pollutant minimization program can successfully result in compliance with WQBELs below detection levels. Pollutant minimization programs account for a significant proportion of the total compliance cost under the low-end scenario. The impact of these requirements were evaluated by deriving cost estimates assuming that permitting authorities would only require increased monitoring for any pollutant for which a Guidance-based WQBEL was below analytical detection levels. An analysis was performed of the impact of only requiring monitoring for pollutants for which Guidance-based WQBELs are below analytical detection levels.

It is estimated that annual compliance costs for direct dischargers will decrease by over 60 percent. The estimated pollutant load reductions decrease to 1.3 million lbs-eq/day, which is almost 80 percent less than the reduction estimated for the final Guidance. Under the high-end, compliance costs do not drop as dramatically as the low-end costs due to the shift towards end-of-pipe treatment, however, the pollutant load reductions decrease by over 50 percent.

Intake Credits

In generating cost estimates for the proposed Guidance, intake credits were provided by assuming there was no reasonable potential for outfalls at facilities that added no additional pollutants prior to discharge. In an effort to evaluate the impact of intake credits on estimated compliance costs, compliance costs under a number of different intake credit scenarios were developed. For discharges to different bodies of water, no significant impact occurred (less than 0.5 percent) to either the compliance costs or pollutant load reductions at either the low- or high-end scenarios, regardless of whether intake credits are relaxed (no net increase) or made more stringent (no intake credit allowed). This result occurred because discharges occurred only infrequently to different bodies of water that were non-attained.

Alternatively, the form of intake credits does impact discharges to the same body of water. When intake credits are allowed, a slight drop in costs is experienced concurrent with a larger proportional drop in pollutant load reduction. At the low-end, compliance costs drop by $700,000 (a 1.7 percent decrease), but pollutant load reductions drop by over 17 percent. At the high-end, costs decrease by less than 1 percent, but pollutant load reductions decrease by 13.5 percent.

When intake credits were not allowed for discharges to the same body of water, the annual compliance costs for direct dischargers increased by $245 million, representing over a 600 percent increase from the final Guidance low-end estimate. However, pollutant load reductions increased to 6.4 million lbs-eq/year, which represents only a 9 percent increase from the final Guidance low-end estimate. The same trend results using high-end scenario costs where the costs increase by over 60 percent, but pollutant reductions increase by only 7 percent.

Tier II Criteria

One of the stated limitations of the cost estimate for the proposed Guidance was that compliance costs were not estimated for pollutants other than those for which numeric Tier I criteria were proposed. The cost estimate for the final Guidance is based upon evaluation of compliance with 69 pollutants of initial focus. To determine the potential impact of the use of Tier I criterion versus Tier II values, compliance costs under a variety of scenarios were developed.

If only Tier I criteria are used, the annual compliance costs for direct dischargers would drop by $5 million, which is just under 12 percent of the final Guidance low-end estimate. The pollutant load reductions would also decrease by about 8 percent of the estimate for the final Guidance. Under the high-end, both costs and pollutant load reductions decrease similarly (2 percent drop in costs and 6 percent drop in pollutant load reduction from the high-end estimate from the final Guidance).

If Tier I and II criteria are used for all pollutants, the annual compliance costs increase insignificantly at both the low- and high-end. This result was expected since the scenario only adds Tier II wildlife values. Although many of these additional Tier II wildlife values are more stringent than other Guidance criteria, the impact is insignificant since both the Tier II wildlife values and the other Guidance criteria are below analytical detection levels.

Wildlife Criteria/Mercury Criteria

The final Guidance limits the use of the wildlife criteria methodology to the Tier I procedure for the 22 BCCs for which sufficient data exist. In response to the many concerns raised regarding the stringency of wildlife criteria and the potential significant costs associated with complying with the criteria, a number of alternatives were evaluated.

Using additional wildlife criteria (beyond those required for the 22 BCCs) results in an insignificant increase in annual compliance costs. Alternatively, excluding all wildlife criteria also results in essentially no difference in compliance cost estimates and pollutant load reductions at both the low- and high-end. These results indicate that factors other than the wildlife criteria tend to drive the costs of the final Guidance. In the absence of wildlife criteria, the Guidance human health criteria would form the basis for Guidance-based WQBELs. The Guidance human health criteria for most pollutants are below analytical detection levels and, as such, the costs for treatment and pollutant minimization plans would be incurred by a facility. Although the wildlife criteria in general are more stringent than the Guidance human health criteria, they would also result in Guidance-based WQBELs below analytical detection levels. Therefore, the same treatment and pollutant minimization plan requirements, costs, and pollutant load reductions would occur.

Allowance of Mixing Zones for BCCs

As promulgated in Procedure 3 of Appendix F to Part 132, the final Guidance retained the requirement for elimination of mixing zones for BCCs within 12 years. The final Guidance also provides some flexibility to allow limited mixing zones for BCCs if the facility can show that all prudent and feasible treatment technologies are being implemented to reduce the discharge of BCCs to the maximum extent possible. In estimating costs for the final Guidance, it was conservatively assumed that no mixing zones would be allowed for BCCs. To determine the impact of this requirement on facilities (in terms of cost) and the environment (in terms of pollutant load reductions), the sample facilities were reevaluated allowing the same mixing zones for BCCs as are allowed for non-BCCs.

The addition of mixing zones for BCCs results in an estimated incremental annual cost savings to direct dischargers of just over $200,000, which is less than a 0.5 percent decrease from the final Guidance low-end cost estimate. In terms of pollutant load reductions, the addition of mixing zones results in an insignificant decrease in pollutant load reductions. Slight reductions in cost and pollutant load reductions were also found under the high-end scenario.

The relatively small impact associated with allowing mixing zones for BCCs is due to the fact that the criteria for most BCCs are relatively stringent, and usually well below analytical detection levels. Even with the dilution afforded by the mixing zones, resulting WQBELs remain below analytical detection levels and, as a result, do not drastically impact the costs and load reductions (i.e., the pollutant controls would not change if both WQBELs were below analytical detection levels).

Additivity

In an effort to evaluate the impact of the additivity provision on the compliance cost of the final Guidance, cost estimates for two scenarios were developed. Under one scenario, the assumption was that additivity would be controlled if the total carcinogenic risk in a discharge was less than 10^{-5} and accounted for by assuming that individual criteria were based on a 10^{-5} risk level. Under the second scenario, the assumption was that the additive effects from carcinogens would be accounted for if individual criteria were based on a 10^{-6} risk level.

The impact of the first scenario was relatively insignificant (less than 0.5 percent decrease in costs and just over 1 percent decrease in pollutant load reductions at both low- and high-end estimates). The relatively insignificant changes in cost and pollutant load reductions are based on the fact that most facilities did not detect more than a few carcinogens in their discharge. As a result, the final Guidance estimates (based upon a total carcinogenic risk of 10^{-5} but accounted for by distributing the risk across all carcinogens in the effluent) did not represent more stringent WQBELs for carcinogens, as compared to only accounting for the risk through the individual criteria.

When the individual criteria risk level is adjusted down to 10^{-6}, a more dramatic increase in costs occurs. A 10^{-6} risk level for individual criteria would increase the annual compliance costs for direct dischargers to over $51 million under the low-end. The associated load reductions do not increase as dramatically, accounting for only an additional 6,000 lb-eq/year.

The reason a large pollutant reduction did not accompany the large increase in costs under the low-end scenario is the assumption that a significant number of facilities would pursue some sort of regulatory relief, for which there is no pollutant reduction credit, to meet the more stringent criteria based on a 10^{-6} risk level.

The same trend occurs at the high-end, where costs increase by over 30 percent, but pollutant load reductions decrease by less than 1 percent. However, under the high-end scenario where variances are limited to categories that exceed the high-end cost trigger, the significant increase in costs is due to the costs associated with installing and maintaining end-of-pipe treatment for pollutants impacted by the more stringent criteria. The insignificant load reductions associated with the large increase in costs are due to the fact that some regulatory relief was still justified under the high-end. Further, for some pollutants with criteria below the analytical detection level, the shift from criteria based on a 10^{-5} risk level to criteria based on a 10^{-6} risk level resulted in criteria further below analytical detection levels, which had no impact on pollutant load reductions.

Antidegradation

It is assumed that the antidegradation provision of the final Guidance, as promulgated under Appendix E to Part 132, may impact the regulated community. However, due to the variety of site-specific factors that would influence the future impact of the antidegradation provision, it is uncertain whether the impact will be significant. Therefore, an analysis of the potential impact of the antidegradation provision was performed in the form of estimating the cost to lost opportunities for businesses in the Great Lakes Basin.

Under the worst case where it was assumed that all (100 percent) facilities with BCCs in their discharge (approximately 5 percent of all facilities) requested an antidegradation review and were denied permission to increase loads, an opportunity cost of $43.2 million would be lost due to the Guidance. More realistically, if it was assumed that half (50 percent) of the facilities requesting antidegradation reviews for BCCs were allowed to increase discharges, only $21.6 million of opportunity cost would be lost each year. Finally, assuming that only 10 percent of the facilities discharging BCCs request an antidegradation review, and only half are denied, then the opportunity lost for growth would be approximately $2.2 million.

If the low-end estimate is used, then a modest 3 percent increase in the low-end annual compliance cost results. The potential benefits, although not quantified, could be relatively significant for some receiving waters because additional discharges of BCCs would be denied.

Future Impact of Detection Levels

In recent years, several States in the Great Lakes System have promulgated water quality criteria for various toxic pollutants that are more restrictive than the level of analytical detection. Implementation of these existing water quality criteria by these States do take into account the ability to detect the pollutant in the wastestream. Likewise, Procedure 8, Appendix F, of Part 132 clearly provides that the water quality-based effluent limit must be derived from the water quality criterion; compliance with that limit, however, will be based on the minimum level (ML) where available. When a promulgated ML is not available, compliance with that limit may be based on the lowest level of quantification (at the State's discretion) defined in Procedure 8 of Part 132.

In estimating the compliance cost for the final Guidance, it was conservatively assumed that the method detection level (MDL) would serve as the compliance level. In actuality, the State permitting authority is only required to use the ML (as defined under 40 CFR Part 136) as the basis for reporting compliance with the Guidance-based WQBEL. Although the pollutant MDL was used for costing purposes, it is acknowledged that estimating treatment costs for WQBELs below the MDL, and most likely below the ML, would be speculative for many pollutants, particularly as such estimation relates to expected future performance.

Nevertheless, an evaluation of the potential impact that improvements to analytical detection levels would have on compliance cost estimates was performed. In particular, costs and pollutant load reductions were estimated under two scenarios, one that assumes MDLs improve 10-fold over time and another that assumes MDLs improve 100-fold over time. This equivalent to a 30 to 60 fold or 300 to 600 fold improvement, respectively, in the minimum level of quantification, which is used for determining compliance in the final Guidance.

The results of the analysis show conceivable increases in estimated compliance costs. When MDLs become 10 times more stringent, annual costs increase by over $500 million dollars. Pollutant load reductions also increase when MDLs decrease 10-fold by over 12 million toxic pounds-equivalent per year. When MDLs become 100 times more stringent, the annual compliance costs are estimated to increase by just over $880 million and pollutant load reductions would increase by approximately 19 million toxic pounds-equivalent per year above the final Guidance estimates. These results indicate that as analytical detection levels improve, the costs to implement the final Guidance increase. However, the increase in compliance costs are offset by comparable pollutant load reductions.

1. INTRODUCTION

On April 16, 1993, the Environmental Protection Agency (EPA) proposed the Great Lakes Water Quality Guidance (58 *FR* 20802) which included minimum water quality criteria, antidegradation provisions, and implementation procedures for the Great Lakes System. In support of this proposal, an estimate of the incremental cost to direct dischargers resulting from the implementation of the proposed Guidance was developed. The resulting estimate reflected the incremental cost of complying with prospective permit requirements stemming from compliance with procedures and water quality criteria specified in the proposed Guidance. In addition, because some of the compliance costs may be passed on to users of publicly owned treatment works, preliminary cost estimates for indirect dischargers (i.e., dischargers to POTWs) were developed. Preliminary estimates of the reductions of pollutant loadings resulting from implementation of the proposed Guidance also were developed to evaluate the resulting cost-effectiveness.

In response to the public comments received on the proposed Guidance, EPA has revised the proposed Guidance to address many of the issues raised by the public. While revising the proposed Guidance, EPA requested support in evaluating the costs associated with complying with the final Guidance.

1.1 PURPOSE OF THIS REPORT

This report provides compliance cost information for use by EPA in decision-making for the final Guidance. The primary purpose of this study was to develop the cost of control measures (e.g., pollution prevention, end-of-pipe treatment, or other pollutant controls) needed by point sources to meet effluent limitations developed using the final Guidance water quality criteria and Implementation Procedures. The estimate considers only the incremental cost of complying with the final Guidance.

The overall approach to developing a cost estimate for control measures for point sources due to implementation of the final Guidance was the same as that used for estimating costs for the proposed Guidance. In general, this approach involved developing detailed cost estimates for a randomly selected subset of facilities and then extrapolating these costs to the entire population of facilities. In estimating compliance costs for the selected facilities, SAIC generally compared existing permit limitations, which are representative of nationally promulgated effluent limitations and existing State water quality standards, to prospective water quality-based limitations based on the final Guidance. The control measures needed to provide the incremental pollutant removal required to comply with the new Guidance-based effluent limitations were then evaluated. Finally, compliance costs were estimated for these control measures based on information on treatment technologies and cost analyses available in the literature.

The secondary purposes of this study were to revise estimates of the potential compliance costs to indirect dischargers and estimates of the cost-effectiveness of the final Guidance. The costs to indirect dischargers are based on an estimated percentage of indirect dischargers that would incur compliance costs similar to direct dischargers. Cost-effectiveness, defined as the incremental annualized cost of a pollution control option per incremental pound-equivalent of pollutant removed by that control option, is based on the methodology used by EPA in developing national effluent guideline's limitations and standards under the Clean Water Act (CWA).

This analysis represents a "snapshot" of current conditions. It does not address the economic impacts on specific firms or the region as a whole. It does not attempt to address the effects or costs of future changes in policy, science, or the industrial structure or population of the Great Lakes region. The costs estimated here do not include the ancillary costs of pollutant treatment technologies that generate transfers to other media (i.e., air and ground water). In addition, this report addresses costs to existing point source dischargers only. It does not attempt to identify the least costly means of controlling a particular pollutant or to allocate available loads equitably between point and non-point sources.

Finally, this report does not identify or estimate benefits of compliance with the final Guidance. Information on benefits is being developed by EPA using a case study approach in a separate study.

1.2 ORGANIZATION OF THIS REPORT

The remainder of this report is organized into four sections. Section 2 describes the revisions made to the methodology for calculating compliance costs for the final Guidance. Section 3 discusses the results of the revised cost estimates related to the final Guidance. Section 4 presents the estimates of cost-effectiveness of the final Guidance. Section 5 presents the results of evaluations performed on regulatory alternatives to the final Guidance that were identified and considered by EPA.

2. METHODOLOGY

This section updates the methodology used to estimate the costs for the regulated community to implement the final Great Lakes Water Quality Guidance (the final Guidance). The methodology used to estimate costs for the proposed Guidance was presented in the "Assessment of Compliance Costs for Point Source Dischargers Resulting from Implementation of the Proposed Great Lakes Water Quality Initiative," April 16, 1993. The revisions and updates to the original methodology presented here were made primarily in response to revisions to the proposed Guidance, comments received during the public comment period, and comments from the Office of Management and Budget (OMB). The revised methodology is provided as a supplement to the April 16, 1993 report and, as such, does not repeat all information presented previously.

2.1 SUMMARY OF METHOD FOR DEVELOPING COST ESTIMATE FOR THE PROPOSED GUIDANCE

The overall approach to developing a cost estimate for control measures for point sources due to implementation of the proposed Guidance was to develop detailed cost estimates for a randomly selected subset of facilities and then extrapolate these costs to the entire population of facilities. A sample of 50 facilities was selected to represent the estimated 588 major dischargers and 9 minor facilities to represent the 3,207 minor dischargers in the Great Lakes Basin. For major dischargers, sample facilities were selected from each of the major categories of facilities, which included nine primary industrial groups and a category for municipal wastewater treatment facilities, also known as Publicly Owned Treatment Works (POTWs). The nine industrial categories were Mining, Food and Food Products, Pulp and Paper, Inorganic Chemical Manufacturing, Organic Chemical Manufacturing/Petroleum Refining, Metals Manufacturing, Electroplating/Metal Fabrication, Steam Electric Power Plants, and Miscellaneous facilities (e.g., remedial clean-up discharges, tire manufacturers). Sample major facilities also were selected to ensure representation across facility size (as measured by discharge flow volume), through stratification by flow within each category.

Because minimal compliance costs were anticipated by minor dischargers, a limited number of randomly selected minor dischargers were analyzed to verify that assumption. Furthermore, because limited discharge flow data were available for minor dischargers, it was not possible to adopt a flow-stratified analytical plan similar to that used for major dischargers.

For each sample facility under review, the most current National Pollutant Discharge Elimination System (NPDES) permit data and background information were collected to calculate the limits that would be anticipated from current regulatory requirements (if not incorporated into the current permit) and to develop additional permit requirements based on the proposed Guidance. Information was gathered from State and Environmental Protection Agency (EPA) Regional files that included permit applications, permit fact sheets or rationale, inspection reports, discharge monitoring reports, pretreatment reports, short-term waste characterization studies, receiving stream low-flow scenarios and total maximum daily loads/waste load allocation reports, and any other readily available information including industry-wide studies of various industrial categories used in developing effluent guidelines.

For each sample facility, new permit limits and additional permit conditions were developed based on the implementation procedures in the proposed Guidance. The proposed criteria would require some permitted facilities to meet new limits and adopt other permit conditions, such as whole effluent toxicity testing and additional monitoring. The limits developed for estimating costs were calculated for those 32 pollutants for which numeric Tier I criteria were proposed. For a given facility, only those pollutants that were detected in the discharge, or expected to be present in the discharge but reported as not detected because of use of less sensitive EPA-approved analytical methods, were evaluated. The need for whole effluent toxicity limits and monitoring was also evaluated in accordance with the proposal. For each facility, limits were calculated for the outfalls that contain or may contain observed or anticipated loadings for the pollutants of concern.

If the existing effluent limits for some of the permitted facilities selected did not reflect current State water quality standards and implementation policies, permit limits were recalculated to reflect the newly revised State standards and requirements, which are based on the adoption of toxic water quality standards under Section 303(c)(2)(B) of the Clean Water Act (CWA) (referred to here as baseline requirements). This approach more accurately reflected differences between existing effluent limits based on newly revised State requirements and procedures required in the proposed Guidance.

In determining specific requirements imposed by the proposed Guidance, site-specific wasteload allocations (WLAs) for discharges to both the open waters of the Great Lakes and their tributaries were calculated using equations set forth in the proposed implementation procedures. Because of the general lack of readily available background concentration data for receiving waters, two different WLAs were calculated for each sample facility. The first WLA assumed zero background in the absence of background data (WLA #1). The second WLA assumed a value for background concentrations where no background data existed (WLA #2). The assumed background values were approximately 50 percent of the proposed Guidance water quality criteria.

The resulting WLAs then were used to establish water quality-based effluent limits (WQBELs) for the sample facilities; the daily maximum WQBEL for a pollutant was set equal to the Final Acute Value, which represents the WLA to achieve the acute aquatic life criterion; monthly average WQBELs were set equal to the most stringent WLA calculated to protect chronic aquatic life, wildlife, or human health criteria. When negative WLAs were calculated for a pollutant (because discharges from all sources of pollutants would be expected to exceed criteria for a receiving water), two different sets of WQBELs were calculated for each facility, which resulted in different compliance cost scenarios. In cases where negative WLAs were calculated using WLA #1, the WQBEL was set equal to the most stringent water quality criteria (WQBEL #1); when negative WLAs were calculated using WLA #2, then the WQBEL was set equal to the assumed background concentration (WQBEL #2).

If either WQBEL #1 or WQBEL #2 was more stringent than the existing effluent limits—either in current permits or calculated against current regulatory requirements—then costs were developed based on options that likely would be available to the facility to comply with the more stringent effluent limits.

To estimate costs to the particular facilities reviewed and to develop potential compliance options, an engineering analysis for each facility in the sample was conducted. This included a review of existing treatment systems at the facility and an assessment of the need to add new or supplement existing treatment capabilities. Having defined the control options, the compliance costs to facilities implementing each option were estimated. Compliance costs generally included treatment costs, monitoring, and operations and maintenance costs, and a variety of one-time costs of limited durations (e.g., waste minimization audits of production processes). Residual management costs were also estimated for industrial and municipal facilities that were projected to install end-of-pipe treatment and generate additional sludge (e.g., sludge produced from chemical precipitation).

If the analysis showed that additional treatment was the most likely control method to be used to comply with either WQBEL #1 or #2, then it was generally assumed that this treatment would be added as an end-of-pipe unit process (i.e., the treatment unit process would be added at a point just prior to discharge to the receiving water). While additional treatment at end-of-pipe may be neither technically nor economically efficient in a variety of circumstances, the necessary facility- or process-specific information, such as contributing wastewater flows, in-plant treatment capabilities or opportunities, process waste characteristics, or recycling capabilities that would allow an assessment of other potentially less expensive alternatives were not available.

In many instances, however, it was determined that additional end-of-pipe treatment was not necessary to allow a facility to meet Guidance-based WQBELs. This was the case where existing treatment facilities could accomplish the required treatment, the incremental amounts of pollutants to be removed were insignificant, or where waste minimization/pollution prevention control techniques were believed to be adequate to comply with the Guidance. The appropriate control technique, therefore, was determined by the best professional judgement of the engineer performing the costing analysis, based on the available facility file information.

In the case of POTWs, consideration was given to the number and types of industrial users discharging to the collection system, as well as the size of the POTW. If additional pretreatment controls or modifications seemed unlikely to achieve the pollutant reductions, then additional treatment at the POTW was considered the next most likely option.

Monitoring costs for permitted facilities were also estimated. In those cases where additional parameters and limitations were deemed necessary because of the Guidance, the monitoring regimes (i.e., sampling frequency) were established consistent with the existing monitoring requirements for other parameters. Monitoring costs were then estimated based on average costs per analytical method for the more common techniques.

Because the discharge of bioaccumulative chemicals of concern (BCCs) is of special interest under the proposed Guidance, monitoring-only costs were included for Tier I BCCs for all affected facilities, regardless of whether Tier I BCCs were detected or expected to be present in a discharge.

A number of other costs were also considered depending on the specific circumstances surrounding a particular type of facility. These were generally one-time costs related to pollutant minimization studies, bioconcentration studies, whole effluent toxicity testing, pretreatment program revisions, waste minimization audits, and implementation of pollution prevention techniques. Generally, these costs were included with the capital costs for purposes of calculating annualized costs of compliance.

Four different cost estimates were developed to account for differences between limits based on WLA #1 (zero background absent actual data) and WLA #2 (assumed 50 percent of the most stringent Guidance criteria as background absent actual data), as well as the potential range of costs associated with implementation of waste and pollutant minimization studies and controls. These scenarios are described below.

Scenario 1: Limits based on WLA #1 and the low end of the estimated range of waste minimization costs for all facilities.

Scenario 2: Limits based on WLA #2, the middle of the estimated range of waste minimization costs for industrial facilities, and the high end of the estimated range costs for the POTWs aggressively implementing the pretreatment program to promote source control.

Scenario 3: Limits based on WLA #2, the middle of the estimated range of waste minimization costs for industrial facilities, and end-of-pipe treatment installation by POTWs.

Scenario 4: Limits based on WLA #2, the high end of an estimated range of waste minimization costs, and end-of-pipe treatment installation by POTWs.

The major difference between Scenario 2 and Scenario 3 was the emphasis on pollution prevention versus end-of-pipe treatment. Assumptions underlying Scenario 2 emphasized pollution prevention through source control. Scenario 3 focused on end-of-pipe treatment, especially at POTWs.

To develop a single cost estimate for each facility for each scenario described above, the three cost categories mentioned above (treatment, monitoring, and one-time costs) were combined into a single annualized cost, which reflects the annual economic costs associated with recurring activities (e.g., compliance monitoring, and operation and maintenance), repaying capital expenses, and special studies. Annualized costs were calculated by assuming that all capital costs and special study costs would be paid by borrowing money at an interest rate of seven percent and paying it back over a 10-year period. Annual costs of monitoring, operation, and maintenance were added directly.

Given a single estimate of the annualized cost for each facility, the procedure for extrapolating costs from the sample to the entire population was pre-determined by the stratified random sampling procedure used to select the subset of facilities examined in detail. Using the single annualized cost figure for each plant, an estimate of the cost for each category was calculated by averaging the values for applicable (sample) plants and then multiplying by the total (population) number of plants in that stratum. The cost estimate for the category was calculated by summing the strata in the category. The cost estimate for the entire universe of facilities was the sum across categories. This procedure was followed to estimate costs for each scenario.

An estimated 3,500 indirect industrial dischargers that discharge to POTWs in the Great Lakes Basin were identified, and preliminary estimates of compliance costs were developed for these dischargers. These preliminary cost estimates were based on the assumption that indirect dischargers affected by the proposed Guidance would incur costs comparable to those incurred by direct industrial dischargers in the same category. In addition, it was assumed that costs to industrial users subject to categorical pretreatment standards would be higher than the costs to non-categorical significant industrial users. The following four scenarios for indirect dischargers are consistent with the four cost scenarios developed for direct dischargers.

Scenario 1: Assumes that 10 percent of all indirect dischargers in the Great Lakes Basin would install additional controls.

Scenario 2: Assumes that 30 percent of all indirect dischargers in the Great Lakes Basin would install additional controls.

Scenario 3: Assumes that 20 percent of all indirect dischargers in the Great Lakes Basin would install additional controls.

Scenario 4: Assumes that 20 percent of all indirect dischargers in the Great Lakes Basin would install additional controls (same as Scenario 3).

The estimated percent of indirect dischargers affected by the proposed Guidance was based on an assessment of conditions involving industrial users and their toxic discharges to a moderately large POTW in the Great Lakes Basin.

2.2 APPROACH FOR ESTIMATING COMPLIANCE COSTS FOR THE FINAL GUIDANCE

This section discusses the revisions to the approach used to derive compliance cost estimates for the proposed Guidance. The revisions to the approach are based primarily upon the changes to the proposal discussed throughout the preamble and rule for the final Guidance, and the public comments received on the methodology used for the proposal.

In general, the basic methodology attributed to the proposed Guidance (as described in Section 2.1) was employed to estimate compliance costs and pollutant load reductions for the final Guidance. However, the approach was revised, based on comments received, to more accurately project the costs to the regulated community and to better account for the pollutant load reductions. Revisions to the original analysis for the proposed Guidance are described below.

It should be noted that many of the provisions included in the final Guidance provide implementation flexibility for permitting authorities. Rather than requiring States and Tribes to adopt a specific procedure, the final Guidance provides a recommended approach, and flexibility was provided for the State or Tribe to use alternative approaches. For purposes of estimating compliance costs, it was assumed that permitting authorities would use the procedures recommended by EPA in the preamble to the final Guidance. In general, the use of these procedures was considered conservative for the costing analysis since it is likely that States will sometimes adopt procedures that are less stringent than those recommended by EPA, and will rarely adopt procedures that are more stringent.

While the cost analysis implementation procedures were generally as, or more, stringent than those that will be used by States, there were a few areas where assumptions could underestimate potential costs. These include the following areas:

- Cost analyses considered only 69 of the 138 pollutants of initial focus (see Section 2.2.3.1). It is possible that other pollutants may eventually be detected in facility discharges and may require some type of control.

- Tier II values could be estimated for only some of the 69 pollutants because actual procedures call for pollutant-specific evaluations. Data collected by facilities could result in more stringent Tier II values in some instances.

- Costs attributed to the antidegradation provisions of the final Guidance could only be estimated using a sensitivity analysis. While the assumptions were considered conservative, the actual costs may be higher or lower than predicted.

- Where total maximum daily loads (TMDLs) are developed by States, the WLAs and resulting WQBELs will differ from those calculated in the cost analyses. While this should generally result in less stringent WQBELs for point sources, it could also result in more stringent WQBELs under certain circumstances.

Acknowledging that the assumptions noted above may result in an underestimation of potential costs, the analysis also utilized a number of assumptions that will likely result in an overestimation of costs. Specific elements of the costing analyses where more stringent assumptions were utilized are provided in Table 2-1 and Table 2-2.

TABLE 2-1 COST STUDY ASSUMPTIONS REGARDING CRITERIA/STANDARDS THAT ARE MORE STRINGENT THAN REQUIRED BY FINAL GUIDANCE

GUIDANCE REQUIREMENT	MORE STRINGENT COST ESTIMATE ASSUMPTIONS
Appendix B - Bioaccumulation Factors (BAFs)	
Human heath and wildlife criteria to be derived using measured or predicted BAFs.	BAFs used to develop criteria for the costing analysis were calculated using conservative assumptions. BAFs were therefore more stringent than those that would be calculated by States and should result in more stringent criteria than would be developed by States. Projected costs, therefore, will likely overestimate actual costs.
Appendix C - Human Health	
Requires use of drinking water factors where discharge is to open waters, connecting channels, or designated drinking water sources. Uses 15 grams/day consumption rate.	Assumed all receiving waters were drinking water sources. This resulted in more stringent criteria. Therefore, projected costs will likely over-estimate actual costs. Assumed a fish consumption rate of 45 grams/day. States will most likely use 15 grams/day; thus, the cost projections will likely overestimate actual costs.

TABLE 2-2 COST STUDY ASSUMPTIONS REGARDING IMPLEMENTATION PROCEDURES THAT ARE MORE STRINGENT THAN REQUIRED BY FINAL GUIDANCE

GUIDANCE REQUIREMENT	MORE STRINGENT COST ESTIMATE ASSUMPTION
Procedure 1: Site Specific Modifications	
Allows States to use more or less stringent, human health, wildlife, and aquatic life criteria and BAFs.	Cost analyses are based on final Guidance recommendations. It is most likely that States will use the provision to relax criteria and BAFs, thus, projected costs will likely overestimate actual costs.
Procedure 3: TMDL/WLA	
All mixing zones for BCCs eliminated within 12 years of rule publication. Extensions may be granted for technical and economic considerations. Defines critical low flow for wildlife protection as the 90-year, 10-day flow (90Q10).	Assumed immediate elimination of all mixing zones for BCCs. Costs were developed assuming BCC criteria were applied at end-of-pipe. Since States will likely allow mixing zones for many existing sources up to 12 years, this would allow permittees to defer some costs over the 12-year period. Projected costs, therefore, will likely overestimate actual costs. Used 30-year, 5-day (30Q5) critical low flow for protection of wildlife.

TABLE 2-2 ASSUMPTIONS REGARDING IMPLEMENTATION PROCEDURES THAT ARE MORE STRINGENT THAN REQUIRED BY FINAL GUIDANCE (continued)

GUIDANCE REQUIREMENT	MORE STRINGENT COST ESTIMATE ASSUMPTION
Procedure 4: Additivity	
Requires States to adopt an additivity provision.	WQBELs were calculated assuming that all carcinogens were additive. Assumed an additive risk of $1x10^{-5}$. This assumption is likely to be at the stringent end of the options selected by States. The projected costs, therefore, should slightly overestimate actual costs.
Procedure 6: Whole Effluent Toxicity (WET)	
WET limits must be determined where reasonable potential is determined. States must develop and apply WET limits, but may defer limit application until sufficient data have been generated.	Costed WET testing requirements for all facilities where WET data were unavailable and where toxic pollutants were present in discharge. Rigorous WET testing requirements likely will exceed State requirements; thus, projected costs likely will overestimate actual costs.
Procedure 8: WQBELs Below Detection	
Permits will specify the most sensitive analytical technology and will establish the "Minimum Level of Quantification" (MLOQ).	Cost analyses used the method detection level (MDL) as the target concentration. Since the MDL will be equal to, or more stringent than the MLOQ, the projected costs will likely overestimate the actual costs.
Procedure 9: Compliance Schedules	
Final Guidance allows States to provide a three year compliance period upon permit reissuance. This could allow costs to be deferred for up to eight years (i.e., five year permit cycle + three year schedule).	Cost analyses did not consider compliance schedules. Costs were assumed to be incurred immediately. Since States will likely provide compliance periods for many existing sources, projected costs will likely overestimate actual costs.

2.2.1 Selection of Direct Discharge Facilities

The selection process for the 59 direct discharge facilities that were used to develop cost estimates based on the proposed Guidance was described in detail in the April 16, 1993 compliance cost report. The cost analyses for the final Guidance were performed for the same group of direct dischargers with several exceptions described below.

During the data collection effort for the revised cost analyses (described in Section 2.2.2 of this report), it was determined that four of the 59 sample facilities had either ceased operation, altered manufacturing processes, or redirected process discharges. These facilities, therefore, were replaced by alternate facilities drawn at random from the appropriate category and flow strata. Table 2-3 summarizes the reasons for the removal of the facilities and presents the facilities used as replacements. In addition, Table 2-4 provides a complete list of the 59 study facilities used for the final cost analyses.

TABLE 2-3 DISCHARGERS REMOVED FROM THE COST ANALYSIS AND REPLACEMENT FACILITIES

FACILITY NAME	CATEGORY	REASON FOR REMOVAL	ALTERNATE FACILITY EVALUATED
Cyprus Northshore Mining Corp. (MI0046981)	Mining	Process discharge was redirected to a POTW.	Martin Marietta (MI0004154)
RMI Company (OH0002305)	Metals Manufacturing	Process discharge was redirected to a POTW.	Great Lakes Metals Corporation (OH0032727)
Bellville Plating Company (MI0004456)	Metal Finishing	Process discharge was redirected to a POTW.	Johnson Control, Inc. (MI0003484)
Minnesota Power - Duluth (MN0001015)	Steam Electric	Facility is not currently operating. Effluent data and other file information were, therefore, unavailable.	Holland BPW - DeYoung Power Plant (MI0001473)

2.2.2 Collection of Data/Information

The original analysis for the proposed Guidance was performed based on data collected from EPA Region 5, State permitting authorities, EPA development documents, and special studies. Discharge data were based on 1990 Permit Compliance System (PCS) data, and facility-specific permit file information were generally from 1992. For the final Guidance, the current information and data (including permits, fact sheets, permit applications, and other relevant discharge information) were updated and verified, and were used as the basis for comparison to Guidance requirements. In addition, State permitting authorities were requested to review each sample facility evaluated in the original cost estimate for the proposed Guidance and to provide comments and additional information as necessary to ensure accurate reflection of current permit requirements and discharge conditions.

For the cost estimate for the final Guidance, 1993 PCS discharge data were used, as well as permit file information and data provided by the State permitting authorities (generally representing permits issued as late as through mid-1994). As a result of use of more recent data, a shift was noted in the baseline of permit requirements for the sample facilities; the baseline was lowered based on more stringent NPDES permit requirements being applied by permitting

TABLE 2-4 MAJOR FACILITIES RANDOMLY SELECTED FOR COMPLIANCE COST EVALUATION

NPDES PERMIT NUMBER	FACILITY NAME	REPORTED SIC CODE
MINING		
MI0004154	MARTIN MARIETTA	1011
MN0055301	RESERVE MINING CORP	1011
MI0038369	TILDEN MINING CO	1011
MI0003158	MEDUSA CEMENT CO-CHARLEVOIX	3241
FOOD AND FOOD PRODUCTS		
MI0002542	MICHIGAN SUGAR CO-CROSWELL	2063
MI0002003	MICHIGAN SUGAR CO-SEBEWAING	2063
MI0002267	MICHIGAN SUGAR CO-CARO	2063
MI0002224	MICHIGAN SUGAR CO-CARROLLTON	2063
PULP AND PAPER		
WI0002798	SUPERIOR FIBER PROD-SUPERWOOD	2493
MI0000060	MENOMINEE PAPER CO	2611
NY0000515	SCHOELLER TECHNICAL PAPERS INC	2621
WI0003140	JAMES RIVER PAPER COMPANY	2621
WI0000990	APPLETON PAPERS INC - LOCKSMILL	2611
WI0001848	FORT HOWARD PAPER COMPANY	2611
INORGANIC CHEMICALS		
OH0000990	ZACLON INC	2819
OH0000493	SCM CHEMICALS	2816
IN0000035	UNION CARBIDE LAKESIDE PLANT	2813
MI0002381	ATOCHEM NORTH AMERICA INC	2819
ORGANIC CHEMICALS AND PETROLEUM REFINING		
NY0000345	FMC CORPORATION	2879
NY0000400	LIFE TECHNOLOGIES INC	2834
MI0000868	DOW CHEM USA-MIDLAND	2821
NY0003328	E.I. DUPONT DE NEMOURS & CO	2869

TABLE 2-4 MAJOR FACILITIES RANDOMLY SELECTED FOR COMPLIANCE COST EVALUATION (continued)

NPDES PERMIT NUMBER	FACILITY NAME	REPORTED SIC CODE
METALS MANUFACTURING		
MI0002763	EXTRUDED METALS	3354
MI0001902	QUANEX CORP-MICH SEAMLESS TUB	3317
OH0032727	GREAT LAKES METALS CORP.	3360
IN0000175	BETHLEHEM STEEL CORPORATION	3312
MI0002399	MCLOUTH STEEL-TRENTON	3312
METAL FINISHING		
MI0002836	FEDERAL MOGUL CORP-GREENVILLE	3714
MI0003484	JOHNSON CONTROL INC	3691
OH0000281	ARGO TECH CORPORATION	3471
WI0001309	KOHLER CO	3471
STEAM ELECTRIC		
OH0003786	TOLEDO EDISON CO - OAK HARBOR	4911
MI0001473	HOLLAND BPW-DEYOUNG POWER PLANT	4911
W10000922	WI ELECTRIC POWER CO - PORT WASH	4911
MI0001431	CPCO-BIG ROCK POINT PLANT	4911
MI0001848	DECO-MONROE PLANT	4911
MI0001678	CPCO-KARN & WEADOCK PLANT	4911
MISCELLANEOUS		
NY0000078	GARLOCK INC	3069
NY0000973	WEST VALLEY DEMONSTRATION PROJ	9711
MI0042994	MDNR-VERONA WELL FIELD	9999
NY0101575	DUNLOP TIRE CORP	3011
MUNICIPALS		
NY0022985	PERRY (V) WWTP	4952
OH0024686	CLYDE, CITY OF	4952
M10022489	BUCHANAN WWTP	4952
M10021334	LUDINGTON WWTP	4952
OH0024929	DELPHOS, CITY OF	4952

TABLE 2-4 MAJOR FACILITIES RANDOMLY SELECTED FOR COMPLIANCE COST EVALUATION (continued)

NPDES PERMIT NUMBER	FACILITY NAME	REPORTED SIC CODE
M10042439	WEST BAY CO REGIONAL WWTP	4952
W10024767	MILWAUKEE MSD - JONES ISLAND	4952
PA0026301	ERIE WASTEWATER TREATMENT PLANT	4952
M10022276	BATTLE CREEK WWTP	4952

authorities. The overall effect of lowering the baseline was that estimated compliance costs and pollutant load reductions were not as substantial as were originally projected for the proposed Guidance.

One of the limitations of the original compliance cost study for the proposed Guidance was a general lack of site-specific receiving water data (i.e., background data) for the sample facilities. To fully evaluate EPA's provisions in the final Guidance for intake credits (i.e., determining whether discharges are to same or different bodies of water and for identifying non-attainment waters), as well as to ensure that all available data were used for the cost analysis, additional background concentration data for each of the sample facilities was collected. Data submitted as a part of the public comments, as well as the water quality files contained in the STORET data base, were reviewed and considered. In addition, State permitting authorities were contacted frequently to collect all applicable data.

Consistent with Procedure 3 of Appendix F to the final Guidance, fish tissue data (either caged or resident fish tissue data) were also collected to represent ambient water column background concentrations. When fish tissue data were available for the pollutants being evaluated at a sample facility, a simplified approach for converting the tissue data to ambient water column concentrations was used. This method entailed dividing fish tissue data (in mg/kg wet weight) by the pollutant-specific bioaccumulation factor (BAF) used to derive Tier I criteria (in l/kg) and multiplying the result by 1,000 to give the result as concentration of pollutant (μg/l). When data for more than one species was available, the geometric mean for all species was calculated and used.

2.2.3 Calculation of Permit Limits/Conditions

The proposed Guidance Implementation Procedures outlined the specific methodologies to calculate WQBELs and determine the need to include the calculated limits in a permit. The final Guidance, however, establishes only the framework for WQBEL calculation in the regulation. This approach provides State permitting authorities the flexibility to develop their own specific procedures for WQBEL calculation as long as the assumptions used are consistent with final Guidance requirements. While the procedures outlined in the proposed Guidance are not included in the regulation for the final Guidance, the preamble does indicate that procedures in the proposed Guidance are fully consistent with the final Guidance, and may be used by States to satisfy Guidance requirements. Because several States will likely use the recommended procedures, the final costing analysis did not revise the formulae used to calculate WQBELs.

While the general approach and the equations used to calculate WQBELs were not modified in order to perform the final costing analyses, there were several significant changes to the criteria and implementation procedures in the final Guidance that impacted WQBEL calculations. The specific revisions to the final Guidance that affected the costing analyses, and the approach used to address these revisions are described below.

2.2.3.1 Expanded List of Pollutants Evaluated in Cost Analyses

The proposed Guidance, while generally applying to all pollutants, was structured to provide an initial focus on 138 pollutants. The 138 pollutants were identified as those being known or suspected of being of primary concern in the Great Lakes Basin. The proposed Guidance included numeric criteria to protect aquatic life, human health, and/or wildlife for 32 of the 138 pollutants. The cost study for the proposed Guidance was based on these 32 pollutants. Because of concern that the 32 pollutants did not represent all the possible pollutants that may contribute to potential costs, the study evaluated whether additional pollutants should be included in the cost analysis. The evaluation used three criteria— loadings, frequency of occurrence, and toxicity, to determine whether additional pollutants should be included in the final analysis.

To determine which pollutants exhibited significant loadings to the Great Lakes Basin, the loadings for all 138 pollutants of initial focus listed in the proposed Guidance at the 59 study facilities were calculated. The loadings were based on facility permit limits or measured effluent concentrations. The loadings were then multiplied by EPA toxic weights to normalize the toxicity of each pollutant to that of copper. (See Section 4 for further discussions related to EPA toxic weights.) Using the statistical extrapolation factors developed for the costing analysis, the total toxic weighted loadings for the 138 pollutants were extrapolated to the universe of major dischargers in the Great Lakes Basin. Based on the results of this evaluation, it was determined that pollutants that exhibited "de minimis" loadings would be omitted from the final costing analysis. The "de minimis" value selected was 10 pounds-copper toxicity equivalents per day. This value corresponds to a total pollutant load from all major point source dischargers to the Great Lakes Basin of 10 pounds of copper per day.

In addition to the loadings analysis, it was important to ensure that other pollutants that were frequently limited or required to be monitored at facilities, but that might have been undetected or that exhibited low toxicity and thus were not captured in the loadings analysis, were also included in the final costing analyses. Since the loadings analyses should have captured the most significant pollutants of concern, this evaluation was considered a "safety net." This analysis captured any pollutant that was limited, detected, or required to be monitored at three or more of the 59 sample facilities.

As a final "safety net" it was important to ensure that any pollutant limited, detected, or required to be monitored at any facility that exhibited a high toxicity (high toxic weight) was included in the final costing. This evaluation was performed by multiplying the "frequency of occurrence" for a given pollutant by its toxic weight. The resulting value was designated the "Occurrence Toxic Equivalent" (OTE). The OTE analysis captured those pollutants that might have not been detected and thus escaped the loadings evaluation, but that had monitoring requirements at one or more facilities. A target value of 0.1 OTE was selected to ensure that any pollutant with a toxic weight of 50 or greater, and even a single monitoring requirement at one sample facility, would be included in the final costing analysis.

The additional pollutant evaluation identified 76 pollutants that were limited, detected in the effluent, or required to be monitored at one or more of the 59 sample facilities. From this list of 76 pollutants, 37 were determined to be of consequence to the loadings and costing analyses using the rationale described above. This increased the total number of pollutants evaluated for compliance costs and load reductions in the final analysis to 69. The list of pollutants included in the final analysis and those found but not included in the costing analyses are provided in the Table 2-5.

An example of a pollutant found at study facilities, but excluded from the final analyses, is vinyl chloride. Vinyl chloride was limited in a permit for one facility and was detected in the effluent at a second facility. Based on the permit limit and the monitoring data, a total load of vinyl chloride of 0.04 pounds per day was determined. Using the vinyl chloride toxic weight of 0.0013 and extrapolating the load to the 588 major discharges in the Great Lakes Basin, a total toxic weighted load of 0.0018 pounds-equivalent per day was estimated, which is below the "de minimis" criteria of 10 pounds-equivalent per day. The occurrence frequency for vinyl chloride (2 of 50 facilities or four percent) did not exceed the trigger of five percent. The OTE was then calculated by multiplying the occurrence frequency of four percent by the toxic weight (0.0013). This resulted in an OTE of 0.00005, which is less than the 0.1 OTE trigger. As a result of this analysis, vinyl chloride was not considered in the final costing analyses.

2.2.3.2 Development of Tier I Criteria and Tier II Values Used in Cost Analyses

Having established the list of 69 pollutants for the final costing analyses, criteria for these pollutants were developed utilizing the Tier I and Tier II procedures outlined in Appendices A, B, C, and D of the final Guidance and readily available toxicity data. For the 32 pollutants for which numeric criteria were established in the proposed Guidance, the criteria for protection of aquatic life were generally used; however, the criteria for protection of wildlife and human health were revised to reflect modifications to the Guidance procedures for determination of BAFs. In addition, it was necessary to calculate criteria values for the additional 37 pollutants added to the costing analysis, using the final Guidance methodologies and the most current toxicity data. The results of the criteria development efforts are provided in Table 2-6.

TABLE 2-5 PARAMETERS IDENTIFIED FOR FINAL COSTING ANALYSES

PROPOSED GUIDANCE PARAMETERS	PARAMETERS ADDED FOR FINAL ANALYSES	PARAMETERS FOUND BUT NOT ANALYZED
2,3,7,8-TCDD	1,1-Dicholoroethane	2-Nitrophenol
2,4-Dimethylphenol	1,1-Dichloroethylene	4-Nitrophenol
2,4-Dinitrophenol	1,1,1-Trichloroethane	1,2-Dichlorobenzene
Arsenic(III)	1,2-Dichloroethane	1,3-Dichlorobenzene
Benzene	1,2-Dichloropropane	1,4-Dichlorobenzene
Cadmium	1,2-trans-Dichloroethylene	3,4-Benzofluoranthene
Chlordane	1,2,4,5-Tetrachlorobenzene	11,12-Benzofluoranthene
Chlorobenzene	2,4,6-Trichlorophenol	1,1,2-Trichloroethane
Chromium(III)	3,3-Dichlorobenzidine	1,2,4-Trichlorobenzene
Chromium(VI)	4,4-DDD	1,1,2,2-Tetrachloroethane
Copper	4,4-DDE	1,2,3,4-Tetrachlorobenzene
Cyanide, Free	Acrylonitrile	2-Chlorophenol
Cyanide, Total	Aldrin	2,4-Dichlorophenol
DDT	alpha-Endosulfan	2,4-Dichlorophenoxyaceticacid
Dieldrin	alpha-Hexachlorocyclohexane	Acenaphthene
Endrin	Aluminum	Acenaphthalene
Heptachlor	Antimony	Acrolein
Hexachlorobenzene	Benzidine	Anthracene
Hexachloroethane	Benzo[a]pyrene	Bis(2-chloroethyl)ether
Lindane	Beryllium	Bis(2-chloroisopropyl)ether
Mercury	beta-Endosulfan	Bromoform
Methylene Chloride	beta-Hexachlorocyclohexane	Butylbenzylphthalate
Nickel	Carbon tetrachloride	Chlorodibromomethane
Parathion	Chloroform	Chloroethane
PCBs	Chlorpyrifos	Dichlorobromomethane
Pentachlorophenol	Chrysene	Diethyl phthalate
Phenol	Endosulfan	Di-n-butylphthalate
Toluene	Fluoranthene	Dimethylphthalate
Total Selenium	Fluoride	Ethylbenzene
Toxaphene	Hexachlorocyclohexane	Fluorine
Trichloroethylene	Iron	Hexachlorobutadiene
Zinc	Lead	Indeno[1,2,3 cd]pyrene
	Pentachlorobenzene	Isophorone
	Phenanthrene	Methyl bromide
	Silver	Methylchloride
	Tetrachloroethylene	Octachlorostyrene
	Thallium	Pyrene
		Vinyl Chloride

TABLE 2-6 CRITERIA DEVELOPED FOR USE IN FINAL COST ANALYSES*

PARAMETER (1,2)	AQUATIC LIFE (3)		WILDLIFE	HUMAN HEALTH (4)		HUMAN HEALTH (5)	
	Final Acute Value (µg/l)	Criterion Continuous Concentration (µg/l)	Wildlife Domestic Animal Criteria (µg/l)	Human Non-Cancer Value (15g) (µg/l)	Human Cancer Value (15g) (µg/l)	Human Non-Cancer Value (45g) (µg/l)	Human Cancer Value (45g) (µg/l)
Acrylonitrile	7.55E+03	4.19E+02			6.43E-01		6.34E-01
Aldrin	6.00E+00		6.70E-07	5.38E-05	1.32E-06	1.79E-05	4.40E-07
Aluminum	1.50E+03	8.70E+01					
Antimony	1.76E+02	3.00E+01		1.11E+01		1.10E+01	
Arsenic (III)	6.80E+02	1.50E+02		8.34E+00	2.04E-01	8.22E+00	2.01E-01
Benzene	5.30E+03	2.94E+02		1.88E+01	1.14E+01	1.69E+01	1.02E+01
Benzidine	2.50E+03	1.39E+02		8.34E+01	1.51E-03	8.22E+01	1.49E-03
Benzo[a]pyrene					1.05E-05		3.52E-06
Beryllium	1.30E+02	5.30E+00		1.23E+02	7.12E-02	9.81E+01	5.70E-02
Cadmium	3.61E+00	6.60E-01		1.39E+01		1.37E+01	
Carbon tetrachloride	3.52E+04	1.96E+03		1.56E+01	2.15E+00	1.11E+01	1.53E+00
Chlordane	2.40E+00	4.30E-03	9.24E-05	8.21E-03	1.44E-04	2.74E-03	4.79E-05
Chlorobenzene			1.97E+01	4.18E+02		2.92E+02	
Chloroform	2.89E+04	1.24E+03		2.72E+02	5.57E+01	2.57E+02	5.26E+01
Chlorpyrifos	1.66E-01	4.10E-02	3.47E-01	1.20E+01		4.42E+00	
Chromium (III)	6.81E+02	4.20E+01		2.78E+04		2.74E+04	
Chromium (VI)	3.16E+01	1.06E+01		1.39E+02		1.37E+02	
Chrysene					3.10E-05		1.03E-05
Copper	1.40E+01	4.94E+00		1.00E+03		1.00E+03	
Cyanide, free	4.40E+01	5.20E+00		5.56E+02		5.48E+02	
Cyanide, total				6.11E+02		6.02E+02	
4,4-DDD	6.00E-01	3.33E-02	2.78E-06		4.65E-04		1.55E-04
4,4-DDE	1.05E+03	5.83E+01	2.78E-06		2.46E-05		8.20E-06
DDT	1.10E+00	1.00E-03	2.78E-06	1.20E-03	8.85E-05	4.01E-04	2.95E-05
3,3-Dichlorobenzidine					3.51E-01		1.67E-01
1,1-Dichloroethane							
1,2-Dichloroethane	1.18E+05	6.56E+03			3.82E+00		3.76E+00
1,1-Dichloroethylene				2.39E+02	5.54E-01	2.18E+02	5.04E-01

TABLE 2-6 CRITERIA DEVELOPED FOR USE IN FINAL COST ANALYSES* (continued)

PARAMETER (1,2)	AQUATIC LIFE (3)		WILDLIFE	HUMAN HEALTH (4)		HUMAN HEALTH (5)	
	Final Acute Value (µg/l)	Criterion Continuous Concentration (µg/l)	Wildlife Domestic Animal Criteria (µg/l)	Human Non-Cancer Value (15g) (µg/l)	Human Cancer Value (15g) (µg/l)	Human Non-Cancer Value (45g) (µg/l)	Human Cancer Value (45g) (µg/l)
1,2-trans-Dichloroethylene			1.60E+02	5.36E+02		4.93E+02	
1,2-Dichloropropane					5.04E+00		4.70E+00
Dieldrin	4.80E-01	5.60E-02	2.34E-06	1.87E-04	2.93E-06	6.24E-05	9.75E-07
2,4-Dimethylphenol	2.12E+03	1.18E+02	4.10E+00	2.20E+02		1.06E+02	
2,4-Dinitrophenol			3.41E+00	5.49E+01		5.29E+01	
alpha-Endosulfan	2.20E-01	5.60E-02	5.67E-03	3.97E-01		1.63E-01	
beta-Endosulfan	2.20E-01	5.60E-02	5.67E-03	3.97E-01		1.63E-01	
Endosulfan	2.20E-01	5.60E-02	5.67E-03	9.71E-01		6.02E-01	
Endrin	1.80E-01	3.70E-02	6.50E-05	5.15E-02		1.72E-02	
Fluoranthene	3.98E+03	2.21E+02		2.85E+02		1.15E+02	
Fluoride				3.33E+03		3.29E+03	
Heptachlor	5.20E-01	3.80E-03	1.20E-03	9.65E-02	1.79E-04	3.22E-02	5.97E-05
Hexachlorobenzene	1.20E+01	3.68E+00	5.58E-04	2.69E-02	2.62E-04	8.97E-03	8.76E-05
alpha-Hexachlorocyclohexane					2.87E-03		9.90E-04
beta-Hexachlorocyclohexane					1.00E-02		3.46E-03
Hexachlorocyclohexane	2.00E+00	8.00E-02			1.00E-02		3.46E-03
Hexachloroethane	9.80E+02	5.44E+01		2.45E+00	3.08E+00	8.88E-01	1.12E+00
Iron		1.00E+03					
Lead	5.91E+01	1.04E+00		1.50E+01		1.50E+01	
Lindane	1.90E+00		2.90E-03	2.80E-01	8.17E-03	9.54E-02	2.78E-03
Mercury	1.41E+00	4.40E-01	9.12E-04	1.60E-03		5.35E-04	
Methylene Chloride				1.79E+03	4.73E+01	1.75E+03	4.60E+01
Nickel	5.20E+02	2.89E+01		5.56E+02		5.48E+02	
Parathion	1.30E-01	1.30E-02					
PCBs	2.00E+00	1.40E-02	9.20E-05	6.86E-05	1.39E-05	2.29E-05	4.64E-06
Pentachlorobenzene			1.30E-03	9.53E-02		3.19E-02	
Pentachlorophenol	1.06E+01	4.05E+00		1.47E+02	5.12E-01	5.57E+01	1.93E-01

TABLE 2-6 CRITERIA DEVELOPED FOR USE IN FINAL COST ANALYSES* (continued)

PARAMETER (1,2)	AQUATIC LIFE (3)		WILDLIFE	HUMAN HEALTH (4)		HUMAN HEALTH (5)	
	Final Acute Value (μg/l)	Criterion Continuous Concentration (μg/l)	Wildlife Domestic Animal Criteria (μg/l)	Human Non-Cancer Value (15g) (μg/l)	Human Cancer Value (15g) (μg/l)	Human Non-Cancer Value (45g) (μg/l)	Human Cancer Value (45g) (μg/l)
Phenanthrene	*6.00E+01*	*6.30E+00*					
Phenol	**7.20E+03**	**1.10E+02**	*1.63E-02*	**1.21E+03**		**4.23E+02**	
Selenium (Total)	**3.69E+01**	**4.61E+00**		**1.35E+02**		**1.26E+02**	
Silver	*1.05E+00*			**1.39E+02**		**1.37E+02**	
1,2,4,5-Tetrachlorobenzene			*2.98E-03*	**2.23E-01**		**7.57E-02**	
2,3,7,8-TCDD	*1.00E-02*	*1.00E-05*	**2.00E-09**	**4.80E-08**	**6.15E-09**	**1.60E-08**	**2.05E-09**
Tetrachloroethylene	*5.28E+03*	*2.93E+02*	*1.20E+00*	**1.65E+02**		**9.85E+01**	
Thallium	*1.40E+03*	*4.00E+01*		**1.30E+00**		**7.82E-01**	
Toluene	*1.75E+04*	*9.72E+02*	*6.75E+00*	**4.89E+02**		**1.72E+02**	
Toxaphene	*1.46E+00*	*2.00E-04*	**7.70E-05**	**5.94E-03**	**1.93E-05**	**1.98E-03**	**6.43E-06**
1,1,1-Trichloroethane			*9.00E+01*	**8.81E+02**		**7.33E+02**	
Trichloroethylene	*4.50E+04*	*2.50E+03*		**4.45E+02**	**2.81E+01**	**3.61E+02**	**2.28E+01**
2,4,6-Trichlorophenol		*9.70E+02*			**2.52E+01**		**1.78E+01**
Whole Effluent Toxicity (WET)							
Zinc	**1.31E+02**	**5.98E+01**		**8.13E+03**		**7.64E+03**	
Number of Tier I Criteria	16	15	7	46	31	46	31
Number of Tier II Values	34	34	21	6	2	6	2

* Criteria were developed assuming:

  Hardness = 50.0 mg/l as $CaCO_3$
  pH = 6.50 S.U.

Criteria used in calculating WQBELs were adjusted for actual hardness and pH as appropriate.

(1) Shaded parameters indicate that criteria were presented in the proposed Guidance
(2) Values that are shaded and bolded are considered "Tier I" criteria - all others are considered "Tier II values"
(3) Criteria for metals are for the "dissolved" fraction
(4) Human health criteria calculated assuming a fish consumption rate of 15 grams per day
(5) Human health criteria calculated assuming a fish consumption rate of 45 grams per day

Aquatic Life

Criteria for the protection of aquatic life were determined for 50 of the 69 costed pollutants using Tier I and Tier II methodologies. Generally, the most current toxicity data were used as input to calculate aquatic life criteria used for the costing analyses; however, where toxicity data were insufficient to calculate tier I criteria, estimates of appropriate Tier II values were developed. The following methods were used to calculate aquatic life criteria:

- Tier I criteria were calculated using the same procedures and data utilized for the proposed Guidance. The values, therefore are identical to those published in Tables 1 and 2 of the proposed Guidance.

- Tier II values were determined based on the availability of toxicity data for the specific pollutant. Where the EPA Office of Science and Technology (OST) had published or proposed aquatic life criteria for a pollutant (e.g., National Toxics Rule), it was assumed that reliable toxicity data existed; thus, the published criteria were used as the Tier II values. For pollutants where criteria had not been published or proposed, the "lowest observed effect level" (LOEL) was used to derive the Final Acute Value (FAV) and to obtain the Criteria Continuous Concentration (CCC).[1]

Human Health

Criteria for the protection of human health were determined for 64 of the 69 costed pollutants. The criteria for 58 of the 64 pollutants were determined using Tier I methodologies, and Tier II values were determined for the remaining 6. The only difference between the Tier I and Tier II methodologies used to develop criteria for the cost analyses, pertained to the data available to calculate BAFs. Where sufficient data were available to accurately calculate BAFs, criteria were considered Tier I. Where minimum data were not available to develop reliable BAFs, existing data were used to estimate BAFs. Criteria calculated using the estimated BAFs were considered Tier II values.

Human health criteria were also calculated for copper and lead using alternate methods. Since neither slope factors nor reference dose data were available for these pollutants, the costing analyses used the drinking water "maximum contaminant levels" (MCL) as the criteria.

Tier I methods were used for all pollutants for which BAFs could be accurately calculated and for which carcinogen slope factors or toxic reference dose data were available. For the purposes of the costing analyses, EPA provided revised BAFs for many of the study pollutants. In addition, EPA provided the most recent carcinogen slope factors and toxic reference dose data

[1]Following the development of the cost estimates, it was determined that the procedures used to calculate Tier II aquatic life values were inconsistent with final Guidance methodologies. A subsequent analysis of the affect of these inconsistencies on projected costs and load reductions determined that impacts were negligible. A summary of the impact analysis is provided in Appendix A.

for each of the study pollutants. In nearly all instances, the parameters and assumptions used to calculate human health criteria for the cost analyses resulted in criteria that were more stringent than those published in the proposed Guidance. Following the completion of the cost analyses, EPA again updated its calculation of BAFs, slope factors, and reference doses, in order to calculate numeric criteria for the final Guidance. Based on the revised parameters and assumptions, many of the human health criteria published in the final Guidance were less stringent than those used for the costing analyses. A comparison of the criteria published in the proposed Guidance, those published in the final Guidance, and those used for the costing analyses, are provided in Table 2-7.

TABLE 2-7 COMPARISON OF MOST STRINGENT HUMAN HEALTH CRITERIA IN THE PROPOSED GUIDANCE, FINAL GUIDANCE, AND COST EVALUATIONS

CHEMICAL	PROPOSED GUIDANCE (μg/l)	FINAL GUIDANCE (μg/l)	COST EVALUATIONS (μg/l)
Benzene	1.00E+01	1.16E+01	1.02E+01
Chlordane	2.00E-04	2.46E-04	4.79E-05
Chlorobenzene	5.00E+02	4.69E+02	2.92E+02
Cyanide	8.00E+02	6.00E+02	6.02E+02
DDT	7.00E-05	1.46E-04	2.95E-05
Dieldrin	1.00E-04	6.45E-06	9.75E-07
2,4-Dimethylphenol	3.00E+02	4.45E+02	1.06E+02
2,4-Dinitrophenol	7.00E+01	5.52E+01	5.29E+01
Hexachlorobenzene	1.00E-04	4.49E-04	8.76E-05
Hexachloroethane	2.00E+00	4.21E+00	8.88E-01
Lindane			
- Noncancer	7.00E-01	4.72E-01	9.54E-02
- Cancer Tier II	———	———	2.78E-03
Mercury[1]	2.00E-03	1.99E-03	5.35E-04
Methylene chloride	5.00E+01	4.74E+01	4.60E+01
PCBs (class)	3.00E-06	3.91E-06	4.64E-06
2,3,7,8-TCDD	1.00E-08	8.53E-09	2.05E-09
Toluene	6.00E+03	5.59E+03	1.72E+02
Toxaphene	2.00E-05	6.74E-05	6.43E-06
Trichloroethylene	3.00E+01	2.95E+01	2.81E+01

[1] Includes Methylmercury

Wildlife

Criteria for the protection of wildlife were calculated for 7 of the 69 costed pollutants using Tier I methodologies and for an additional 21 pollutants using Tier II methodologies. The Tier I methods used were identical to those published in the proposed Guidance; however, BAFs were updated by EPA based on revised data. Use of these revised BAFs generally resulted in the calculation of wildlife criteria that were less stringent than those published in the proposed Guidance. However, following completion of the cost analyses, EPA again updated the parameters used to calculate the wildlife criteria in order to calculate numerical values for the final Guidance. These updates resulted in final wildlife criteria that were less stringent than those used for the cost analyses. Table 2-8 provides a comparison of the wildlife criteria published in the proposed Guidance, those published in final Guidance and those used in the cost analyses.

Tier II wildlife values were calculated using the same procedures used to calculate Tier I criteria; however, the wildlife toxicity data were limited for these pollutants; thus Tier I criteria could not be determined. A summary of the Tier II methodology is provided in Appendix B.

TABLE 2-8 COMPARISON OF WILDLIFE CRITERIA IN THE PROPOSED GUIDANCE, FINAL GUIDANCE, AND COST EVALUATIONS

CHEMICAL	PROPOSED GUIDANCE (µg/l)	FINAL GUIDANCE (µg/l)	COST EVALUATIONS (µg/l)
DDT (and metabolites)	8.70E-07	1.10E-05	2.78E-06
Mercury[1]	1.80E-04	1.30E-03	9.12E-04
PCBs (class)	1.70E-05	7.40E-05	9.20E-05
2,3,7,8-TCDD	9.60E-09	2.00E-09	2.00E-09

[1] Includes Methylmercury

Dissolved Metals Water Quality Criteria

As described above, EPA revised many of the criteria originally proposed under the Guidance. Among the various updates made by EPA, was the change in promulgation of criteria for metals in the dissolved form, as opposed to the total form for aquatic life. The procedures used to derive metals criteria in the dissolved form for use in deriving compliance cost estimates is described briefly below.

In order to apply metals criteria in the dissolved form, conversion factors, based on toxicity testing results, were used to revise criteria from the total form to the dissolved form. The conversion factors were based on the ratio of dissolved metals to total metals present in the laboratory toxicity tests performed to establish the criteria for toxic metals. Conversion factors were obtained from the EPA report "Results of Simulation Tests Concerning the Percent Dissolved Metal in Freshwater Toxicity Tests" (EPA Duluth 1994) and from the EPA Policy memo from Martha G. Prothro to EPA's Water Management and Environmental Services Division Directors in Regions I-X dated October 1, 1993.

Conversion factors ranged from 0.333 for trivalent chromium, to 1.0 for trivalent arsenic. Where conversion factors were not available, a conversion factor of 1.0 was assumed. The conversion factor of 1.0 was determined to be appropriate because the majority of the actual values were in the range of 0.90 to 1.0. The criteria for the dissolved form of the metals were then adjusted back to the total form using the theoretical partitioning relationship between the total/dissolved phases described in the October 1, 1993 EPA policy memo.

The October 1, 1993 memo reiterates EPA's position that permit limits for metals must be established for total metals and describes three methodologies for translating dissolved metals criteria to the total form. Two of the three methods rely on site-specific studies performed to determine actual in-stream partitioning relationships. However, since actual metals partitioning data were not available for any of the 59 study facilities, the third alternative, based on the theoretical partitioning relationship, was used to calculate Guidance-based WQBELs. The theoretical partitioning relationship is based on a partitioning coefficient, determined empirically for each metal, and the concentration of total suspended solids (TSS) in the receiving water.

In performing the cost analysis for each study facility, an attempt was made to determine the TSS concentration of the receiving water. These data were generally available in the facility file, or were obtained through the EPA STORET database. In a few instances, however, TSS data were not available. In these cases a default TSS value ranging from 10 to 20 mg/l was selected based on the best professional judgement of the reviewer. This range was reflective of actual TSS data available for other study facilities.

Using the theoretical partitioning relationship, partitioning factors (T) were determined in the range of 2.0 for nickel, to 20.55 for trivalent chromium. Where empirically determined partitioning coefficients were not available, a partitioning factor of 2.0 was assumed. Therefore, partitioning factors assumed to be 2.0 would produce an appropriately stringent permit limit. Table 2-9 provides a summary of the parameters used to translate the metals criteria from dissolved metals to total metals fractions at a TSS concentration of 20 mg/l.

2.2.3.3 Revised Implementation Procedures

Intake Credits

In estimating the compliance costs for the sample facilities, the intake credit provisions of the final guidance were applied to applicable facilities. Consistent with the proposal, intake credits were provided in one of two general ways.

TABLE 2-9 PARAMETERS USED TO TRANSLATE DISSOLVED METALS CRITERIA TO TOTAL RECOVERABLE WQBELs

COMPOUND	K_{po} STREAM	α STREAM	K_{po} LAKE	α LAKE	K_d STREAM	K_d LAKE	T STREAM	T LAKE
Aluminum	N/A	N/A	N/A	N/A	N/A	N/A	2.00	2.00
Antimony	N/A	N/A	N/A	N/A	N/A	N/A	2.00	2.00
Arsenic (III)(*)	480,000	-0.7286	N/A	N/A	54,114	N/A	2.08	2.00
Beryllium	N/A	N/A	N/A	N/A	N/A	N/A	2.00	2.00
Cadmium	4,000,000	-1.1307	3,520,000	-0.9246	135,203	220,602	3.70	5.41
Chromium (III)(**)	3,360,000	-0.9304	2,170,000	-0.2662	206,948	977,520	5.14	20.55
Chromium (VI)	N/A	N/A	N/A	N/A	N/A	N/A	2.00	2.00
Chromium	3,360,000	-0.9304	2,170,000	-0.2662	206,948	977,520	5.14	20.55
Copper	1,040.000	-0.7436	2,850,000	-0.9000	112,095	192,273	3.24	4.85
Iron	N/A	N/A	N/A	N/A	N/A	N/A	2.00	2.00
Lead	310,000	-0.1856	2,040,000	-0.5337	177,783	412,354	4.56	9.25
Mercury	2,910,000	-1.1356	1,970,000	-1.1718	96,927	58,873	2.94	2.18
Nickel	490,000	-0.5719	2,210,000	-0.7578	88,336	228,282	2.00	5.57
Selenium (Total)	N/A	N/A	N/A	N/A	N/A	N/A	2.00	2.00
Selenium (IV)	N/A	N/A	N/A	N/A	N/A	N/A	2.00	2.00
Selenium (VI)	N/A	N/A	N/A	N/A	N/A	N/A	2.00	2.00
Silver	N/A	N/A	N/A	N/A	N/A	N/A	2.00	2.00
Thallium	N/A	N/A	N/A	N/A	N/A	N/A	2.00	2.00
Zinc	1,250,000	-0.7038	3,340,000	-0.6788	151,791	437,127	4.04	9.74

Where:

$K_d = K_{po} * (TSS)^{\alpha}$

$T = 1 + [K_d * (TSS) * (1E\text{-}6)]$

K_{po} = Empirically determined partitioning coefficient
α = Constant
K_d = Site-specific partitioning coefficient

Notes: N/A = Data Not Available
* = Assumed As(III) partitions similarly to total Arsenic
** = Assumed Cr(III) partitions similarly to total Chromium
(1) Variables correspond to those described in EPA October 1993 memo.
(2) "T" indicates the multiplier for translating "dissolved" to "total" metals fractions.
(3) Table values assume TSS = 20 mg/l. Cost analyses were developed using site-specific TSS concentrations.

First, the evaluation determined whether there would be a reasonable potential for the discharge to cause or contribute to an excursion above a narrative or numeric water quality criterion. For purposes of estimating compliance costs, no reasonable potential was determined, and WQBELs were not established, for outfalls that met the following criteria:

- The facility withdrew 100 percent of the intake water containing the pollutant from the same body of water into which the discharge was made.
- The facility did not contribute any additional mass of the identified intake water pollutant to its wastewater.
- The facility did not chemically or physically alter the identified intake water pollutant in a manner that would cause adverse water quality impacts that would not occur if the pollutants were left in-stream.
- The facility did not increase the identified intake water pollutant concentration compared to the pollutant concentration in the intake water.
- The timing and location of the discharge would not cause adverse water quality impacts to occur that would not occur if the identified intake pollutants were left in-stream.

It should be noted that when intake pollutant data for a sample facility was not available, it was assumed that there would be a reasonable potential to exceed WQBELs, and appropriate compliance costs were estimated for the sample facility. This assumption tends to overstate the costs, since some of the facilities for which no data was available could qualify for an intake credit. There were also instances when some intake pollutant data was available, but not all the data needed to determine whether all five of the criteria described above would be met. In general, for purposes of estimating compliance costs, it was assumed there would be no reasonable potential to exceed water quality standards if at least the first two criteria described above (i.e., withdrawing 100 percent from the same body of water, and no additional pollutant was added to the discharge) were met. This assumption could potentially underestimate the cost impact of the intake credit provisions contained in the final Guidance.

Second, intake credits were granted for sample facilities when the level of the pollutant upstream of the discharge exceeded the most stringent applicable water quality criterion for that pollutant. When this situation occurred, relief was provided by making the WQBEL for the pollutant(s) equal to the most stringent Guidance criterion, instead of prohibiting the discharge or making another more stringent assumption. This was done for both discharges to different and same bodies of water. The final Guidance allows "no net increase" (i.e., discharge at background concentrations) for up to 12 years, or until a total maximum daily load (TMDL) is established, for discharges to the same body of water. Cost estimates conservatively assumed that TMDLs justifying loads greater than criteria would not be developed after 12 years and dischargers to the same body of water would eventually need to comply with the most stringent criteria at end-of-pipe.

Additivity/TEFs

The estimate of costs for the sample facilities accounted for additivity of human carcinogenic effects of pollutants contained in a discharge. To estimate costs for the final Guidance, it was assumed that the total carcinogenic risk of the mixture of two or more carcinogens in a discharge would not exceed a lifetime incremental cancer risk equal to one in 100,000 (10^{-5}). The final Guidance allows States to use a less stringent incremental cancer risk for additivity; however, a risk level of 10^{-5} was assumed for the mixture for estimating costs because some States may choose to use a 10^{-5} risk level. In addition, the final Guidance allows a State or Tribe to account for additivity by establishing individual human carcinogen doses at levels corresponding to an incremental cancer risk of one in 1,000,000 (10^{-6}), or applying a scientifically defensible method to account for the additive effects of carcinogens.

The first step in estimating the cost attributable to additivity was to determine the number of potential carcinogens discharged by a study facility, the concentration of those pollutants in the discharge, and the background concentrations in the ambient water for those pollutants. The second step was to determine the human cancer value (HCV) associated with a lifetime incremental cancer risk equal to one in 100,000 for those individual pollutants identified in the discharge. The third step was to divide each of the HCVs for those carcinogens identified in the discharge by the total number of carcinogens in the discharge to determine the allowable concentration for each carcinogen that could be discharged. This concentration was then compared to the actual concentration in the discharge for that pollutant to determine whether the facility needed to reduce that pollutant. This approach results in an equivalent (proportional) reduction for each HCV at a sample facility. This approach was selected to provide a consistent method for addressing additivity to all sample facilities.

Toxicity equivalent factors (TEFs) were also considered when establishing wasteload allocations for both human health non-cancer and cancer criteria for compounds similar to 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) in accordance with Procedure 4 of Appendix F of the final Guidance. It should be noted, however, that for those sample facilities for which 2,3,7,8-TCDD WQBELs were established, no concentration data existed for the chlorinated dibenzo-p-dioxins (CDDs) and chlorinated dibenzofurans (CDFs) in an effluent. Thus equivalent concentrations for 2,3,7,8-TCDD-type chemicals were not developed.

Acute Mixing Zones for Whole Effluent Toxicity (WET)

The implementation procedures presented in the proposed Guidance required that facilities comply with an acute WET criterion of 1.0 acute toxic unit (TU_a) at the end-of-pipe (i.e., no mixing zone allowed). The final Guidance requires that no discharges exceed 0.3 TU_a at the edge of an approved acute mixing zone. As a result, for purposes of estimating costs, mixing zones were allowed to comply with acute WET criteria. WLA equations provided in Procedure 3 of Appendix F of the proposed Guidance and the 1-year, 10-day (1Q10) critical receiving water flow as recommended in Procedure 3 of Appendix F of the final Guidance were used to calculate acute WET limits.

2.2.4 Estimation of Facility Compliance Costs

Subsequent to the analyses for determining which Guidance pollutants should be regulated and for developing WQBELs based on the final Guidance water quality criteria, the costs of compliance to be borne by each sample facility were determined or estimated. Prior to estimating compliance costs, an engineering analysis of how the facility could comply with the Guidance-based effluent limitations was performed. The costs were then estimated based on the decisions and assumptions made in the analysis. Compliance costs evaluated at each facility included capital costs for treatment, annual costs (compliance monitoring, operation and maintenance, or O&M, and residuals management costs), and special costs defined as one-time costs that would be incurred during the first year of the permit. The procedures used for calculating facility costs, and for annualizing capital (and other one-time) costs, were not revised to develop the final cost estimates. The procedures for determining the appropriate control measure for a specific facility, however, were revised as described below.

In deriving the cost estimate for the proposed Guidance, it was assumed that when treatment costs became excessive in light of the amount of pollutant to be removed, or if information regarding the existing treatment system was lacking, that waste minimization/pollution prevention techniques would be the preferred control approach selected by the regulated community. In addition, for the proposed Guidance, the evaluation also did not consider the alternatives available to facilities through regulatory relief mechanisms such as variances, mixing zone studies, phased-TMDLs, site-specific criteria, and others.

The Guidance, consistent with the CWA and NPDES program, does not direct facilities on how to comply with permit requirements. Therefore, each regulated facility can consider a variety of options to comply with permit requirements. In estimating compliance costs, control options were selected considering both the technological achievability and the reasonableness of the selected control measure(s). The determination of the appropriate pollutant control strategy, therefore, was performed on a case-by case basis using engineering best professional judgement.

To ensure consistency in estimating the general types of controls that would be necessary for a sample facility to comply with the final Guidance (assuming that the final Guidance resulted in more stringent requirements), as well as to integrate the other alternatives available through the final Guidance into the cost analysis, a costing decision matrix was developed that was used for each sample facility. The underlying assumption of the decision matrix is that a facility will examine lower-cost alternatives prior to incurring the expense and potential liabilities associated with constructing end-of-pipe treatment facilities.

2.2.4.1 Compliance Cost Decision Matrix

To model the decision process used by actual facilities, a cost decision matrix was developed to determine appropriate, cost-effective control measures that could be used by a facility to meet final Guidance-based WQBELs. Specific rules were established in the matrix to provide reviewers with guidance in selecting options in a consistent manner. The matrix is presented in Figure 2-1.

FIGURE 2-1 COMPLIANCE COST DECISION MATRIX

I. REASONABLE POTENTIAL

1. Does the pollutant have a reasonable potential to exceed water quality criteria?
   - Does the facility add pollutants to non-contact cooling water (simple pass-through)?
   - Is there reasonable potential based on Procedure 5 of the proposed Guidance?

No → *No current Guidance-related compliance costs.*

Possible future costs associated with EEQ for BCCs.

↓ Yes

II. MODIFY/ADJUST EXISTING TREATMENT

1. Is the WQBEL for the pollutant above analytical detection levels?
2. Does the existing wastewater treatment system have the capability to treat/remove the pollutant?
3. Is the WQBEL for the pollutant greater than documented treatable levels?
4. Are modifications/adjustments to the existing wastewater treatment system feasible in light of the pollutant reduction necessary to achieve the WQBEL (i.e., is the reduction less than 10-25% of the current discharge levels)?

Yes → Facility incurs costs to modify/adjust existing treatment system.

↓ No

III. WASTE MINIMIZATION/POLLUTION PREVENTION

1. Is the production process or source generating the pollutant amenable to waste minimization/pollution prevention techniques?

<u>Industrials Only</u>

2. Is the WQBEL for the pollutant above analytical detection levels?
   - If no, is the production process or pollutant source amenable to control techniques expected to reduce pollutant to below analytical detection levels (e.g., product substitution)?
3. Is the level of pollutant reduction required to meet the WQBEL insignificant (i.e., less than 10-25% of current discharge levels)?

<u>POTWs Only</u>

2. Is the WQBEL for the pollutant above analytical detection levels?
3. Is the level of pollutant reduction required to meet the WQBEL insignificant (i.e., less than 10-25% of current discharge levels)?
4. Are increased industrial user/source controls feasible?

Yes → Facility incurs costs to implement waste minimization/pollution prevention.

↓ No

FIGURE 2-1 COMPLIANCE COST DECISION MATRIX (continued)

IV. NEW/ADDITIONAL TREATMENT SYSTEM

1. Is the WQBEL for the pollutant above analytical detection levels?
2. Is the WQBEL for the pollutant above documented treatable levels?
3. Is the new/additional treatment technology feasible in light of the:
   - existing treatment process(es)?
   - production process(es)?
   - pollutant source(s)?
   - level of pollutant reductions required to achieve the WQBEL (i.e., is it greater than 10-25% of the current discharge levels)?
   - cost to add the necessary treatment? [Note: Under the low-end scenario, the cost trigger is $200/toxic lb-equivalent for a specific facility for a pollutant. Under the high-end scenario, the cost trigger is $500/toxic lb-equivalent for the industrial category.]

Yes → Facility incurs costs to install additional end-of-pipe treatment (or in-plant treatment).

↓ No

V. OTHER CONTROLS

1. Is the pollutant concentration above treatable levels and is the WQBEL below analytical detection levels?
2. Is a combination of end-of-pipe treatment and waste minimization/pollution prevention feasible in light of the:
   - existing treatment process(es)?
   - production process(es)?
   - pollutant source(s)?
   - level of pollutant reductions required to achieve the WQBEL (i.e., is it greater than 10-25% of the current discharge levels)?
   - cost to add the necessary treatment? [Note: Under the low-end scenario, the cost trigger is $200/toxic lb-equivalent for a specific facility for a pollutant. Under the high-end scenario, the cost trigger is $500/toxic lb-equivalent for the industrial category.]

Yes → Facility incurs costs for other controls.

↓ No

FIGURE 2-1 COMPLIANCE COST DECISION MATRIX (continued)

VIa. Phased TMDL	VIb. Variances from Water Quality Standards	VIc. Site-Specific Criteria	VId. Change Designated Use	VIe. Alternative Mixing Zone
1. Is the discharge to a non-attainment receiving water? 2. Are the other sources of pollutants to the receiving water known?	1. Is the pollutant naturally occurring? 2. Are there natural, ephemeral, intermittent or low flow conditions? 3. Are there human-caused conditions or sources? 4. Are dams, diversions, or other types of hydrologic modifications present? 5. Do the physical conditions related to the natural features of the water body contribute? 6. Would the controls result in substantial and widespread economic and social impact? If yes, will the discharge comply with anti-degradation requirements and cause no increased risk to human health and the environment?	1. Are local environmental conditions not reflected in criteria? 2. Are bio-accumulation factors appropriate?	1. Is the pollutant naturally occurring? 2. Are there natural, ephemeral, intermittent or low flow conditions? 3. Are there human-caused conditions or sources? 4. Are dams, diversions, or other types of hydrologic modifications present? 5. Do the physical conditions related to the natural features of the water body contribute? 6. Would the controls result in substantial and widespread economic and social impact?	1. If a tributary, does the discharge dilution factor need to be greater than 0.75 to provide relief?
Facility incurs future cost to comply with TMDL. If existing effluent concentration is greater than treatable levels, then go to IV, and facility incurs costs to reduce the effluent to treatable levels. If existing effluent concentration is less than treatable levels, then go to III, and facility incurs costs to implement waste minimization.	Facility incurs costs for preparing variance request and future compliance costs when variance expires. If existing effluent concentration is greater than treatable levels, then go to IV, and facility incurs costs to reduce the effluent to treatable levels. If existing effluent concentration is less than treatable levels, then go to III, and facility incurs costs to implement waste minimization.	Facility incurs costs for preparing request for site-specific criteria. If existing effluent concentration is greater than treatable levels, then go to IV, and facility incurs costs to reduce the effluent to treatable levels. If existing effluent concentration is less than treatable levels, then go to III, and facility incurs costs to implement waste minimization.	Facility incurs costs associated with preparing a use attainability analysis. If existing effluent concentration is greater than treatable levels, then go to IV, and facility incurs costs to reduce the effluent to treatable levels. If existing effluent concentration is less than treatable levels, then go to III, and facility incurs costs to implement waste minimization.	Facility incurs costs to prepare demonstration. If existing effluent concentration is greater than treatable levels, then go to IV, and facility incurs costs to reduce the effluent to treatable levels. If existing effluent concentration is less than treatable levels, then go to III, and facility incurs costs to implement waste minimization.

Under the decision matrix, costs for minor treatment plant operation and facility changes were considered first. Modification or adjustment of existing treatment was determined to be feasible where literature indicated that the existing treatment process could achieve the revised WQBEL and where the additional pollutant reduction was relatively small (e.g., 10 - 25 percent of current discharge levels).

Where it was not technically feasible to simply adjust existing operations, the next most attractive control strategy was determined to be waste minimization/pollution prevention controls. These controls, however, were costed only where they were considered feasible based on the reviewing engineer's understanding of the process(es) at a facility. The practicality of techniques was determined based on several "rules of thumb" established in the decision matrix. Decision considerations included the level of pollutant reduction achievable through waste minimization/pollution prevention techniques, appropriateness of waste minimization/pollution prevention for the specific pollutant, and knowledge of the manufacturing processes generating the pollutant of concern. In general, detailed treatment and manufacturing process information was not available in NPDES permit files; therefore, the assessment of feasibility was primarily based on best professional judgement using general knowledge of industrial and municipal operations.

If waste minimization/pollution prevention alone was deemed not feasible to reduce pollutant levels to those needed to comply with the final Guidance criteria, a combination of waste minimization/pollution prevention and simple treatment was considered. If these relatively low-cost controls could not achieve the Guidance-based WQBELs, then end-of-pipe treatment was considered.

Development of end-of-pipe treatment cost estimates began with a review of the existing treatment systems at each facility. Decisions to add new treatment systems or to supplement existing treatment systems were based on this initial evaluation. For determining the need for additional or supplemental treatment, sources of performance information included EPA Development Documents for effluent guidelines and standards for the facility's industrial classification and the EPA Office of Research and Development, Risk Reduction Engineering Laboratory's "RREL Treatability Database" (Version 4.0). The pollutant removal capabilities of the existing treatment systems and/or any proposed additional or supplemental systems were evaluated based on the following criteria: (1) the effluent levels that were being achieved currently at the facility; (2) the levels that were achieved at similar facilities with similar treatment systems documented in the effluent guideline Development Documents; and (3) the levels that are documented in the EPA "RREL Treatability Database." If this analysis showed that additional treatment was needed, unit processes that would achieve compliance with the GLWQG-based effluent limitations were then chosen using the same documentation.

Following the calculation of end-of-pipe treatment costs, the relationship between the cost of adding the treatment and other types of remedies or controls was considered. Specifically, if the estimated annualized cost for removal of a pollutant exceeded $200 per toxic pounds-equivalent then the decision matrix indicated that dischargers would explore the use of other remedies or controls. This cost trigger was based on the upper end of the range of the costs to comply with promulgated effluent guideline limitations and standards for direct discharger industrial categories. When it was assumed that facilities would pursue alternative relief, no treatment cost was estimated for a facility; however, a nominal cost for some efforts to reduce the pollutant until the relief is granted was included. In addition, pollutant load reductions were not calculated or credited for any pollutant for which alternative relief was assumed.

Finally, based on discussions with EPA Regional and State permitting agencies and outside experts, the typical cost to facilities pursuing relief from Guidance-based WQBELs was estimated. These costs will be in the form of additional monitoring, performing special studies, etc., to support facilities' requests for relief from the Guidance-based WQBEL. The costs estimated by the Regions and States for the relief mechanisms ranged from $1,000,000 per pollutant for phased-TMDLs to $20,000 for criteria modifications. Table 2-10 provides a summary of the cost estimates provided by States and EPA Regions. For purposes of estimating compliance costs, a mid-range cost value of $200,000 per pollutant was used each time a relief mechanism was assumed necessary.

TABLE 2-10 COST ESTIMATES FOR PURSUING REGULATORY RELIEF

SOURCE	REGULATORY RELIEF MECHANISM*				
	Phased-TMDL	Variance	Site-Specific Criteria	Change Designated Use	Alternative Mixing Zone
Michigan DNR	NA	NA	NA	NA	NA
Minnesota DNR	NA	$2,000/NA	NA/$50,000	$2.000/NA	$5,000/NA
New York DEC	$400/NA	NA/$100,000	NA/$200,000	NA/$75,000	NA/$150,000
Indiana DEM	NA	NA	NA	NA	NA
Ohio EPA	NA	NA/$150,000	NA	NA/$40,000	NA/$150,000
Pennsylvania DER	NA	NA	NA	NA	NA
Wisconsin DNR	NA/$1,000,000	$10,000/$75,000	$70,000/$50,000	NA/$1,000,000	NA/$100,000

NA - Not Available
* - State Costs/Facility Costs

In developing and using the cost decision matrix, it is acknowledged that granting relief from WQBELs is dependent upon the specific circumstances at a facility, as well as the judgement and implementing procedures of the permitting authority. It is also acknowledged that opportunities for waste minimization are dependent upon the specific circumstances at a facility. The use of a $200 per toxic pounds-equivalent trigger for a "facility" assumes that the regulatory flexibility in the final Guidance would be available and granted to all facilities that exceed the cost trigger.

Acknowledging that the use of regulatory relief may be limited depending on the particular circumstances for a "facility," costs were also estimated under a higher cost scenario that assumes regulatory relief would be granted only when the cost for the particular "category of dischargers" exceeds a cost trigger. Particularly, if the estimated annualized cost for a "category of dischargers" exceeded $500 per toxic pounds-equivalent then it was assumed that dischargers within the "category" would be granted regulatory relief. This cost trigger was based on the highest costs to comply with promulgated effluent guideline limitations and standards for direct discharger industrial categories, which ranged from $1 to $500 per toxic pounds-equivalent per industrial category.

2.2.4.2 Pollution Prevention/Waste Minimization Costs

As discussed briefly in the section above, waste minimization/pollution prevention techniques were used as controls for a number of sample facilities. The costs associated with the implementation of these techniques, developed for the proposed Guidance, were based on a limited evaluation of information available through the EPA Pollution Prevention Information Clearinghouse (PPIC). In the absence of information for a particular category of dischargers, best professional judgement was used to estimate the cost to implement pollution prevention.

Since the time of proposal, an attempt was made to collect additional information to verify or replace the original estimates of pollution prevention/waste minimization costs. In particular, input was solicited from the EPA Pollution Prevention Office and the American Institute of Pollution Prevention. Both of these organizations acknowledged the difficulty in developing generic costs because of the site-specific nature of manufacturing processes and pollutants being removed. In fact, the implementation of waste minimization/pollution prevention techniques may actually result in a cost saving for a facility. Because of the general lack of information related to the cost of pollution prevention techniques, the original estimates for waste minimization/ pollution prevention were retained. Specifically, the mid-range pollution prevention/waste minimization estimates were used to develop compliance costs for the final Guidance.

2.2.5 Estimation of Total Compliance Costs to the Regulated Community

As in the cost analyses for the proposed Guidance, compliance cost estimates were calculated for each facility chosen to represent a category or group of similar facilities. This resulted in estimates of three major types of costs for each facility— capital costs, annual costs, and special studies costs. Capital costs include the total investment cost needed to comply with new permit limits. Annual costs include costs of yearly monitoring events, operation and maintenance (O&M), but none of the recurring costs of capital. The costs of special studies include one-time-only monitoring events, such as bioaccumulation studies, and major investigative efforts, such as waste or pollutant minimization audits.

To develop a single cost estimate for each facility, the cost categories were combined into a single "annualized cost," that reflects the annual expense associated with recurring activities, repaying capital expenses, and special studies. Annualized costs were calculated by assuming that all capital costs, special monitoring costs and special minimization study costs would be paid by borrowing money at an interest rate of seven percent and paying it back over a 10-year period. Annual costs of monitoring, operation, and maintenance were added directly.

Given a single estimate of the annualized cost for each facility, the procedure for extrapolating costs from the sample to the entire population is predetermined by the stratified random sampling procedure (described in Section 2.1 of the cost report for the proposed Guidance) used to select the subset of facilities examined in detail.

Using the single annualized cost figure for each plant, an estimate of the cost for each flow stratum can be calculated by averaging the two (or in some cases three) values for individual (sample) plants, and then multiplying by the total (population) number of plants in that category/stratum. The cost estimate for the category is calculated simply by summing over the two (or in some cases three) flow strata in the category. The cost estimate for the entire universe of facilities is simply the sum across categories. The results of these calculations are reported in Section 3.

2.2.6 Estimation of Compliance Costs for Indirect Dischargers

The approach to estimating indirect discharger costs, for the proposed Guidance, was based on an analysis of one major, highly industrialized, sample POTW (City of Battle Creek, Michigan). Based on this evaluation, it was assumed that the number of indirect dischargers that could be affected ranged from 10 to 30 percent. To further verify this range for use in estimating costs for the final Guidance, information for an additional eight POTWs was analyzed, based on data collected from the Michigan Department of Natural Resources (DNR) and Wisconsin DNR. In addition, the original sample POTW was re-evaluated based on changes to the final Guidance (as reflected in estimated WQBELs for the POTW).

Since not all of the eight POTWs were selected as one of the 59 study facilities, it was assumed for the purpose of this analysis, that the pollutants limited by each POTW's existing NPDES permit would be the same as those that would require regulation under the final Guidance (i.e., the Guidance would not result in additional pollutants being regulated, but would result in more stringent permit limits). Based on the results provided in the EPA *An Analytical Survey of Nine POTWs from the Great Lakes Basin* (Draft Report, December 15, 1994), this assumption was considered reasonable in light of the limited detection of pollutants, particularly BCCs. It should be noted that information for three of the additional POTWs was not sufficient to determine the number of industries potentially affected.

For each POTW, the potential indirect dischargers of each regulated pollutant were identified from among the POTW's list of indirect dischargers, as well as the number of industrial users found to be violating the POTW's permit limits for any of the pollutants of concern over a 1-year period. Based on these data, the range of potentially affected indirect users is estimated to be 8 to 44 percent of the total number of the indirect dischargers to a POTW. The results show that the assumed range of indirect dischargers affected (10 to 30 percent) had a reasonable basis. Table 2-11 summarizes the results of the evaluation of Battle Creek, Michigan and the additional eight POTWs.

For purposes of developing costs for the final Guidance, it was assumed that 30 percent of all indirect dischargers in the Great Lakes Basin would be impacted by source control efforts by POTWs as a result of more restrictive Guidance-based WQBELs. The average compliance cost per direct discharger facility was also updated, based on the revisions made to the sample facilities as a result of the final Guidance.

TABLE 2-11 SUMMARY OF INDIRECT DISCHARGERS POTENTIALLY AFFECTED BY THE GUIDANCE AT NINE PRETREATMENT POTWs

POTW	NUMBER OF SIUs	POLLUTANTS PRESENT	FORMER PRETREATMENT VIOLATORS WITH GUIDANCE POLLUTANTS (% OF TOTAL)	POTENTIAL DISCHARGERS OF GUIDANCE POLLUTANTS (% OF TOTAL)
Battle Creek, MI	36	CN	3 (8.3%)	8 (22%)
Greenbay, WI	35	Cd, Cr, Cu, Pb, Ni, Zn, CN	*	11 (31%)
DePere, WI	36	Cr, Cu, Zn, Ag, CN, Hg	*	10 (27%)
Heart of the Valley, WI	9	Cd, Cu, Ag, CN, Cr	1 (11%)	4 (44%)
Appleton, WI	13	Cd, Cr, Cu, Pb, Ni, Zn, Hg, CN	2 (15%)	5 (38%)
Saginaw, MI	20	*	*	*
Mt. Pleasant, MI	4	*	*	*
Bay City, MI	10	*	*	*
Nenah, WI	19	Cd, Cr, Cu, Pb, Ni, Zn, Hg, CN	3 (16%)	6 (31%)

* Information not available

3. RESULTS

Compliance costs estimates related to the implementation of the final Guidance were developed, based on the adjustments made to the cost study approach, described in Section 2. This section presents the results of the adjustments and discusses.

3.1 OVERVIEW OF APPROACH

The approach for this final cost analysis was to update the detailed technical review of the sample of 59 facilities evaluated for the proposed Guidance to reflect changes in the final Guidance criteria and implementation procedures. These facility-specific compliance cost evaluations were then used to extrapolate to an overall estimate of costs for all facilities in the Great Lakes System.[1]

As discussed throughout Section 2, several methodological changes were made to minimize the assumptions needed to derive compliance costs for the sample facilities. One of the more significant changes involved the use of a decision matrix for selecting the appropriate facility-specific control option(s) to comply with final Guidance water quality-based effluent limits (WQBELs). The underlying assumption of the decision matrix is that facilities would first pursue least-cost controls prior to incurring the costs to install end-of-pipe treatment. As a final step before assuming that treatment would be installed by the facility, the relationship between the cost of adding the treatment and other types of remedies or controls were considered. If it was concluded that other remedies or controls would be more feasible than installing end-of-pipe treatment, then it was assumed that a facility would alternatively pursue some type of regulatory relief from the WQBEL.

As described in Section 2.2.4.1, two different cost scenarios were developed to primarily account for the flexibility provided in the final Guidance (i.e., use of regulatory relief). Under the low-end compliance cost scenario, if the estimated annualized cost for removal of a pollutant by a facility exceeded $200 per toxic pounds-equivalent then it was assumed that the facility would explore the use of other remedies or controls. Acknowledging that the use of regulatory relief may be limited depending on the particular circumstances for a "facility," compliance costs were also estimated under a high-end cost scenario that assumes regulatory relief would be granted only when the cost for the particular "category of dischargers" exceeds $500 per toxic pounds-equivalent. If the high-end trigger for the category was exceeded, then it was assumed that dischargers within the "category" would be granted regulatory relief.

[1] The results of these individual analyses are provided in a separate report prepared for EPA entitled "Technical Background Document for the Great Lakes Water Quality Guidance Implementation Procedures Final Compliance Cost Study" (March 13, 1995).

3.2 DISCUSSION OF RESULTS

Table 3-1 presents a summary of the total annualized costs of implementing the final Guidance to direct and indirect dischargers. As shown in Table 3-1, the compliance cost for the final Guidance is estimated to range from $61 million dollars to $376 million dollars.

Under the low-end estimate, direct dischargers account for 67 percent of the total estimated compliance cost, and indirect dischargers are estimated to incur 33 percent of the total cost. Under the high-end estimate, direct dischargers account for 98 percent of the total estimated cost, and indirect dischargers account for 2 percent. This shift in proportion of costs between direct and indirect dischargers between the high and the low cost estimates is due to the increased use of end-of-pipe treatment for direct dischargers under the high-end estimates. In addition, it was assumed that a smaller proportion of indirect dischargers (10 percent) would be impacted under the high-end estimate, since municipal wastewater treatment plants are adding end-of-pipe treatment, which should reduce the need for control of indirect dischargers (i.e., reduce the need for increased pretreatment program efforts).

3.2.1 Analysis of Low-End Cost Estimate for Direct Dischargers

Table 3-2 presents the projected annualized cost for each direct discharger and major cost category under the low-end cost scenario. As shown in Table 3-2, under the low-end cost estimate for the direct dischargers, municipal majors are expected to incur about 58 percent of total costs and industrial majors account for 38 percent of total compliance costs. Minor direct dischargers are estimated to incur 4 percent of the total costs for direct dischargers. The two major industrial categories with the largest total annualized cost are the pulp and paper (20 percent of total) and miscellaneous (11 percent) categories. The food and food products, metal finishing, mining, and metals manufacturing categories are estimated to incur less than 1 percent of the total annualized compliance cost.

Although the municipal major category accounts for over 58 percent of the total estimated cost, the average annual cost is just over $75,000 per facility. Average annualized costs for industrial majors vary widely across categories, with the highest average cost estimated for the miscellaneous ($168,000 per plant) and pulp and paper ($151,000 per plant) categories. For minor facilities, average costs are negligible at an estimated $500 per facility.

Figure 3-1 presents a summary of the distribution of low-end compliance costs across cost categories. Costs to direct dischargers for developing and implementing pollutant minimization programs (required when WQBELs are below analytical detection levels) account for most of the costs (58 percent of total annual costs). Annualized capital and operation and maintenance (O&M) costs make up just over 21 percent of the total annual costs, and waste minimization (i.e., pollution prevention) costs account for just over 11 percent. Under the low-end cost scenario, regulatory relief was assumed when the control costs for a pollutant at a facility exceeded $200 per toxic pounds-equivalent. Based on the analysis of sample facilities, it was estimated that regulatory relief would be required for less than 1 percent of all direct

TABLE 3-1 SUMMARY OF ANNUALIZED COMPLIANCE COSTS ATTRIBUTABLE TO THE FINAL GREAT LAKES WATER QUALITY GUIDANCE

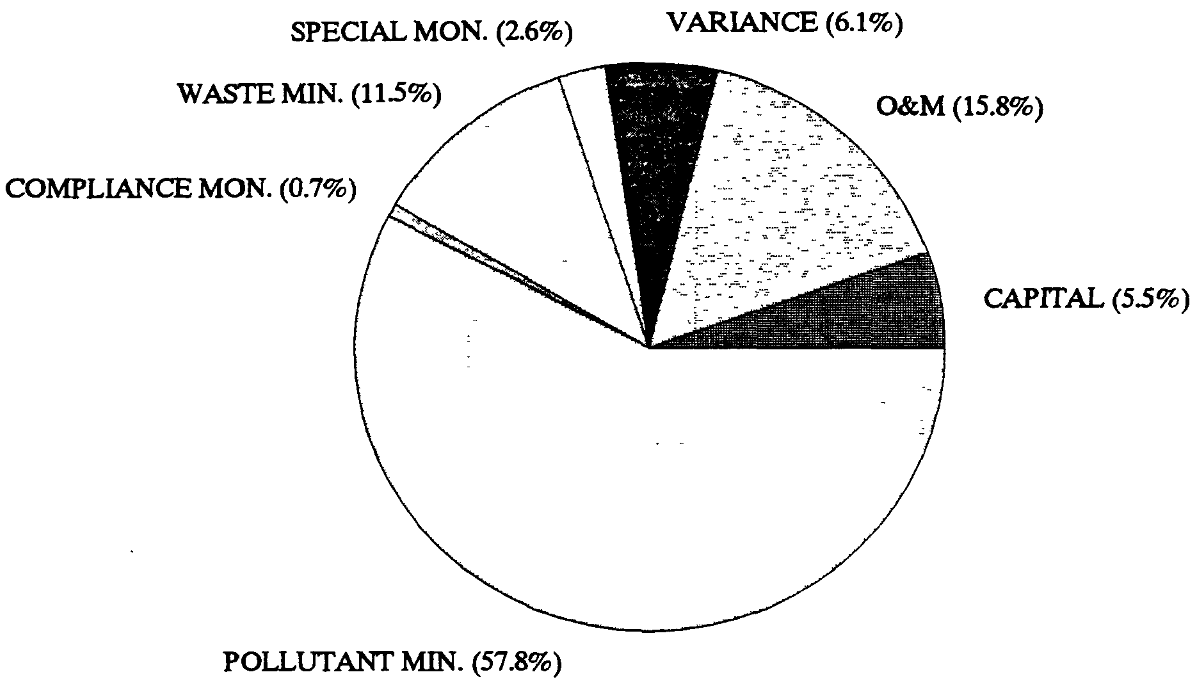
COST CATEGORIES	NUMBER OF FACILITIES	LOW-END COST SCENARIO		HIGH-END COST SCENARIO	
		ESTIMATED COSTS (FIRST QUARTER 1994 $, MILLIONS)	GROUP COST AS PERCENT OF TOTAL COST	ESTIMATED COSTS (FIRST QUARTER 1994 $, MILLIONS)	GROUP COST AS PERCENT OF TOTAL COST
Major Direct Dischargers--Industrial	272	15.7	25.8	108.2	28.7
Major Direct Dischargers--Municipal	316	23.8	39.0	259.8	69.1
Minor Direct Dischargers	3,207	1.6	2.6	1.6	0.4
Indirect Dischargers	3,528	19.9	32.6	6.6	1.8
TOTAL	7,323	61.0	100.0	376.2	100.0

TABLE 3-2 FINAL GUIDANCE COMPLIANCE COST ESTIMATES FOR DIRECT DISCHARGERS: LOW-END SCENARIO[1]

Discharger Category	Number of Plants	Capital	O&M[2]	Compliance Monitoring	Special Monitoring[3]	Pollutant Minimization Program	Waste Minimization[4]	Regulatory Relief	Total	Category Cost as % of Total Cost	Average Cost per Plant
MAJORS											
Food and Food Products	12	$0	$0	$0	$4,272	$0	$0	$0	$4,272	0.0%	$356
Inorganic Chemicals	19	$0	$100,000	$18,096	$2,848	$486,124	$170,852	$227,804	$1,005,724	2.4%	$52,933
Metal Finishing	31	$0	$0	$2,520	$11,963	$0	$0	$0	$14,483	0.0%	$467
Mining	14	$0	$0	$2,520	$17,087	$55,629	$0	$0	$75,236	0.2%	$5,374
Metals Manufacturing	37	$0	$0	$90,024	$0	$0	$54,579	$0	$144,603	0.4%	$3,908
Miscellaneous	27	$1,847,348	$2,270,625	$9,323	$65,138	$34,935	$106,785	$213,566	$4,547,719	11.1%	$168,434
Municipals	316	$0	$3,033,333	$64,312	$467,274	$20,039,467	$154,223	$0	$23,758,610	57.8%	$75,185
Org Chemicals/ Pet Refining	28	$0	$0	$5,400	$138,396	$33,038	$331,028	$0	$507,860	1.2%	$18,138
Pulp and Paper	54	$0	$750,000	$77,769	$41,013	$3,119,409	$2,589,492	$1,580,390	$8,158,073	19.8%	$151,075
Steam Electric	50	$378,721	$361,200	$17,280	$11,963	$0	$0	$512,559	$1,281,723	3.1%	$25,634
SUBTOTAL	588	$2,226,069	$6,515,158	$287,244	$759,953	$23,768,601	$3,406,959	$2,534,320	$39,498,303	96.0%	
MINORS											
Municipal	927	$0	$0	$0	$316,756		$1,319,770	$0	$1,636,527	4.0%	$1,765
Non-Municipal	2280	$0	$0	$0	$0	$0	$0	$0	$0	0.0%	$0
SUBTOTAL	3207	$0	$0	$0	$316,756	$0	$1,319,770	$0	$1,636,527	4.0%	
TOTALS	**3795**	**$2,226,069**	**$6,515,158**	**$287,244**	**$1,076,709**	**$23,768,601**	**$4,726,729**	**$2,534,320**	**$41,134,830**	**100.0%**	
PERCENT OF TOTALS		**5.4%**	**15.8%**	**0.7%**	**2.6%**	**57.8%**	**11.5%**	**6.2%**	**100.0%**		

[1] Annual costs in 1st Quarter 1994 Dollars.
[2] Includes costs for residuals disposal.
[3] Includes costs for bioaccumulation studies for BCCs and whole effluent toxicity monitoring.
[4] Includes costs for pretreatment program revisions for municipal dischargers.

FIGURE 3-1: FINAL GUIDANCE COMPLIANCE COST ESTIMATES FOR DIRECT DISCHARGERS: LOW-END SCENARIO



dischargers. For these facilities, cost for controls to comply with the final Guidance (e.g., capital and O&M, pollutant minimization programs, waste minimization, etc.) were shifted to costs related to pursuing regulatory relief. The resulting costs associated with pursuing regulatory relief account for just over 6 percent of the total annual costs.

Table 3-3 presents a summary of compliance costs under the low-end scenario by pollutant. As shown in Table 3-3, controls for mercury account for more than 20 percent of annual costs (attributable primarily to pollutant minimization program-related costs). Other pollutants accounting for significant costs include methylene chloride, aluminum, benzene, and copper.

3.2.2 Analysis of High-End Cost Estimate for Direct Dischargers

Under the high-end scenario, regulatory relief was assumed necessary when the total cost for a category exceeded $500 per toxic pounds-equivalent reduced. Only the steam electric industrial category was estimated to exceed the $500 toxic pounds-equivalent cost trigger. In general, estimated costs for end-of-pipe treatment of significant volumes of non-contact cooling water accounted for the high costs within the steam electric category. As a result of these significant costs, costs for end-of-pipe treatment were shifted to costs to pursue regulatory relief.

Table 3-4 presents the projected annualized cost for each discharger and major cost category under the low-end scenario. As shown in Table 3-4, under the high-end estimate for the direct dischargers, municipal majors are expected to incur just over 70 percent of total costs and industrial majors account for 29 percent of total annual compliance costs. Minor direct dischargers are estimated to incur less than 1 percent of the total costs.

The two major industrial categories with the largest total annualized cost are the pulp and paper (23 percent of total) and miscellaneous (3 percent) categories. Even under the high-end, the food and food products, metal finishing, mining, and metals manufacturing categories are still estimated to incur less than 1 percent of the total annualized compliance cost. In addition, due to the shift from end-of-pipe treatment to regulatory relief, the steam electric category also accounts for less than 1 percent of the total compliance cost.

The municipal major category accounts for almost 70 percent of the total estimated cost, the average annual cost is just over $822,000 per facility. Average annualized costs for industrial majors vary widely across categories, with the highest average cost estimated for pulp and paper ($1,583,000 per plant) and miscellaneous ($433,700 per plant) categories. For minor facilities, average costs are negligible at an estimated $500 per facility.

Figure 3-2 presents a summary of the distribution of low-end compliance costs across cost categories. For the high-end scenario, costs to direct dischargers shifted away from developing and implementing pollutant minimization plans and waste minimization to capital and O&M costs (more than 52 percent of total annual costs) associated with construction and application of end-of-pipe treatment. Annualized costs for developing and implementing pollutant minimization plans account for just over 6 percent and waste minimization costs

TABLE 3-3 BREAK-OUT OF FINAL GUIDANCE COMPLIANCE COSTS BY POLLUTANT: LOW-END SCENARIO

PARAMETER	TOTAL ANNUAL COSTS ($)*	PERCENT OF TOTAL COST
Acrylonitrile	0	0.0%
Aldrin	0	0.0%
Aluminum	2,793,250	6.9%
Antimony	0	0.0%
Arsenic(III)	139,280	0.3%
Benzene	2,101,420	5.2%
Benzidine	0	0.0%
Benzo[a]pyrene	0	0.0%
Beryllium	0	0.0%
Cadmium	11,400	0.0%
Carbon Tetrachloride	92,300	0.2%
Chlordane	687,167	1.7%
Chlorobenzene	0	0.0%
Chloroform	339,336	0.8%
Chlorpyrifos	0	0.0%
Chromium(III)	0	0.0%
Chromium(VI)	0	0.0%
Chrysene	0	0.0%
Copper	2,100,048	5.2%
Cyanide, Free	1,088,809	2.7%
Cyanide, total	0	0.0%
4,4-DDD	8,250	0.0%
4,4-DDE	8,250	0.0%
DDT	695,417	1.7%
3,3-Dichlorobenzidine	5,820	0.0%
1,1-Dichloroethane	972,000	2.4%

TABLE 3-3 BREAK-OUT OF FINAL GUIDANCE COMPLIANCE COSTS BY POLLUTANT: LOW-END SCENARIO (continued)

PARAMETER	TOTAL ANNUAL COSTS ($)*	PERCENT OF TOTAL COST
1,2-Dichloroethane	92,300	0.2%
1,1-Dichloroethylene	256,280	0.6%
1,2-trans-Dichloroethylene	0	0.0%
1,2-Dichloropropane	0	0.0%
Dieldrin	695,417	1.7%
2,4-Dimethylphenol	0	0.0%
2,4-Dinitrophenol	0	0.0%
alpha-Endosulfan	0	0.0%
beta-Endosulfan	0	0.0%
Endosulfan	0	0.0%
Endrin	687,167	1.7%
Fluoranthene	0	0.0%
Fluoride	10,920	0.0%
Heptachlor	1,786,935	4.4%
Hexachlorobenzene	698,342	1.7%
alpha-Hexachlorocyclohexane	1,751,908	4.3%
beta-Hexachlorocyclohexane	687,167	1.7%
Hexachlorocyclohexane	687,167	1.7%
Hexachloroethane	0	0.0%
Iron	10,920	0.0%
Lead	41,920	0.1%
Lindane	1,088,593	2.7%
Mercury	12,646,210	31.2%
Methylene Chloride	3,063,667	7.6%
Nickel	0	0.0%
Parathion	0	0.0%

TABLE 3-3 BREAK-OUT OF FINAL GUIDANCE COMPLIANCE COSTS BY POLLUTANT: LOW-END SCENARIO (continued)

PARAMETER	TOTAL ANNUAL COSTS ($)*	PERCENT OF TOTAL COST
PCBs	689,303	1.7%
Pentachlorobenzene	687,167	1.7%
Pentachlorophenol	1,863,493	4.6%
Phenanthrene	0	0.0%
Phenol	0	0.0%
Selenium, Total	0	0.0%
Silver	0	0.0%
1,2,4,5-Tetrachlorobenzene	0	0.0%
2,3,7,8-TCDD	687,167	1.7%
Tetrachloroethylene	0	0.0%
Thallium	0	0.0%
Toluene	0	0.0%
Toxaphene	698,342	1.7%
1,1,1-Trichloroethane	0	0.0%
Trichloroethylene	0	0.0%
2,4,6-Trichlorophenol	0	0.0%
Whole Effluent Toxicity	654,121	1.6%
Zinc	2,520	0.0%
TOTAL	40,529,768	100.0%

* All costs are in 1st Quarter 1994 dollars; total cost may not match Table 3-2 due to rounding during extrapolation.

account for less than 1 percent of total annual costs. Since regulatory relief was assumed for only one category under the high-end, the costs associated with regulatory relief account for less than 1 percent of the total annual compliance cost.

Table 3-5 presents a summary of compliance costs under the high-end scenario by pollutant. As shown in Table 3-5, controls for lead account for more than 60 percent of annual costs (attributable primarily to end-of-pipe treatment related controls). Other pollutants that account for significant costs include heptachlor, pentachlorophenol, lindane, and mercury.

TABLE 3-4 FINAL GUIDANCE COMPLIANCE COST ESTIMATES FOR DIRECT DISCHARGERS: HIGH-END SCENARIO[1]

Discharger Category	Number of Plants	Capital	O&M[4]	Compliance Monitoring	Special Monitoring[2]	Pollutant Minimization Program	Waste Minimization[3]	Regulatory Relief	Total	Category Cost as % of Total Cost	Average Cost Per Plant
MAJORS											
Food and Food Products	12	$0	$0	$0	$4,272	$0	$0	$0	$4,272	0.001%	$356
Inorganic Chemicals	19	$779,488	$1,525,000	$18,096	$2,848	$486,124	$56,952	$0	$2,868,504	0.78%	$150,974
Metal Finishing	31	$0	$0	$2,520	$11,963	$0	$0	$0	$14,483	0.004%	$467
Mining	14	$0	$0	$2,520	$17,087	$55,629	$0	$0	$75,236	0.02%	$5,374
Metals Manufacturing	37	$0	$0	$90,024	$0	$0	$54,579	$0	$144,603	0.04%	$3,908
Miscellaneous	27	$4,803,105	$6,811,875	$9,323	$52,320	$34,935	$0	$0	$11,711,565	3.2%	$433,762
Municipals	316	$7,439,228	$231,666,667	$64,312	$467,252	$20,039,446	$154,223	$0	$259,831,172	70.3%	$822,251
Org Chemicals/ Pet Refining	28	$3,016,982	$3,315,000	$5,400	$138,396	$33,038	$53,393	$0	$6,562,201	1.8%	$234,364
Pulp and Paper	54	$33,769,526	$48,433,125	$77,769	$41,013	$3,119,409	$26,693	$0	$85,467,534	23.1%	$1,582,732
Steam Electric	50	$378,721	$361,200	$17,280	$11,963	$0	$0	$512,559	$1,281,723	0.35%	$25,634
SUBTOTAL	588	$50,187,049	$292,112,867	$287,244	$747,114	$23,768,580	$345,839	$512,559	$367,961,293	99.6%	
MINORS											
Municipal	927	$0	$0	$0	$316,849	$0	$1,319,863	$0	$1,636,526	0.44%	$1,765
Non-Municipal	2280	$0	$0	$0	$0	$0	$0	$0	$0	0.0%	$0
SUBTOTAL	3207	$0	$0	$0	$316,849	$0	$1,319,863	$0	$1,636,526	0.4%	
Totals	3795	$50,187,063	$292,112,870	$287,245	$1,063,867	$23,768,598	$1,665,618	$512,559	$369,597,819	100.0%	
Percent of Totals		13.6%	79.0%	0.1%	0.3%	6.4%	0.5%	0.1%	100.0%		

[1] Annual costs in 1st Quarter 1994 Dollars.
[2] Includes costs for bioaccumulation studies for BCCs and whole effluent toxicity monitoring.
[3] Includes costs for pretreatment program revisions for municipal dischargers.
[4] Includes costs for residuals disposal.

FIGURE 3-2: FINAL GUIDANCE COMPLIANCE COST ESTIMATES FOR DIRECT DISCHARGERS: HIGH-END SCENARIO

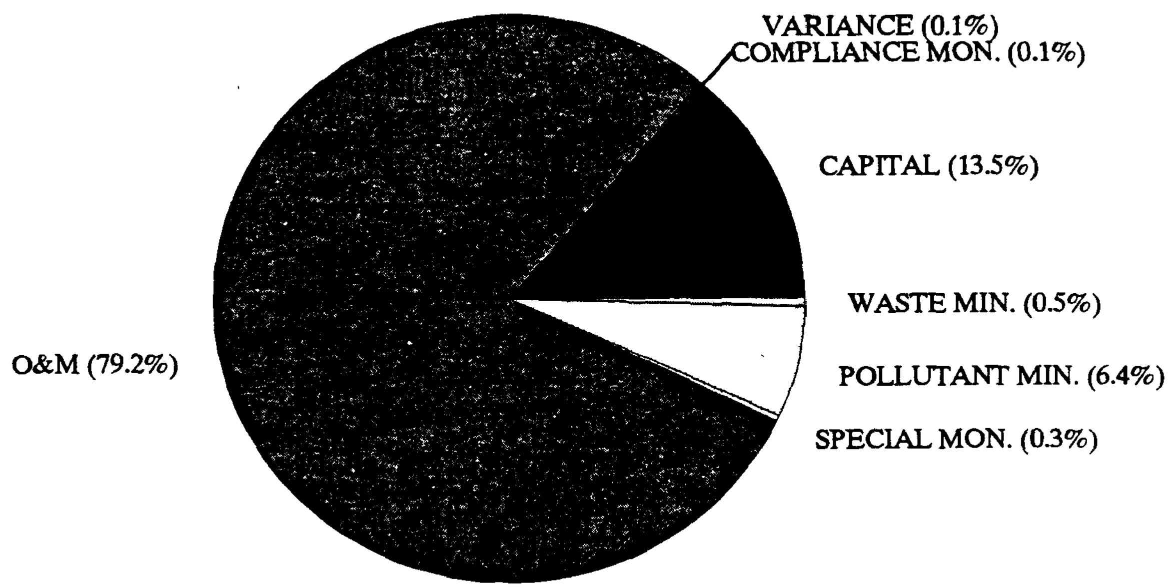


TABLE 3-5 BREAK-OUT OF FINAL GUIDANCE COMPLIANCE COSTS BY POLLUTANT: HIGH-END SCENARIO

PARAMETER	TOTAL ANNUAL COSTS ($)*	PERCENT OF TOTAL COST
Acrylonitrile	0	0.0%
Aldrin	0	0.0%
Aluminum	4,211,188	1.1%
Antimony	0	0.0%
Arsenic(III)	225,080	0.1%
Benzene	2,101,420	0.6%
Benzidine	0	0.0%
Benzo[a]pyrene	0	0.0%
Beryllium	0	0.0%
Cadmium	11,400	0.0%
Carbon tetrachloride	0	0.0%
Chlordane	642,833	0.2%
Chlorobenzene	0	0.0%
Chloroform	2,379,520	0.6%
Chlorpyrifos	0	0.0%
Chromium(III)	0	0.0%
Chromium(VI)	0	0.0%
Chrysene	0	0.0%
Copper	2,100,048	0.6%
Cyanide, Free	824,107	0.2%
Cyanide, Total	0	0.0%
4,4-DDD	8,250	0.0%
4,4-DDE	8,250	0.0%
DDT	651,083	0.2%
3,3-Dichlorobenzidine	5,820	0.0%
1,1-Dichloroethane	11,970,000	3.3%

TABLE 3-5 BREAK-OUT OF FINAL GUIDANCE COMPLIANCE COSTS BY POLLUTANT: HIGH-END SCENARIO (continued)

PARAMETER	TOTAL ANNUAL COSTS ($)*	PERCENT OF TOTAL COST
1,2-Dichloroethane	6,331,000	1.7%
1,1-Dichloroethylene	0	0.0%
1,2-trans-Dichloroethylene	0	0.0%
1,2-Dichloropropane	0	0.0%
Dieldrin	651,083	0.2%
2,4-Dimethylphenol	0	0.0%
2,4-Dinitrophenol	0	0.0%
alpha-Endosulfan	0	0.0%
beta-Endosulfan	0	0.0%
Endosulfan	0	0.0%
Endrin	642,833	0.2%
Fluoranthene	0	0.0%
Fluoride	10,920	0.0%
Heptachlor	24,747,833	6.7%
Hexachlorobenzene	654,008	0.2%
alpha-Hexachlorocyclohexane	6,890,333	1.9%
beta-Hexachlorocyclohexane	642,833	0.2%
Hexachlorocyclohexane	642,833	0.2%
Hexachloroethane	0	0.0%
Iron	10,920	0.0%
Lead	236,008,507	64.2%
Lindane	21,525,000	5.9%
Mercury	15,235,978	4.1%
Methylene Chloride	3,063,667	0.8%
Nickel	0	0.0%
Parathion	0	0.0%

TABLE 3-5 BREAK-OUT OF FINAL GUIDANCE COMPLIANCE COSTS BY POLLUTANT: HIGH-END SCENARIO (continued)

PARAMETER	TOTAL ANNUAL COSTS ($)*	PERCENT OF TOTAL COST
PCBs	644,969	0.2%
Pentachlorobenzene	642,833	0.2%
Pentachlorophenol	22,260,000	6.1%
Phenanthrene	0	0.0%
Phenol	0	0.0%
Selenium, total	0	0.0%
Silver	0	0.0%
1,2,4,5-Tetrachlorobenzene	0	0.0%
2,3,7,8-TCDD	642,833	0.2%
Tetrachloroethylene	0	0.0%
Thallium	0	0.0%
Toluene	0	0.0%
Toxaphene	654,008	0.2%
1,1,1-Trichloroethane	0	0.0%
Trichloroethylene	0	0.0%
2,4,6-Trichlorophenol	0	0.0%
WET	634,456	0.2%
Zinc	2,520	0.0%
TOTAL	367,678,369	100.0%

* Costs are in 1st Quarter 1994 dollars; total cost may not match Table 3-4 due to rounding during extrapolation.

3.2.3 Comparison of Estimated Costs for the Final Guidance to Costs of Proposed Guidance

Table 3-6 provides a comparison of compliance cost estimates for the final Guidance to costs of the proposed Guidance. The proposed Guidance estimates were revised to reflect changes made in the approach to estimating costs for the final Guidance (as described in Section 2). As shown in Table 3-6, reevaluation of the proposed Guidance resulted in an increase in the estimate of costs of about $240 million under the low-end scenario and $265 million for the high-end scenario when compared to the final Guidance.

The annual cost estimate for the final Guidance is significantly lower than the revised estimates for the proposed Guidance. Some of this reduction is attributable to the final Guidance intake credit provisions, which provide relief to several significant dischargers that discharge to non-attained waters, and to the use of dissolved metals criteria, which also tends to lower the costs for the final Guidance.

Common to both the reevaluated proposed Guidance and the final Guidance, the lowering of the permit baseline also accounts for an overall decrease in compliance costs and load reduction. The lowering of the permit baseline was expected due to State implementation of the requirements of Section 303(c) of the Clean Water Act (CWA), which required all States to promulgate water quality criteria for certain toxic pollutants. To ensure that the requirements of Section 303(c) are met, the Environmental Protection Agency (EPA) promulgated the National Toxics Rule (57 *FR* 6084; 12/22/92) to provide water quality criteria for pollutants for which States did not promulgate criteria. More important, each of the Great Lake States has been actively involved in the Great Lakes Water Quality Initiative since 1989, acting as co-partners and major participants in developing the final Guidance.

Consequently, most of the final Guidance and current State water quality standards have a wide number of similarities. In fact, some States have already elected to promulgate more stringent requirements for a variety of Guidance-related provisions in anticipation of the final Guidance. For example, New York, Minnesota, Illinois, and Wisconsin all use a higher fish consumption rate than required by the final Guidance for deriving human health criteria. Many of the Great Lakes States also currently have provisions in their water quality programs to account for additivity of risk from carcinogens. As a result of these and many other efforts by States, the stringency of the National Pollutant Discharge Elimination System (NPDES) permit requirements continues to increase, which decreases the incremental difference between the current State permit limits and Guidance-based WQBELs.

TABLE 3-6 COMPARISON OF PROPOSED AND FINAL COMPLIANCE COST ESTIMATES

COST CATEGORY	ANNUAL COMPLIANCE COST ESTIMATE ($ MILLIONS)			
	ORIGINAL PROPOSAL (LOW ESTIMATE)[1] (1ST QUARTER 1994)	ORIGINAL PROPOSAL (HIGH ESTIMATE)[2] (1ST QUARTER 1994)	FINAL GUIDANCE (LOW ESTIMATE)[3] (1ST QUARTER 1994)	FINAL GUIDANCE (HIGH ESTIMATE)[4] (1ST QUARTER 1994)
Major Direct Dischargers—Industrial	20.7	376.5	15.7	108.2
Major Direct Dischargers—Municipal	259.9	259.9	23.8	259.8
Minor Direct Dischargers	1.6	1.6	1.6	1.6
Indirect Dischargers	19.9	6.6	19.9	6.6
TOTAL COST	302.1	644.6	61.0	376.2

[1] The proposed Guidance cost estimate revised to reflect the low-end cost assumptions made for the Regulatory Impact Analysis for the final Guidance.
[2] The proposed Guidance cost estimate revised to reflect the high-end cost assumptions made for the Regulatory Impact Analysis for the final Guidance.
[3] Estimated costs to comply with the final Guidance using low-end assumptions.
[4] Estimated costs to comply with the final Guidance, but assuming limited regulatory relief is available.

4. EVALUATION OF COST-EFFECTIVENESS

This section presents a revised cost-effectiveness analysis which was performed to compare the estimated costs related to implementing the final Guidance to those of other Environmental Protection Agency (EPA) regulatory programs. In addition, the results from this cost-effectiveness analysis reflect revisions to the reported cost-effectiveness values in the proposed Guidance.

For a pollution control option, cost-effectiveness is defined as the incremental annualized cost per incremental pound of pollutant removal. Cost-effectiveness is measured in dollars per toxic pounds-equivalent removed per year. Toxic pounds-equivalent units are standardized to allow comparison among different pollutants.

This cost-effectiveness analysis has limitations because of the available data and simplifying assumptions used to calculate pollutant reductions for the 59 sample facilities for which compliance cost estimates were derived. These limitations and assumptions, discussed throughout this section, affect the estimation of pollutant reductions and directly influence the cost-effectiveness measure. These limitations and assumptions notwithstanding, the results presented in this section should indicate whether the costs to implement the final Guidance are comparable to other EPA regulatory programs.

4.1 METHODOLOGY

The methodology for evaluating cost-effectiveness used in this study is generally consistent with the methodology used in the proposed Guidance and is based on the methodology used by EPA in analyzing pollutant control options for national effluent guidelines and standards. This methodology entails estimating pollutant loading reductions attributable to the final Guidance implementation procedures for each major sample facility, converting the pollutant reduction estimates into toxic pounds-equivalents, and escalating the weighted pollutant loading reductions to represent the universe of direct discharging facilities in the Great Lakes Basin. The pollutant loading reductions were computed under two different sets of assumptions to arrive at a low-end and a high-end loadings reduction estimate. The total annual costs for both the low-end and the high-end scenarios were then divided by the low-end and the high-end annual loadings reductions, respectively, resulting in low-end and high-end cost effectiveness estimates.

4.1.1 Estimation of Pollutant Reductions

As for the proposed Guidance, pollutant loading reductions were calculated using major municipal and industrial sample facility data to indicate the decrease in pollutant discharge due to more stringent water quality-based effluent limitations (WQBELs) resulting from implementation of the final Guidance. Pollutant loading reductions were calculated by finding the difference between the existing permit limitation (considered the baseline value) and the final Guidance-based effluent limitation.[1]

First, baseline pollutant loadings were determined to establish a fixed reference from which to estimate pollutant loading reductions. In this case, the existing permit limit was used as the baseline discharge concentration for each pollutant. If a permit limit was not available for a pollutant, then the highest reported effluent concentration was used. In cases where the facility did not have a permit limit and reported all values for a pollutant below reasonable detection levels, the pollutant was not evaluated further. Baseline loadings were converted to pounds per day by multiplying the existing permit limitation or effluent concentration (in μg/l) by the facility's average daily flow rate (in million gallons per day, or MGD) and a conversion factor (0.00834) to calculate the loadings in pounds per day.

Next, the low-end and the high-end pollutant loadings were calculated. The low-end estimate represents loadings when regulatory relief is allowed to facilities if the cost exceeds a threshold value. For example, if the expected pollutant reduction was insignificant in comparison to the capital and operational costs incurred for reducing the pollutant, then it was assumed that the facility would be granted a relief by complying with final Guidance limits instead of having to implement treatment systems. In cases when a facility was determined to require relief, any loading reduction was "zeroed" such that no credit was given to the final Guidance for any projected load reduction.

The high-end estimate is based on the cost and pollutant loading reductions resulting from the use of a higher cost threshold for a category of dischargers. Under the assumptions for this estimate, only one industrial category's (the Steam Electric Category) cost exceeded the threshold.

Low-end and high-end pollutant loading reductions were calculated by taking the difference between the baseline and low-end load estimates, and the baseline and high-end load estimates. Several assumptions were made in determining the reduction for a pollutant:

- If the difference between the baseline value and the final Guidance limitation was negative, a zero loading reduction was assumed. Although it seems counter intuitive, this situation can occur because of the method of determining the need for a WQBEL. In the absence of a permit limit for a pollutant, if the projected effluent quality (based on the reported concentration) exceeded the Guidance-based WQBEL, a final Guidance-based effluent limitation was established. However, there were instances when the projected effluent quality was greater than the final Guidance limit (indicating the need for a WQBEL) but the

[1]It should be noted that using a facility's permit limitations as the baseline for calculating pollutant reductions portrays the difference between existing and final Guidance-based permit limitations rather than a true estimate of the pollutant reductions (or baseline loads) that would be attributable to the final Guidance. Some (or most) facilities may be discharging at concentrations below permitted amounts, so that actual removals (or baseline loads) may be less than estimated here.

maximum reported concentration was less than the final Guidance permit limit. The difference between the maximum reported concentration and the final Guidance permit limit would therefore be negative. In such cases, no loading reduction (as opposed to a negative reduction) was assumed,

- If the final Guidance-based effluent limit was below analytical detection levels, one-half of the analytical detection level was used to compute the final Guidance loading. The final Guidance loading was then subtracted from the baseline load calculated using the facility's existing permit limit. If both the baseline value and the Guidance-based effluent limit were below analytical detection levels, then no pollutant load reduction credit was attributed to the Guidance (but the costs related to implementation of pollutant minimization programs were still included).

- For purposes of calculating a baseline value, it was assumed that the facilities were discharging at the level of the existing permit limitation.[2]

4.1.2 Revised Toxic Weights

Toxic weights were used in the proposed Guidance (and revised in the final Guidance) to derive cost-effectiveness estimates as well as to compare the relative loadings of the 138 pollutants of initial focus analyzed for the cost study. Toxic weights are used as normalizing factors that relate the toxicity of any pollutant to the toxicity of copper. The factor considers the aquatic toxicity and the human health effects of a pollutant and is calculated using the following formula:

Toxic Weight = 5.6/[fresh water chronic criteria (μg/l)] + 5.6/[human health criteria (μg/l)]

The value of 5.6 μg/l was the original National chronic water quality criterion for copper; thus, the toxic weight for copper was equal to 1.0. A pollutant with a toxic weight of 10, therefore, would be considered 10 times as toxic as copper.

The national chronic water quality criterion for copper has since been revised to 12 μg/l; however, the 5.6 value is retained for consistency. This results in copper currently having a toxic weight of 5.6/12, or 0.47.

Toxic weights from 1988 were used in calculating baseline pollutant loads and load reductions for the proposed Guidance. These loads and load reductions are expressed in toxic pounds-equivalent. In analyzing the impact of the final Guidance, toxic weights were developed or recalculated for all 69 pollutants included in the cost study, using the most recent criteria and toxicity information available. These updates resulted in both raising and lowering of the 1988

[2]It should be noted that this assumption was primarily the reason that pollutant reductions and compliances were estimated for pollutants for which production has been banned (e.g., PCB, 4,4-DDT, etc.)

toxic weights, depending on the toxicity data available for a specific pollutant. Table 4-1 presents the revised toxic weights for each pollutant evaluated in the cost study.

4.1.3 Toxicity Weighting and Extrapolation of Pollutant Baseline Loadings and Reductions

Each pollutant's baseline load, low-end load, and high-end load were multiplied by their respective toxic weights to express them in units of toxic pounds-equivalent. The toxic weighted loading reductions were then calculated by taking the difference between the baseline values and the low-end values, and the baseline and the high-end values. The total toxic weighted baseline load and reduction for all pollutants for a facility was determined by summing toxic weighted baseline loads and reductions. Each facility's total baseline pollutant load and load reduction were then summed with other facility toxic weighted loads and reductions within each strata and then extrapolated to arrive at the total baseline pollutant loading and reduction for the universe of direct dischargers into the Great Lakes Basin.

4.1.4 Determining Cost-Effectiveness

Cost-effectiveness was determined by multiplying the total pounds-equivalent for all pollutants (in pounds-equivalent per day) by 365 days to derive the total annual low-end and high-end toxic weighted pollutant reductions. The total annualized low-end costs were divided by the total annual low-end toxic pounds reduced to determine the cost-effectiveness, expressed in dollars per toxic pounds-equivalent removed. The procedure was repeated to determine the high-end cost-effectiveness.

4.2 RESULTS

Tables 4-2 and 4-3 present the annual unweighted and toxic weighted extrapolated baseline pollutant load and loading reductions attributed to implementation of the final Guidance. As shown in Table 4-3, the toxicity-weighted baseline pollutant loading was projected to be just over 35 million toxic pounds-equivalent per year (lbs-eq/year). This baseline pollutant loading represents almost a 72 percent reduction in the baseline projected by EPA for its original analysis of the proposed Guidance (126 million lbs-eq/year).

This downward shift in the baseline pollutant loadings is particularly significant in light of the fact that more than 35 pollutants were added for the analysis of the final Guidance. This shift is attributable to the fact that the existing permit baseline also moved downward (i.e., existing permit limits for the sample facilities were found to be more stringent). This downward shift in the permit baseline is due, in part, to increased efforts by States to protect water quality. The use of dissolved criteria for metals for the final Guidance, which tended to eliminate metals for the cost and loading analysis, also accounted for a shift in the baseline. Finally, in contrast to the cost analysis for the proposed Guidance, where baseline loads were estimated even when

TABLE 4-1 TOXIC WEIGHTS FOR POLLUTANTS EVALUATED IN THE FINAL GUIDANCE

PARAMETER	TOXIC WEIGHT	PARAMETER	TOXIC WEIGHT
Acrylonitrile	8.50E-01	Endosulfan	1.00E+02
Aldrin	5.00E+01	Endrin	9.80E+01
Aluminum	6.40E-02	Fluoranthene	9.20E-01
Antimony	1.90E-01	Fluoride	3.50E-02
Arsenic(III)	4.00E+00	Heptachlor	4.10E+03
Benzene	1.80E-02	Hexachlorobenzene	7.20E+02
Benzidine	1.00E+03	alpha-Hexachlorocyclohexane	4.30E+01
Benzo[a]pyrene	4.30E+03	beta-Hexachlorocyclohexane	1.20E+01
Beryllium	5.30E+00	Hexachlorocyclohexane	1.80E+01
Cadmium	5.20E+00	Hexachloroethane	7.40E-02
Carbon tetrachloride	1.30E-01	Iron	5.60E-03
Chlordane	2.30E+03	Lead	1.80E+00
Chlorobenzene	2.90E-03	Lindane	7.00E+01
Chloroform	2.10E-03	Mercury	5.00E+02
Chlorpyrifos	1.40E+02	Methylene Chloride	4.20E-04
Chromium(III)	2.67E-02	Nickel	3.60E-02
Chromium(VI)	3.55E+01	Parathion	4.30E+02
Chrysene	1.80E+01	PCBs	7.49E+03
Copper	4.70E-01	Pentachlorobenzene	2.30E+00
Cyanide, Free	1.08E+00	Pentachlorophenol	5.00E-01
Cyanide, Total	1.08E+00	Phenanthrene	1.90E+01
4,4-DDD	7.60E+02	Phenol	2.80E-02
4,4-DDE	9.50E+02	Selenium, Total	1.10E+00
DDT	6.50E+03	Silver	4.70E+01
3,3-Dichlorobenzidine	7.30E+00	1,2,4,5-Tetrachlorobenzene	2.00E+00
1,1-Dichloroethane	3.90E-04	2,3,7,8-TCDD	4.20E+08
1,2-Dichloroethane	6.20E-03	Tetrachloroethylene	7.40E-02
1,1-Dichloroethylene	1.80E-01	Thallium	1.40E-01
1,2-trans-Dichloroethylene	9.30E-05	Toluene	5.60E-03
1,2-Dichloropropane	1.50E-02	Toxaphene	2.90E+04
Dieldrin	5.70E+04	1,1,1-Trichloroethane	4.30E-03
2,4-Dimethylphenol	5.30E-03	Trichloroethylene	6.30E-02
2,4-Dinitrophenol	8.40E-03	2,4,6-Trichlorophenol	3.50E-01
alpha-Endosulfan	1.00E+02	Zinc	5.10E-02
beta-Endosulfan	1.00E+02		

TABLE 4-2 UNWEIGHTED POLLUTANT LOADING REDUCTIONS

POLLUTANT	POLLUTANT LOADING (LBS/YEAR)		
	BASELINE	REDUCTION (LOW ESTIMATE)	REDUCTION (HIGH ESTIMATE)
Acrylonitrile	—*	—	—
Aldrin	—	—	—
Aluminum	37,185,781	397,172	397,172
Antimony	—	—	—
Arsenic (III)	5,494	5,389	5,389
Benzene	9,111	56	56
Benzidine	—	—	—
Benzo[a]pyrene	—	—	—
Beryllium	—	—	—
Cadmium	66,313	0	0
Carbontetrachloride	4,985	4,054	4,323
Chlordane	424	289	289
Chlorobenzene	—	—	—
Chloroform	61,429	3,333	3,333
Chlorpyrifos	—	—	—
Chromium (III)	—	—	—
Chromium (VI)	—	—	—
Chrysene	—	—	—
Copper	5,111	1,583	1,583
Cyanide, Free	87,218	9,657	9,657
Cyanide, Total	—	—	—
4,4-DDD	0	0	0
4,4-DDE	0	0	0
DDT	10	0	0
3,3-Dichlorobenzidine	15,132	9,400	12,392

TABLE 4-2 UNWEIGHTED POLLUTANT LOADINGS (continued)

POLLUTANT	POLLUTANT LOADING (LBS/YEAR)		
	BASELINE	REDUCTION (LOW ESTIMATE)	REDUCTION (HIGH ESTIMATE)
1,1-Dichloroethane	—	—	—
1,2-Dichloroethane	4,677	3,065	3,065
1,1-Dichloroethylene	344	0	0
1,2-trans-Dichloroethylene	—	—	—
1,2-Dichloropropane	333	333	333
Dieldrin	56	37	37
2,4-Dimethylphenol	—	—	—
2,4-Dinitrophenol	—	—	—
alpha-Endosulfan	—	—	—
beta-Endosulfan	—	—	—
Endosulfan	—	—	—
Endrin	1,934	1,875	1,875
Fluoranthene	—	—	—
Fluoride	73,584	0	0
Heptachlor	567	106	537
Hexachlorobenzene	754	272	272
alpha-Hexachlorocyclohexane	1,926	1,900	1,902
beta-Hexachlorocyclohexane	1,929	1,869	1,869
Hexachlorocyclohexane	1,926	1,843	1,843
Hexachloroethane	—	—	—
Iron	3,166,429	0	0
Lead	997,118	600,078	666,078
Lindane	77	0	76
Mercury	1,039	133	136
Methylene Chloride	11,905	4,762	4,762

TABLE 4-2 UNWEIGHTED POLLUTANT LOADINGS (continued)

POLLUTANT	POLLUTANT LOADING (LBS/YEAR)		
	BASELINE	REDUCTION (LOW ESTIMATE)	REDUCTION (HIGH ESTIMATE)
Nickel	2,444	2,111	2,111
Parathion	—	—	—
PCBs	61	0	0
Pentachlorobenzene	192,974	191,967	191,969
Pentachlorophenol	13,484	0	11,782
Phenanthrene	—	—	—
Phenol	—	—	—
Selenium, total	—	—	—
Silver	9,078	0	—
1,2,4,5-Tetrachlorobenzene	194,448	188,401	193,268
2,3,7,8-TCDD	0	0	0
Tetrachloroethylene	—	—	—
Thallium	—	—	—
Toluene	2,143	0	357
Toxaphene	580	1	1
1,1,1-Trichloroethane	—	—	—
Trichloroethylene	96	72	72
2,4,6-Trichlorophenol	—	—	—
Zinc	34,020	1,490	1,490
TOTALS	44,183,751	1,431,248	1,452,029

* Indicates that there was no reasonable potential for the pollutant to exceed Guidance-based WQBELs for any of the sample facilities.

TABLE 4-3 TOXICITY WEIGHTED POLLUTANT LOADING REDUCTIONS

POLLUTANT	POLLUTANT LOADING (LBS-EQ/YEAR)		
	BASELINE	REDUCTION (LOW ESTIMATE)	REDUCTION (HIGH ESTIMATE)
Acrylonitrile	—*	—	—
Aldrin	—	—	—
Aluminum	2,379,890	25,419	25,419
Antimony	—	—	—
Arsenic (III)	21,975	21,556	21,556
Benzene	164	1	1
Benzidine	—	—	—
Benzo[a]pyrene	—	—	—
Beryllium	—	—	—
Cadmium	344,827	0	0
Carbontetrachloride	648	527	562
Chlordane	975,523	664,604	664,604
Chlorobenzene	—	—	—
Chloroform	129	7	7
Chlorpyrifos	—	—	—
Chromium (III)	—	—	—
Chromium (VI)	—	—	—
Chrysene	—	—	—
Copper	2,402	744	744
Cyanide, Free	95,940	10,623	10,623
Cyanide, Total	—	—	—
4,4-DDD	45	23	23
4,4-DDE	21	10	10
DDT	88,152	212	212
3,3-Dichlorobenzidine	110,466	68,619	90,465

TABLE 4-3 POUNDS-EQUIVALENT POLLUTANT LOADING REDUCTIONS (continued)

POLLUTANT	POLLUTANT LOADING (LBS-EQ/YEAR)		
	BASELINE	REDUCTION (LOW ESTIMATE)	REDUCTION (HIGH ESTIMATE)
1,1-Dichloroethane	—	—	—
1,2-Dichloroethane	29	19	19
1,1-Dichloroethylene	62	0	0
1,2-trans-Dichloroethylene	—	—	—
1,2-Dichloropropane	5	5	5
Dieldrin	3,190,719	2,092,368	2,092,368
2,4-Dimethylphenol	—	—	—
2,4-Dinitrophenol	—	—	—
alpha-Endosulfan	—	—	—
beta-Endosulfan	—	—	—
Endosulfan	—	—	—
Endrin	189,557	183,778	183,778
Fluoranthene	—	—	—
Fluoride	73,584	0	0
Heptachlor	2,324,390	434,659	2,201,441
Hexachlorobenzene	542,816	195,908	195,908
alpha-Hexachlorocyclohexane	82,945	81,721	81,788
beta-Hexachlorocyclohexane	23,117	22,423	22,423
Hexachlorocyclohexane	34,675	33,172	33,172
Hexachloroethane	—	—	—
Iron	17,732	0	0
Lead	1,794,813	1,080,141	1,080,141
Lindane	5,366	0	5,289
Mercury	519,286	66,304	67,878

TABLE 4-3 POUNDS-EQUIVALENT POLLUTANT LOADING REDUCTIONS (continued)

POLLUTANT	POLLUTANT LOADING (LBS-EQ/YEAR)		
	BASELINE	REDUCTION (LOW ESTIMATE)	REDUCTION (HIGH ESTIMATE)
Methylene Chloride	5	2	2
Nickel	88	76	76
Parathion	—	—	—
PCBs	454,908	0	0
Pentachlorobenzene	443,840	441,528	441,528
Pentachlorophenol	6,742	0	5,891
Phenanthrene	—	—	—
Phenol	—	—	—
Selenium, Total	—	—	—
Silver	426,685	0	—
1,2,4,5-Tetrachlorobenzene	388,895	376,802	386,536
2,3,7,8-TCDD	3,989,245	0	0
Tetrachloroethylene	—	—	—
Thallium	—	—	—
Toluene	12	0	2
Toxaphene	16,833,496	36,956	36,956
1,1,1-Trichloroethane	—	—	—
Trichloroethylene	8	6	6
2,4,6-Trichlorophenol	—	—	—
Zinc	1,735	76	76
TOTALS	35,364,934	5,838,289	7,649,510

* Indicates that there was no reasonable potential for the pollutant to exceed Guidance-based WQBELs for any of the sample facilities.

all data were reported below analytical detection levels (in the absence of a permit limit), the cost analysis for the final Guidance excluded pollutants that were never detected from further evaluation.

Upon implementation of the final Guidance, the estimated pollutant loadings under the low-end estimate would be reduced by 5.8 million lbs-eq/year, which represents a 16 percent reduction of the baseline pollutant loadings. Under the high-end cost estimate, pollutant loading reductions would increase by 1.8 million lbs-eq/year to a total of 7.6 million lbs-eq/year, which represents a 22 percent reduction of the baseline pollutant loadings.

The percent reductions estimated for the final Guidance are also lower than those projected for the proposed Guidance which was reevaluated using the revised approach for estimating costs and load reductions. Pollutant loadings under the proposed Guidance would be 8.4 million lbs-eq/year (24 percent reduction) and 10.1 million lbs-eq/year (29 percent reduction) for the low- and high-end scenarios, respectively. The drop in estimated pollutant loadings can also be credited to the changes made by EPA to the criteria for the final Guidance (e.g., adjusting bioaccumulation factors, use of dissolved criteria for metals) and the toxic weights. The combined result of these changes was essentially less stringent criteria, which would tend to reduce the difference between existing permit limits and the Guidance-based WQBELs.

Under the low-end estimate for the final Guidance, the largest pollutant load reductions occur for dieldrin and lead, which account for over 50 percent toxic weighted load reduction. Chlordane, heptachlor, and pentachlorobenzene were also reduced by significant amounts from the baseline. Under the high-end estimate, the largest pollutant load reductions occur for heptachlor, dieldrin, and lead, which account for about 70 percent of the toxic weighted load reduction.

Approximately 80 percent of the pollutant load reduction for the final Guidance, regardless of the scenario, is attributable to reducing bioaccumulative pollutants of concern (BCCs) as a result of pollutant minimization plans and end-of-pipe treatment. However, it should be noted that for several BCCs (e.g., PCBs, 2,3,7,8-TCDD, mercury, toxaphene), little or no reduction from the baseline is estimated. This phenomenon occurs because of the method used to derive load reductions. As described in Section 4.1.1, when an existing permit limit or a Guidance-based WQBEL is below the analytical detection level, one-half of the method detection level is used for each limit or WQBEL. The result of this approach is that no pollutant reduction would be estimated, regardless of whether the Guidance-based WQBEL was further below detection levels than the existing permit limit. Therefore, in effect, for several of the toxic pollutants of concern, the lack of estimated reduction is due to the downward shift in the permit baseline (i.e., more stringent existing permit limits).

The cost-effectiveness of the final Guidance under the low-end estimate is just under $7.00/lbs-eq for the direct dischargers only; with the cost for indirect dischargers, the cost-effectiveness rises to $10.30/lbs-eq. Under the high-end estimate, the cost-effectiveness increases to just over $49.00/lbs-eq.

The estimates for the final Guidance are considerably more cost-effective than those estimated for the proposed Guidance using the revised approach ($35.96/lbs-eq for the low-end scenario and $63.83/lbs-eq for the high-end scenario). For comparative purposes, cost-effectiveness values for effluent limitations guidelines and standards range from just over $1.00/lbs-eq/year to more than $500/lbs-eq/year.

5. EVALUATION OF REGULATORY OPTIONS

The proposed Guidance generated extensive comments related to the potential costs of the Guidance. Many comments related to the cost associated with specific provisions of the Guidance. Most of the regulated community, driven by the uncertainty of future impacts of the Guidance, also claimed that the costs could be orders of magnitude higher than those estimated for the proposed Guidance. There also were concerns from several States that the estimated impact of the proposed Guidance, in relation to their current program of regulating point source dischargers, was too great.

In response to the issues raised regarding the cost of various provisions of the proposed Guidance, additional analyses were performed to evaluate the impact of possible regulatory options and address these issues. This section discusses the major issues raised by commenters, the approach used to evaluate these issues, and the results of these analyses.

5.1 SUMMARY OF ISSUES RELATED TO COMPLIANCE COST ESTIMATES

There were many comments received on the compliance cost and pollutant loading reduction estimates that were provided for the proposed Guidance. Based on the comments submitted, there were several issues identified that could significantly impact the estimated compliance cost for the final Guidance. These issues were considered "cost drivers."

Table 5-1 summarizes the cost driver issues related to the Guidance compliance cost estimates.

5.2 DESCRIPTION OF REGULATORY OPTIONS

In response to the cost driver issues identified in the public comments, a number of regulatory alternatives for these issues were developed and analyzed to determine the impact of the cost drivers on the compliance cost and pollutant load reduction estimates for the Guidance.

Table 5-2 presents a summary of the regulatory alternatives that were identified to address the issues described in Section 5.1 above. In general, for each cost driver, costs and pollutant load reduction estimates were derived for one alternative believed to be less stringent than the regulation contained in the proposed Guidance, as well as an alternative considered more stringent. However, due to the nature of some of the issues, both types of alternatives (i.e., less and more stringent) could not be developed.

5.3 METHODOLOGY TO EVALUATE REGULATORY OPTIONS

For each of the cost driver issues, (except the evaluation of the antidegradation provisions and the impact of future improvement of analytical detection levels), the same methodology, as described in Section 2 of this report, was used to estimate the compliance cost and pollutant

TABLE 5-1 SUMMARY OF ISSUES RAISED RELATED TO COMPLIANCE COST ESTIMATES FOR THE PROPOSED GUIDANCE

ISSUE	DESCRIPTION
Fish Consumption Rate for Guidance Criteria Development	There were several comments related to the concern over the 15 grams per day (grams/day) fish consumption assumption used to establish proposed Guidance criteria. Several commenters stated that the consumption rate should be increased to ensure protection of populations in the Great Lakes Basin that are highly dependent upon fish for nourishment.
Use of Pollutant Minimization Program (PMP) to Achieve Guidance-Based Limits Below Analytical Detection Levels	Many comments from the regulated community stated that compliance costs relied too much on pollution prevention techniques. Commenters maintained that pollution prevention techniques may not always be feasible for some industries and processes. This was particularly noted for mercury and PCBs that are apparently present in intake waters (deposited to surface waters through atmospheric deposition and precipitation) for which pollution prevention would be infeasible. In the absence of process-specific information, many commenters felt that it is impossible to determine whether pollution prevention would reduce pollutants in process wastewaters.
Future Impact of Improved Analytical Detection Levels	Many commenters disagreed with the cost study approach for the proposed Guidance to only use current analytical detection levels as the basis for estimating costs. Furthermore, many commenters stated that regular improvements in analytical detection levels should be expected over time, resulting in a dramatic impact on the costs to comply with the final Guidance in the future. Commenters felt that they would need to design and operate treatment systems and incur the costs now to achieve the water quality-based effluent limits (WQBELs), in order to reduce the chance that the technology will have to be replaced when analytical detection levels improve in the future. Several commenters also stated that the cost associated with implementing pollution prevention and waste minimization (through the required pollutant minimization plan) to consistently keep discharge levels below detection levels were underestimated.
Intake Credits	There were many comments related to whether pollutants in a discharge that originate in the discharger's water supply should be regulated. Many commenters particularly believed that the compliance costs would be very high if intake credits were not provided for once-through, non-contact cooling water. In fact, most of the regulated community studies assumed that the proposed Guidance would not exempt once-through, non-contact cooling water, and these wastestreams were treated as process wastestreams for purposes of estimating compliance costs.
Tier II Criteria	One of the limitations of the compliance cost report for the proposed Guidance was that only the costs to comply with the numeric Tier I criteria was considered. Many commenters agreed and stated there would be a significant cost to comply with Tier II values. This cost would first include monitoring to generate the data for the value itself, and then the cost to comply once the values were used as the basis for a Guidance-based WQBEL.

TABLE 5-1 SUMMARY OF ISSUES RAISED RELATED TO COMPLIANCE COST ESTIMATES FOR THE PROPOSED GUIDANCE (continued)

ISSUE	DESCRIPTION
Wildlife Criteria	A significant number of comments were received stating that the wildlife criteria would result in significant compliance costs for the regulated community.
Elimination of Mixing Zones for Bioaccumulative Chemicals of Concern (BCCs)	Numerous comments were submitted that stated the compliance cost study neglected the costs related to the eventual elimination of mixing zones provision for BCCs. Furthermore, most commenters stated that the elimination of mixing zones for BCCs in 12 years will impose enormous costs without commensurate benefits.
Antidegradation	Numerous comments were received concerning the lack of analysis for the proposed antidegradation provisions of the proposed Guidance. Although a sensitivity analysis was performed for the antidegradation issue at the time of proposed Guidance, many comments stated that the analysis only estimated the cost of the demonstration process. Many commenters felt that although the demonstration process can assist in compliance, it does not ensure compliance or necessarily make it cheaper. Finally, many commenters stated that the antidegradation provisions will inhibit economic growth in the Great Lakers Basin, because facilities would be prohibited from returning to full production or increasing current production capacities.
Additivity	Several comments related to the potential impact of the additivity provision discussed in the preamble to the proposed Guidance. Most of these commenters felt that the additivity provision will increase the estimated compliance costs of the Guidance.

TABLE 5-2 SUMMARY OF REGULATORY ALTERNATIVES EVALUATED FOR THE MAJOR ISSUES RAISED RELATED TO COMPLIANCE COST ESTIMATES FOR THE PROPOSED GUIDANCE

ISSUE	PROPOSED GUIDANCE REQUIREMENT	PROCEDURE USED FOR ESTIMATING FINAL GUIDANCE COST	REGULATORY ALTERNATIVES EVALUATED
Fish Consumption Rate for Guidance Criteria Development	Required use of 15 grams/day.	Assumed 15 grams/day.	1. Assume 45 grams/day.
Use of Pollutant Minimization Program (PMP) to Achieve Guidance-Based Limits Below Analytical Detection Levels	Required five-step PMP with the goal of achieving zero discharge of pollutants.	Required PMPs when Guidance-based WQBELs were below analytical detection levels.	1. Require only monitoring when WQBELs are below detection levels.
Future Impact of Improved Analytical Detection Levels	Effluent limit placed in permit; minimum level (ML) used as the compliance effluent level.	Used method detection level (MDL) as compliance level.	1. Assume future MDLs improve 10-fold. 2. Assume future MDLs improve 100-fold.
Intake Credits	Allowed simple pass-through of pollutants.	Allow simple pass-through; intake credits allowed for different body of water - the WQBEL is set equal to most stringent final Guidance criteria; intake credits allowed for same body of water - the WQBEL is set equal to most stringent Guidance criteria.	1. Intake credits allowed for different body of water; the WQBEL is set equal to the background concentration. 2. Intake credits allowed for different body of water; the WQBEL is set equal to zero. 3. Intake credits allowed for the same body of water; the WQBEL is set equal to the background concentration. 4. Intake credits allowed for the same body of water; the WQBEL is set equal to zero.
Tier II Values	Development of Tier II values at the discretion of the permitting authority.	Used Tier I criteria for aquatic life, human health, and wildlife protection and estimated Tier II values for aquatic life and human health protection for pollutants present in effluent at levels of concern.	1. Use Tier I criteria only for aquatic life, human health, and wildlife protection. 2. Use Tier I criteria and Tier II values for aquatic life, human health, and wildlife protection.

TABLE 5-2 SUMMARY OF REGULATORY ALTERNATIVES EVALUATED FOR THE MAJOR ISSUES RAISED RELATED TO COMPLIANCE COST ESTIMATES FOR THE PROPOSED GUIDANCE (continued)

ISSUE	PROPOSED GUIDANCE REQUIREMENT	PROCEDURE USED FOR ESTIMATING FINAL GUIDANCE COST	REGULATORY ALTERNATIVES EVALUATED
Wildlife Criteria	Use Tier I criteria and Tier II values for wildlife criteria.	Used Tier I wildlife criteria methods for 22 BCCs that have sufficient data.	1. Use Tier I criteria only for aquatic life, human health, and Tier I criteria and Tier II values for wildlife protection. 2. Use no wildlife criteria.
Elimination of Mixing Zones for BCCs	Within 12 years, mixing zones will be eliminated for BCCs for existing dischargers.	Assumed no mixing zones allowed for BCCs.	1. Mixing zones allowed for BCCs (same as for non-BCCs).
Antidegradation	Antidegradation trigger for BCCs is any increase in loadings above the existing effluent quality; antidegradation trigger for non-BCCs is any significant increase in loadings above the existing permit limit.	Projected lost opportunity costs under three scenarios to analyze cost impact.	1. All facilities discharging BCCs request antidegradation and are denied. 2. All facilities discharging BCCs request antidegradation reviews and one-half are allowed to increase discharge of BCCs. 3. One-tenth facilities discharging BCCs request antidegradation reviews and one-half are allowed to increase discharge of BCCs.
Additivity	None proposed in proposed Guidance (several options were discussed).	Total cancer risk from a mixture of carcinogens of 10^{-5}.	1. Cancer risk for individual criteria based on 10^{-5}. 2. Cancer risk for individual criteria based on 10^{-6}.

reduction impact of each regulatory alternative. Since evaluation of the impact of antidegradation provisions and improved analytical detection levels involves predicting impacts in the future, alternative methods were developed. These alternative methods are described further in the following sections.

5.3.1 Method for Evaluating the Impact of the Antidegradation Provisions of the Final Guidance

An alternative methodology was also used to analyze the impact of the antidegradation provisions considered for the final Guidance because the impacts would be highly site-specific and unpredictable in terms of when a facility will need to request an antidegradation review. Further, of particular concern to commenters was the possible lost economic opportunities should they be denied the ability to increase discharges in the future.

Therefore, the method used to estimate the impact of the final Guidance antidegradation provisions involved estimating what lost opportunity costs may result. This analysis was particularly based on the antidegradation requirements for BCCs contained in the final Guidance, that requires an antidegradation review if there is a deliberate action on the part of a facility that results in a significant lowering of water quality (i.e., the activity results in an increase in BCC loadings).[1] The general premise behind the antidegradation analysis was that the economic growth in the Great Lakes region would continue at a pace equal to the average growth over the last 8 years (1987-1994).

Table 5-3 shows one measure of economic growth (the total value of shipments) for six major industrial categories in the Great Lakes Basin for which data were readily available. Based on these data, the total value of shipments in the Great Lakes Basin in 1994 is projected to be $172 billion; the average annual growth (total value of shipments) over the 8-year period across all categories is just over 1 percent (1.29).

Acknowledging that not all industrial facilities are direct dischargers, and therefore not all economic growth is attributable to direct dischargers, data was collected to determine what proportion of the total industry was made up of direct dischargers. Table 5-4 shows data collected from EPA development documents supporting effluent limitations guidelines and standards for the six industrial categories for which economic data was collected. As shown in Table 5-4, and assuming that national proportions are reflective of the Great Lakes Basin, direct dischargers account for 38.9 percent of the total industry on average across all six industrial categories. Multiplying the 1994 total value of shipments ($172 billion) by 38.9 percent results in a total value of shipments attributable to direct dischargers of $67 billion.

[1] The final Guidance does not require State and Tribal permitting authorities to adopt antidegradation procedures for non-BCCs. Therefore, the cost impact analysis focused only on BCCs.

TABLE 5-3 VALUE OF SHIPMENTS FOR SIX MAJOR INDUSTRIAL SECTORS (MILLIONS OF DOLLARS)

	1987	1988	1989	1990	1991	1992	1993	1994	Average (1987-1994)
METALS									
National	$26,346	$29,057	$30,039	$29,512	$25,882	$26,331	$25,874	$25,893	
Great Lakes	$7,377	$8,136	$8,411	$8,263	$7,247	$7,373	$7,245	$7,250	
Growth(%)		10.3%	3.4%	-1.8%	-12.3%	1.7%	-1.7%	0.1%	-0.04%
FOOD PRODUCTS									
National	$329,725	$337,265	$333,011	$339,697	$344,351	$347,649	$352,013	$355,533	
Great Lakes	$92,323	$94,434	$93,243	$95,115	$96,418	$97,342	$98,564	$99,549	
Growth (%)		2.3%	-1.3%	2.0%	1.4%	1.0%	1.3%	1.0%	1.09%
PULP AND PAPER									
National	$46,962	$48,959	$48,633	$48,890	$48,033	$48,589	$48,715	$49,923	
Great Lakes	$13,149	$13,709	$13,617	$13,689	$13,449	$13,605	$13,640	$13,978	
Growth (%)		4.3%	-0.7%	0.5%	-1.8%	1.2%	0.3%	2.5%	0.89%
METAL MANUFACTURING									
National	$50,971	$57,998	$56,464	$55,595	$51,234	$55,525	$58,300	$59,780	
Great Lakes	$14,272	$16,239	$15,810	$15,567	$14,346	$15,547	$16,324	$16,738	
Growth (%)		13.8%	-2.6%	-1.5%	-7.8%	8.4%	5.0%	2.5%	2.52%
INORGANIC CHEMICALS									
National	$17,386	$18,238	$18,585	$20,096	$19,781	$19,977	$20,195	$20,437	
Great Lakes	$4,868	$5,107	$5,204	$5,627	$5,539	$5,594	$5,655	$5,722	
Growth (%)		4.9%	1.9%	8.1%	-1.6%	1.0%	1.1%	1.2%	2.38%
ORGANIC (PETROCHEMICALS)									
National	$96,222	$101,036	$103,187	$103,738	$99,477	$100,273	$101,075	$102,288	
Great Lakes	$26,942	$28,290	$28,892	$29,047	$27,854	$28,076	$28,301	$28,641	
Growth (%)		5.0%	2.1%	0.5%	-4.1%	0.8%	0.8%	1.2%	0.91%
TOTALS									
National	$567,612	$592,553	$589,919	$597,528	$588,758	$598,344	$606,172	$613,854	
Great Lakes	$158,931	$165,915	$165,177	$167,308	$164,853	$167,537	$169,729	$171,878	

Source for National Numbers: U.S. Industrial Outlook, 1994 Great Lakes' share of total national shipments assumed at 28 percent based on "The Great Lakes Economy, Looking North and South", Federal Reserve Bank of Chicago and the Great Lakes Commission, 1991.

Based on an average annual growth rate of 1.29 percent, the resulting estimated incremental annual growth above 1994 estimates, which is attributable to direct dischargers in the Great Lakes Basin, is estimated to be $864 million. This estimate served as the baseline from which Guidance antidegradation requirement impacts were estimated.

TABLE 5-4 PROPORTION OF DIRECT DISCHARGERS TO TOTAL INDUSTRY ESTIMATES

INDUSTRIAL CATEGORY	TOTAL NUMBER OF DISCHARGERS	NUMBER OF DIRECT DISCHARGERS	DIRECT DISCHARGERS AS PERCENT OF TOTAL (%)
Iron and Steel	1,020	733	71.9
Pulp and Paper	674	338	50.2
Nonferrous Metals	448	112	25.0
Inorganic Chemicals	1,142	481	42.1
Organic Chemicals, Plastics, and Synthetic Resins	941	300	31.9
Pharmaceuticals	439	55	12.5
Average			38.9

Source: EPA Development Documents

The impact on the total estimated annual growth in the Great Lakes Basin ($864 million) was then estimated under three different scenarios:

- High-End Scenario - assuming that all facilities that contained BCCs in their discharge (approximately 5 percent of all direct dischargers) would request an antidegradation review and all 5 percent were denied their request to increase the discharge of pollutants.

- Mid-Range Scenario - assuming that half of the facilities discharging BCCs and requesting antidegradation reviews were allowed to increase discharges.

- Low-End Scenario - assuming that only 10 percent of the facilities discharging BCCs would request an antidegradation review each year, and half of the facilities requesting antidegradation reviews were allowed to increase discharges.

5.3.2 Method for Evaluating the Impact of Future Improvements to Analytical Detection Levels

The methodology used to derive estimates of possible Guidance-driven compliance costs and pollutant load reductions when analytical detection levels become more stringent in the future is based on the premise that pollutant control cost-effectiveness will remain constant over time. If it is assumed that treatment technology will keep pace with improvements in analytical detection levels, then the cost-effectiveness based on the Guidance high-end cost estimates provides a reasonable upper-bound estimate of costs.

Compliance costs and pollutant load reductions were estimated under two scenarios: (1) assuming that analytical method detection levels (MDLs) improve 10-fold over time, and (2) assuming that MDLs improve 100-fold over time. The first step in estimating compliance costs under these future scenarios was to develop expected pollutant load reductions for each category of direct dischargers evaluated for the final Guidance. The same procedure used to derive pollutant load reduction estimates for the sample facilities (as described in Sections 2 and 4) was used to estimate pollutant load reductions. The resulting incremental pollutant load reductions attributable to MDLs decreasing 10- and 100-fold (in toxic pounds-equivalent) were then multiplied by the high-end cost-effectiveness values for each category (in annual cost per toxic pounds-equivalent) to develop the incremental cost of each scenario.

It should be noted that many of the same conservative assumptions that were used in the cost analysis were continued for purposes of estimating the impact of improvement in analytical detection levels. These assumptions include:

- Assuming no mixing zone is allowed for BCCs; and
- Assuming that the future MDL will be used as the compliance level. This equivalent to a 30 to 60 fold or 300 to 600 fold improvement, respectively, in the minimum level of quantification, which is used for determining compliance in the final Guidance.

In addition, because the analysis is based on the high-end compliance cost estimates, the use of regulatory flexibility provided in the final Guidance (e.g., phased total maximum daily loads/water quality assessments, economic/technical feasibility determination for elimination of mixing zones for BCCs, site-specific criteria modification, etc.) was limited to the steam electric category (see related discussion in Section 3.2.2). As a result, except for the steam electric category, the analysis uses the average high-end compliance costs for a category which are heavily weighted with end-of-pipe treatment costs.

Finally, the analysis does not off-set costs for treatment that may be required to achieve current NPDES permit limits that are below analytical detection levels.

5.4 RESULTS

The following subsections present the results of the analyses performed for each of the final Guidance regulatory alternatives. For each cost driver a summary table is provided to compare the results to the estimates for the final Guidance.

5.4.1 Fish Consumption Rates

Many commenters believed that EPA's proposed fish consumption rate of 15 grams per day (grams/day) for establishing human health protection criteria would not be protective of recreational and subsistence anglers such as the Native American anglers and minority anglers, or women of childbearing age and children within the Great Lakes Basin. Further, some commenters suggested that a higher fish consumption rate ranging from 30-60 grams/day would be necessary to protect lower income and minority subpopulations that eat more sport caught fish on average. In an effort to evaluate the impact of increasing fish consumption rate assumptions, an analysis of the compliance costs associated with increasing the consumption rate to 45 grams/day was performed.

Table 5-5 summarizes the results of the analysis of the impact of alternative fish consumption rates on the estimated costs and pollutant loading reductions of the final Guidance. The estimates for the final Guidance were based on a consumption rate of 45 grams/day. As shown in Table 5-5, decreasing the consumption rate to 15 grams/day had negligible impact on the estimated compliance cost and expected pollutant load reductions. The cost results at the high-end also show relatively insignificant increases in estimated costs and pollutant load reductions. The primary reason that decreasing fish consumption had little impact on costs or load reductions was because the resulting difference in criteria using 15 and 45 grams/day assumptions was not significant enough to change the control options selected for a pollutant at a particular facility. This was particularly the case for most BCCs, for which criteria using 15 or 45 grams/day remained below analytical detection levels.

TABLE 5-5 EVALUATION OF FISH CONSUMPTION RATES

DESCRIPTION	LOW-END ESTIMATE		HIGH-END ESTIMATE	
	ANNUAL COST (MILLIONS)	POLLUTANT LOAD REDUCTION (10^3 LBS-EQ/YR)	ANNUAL COST (MILLIONS)	POLLUTANT LOAD REDUCTION (10^3 LBS-EQ/YR)
Final Guidance	41.1	5,883	369.6	7,659
Final Guidance (15 grams/day)	41.1	5,854	369.6	7,631

All costs 1st Quarter 1994 dollars. Costs are for direct dischargers only.

5.4.2 Use of Pollutant Minimization Programs When WQBELs Are Below Analytical Detection Levels

As discussed in Section 2.2.2, there was an attempt made to collect some data related to the cost and effectiveness of pollution prevention techniques for the pollutants being regulated under the final Guidance. The result of these efforts, which generally constituted an extensive review of the EPA Pollution Prevention Information Clearinghouse (PPIC), was that very little is documented regarding the effectiveness of pollution prevention to remove many of the pollutants subject to the final Guidance. The limited data did, however, suggest that there are facilities that have reduced toxic pollutants to below analytical detection levels using pollution prevention techniques.

Although it is acknowledged that some facilities will want to ensure compliance with WQBELs below detection levels through the use of additional or enhanced end-of-pipe treatment, it is likely that an aggressive pollutant minimization program can successfully result in compliance with WQBELs below detection levels. In fact, several of the sample facilities examined as part of the cost study have successfully performed studies, required as part of their current National Pollutant Discharge Elimination System (NPDES) permit, to effectively reduce all detectable amounts of particular pollutants of concern from their discharge. For example, the State of Wisconsin required the Fort Howard Paper Company, as part of an NPDES permit special condition, to perform a PCB reduction study "to reduce PCBs to the maximum extent possible with a goal of zero discharge." Resulting effluent concentrations of PCBs allowed the State of Wisconsin to recommend reduced permit requirements for PCBs in the subsequent draft reissued permit.

As discussed in Section 3.2.1, pollutant minimization programs account for a significant proportion of the total compliance cost under the low-end scenario. The impacts of these requirements were evaluated by deriving cost estimates assuming that permitting authorities would only require increased monitoring for any pollutant for which a Guidance-based WQBEL was below analytical detection levels. Table 5-6 summarizes the results of the analysis of the impact of only requiring monitoring for pollutants for which Guidance-based WQBELs are below analytical detection levels.

As shown in Table 5-6, it is estimated that annual compliance costs for direct dischargers will decrease by more than 60 percent to $16.6 million. It should be noted that pollutant reduction credit was not taken because monitoring alone is not expected to systematically identify pollutant sources within a facility, as well as result in pollutant removal. As a result the estimated pollutant load reductions decrease to 1.3 million pounds-equivalent/day, which is almost 80 percent less than the reduction estimated for the final Guidance. Under the high-end, compliance costs do not drop as dramatically as the low-end costs, due to the shift towards end-of-pipe treatment; however, the pollutant load reductions decrease by more than 50 percent.

5.4.3 Intake Credits

In generating cost estimates for the proposed Guidance, intake credits were provided by assuming there was no reasonable potential for outfalls at facilities that added no additional pollutants prior to discharge. Furthermore, two different cost scenarios were developed to account for the lack of ambient background concentration data and for when negative wasteload allocations were calculated. As discussed in Section 2.2.3.3 a revised approach was used for estimating costs for the final Guidance to reflect the intake credit provisions of the final Guidance.

TABLE 5-6 EVALUATION OF POLLUTANT MINIMIZATION PROGRAM REQUIREMENTS

DESCRIPTION	LOW-END ESTIMATE		HIGH-END ESTIMATE	
	ANNUAL COST (MILLIONS)	POLLUTANT LOAD REDUCTION (10^3 LBS-EQ/YR)	ANNUAL COST (MILLIONS)	POLLUTANT LOAD REDUCTION (10^3 LBS-EQ/YR)
Final Guidance	41.1	5,883	369.6	7,659
Final Guidance (Require monitoring only when WQBELs are below analytical detection levels)	16.6	1,308	337.9	3,084

All costs 1st Quarter 1994 dollars. Costs are for direct dischargers only.

In an effort to evaluate the impact of intake credits on estimated compliance costs, compliance costs under a number of different intake credit scenarios were developed. The results of these analyses are presented in Table 5-7. As shown in Table 5-7, for discharges to different bodies of water, no significant impact occurred (less than 0.5 percent) to either the compliance costs or pollutant load reductions at either the low- or high-end scenarios, regardless of whether intake credits are relaxed (no net increase) or made more stringent (no intake credit allowed). This result occurred because discharges occurred only infrequently to different bodies of water that were non-attained.

Alternatively, the form of intake credits does impact discharges to the same body of water. When intake credits are allowed, a slight drop in costs is experienced concurrent with a larger proportional drop in pollutant load reduction. At the low-end, compliance costs drop by $700,000 (a 1.7 percent decrease), but pollutant load reductions drop by more than 17 percent. At the high-end, costs decrease by less than 1 percent, but pollutant load reductions decrease by 13.5 percent.

When intake credits were not allowed for discharges to the same body of water, the annual compliance costs for direct dischargers increased by $245 million, representing more than a 600 percent increase from the final Guidance low-end estimate. However, pollutant load reductions increased to 6.4 million pounds-equivalent/year, which represents only a 9 percent increase from the final Guidance low-end estimate. The same trend results using high-end scenario costs where the costs increase by more than 60 percent, but pollutant reductions increase by only 7 percent.

5.4.4 Tier II Criteria

One of the stated limitations of the cost estimate for the proposed Guidance was that compliance costs were not estimated for pollutants other than those for which numeric Tier I criteria were proposed. As discussed in Section 2.2.3.1, the cost estimate for the final Guidance

TABLE 5-7 EVALUATION OF ALTERNATIVE INTAKE CREDIT PROVISIONS

DESCRIPTION	LOW-END ESTIMATE		HIGH-END ESTIMATE	
	ANNUAL COST (MILLIONS)	POLLUTANT LOAD REDUCTION (10^3 LBS-EQ/YR)	ANNUAL COST (MILLIONS)	POLLUTANT LOAD REDUCTION (10^3 LBS-EQ/YR)
Final Guidance	41.1	5,883	369.6	7,659
Final Guidance (Intake credits allowed for different body of water; the WQBEL is set equal to the background concentration)	41.1	5,883	369.6	7,659
Final Guidance (Intake credits allowed for different body of water; the WQBEL is set equal to zero)	41.2	5,883	369.6	7,659
Final Guidance (Intake credits allowed for same body of water; the WQBEL is set equal to the background concentration)	40.4	4,841	368.3	6,617
Final Guidance (Intake credits allowed for same body of water; the WQBEL is set equal to zero)	286.6	6,386	614.8	8,162

All costs 1st Quarter 1994 dollars. Costs are for direct dischargers only.

is based on evaluation of compliance with 69 pollutants of initial focus. To determine the potential impact of the use of Tier I criteria versus Tier II values, compliance costs under a variety of scenarios were developed.

Table 5-8 presents the results for the different regulatory scenarios evaluated. As shown in Table 5-8, if only Tier I criteria are used, the annual compliance costs for direct dischargers would drop by $5 million, which is just under 12 percent of the final Guidance low-end estimate. The pollutant load reductions would also decrease by approximately 8 percent of the estimate for the final Guidance. Under the high-end, both costs and pollutant load reductions decrease similarly (2 percent drop in costs and 6 percent drop in pollutant load reduction from the high-end estimate from the final Guidance).

If Tier I criteria and Tier II values are used for all pollutants, the annual compliance costs increase insignificantly at both the low- and high-end. This result was expected since the scenario only adds Tier II wildlife values. Although many of these additional Tier II wildlife values are more stringent than other final Guidance criteria, the impact is insignificant since both the Tier II wildlife values and the other Guidance criteria are below analytical detection levels.

TABLE 5-8 EVALUATION OF APPLICATION OF TIER I CRITERIA AND TIER II VALUES

Description	Low-End Estimate		High-End Estimate	
	Annual Cost (Millions)	Pollutant Load Reduction (10^3 lbs-eq/yr)	Annual Cost (Millions)	Pollutant Load Reduction (10^3 lbs-eq/yr)
Final Guidance	41.1	5,883	369.6	7,659
Final Guidance (Use Tier I criteria only for aquatic life, human health, and wildlife protection)	36.1	5,416	363.2	7,192
Final Guidance (Use Tier I criteria and Tier II values for aquatic life, human health, and wildlife protection)	41.1	5,955	369.6	7,731

All costs 1st Quarter 1994 dollars. Costs are for direct dischargers only.

5.4.5 Wildlife Criteria/Mercury Criteria

The final Guidance limits the use of the wildlife criteria methodology to the Tier I procedure for the 22 BCCs for which sufficient data exist. In response to the many concerns raised regarding the stringency of wildlife criteria and the potential significant costs associated with complying with the criteria, a number of alternatives were evaluated.

As discussed in Section 2.2.3.2, the final Guidance cost estimate includes numeric Tier I wildlife criteria for mercury, 2,3,7,8-TCDD, PCBs, and DDTs. In addition, Tier I criteria were developed for three additional BCCs and Tier II values were developed for 21 other pollutants that were used to assist in estimating costs for the final Guidance. Six of the 21 pollutants are not BCCs, which tends to further overstate the impact of the wildlife criteria, as the final Guidance requires development of Tier I wildlife criteria for only BCCs. Furthermore, these values were estimated using many simplifying and conservative assumptions that are expected generally to be more stringent than those values that would be derived by permitting authorities using the wildlife methodology contained in the final Guidance.

Table 5-9 presents the results of the analysis of the impact of wildlife criteria on the cost estimate for the final Guidance. Using the additional wildlife criteria results in an insignificant increase in annual compliance costs. Alternatively, excluding all wildlife criteria also results in essentially no difference in compliance cost estimates and pollutant load reductions at both the low- and high-ends. These results indicate that factors other than the wildlife criteria tend to drive the costs of the final Guidance. In the absence of wildlife criteria, the final Guidance human health criteria would form the basis for Guidance-based WQBELs. The final Guidance human health criteria for most pollutants are below analytical detection levels and, as such, the costs for treatment and pollutant minimization plans would be incurred by a facility. Although the wildlife criteria in general are more stringent than the final Guidance human health criteria, they also would result in Guidance-based WQBELs below analytical detection levels. Therefore, the same treatment and pollutant minimization plan requirements, costs, and pollutant load reductions would occur.

TABLE 5-9 EVALUATION OF APPLICATION OF WILDLIFE CRITERIA

DESCRIPTION	LOW-END ESTIMATE		HIGH-END ESTIMATE	
	ANNUAL COST (MILLIONS)	POLLUTANT LOAD REDUCTION (10^3 LBS-EQ/YR)	ANNUAL COST (MILLIONS)	POLLUTANT LOAD REDUCTION (10^3 LBS-EQ/YR)
Final Guidance	41.1	5,883	369.6	7,659
Final Guidance (Use no wildlife criteria)	41.1	5,856	369.6	7,632
Final Guidance (Use Tier I criteria and Tier II values for aquatic life, human health, and wildlife protection)	41.1	5,955	369.6	7,731

All costs 1st Quarter 1994 dollars. Costs are for direct dischargers only.

5.4.6 Allowance of Mixing Zones for BCCs

As promulgated in Procedure 3 of Appendix F to Part 132, the final Guidance retained the requirement for elimination of mixing zones for BCCs within 12 years. The final Guidance also provides some flexibility to allow limited mixing zones for BCCs if the facility can show that all prudent and feasible treatment technologies are being implemented to reduce the discharge of BCCs to the maximum extent possible.

A sensitivity analysis was performed to address this issue prior to the proposed Guidance. In general, assuming analytical detection limits remain the same, it was concluded that a cost would be incurred infrequently for a BCC after mixing zones have been taken away. This conclusion was based on the fact that many of the WQBELs and associated criteria for BCCs were already below analytical detection levels.

In estimating costs for the final Guidance, it was conservatively assumed was that no mixing zones would be allowed for BCCs. To determine the impact of this requirement on facilities (in terms of cost) and the environment (in terms of pollutant load reductions), the sample facilities were reevaluated allowing the same mixing zones for BCCs as are allowed for non-BCCs.

As shown in Table 5-10, the addition of mixing zones for BCCs results in an estimated incremental annual cost savings to direct dischargers of just over $200,000, which is less than a 0.5 percent decrease from the final Guidance low-end cost estimate. In terms of pollutant load reductions, the addition of mixing zones results in an insignificant decrease in pollutant load reductions. Slight reductions in cost and pollutant load reductions were also found under the high-end scenario.

The relatively small impact associated with allowing mixing zones for BCCs is due to the fact that the criteria for most BCCs are relatively stringent and usually well below analytical detection levels. Even with the dilution afforded by the mixing zones, resulting WQBELs remain below analytical detection levels and, as a result, do not drastically impact the costs and load reductions (i.e., the pollutant controls would not change if both WQBELs were below analytical detection levels).

5.4.7 Additivity

In an effort to evaluate the impact of the additivity provision on the compliance cost of the final Guidance, cost estimates for two scenarios were developed. Under one scenario, the assumption was that additivity would be controlled if the total carcinogenic risk in a discharge was less than 10^{-5} and accounted for by assuming that individual criteria were based on a 10^{-5} risk level. Under the second scenario, the assumption was that the additive effects from carcinogens would be accounted for if individual criteria were based on a 10^{-6} risk level.

TABLE 5-10 EVALUATION OF ALLOWING MIXING ZONES FOR BCCs

DESCRIPTION	LOW-END ESTIMATE		HIGH-END ESTIMATE	
	ANNUAL COST (MILLIONS)	POLLUTANT LOAD REDUCTION (10^3 LBS-EQ/YR)	ANNUAL COST (MILLIONS)	POLLUTANT LOAD REDUCTION (10^3 LBS-EQ/YR)
Final Guidance	41.1	5,883	369.6	7,659
Final Guidance (Mixing zones allowed for BCCs)	40.9	5,839	369.5	7,615

All costs 1st Quarter 1994 dollars. Costs are for direct dischargers only.

As shown in Table 5-11, the impact of the first scenario was relatively insignificant (less than 0.5 percent decrease in costs and just over 1 percent decrease in pollutant load reductions at both low- and high-end estimates). The relatively insignificant changes in cost and pollutant load reductions are based on the fact that most facilities did not detect more than a few carcinogens in their discharge. As a result, the final Guidance estimates (based on a total carcinogenic risk of 10^{-5}, but accounted for by distributing the risk across all carcinogens in the effluent) did not represent more stringent WQBELs for carcinogens, as compared to only accounting for the risk through the individual criteria.

When the individual criteria risk level is adjusted down to 10^{-6}, a more dramatic increase in costs occurs. A 10^{-6} risk level for individual criteria would increase the annual compliance costs for direct dischargers to more than $51 million under the low-end. The associated load reductions do not increase as dramatically, accounting for only an additional 6,000 pounds-equivalent/year. The reason a large pollutant reduction did not accompany the large increase in costs under the low-end scenario is the assumption that a significant number of facilities would pursue some sort of regulatory relief, for which there is no pollutant reduction credit, to meet the more stringent criteria based on a 10^{-6} risk level.

The same trend occurs at the high-end, where costs increase by more than 30 percent, but pollutant load reductions decrease by less than 1 percent. However, under the high-end scenario where variances are limited to categories that exceed the high-end cost trigger, the significant increase in costs is due to the costs associated with installing and maintaining end-of-pipe treatment for pollutants impacted by the more stringent criteria. The insignificant load reductions associated with the large increase in costs is because some regulatory relief was still justified under the high-end. Furthermore, for some pollutants with criteria below the analytical detection level, the shift from criteria based on a 10^{-5} risk level to criteria based on a 10^{-6} risk level resulted in criteria further below analytical detection levels, which had no impact on pollutant load reductions.

TABLE 5-11 EVALUATION OF ADDITIVITY

Description	Low-End Estimate		High-End Estimate	
	Annual Cost (Millions)	Pollutant Load Reduction (10^3 lbs-eq/yr)	Annual Cost (Millions)	Pollutant Load Reduction (10^3 lbs-eq/yr)
Final Guidance	41.1	5,883	369.6	7,659
Final Guidance (Additivity at 10^{-5} risk for individual criteria)	40.9	5,791	369.4	7,567
Final Guidance (Additivity at 10^{-6} risk for individual criteria)	51.4	5,877	481.5	7,653

All costs 1st Quarter 1994 dollars. Costs are for direct dischargers only.

5.4.8 Antidegradation

It is assumed that the antidegradation provision of the final Guidance, as promulgated under Appendix E to Part 132, may impact the regulated community. However, due to the variety of site-specific factors that would influence the future impact of the antidegradation provision, it is uncertain whether the impact will be significant. Therefore, an analysis of the potential impact of the antidegradation provision was performed in the form of estimating the cost to lost opportunities for businesses in the Great Lakes Basin.

As shown in Table 5-12, under the worst case where it was assumed that all (100 percent) facilities with BCCs in their discharge (approximately 5 percent of all facilities) requested an antidegradation review and were denied permission to increase loads, an opportunity cost of 5 percent ($43.2 million) of the incremental annual growth would be lost due to the final Guidance. More realistically, if it was assumed that half (50 percent) of the facilities requesting antidegradation reviews for BCCs were allowed to increase discharges, only $21.6 million of opportunity costs would be lost each year. Finally, assuming that only 10 percent of the facilities discharging BCCs requested an antidegradation review, and only half (50 percent) were denied, then the opportunity lost for growth would be approximately $2.2 million.

An antidegradation review resulting in an increase in baseline loadings should not be expected for BCCs because for many, their use is already banned or severely restricted by the EPA. A study performed for EPA shows that 14 of the 28 BCCs are banned or severely restricted, and another four of the 28 are by-products of banned or severely restricted BCCs.[2] The remaining 10 BCCs have some limited restrictions for use, are not restricted at all, or no data were found for them. Based on this study, the mid- and high-end estimates of lost opportunity are probably unlikely because the increase of banned or restricted BCCs should not occur due to releases from the manufacture or use of the BCC. In fact, it is assumed that the

TABLE 5-12 EVALUATION OF IMPACT OF ANTIDEGRADATION PROVISIONS

DESCRIPTION	ANNUAL COST (MILLIONS)
Final Guidance (Low-End Estimate)	41.1
Final Guidance (High-End Estimate)	369.6
Potential Lost Opportunity Cost (High-end)	43.2
Potential Lost Opportunity Cost (Mid-range)	21.6
Potential Lost Opportunity Cost (Low-end)	2.2

All costs 1st Quarter 1994 dollars. Costs are for direct dischargers only.

[2] Memo to Mark Morris (EPA Office of Science and Technology) from Abt Associates regarding "Use and Production of the Great lakes Initiative Bioaccumulative Chemicals of Concern" (July 21, 1994).

levels of these BCCs will decrease over time in point source discharges and in the environment. Several other BCCs are present as contaminants or by-products of banned or restricted BCCs (e.g., heptachlor epoxide is a metabolic breakdown product of heptachlor), and for the same reason, the levels of these BCCs should also decrease over time. Therefore, antidegradation reviews as a result of an increase in loading levels for BCCs that results in a significant lowering of water quality are not expected.

If the low-end estimate is used, then a modest 3 percent increase in the low-end annual compliance cost results. The potential benefits, although not quantified, could be relatively significant for some receiving waters because additional discharges of BCCs would be denied.

5.4.9 Future Impact of Detection Levels

In recent years, several States in the Great Lakes System have promulgated water quality criteria for various toxic pollutants that are more restrictive than the level of analytical detection. Implementation of these existing water quality criteria by these States do take into account the ability to detect the pollutant in the wastestream. Likewise, Procedure 8, Appendix F, of Part 132 clearly provides that the water quality-based effluent limit must be derived from the water quality criterion; compliance with that limit, however, will be based on the ML where available. When a promulgated ML is not available, compliance with that limit may be based on the lowest level of quantification (at the State's discretion) defined in Procedure 8 of Part 132.

In estimating the compliance cost for the final Guidance, it was conservatively assumed that the MDL would serve as the compliance level. In actuality, the State permitting authority is only required to use the ML (as defined under 40 CFR Part 136) as the basis for reporting compliance with the Guidance-based WQBEL. Although the pollutant MDL was used for costing purposes, it is acknowledged that estimating treatment costs for WQBELs below the MDL, and most likely below the ML, would be speculative for many pollutants, particularly as such estimation relates to expected future performance.

Nevertheless, an evaluation of the potential impact that improvements to analytical detection levels would have on compliance cost estimates was performed. In particular, costs and pollutant load reductions were estimated under two scenarios, one that assumes MDLs improve 10-fold over time and another that assumes MDLs improve 100-fold over time.

The results of the analysis presented in Table 5-13 show conceivable increases in estimated compliance costs. When MDLs become 10 times more stringent, annual costs increase by over $500 million dollars. Pollutant load reductions also increase when MDLs decrease 10-fold by over 12 million toxic pounds-equivalent per year. When MDLs become 100 times more stringent, the annual compliance costs are estimated to increase by just over $880 million and pollutant load reductions would increase by approximately 19 million toxic pounds-equivalent per year above the final Guidance estimates. These results indicate that as analytical detection levels improve, the costs to implement the final Guidance increase. However, the increase in compliance costs are offset by comparable pollutant load reductions.

TABLE 5-13 EVALUATION OF FUTURE IMPACT OF LOWER ANALYTICAL DETECTION LEVELS

DESCRIPTION	ANNUAL COST (MILLIONS)	POLLUTANT LOAD REDUCTION (10^3 LBS-EQ/YR)
Final Guidance (Low-End Estimate)	41.1	5,838
Final Guidance (High-End Estimate)	369.6	7,650
Increment Assuming Future MDLs Improve 10-fold	569.8	12,202
Increment Assuming Future MDLs Improve 100-fold	882.5	18,900

All costs 1st Quarter 1994 dollars. Costs are for direct dischargers only.

APPENDIX A - REEVALUATION OF TIER II AQUATIC LIFE VALUES

Following the completion of the initial assessment of compliance costs resulting from implementation of the final Guidance, it was determined that the procedures used to estimate "Tier II" values for protection of aquatic life differed from those that will be published in the final Guidance for 18 of the 69 costed pollutants. In several cases, the Tier II aquatic life values that were developed for the cost evaluation were less stringent than those determined using the procedures outlined in the final Guidance. Because of this discrepancy, an evaluation was performed to determine whether the less stringent aquatic life values could have impacted the initial cost analyses.

Table A-1 presents a comparison of the Tier II aquatic life values used for the cost evaluation versus Tier II values calculated using the final Guidance methodologies. Table A-1 indicates that the Final Acute Values (FAV) and the Criteria Continuous Concentrations (CCC) calculated using the final Guidance procedures are significantly more stringent than those calculated for the cost analyses for several pollutants. In order to determine how these changes might affect the cost analyses, the most stringent aquatic life criteria were then compared to applicable human health and wildlife criteria.

Table A-2 provides a comparison of the most stringent aquatic life value (calculated using final Guidance methods) and the most stringent human health and wildlife criteria used for the cost analyses. Where either the human health or wildlife criterion was more stringent than the aquatic life value for a pollutant, the water quality-based effluent limit (WQBEL) was driven by the human health or wildlife criterion; thus, there would be no effect on costs or loadings due to the revised aquatic life value. In general, Table A-2 indicates that human health or wildlife values are more stringent for most of these pollutants; however, seven pollutants were identified where the aquatic life values may drive WQBELs under some situations (e.g., human health and wildlife criteria use slightly higher mixing zone flows).

Having identified seven pollutants where the revised Tier II aquatic life value may, under certain circumstances, drive the WQBELs, the potential impact of the revisions was evaluated. The possible impacts of the more stringent aquatic life were determined by first determining which of the 59 study facilities were evaluated for these pollutants, and second, determining whether the lower aquatic life values would change cost or loading calculations.

The results of this analysis indicated that there were no cost or loading impacts due to the revised aquatic life values for chlorpyrifos, hexachloroethane, tetrachloroethane or trichloroethylene. The revised lead value resulted in the elimination of the "reasonable potential" determination at one study facility; however, the only costs projected for the facility were $360 for lead monitoring. This cost would not be incurred if the revised lead value was implemented. The revised toluene value resulted in a minimal underestimation (less than 1 toxic pounds-equivalent) of load reduction at one study facility; however, costs were not impacted. The fluoranthene value resulted in the underestimation of 1.12 toxic pounds-equivalent at one study facility; however, costs were also unaffected for this facility.

Based on the findings of this evaluation, the initial cost and pollutant load reduction results developed for the final Guidance will not be significantly affected by the modifications to the Tier II aquatic life values.

TABLE A-1 COMPARISON OF TIER II AQUATIC LIFE VALUES CALCULATED FOR COST ANALYSES VS. THOSE CALCULATED USING FINAL GUIDANCE METHODS (μg/l)

CHEMICAL	AQUATIC LIFE VALUES USED FOR COST ANALYSES		AQUATIC LIFE VALUES CALCULATED ACCORDING TO FINAL GUIDANCE METHODS	
	FAV	CCC	FAV	CCC
Acrylonitrile	7,550	419	580.8	32.3
Benzene	5,300	294	757.1	42.1
Benzidine	2,500	139	312.5	17.36
Beryllium	130	5.3	16.25	0.903
Carbon tetrachloride	35,200	1,960	4,400	244.4
Chloroform	28,900	1,240	3,612	200.7
Chlorpyrifos	0.166	0.0410	0.043	0.002
4,4-DDD	0.600	0.0333	0.086	0.0048
4,4-DDE	1,050	58.3	47.9	2.66
1,2-Dichloroethane	118,000	6,560	9,076.9	504.3
2,4-Dimethylphenol	2,120	118	1,300	530
Fluoranthene	3,980	221	8.37	0.47
Hexachloroethane	980	54.4	44.8	2.49
Lead **	59.1	1.04	149.4	8.3
Tetrachloroethylene	5,280	293	865.6	48.09
Toluene	17,500	972	2,187.5	121.53
Trichloroethylene	45,000	2,500	660	36.67
Thallium	1,400	40.0	20	1.9

Where: FAV = CMC/adjustment factor CCC = FAV/18 (acute/chronic ratio)

* The CMCs come from the document "water quality criteria summary concentrations" except chlorpyrifos which was calculated using the most recent water quality criteria document and applying an adjustment factor of 4.3 (7 species available).

** Revisions to lead calculations resulted in less stringent aquatic life values. Values displayed were calculated at a hardness of 50 mg/l.

TABLE A-2 COMPARISON OF AQUATIC LIFE VALUES CALCULATED USING FINAL GUIDANCE METHODS VS. THE MOST STRINGENT HUMAN HEALTH AND WILDLIFE CRITERIA (μg/l)

CHEMICAL	AQUATIC LIFE CRITERIA CALCULATED USING FINAL GUIDANCE METHODS		WILDLIFE CRITERION	MOST STRINGENT HUMAN HEALTH CRITERION
	FAV	CCC		
Acrylonitrile	580.8	32.3	-	0.634
Benzene	757.1	42.1	-	10.2
Benzidine	312.5	17.36	-	0.00149
Beryllium	16.25	0.903	-	0.0570
Carbon tetrachloride	4,400	244.4	-	1.53
Chloroform	3,612	200.7	-	52.6
Chlorpyrifos *	0.043	0.002	0.347	4.42
4,4-DDD	0.086	0.0048	-	0.000155
4,4-DDE	47.9	2.66	-	0.00000820
1,2-Dichloroethane	9,076.9	504.3	-	3.76
2,4-Dimethylphenol	1,300	530	-	106
Fluoranthene *	8.37	0.47	-	115
Hexachloroethane *	44.8	2.49	-	0.888
Lead **	149.4	8.3	-	15.0
Tetrachloroethylene *	865.6	48.09	-	90.5
Toluene *	2,187.5	121.53	-	172
Trichloroethylene *	660	36.67	-	22.8
Thallium	20	1.9	-	0.782

* Indicates that the revised aquatic life value <u>may</u> be more stringent than other applicable criteria under some circumstances.

** Revised aquatic life value for lead <u>may</u> be less stringent than other applicable criteria under some circumstances.

APPENDIX B - WILDLIFE CRITERIA DEVELOPMENT

Introduction

The chemicals identified for evaluation were divided into 5 categories and reviewed to determine whether wildlife values could or needed to be calculated. The five categories were:

1. Inorganic metals
2. Bioaccumulative Chemicals of Concern (BCCs)
3. Carcinogens
4. Non-carcinogens
5. No human health data

Wildlife values were calculated for 28 of the 69 chemicals. Table B-1 summarizes the wildlife values for the 28 chemicals along with the BAFs and toxicity data used. Table B-2 summarizes the exposure assumptions used for deriving each wildlife value and Table B-3 compares the wildlife values for six inorganic metals and the chronic aquatic life criteria. The rationale for why certain chemicals were selected for review along with the data used are included in the following sections.

1. Inorganic Metals

Wildlife values for metals were assumed to be similar to existing aquatic life criteria, and therefore were not estimated for use in the cost analyses. This was verified by estimating wildlife values for the six pollutants listed in Table B-3. Of the six pollutants evaluated, all of the wildlife values were greater than the chronic aquatic life values.

The toxicity data for these six pollutants were taken from the report "Interim Wildlife Criteria: Assessment of Screening Level Values". The exposure parameters were the same as those in Table B-2, and the BAFs were assumed to be 1.

2. Bioaccumulative Chemicals of Concern (BCCs)

Wildlife values were estimated for 16 BCCs. Values could not be calculated for hexachlorohexane, alpha-BHC, or beta-BHC because the only toxicity data available is for cancer, which is not an endpoint used for deriving wildlife values.

Mammalian Toxicity Data - The toxicity data for both mammals and avian species for DDT and its metabolites (4,4-DDE and 4,4-DDD), mercury, 2,3,7,8-TCDD, and mercury were the same as used in the proposed Guidance with some modifications of the uncertainty factors.

The mammalian toxicity data for hexachlorobenzene came from the report "Interim Wildlife Criteria: Assessment of Screening Level Values". There were no other mammalian wildlife data available. Because of this it was decided to use rodent studies as the surrogate for mammalian wildlife data.

For the other 10 BCCs, the toxicity data for mammalian species was estimated by assuming that the effective dose - effects level divided by uncertainty factors - was 10-fold greater than the associated human health RfD for that chemical. For example, if the human health RfD was 10 mg/kg/day, then the effective dose for mammalian wildlife was assumed to be 100 mg/kg/day for purposes of estimating wildlife values. A factor of 10 was selected because the intraspecies uncertainty factor normally used in deriving human health criteria is not normally used for estimating wildlife values. This also assumes that the endpoints used for estimating the human health RfD and the associated uncertainty factors were the same as for wildlife, which in many cases may not be valid. However, to provide some estimate of the potential wildlife values this seemed a reasonable assumption.

Avian Toxicity Data - The avian data for toxaphene, dieldrin, and endrin came from the report "Interim Wildlife Criteria: Assessment of Screening Level Values". There was no other avian data available.

Exposure Parameters - The exposure parameters used are summarized in Tables 1 and 2. The BAFs for DDTs, mercury, PCBs, and 2,3,7,8-TCDD are described in the "July 1994 Technical Support Document for Derivation of BAFs" (TSD). The trophic level 4 BAFs for the other BCCs were estimated by multiplying the baseline BAFs reported in the TSD for the pollutant by 0.079 (lipid content for wildlife species) and then multiplying this sum by the fraction of the freely dissolved portion for that pollutant.

The BAFs for trophic level 3 were estimated two ways. The preferred method was to calculate a baseline 1 BAF for trophic level 3 for each chemical using the arithmetic mean of the calculated measured log BAFs for sculpin, alewives, and small smelt. These data are included in the July 1994 TSD. Once the baseline trophic level 3 values were estimated, the same procedure as described above could be used to derive a trophic level 3 BAF to be used for estimating wildlife values. This method was used for chlordane, hexachlorobenzene, lindane, pentachlorobenzene, and 1,2,4,5-tetrachlorobenzene.

When the calculated measured log BAFs for sculpin, alewife, and small smelt were not available for a chemical, it was assumed that the baseline BAFs for trophic level 3 were 80% of the baseline trophic level 4 BAFs for that chemical. The 80% value was used as an conservative assumption. Once the baseline trophic level 3 values were estimated, the same procedure as described above could be used to derive a trophic level 3 BAF. This method was used for aldrin, dieldrin, endrin, heptachlor, and toxaphene.

3. Carcinogens

Wildlife values were not estimated for A, B, or C human carcinogens, with the exception of carcinogenic BCCs. The assumption was made, for several reasons, that the human health criteria for carcinogens would be equal to or more stringent than the associated wildlife values for that pollutant.

First, for some pollutants (e.g., 2,4,6-trichlorophenol), the only available human health values are for cancer. Since cancer is not an endpoint used for assessing effects on wildlife it did not seem appropriate to attempt to derive wildlife values for these pollutants. Second, the human health values for cancer are often very low because of the conservative assumptions used in their derivation. It is unlikely that the wildlife values would be substantially more stringent than the human health cancer criteria with the possible exception of those pollutants with large BAFs, which are already covered by the BCC category.

4. Non-carcinogens

Wildlife values were estimated for 14 human health non-carcinogens (see Table 1). These pollutants were selected because they were not classified as carcinogens and thus it seemed reasonable that the wildlife values could be less than the associated human health values.

The procedure for estimating mammalian wildlife toxicity data was the same as described above for the BCCs. There was no avian data for these 14 chemicals. The toxicity data is summarized in Table 1 and the exposure parameters are summarized in Table B-2. The procedure for estimating trophic 4 wildlife BAFs is the same as described above for BCCs. Because of uncertainty in the precise baseline BAF for trophic level 3 it was decided to assume that the trophic level 3 BAFs were the same as trophic level 4 BAFs. The one exception was for phenol where 80% of the trophic level 4 BAFs was used.

5. No data available

Wildlife values for parathion, 1,1-Dichloroethane, anthracene, and phenanthrene were not estimated because of lack of toxicity data.

TABLE B-1 WILDLIFE VALUES FOR RIA/INFORMATION USED TO CALCULATE VALUES

CHEMICAL	WILDLIFE VALUES (pq/L)		BAFS (L/Kg)		TOXICITY DATA (µg/kg/d)	
	MAMMALIAN	AVIAN	TROPHIC 3	TROPHIC 4	EFFECT LV.	UFs
Aldrin	0.67	—	2,630,574	3,288,217	30	100
Chlordane	92.35	—	357,156	394,961	55	10
Chlorobenzene	19.67 million	—	58	58	19,000	100
Chlorpyrifos	—	347,347	1072	1251	800	10
DDT and metabolites	92	2.78	3,020,000	6,026,000	M - 500 A - 28	M - 10 A - 9
1,2-trans-Dichloroethylene	160.4 million	—	7	7	20,000	100
Dieldrin	2.34	183	1,260,789	1,575,987	M - 5 A - 500	10
2,4-Dimethylphenol	4.1 million	—	246	246	50,000	300
2,4-Dinitrophenol	3.41 million	—	3	3	2000	1000
Endosulfan alpha-endosulfan beta-endosulfan	5668	—	534	534	5	10
Endrin	651	5097	27,252	34,128	M - 30 A - 300	10
Heptachlor	1213	—	73,150	91,437	150	10
Hexachlorobenzene	558	—	161,392	176,027	150	10
Lindane	2916	—	6873	6716	330	100
Mercury	2590	1479	27,906	139,532	M - 160 A - 64	M - 10 A - 6
PCBs	92	230	658,000	687,000	M - 300 A - 1800	M - 30 A - 30
Pentachlorobenzene	1304	—	35,836	49,350	8000	1000
Phenol	16.27 million	—	2180	2715	60,000	10
TCDD	0.002	0.15	320,000	160,000	M - 1000 A - 14,000	M - 10 A - 10
Tetrachlorobenzene	2975	—	7727	5933	300	100
Tetrachloroethylene	4.11 million	—	147	147	10,000	100
Toluene	6.75 million	—	1953	2441	223,000	100
Toxaphene	77	173	2,676,166	3,345,208	M - 350 A - 1000	10
1,1,1-Trichloroethane	90.04 million	—	23	23	3500	10

Effect Lv. = Effect Level
UFs = Uncertainty Factors
M - Mammalian
A - Avian

TABLE B-2 EXPOSURE PARAMETERS

SPECIES	BODY WEIGHT (kg)	INGESTION RATE (g/day)	DRINKING WATER (l/day)	AVERAGE TROPHIC LEVEL OF FOOD SOURCE: PERCENT OF DIET
Mink	0.8	0.155	0.081	Terrestrial: 20% Aquatic TL3: 80%
Otter	7.4	1.3	0.60	TL3: 80% TL4: 20%
Kingfisher	0.15	0.075	0.017	TL3: 100%
Osprey	1.6	0.3	0.081	TL3: 100%
Eagle	4.65	0.517	0.16	Fish: 92% TL3:80% TL4:20% Birds: 8% herring gull:70%) non-aquatic:30%)

TABLE B-3 WILDLIFE VALUES VS. CHRONIC AQUATIC LIFE VALUES FOR SIX INORGANIC COMPOUNDS

CHEMICAL	WILDLIFE VALUES (µg/l)		AQUATIC LIFE CHRONIC CRITERIA (µg/l)
	AVIAN	MAMMALS	
Aluminum	37,000	—	87
Arsenic	110	—	150
Cadmium	737	—	0.78
Copper	—	66,000	5.2
Nickel	29,000	—	29
Zinc	11,000	—	60