Chapter I5: Streamlined HRC Valuation of I&E Losses at the Monroe Facility

This chapter presents the results of EPA's streamlined habitat-based replacement cost (HRC) valuation of I&E losses at the Monroe facility in Monroe, Michigan, for a baseline scenario based on I&E data for the years 1982 and 1985.

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A description of the HRC method and the process for undertaking a complete HRC valuation of I&E losses is provided in Chapter A11 of Part A of this document. To summarize, a complete HRC valuation of I&E losses reflects the combined costs for implementing habitat restoration actions, administering the programs, and monitoring the increased production after the restoration actions. In a complete HRC valuation, these costs are developed by first identifying the preferred habitat restoration alternative for each species with I&E losses and then scaling the level of habitat restoration until the losses across all the species for that restoration alternative have been exactly offset by the expected increases in production of each species. The total value of the I&E losses at the facility is then calculated as the sum of the costs across the set of preferred habitat restoration alternatives that were identified.

The HRC method is thus a supply-side approach for valuing I&E losses in contrast to the more typically used demand-side valuation approaches (e.g., commercial and recreational fishing impacts valuations). An advantage of the HRC method is that the HRC values address losses for species lacking a recreational or commercial fishery (e.g., forage species). Further, the HRC explicitly recognizes and captures the fundamental ecological relationships between species with I&E losses at a facility and their surrounding environment by determining the value of I&E losses through the cost of the actions required to provide an offsetting increase in the existing populations of those species in their natural environment.

Streamlining was necessary to meet the schedule of the 316(b) existing sources rule and entailed combining Step 2 (identification of species habitat requirements), Step 3 (identification of habitat restoration alternatives), and Step 4 (consolidation and prioritization of habitat restoration alternatives), restricting the analysis to readily available information, and eliminating site visits, in-depth discussions with local experts, and development of primary data (see Chapter A11 of Part A of this document), which would be required before doing an actual restoration. Despite these restrictions, the streamlined HRC provided a more comprehensive, ecological-based valuation of the I&E losses than valuation by traditional commercial and recreational impacts methods. In addition, the streamlined HRC valued direct, indirect, and passive uses not included in more traditional economic valuation techniques used in Chapters I4 and I6.

The calculated range in annualized costs, expressed in 2000 dollars, of restoring sufficient fish production habitat to offset the I&E losses in perpetuity at the Monroe facility for the baseline scenario is $1.1 - $14.4 million.

The following subsections describe the streamlined HRC valuation applied to the Monroe facility and the advantages and disadvantages of streamlining the HRC method.

I5-1 Quantify I&E Losses by Species (Step 1)

The streamlined HRC method relies on the same estimates of annual age 1 equivalent species losses that are developed in Chapter I3 from data reported directly by the facility and incorporated in the commercial and recreational fishing impacts valuation presented in Chapter I4. Total I&E losses at the facility may be underestimated, particularly if certain species were not targeted by monitoring efforts or if short duration population spikes occurred outside of monitoring events. The HRC method inherently reduces the former problem by targeting restoration activities that might benefit species lost but not monitored, but like all other measures of I&E losses, it relies on representative monitoring.

Various life stages of organisms were lost to I&E at the Monroe facility. As with other facilities, primarily early stages such as eggs and larvae are entrained, and primarily juveniles and adults are impinged. However, EPA estimated total losses for each species by converting all losses to a common equivalent life stage by applying average mortality rates between life stages for each species. These mortality rates were derived from the literature and best professional judgment. Conversion between life stages did not change the overall scale of required restoration in the streamlined HRC method because many eggs are equivalent to few adults on both the I&E loss and increased production sides of the HRC equation. For example, if on average one adult survives from 10 eggs via a 90% cumulative mortality rate and 1 acre of habitat produces 10 eggs, then restoration of 1 acre is needed to produce either one adult or 10 eggs.

Age 1 equivalent I&E losses of 20 species of fish were calculated using the available I&E monitoring data available from the Monroe facility. A summary of average annual age 1 equivalent losses from the available data is presented in Table I5-1.

Table I5-1: Average Annual I&E Losses of Age 1 Equivalent Fish at the Monroe Facility

Species	Baseline Scenario: (1982 and 1985)		
	Impinged	**Entrained**	**Total**
Gizzard shad	34,323,242	8,747,005	43,070,247
White bass	662,353	772,277	1,434,630
Yellow perch	264,144	567,330	831,474
Shiner spp.	213,319	276,928	490,247
Carp	3,891	394,554	398,445
Sunfish spp.	6,177	311,090	317,267
Freshwater drum	148,171	143,558	291,729
Logperch	156,793	115,373	272,166
Smelt	5,132	89,543	94,675
Suckers	4,958	89,117	94,075
Smallmouth bass	141	48,283	48,424
Walleye	22,658	16,749	39,407
Crappie spp.	793	23,517	24,310
Channel catfish	859	20,594	21,453
Burbot	0	1,765	1,765
Bullhead spp.	1,007	0	1,007
Bluegill	447	0	447
Alewife	156	0	156
Whitefish	0	81	81
Muskellunge	4	0	4
Total	**35,814,245**	**11,617,764**	**47,432,009**

Several species impinged or entrained at the Monroe facility are important to commercial or recreational fishing, including walleye, yellow perch, catfish, and crappie. Many others, including alewife, smelt, and shiners, indirectly affect commerce and recreation because they are prey for commercially or recreationally important aquatic and terrestrial wildlife species such as salmon and northern pike, bald eagles, and mink. Furthermore, all of the species provide numerous, complex, ecological services as sources of carbon and energy transfer through the food web, as well as continuous interactive exploitation of niches available in the Great Lakes ecosystem (a system already under tremendous stress from exotic species introductions, hazardous substance contamination, nonpoint source runoff, heat contamination, habitat loss, overfishing, and I&E) from multiple sources.

For example, freshwater drum feed on a variety of small fish. When food supplies are short, freshwater drum often out-compete other species and thereby may increase mortality rates or decrease growth rates for those species (Edsall, 1967). In addition, several species of Centrarchids, including the crappie, are sensitive to the size of their predators' population. When predators such as walleye are absent, species such as crappie can overcrowd their habitats and exhaust their own food supplies, resulting in stunted growth (Wang, 1986a; Steiner, 2000). Finally, some species are already subject to wide fluctuations in population size from year to year, and may not be able to tolerate I&E losses, particularly at certain times of the year. For example, the gizzard shad is often subject to high mortality in the winter (Miller, 1960).

I5-2 Identify Species Habitat Requirements (Step 2), Identify Habitat Restoration Alternatives (Step 3), and Prioritize Restoration Alternatives (Step 4)

EPA combined steps 2, 3, and 4 of the HRC method by seeking a single habitat restoration program capable of increasing production for most of the species with quantified I&E losses at the Monroe facility. Addressing each of these steps separately for each of the I&E species would improve the analysis but would require more time than was available for the analysis for the proposed rule.

The selection of coastal wetland restoration as the preferred restoration alternative for offsetting the I&E losses at the Monroe facility builds of the work conducted in the streamlined HRC valuation of the I&E losses at the nearby J.R. Whiting facility. This decision is viewed as appropriate recognizing the relative proximity of the Monroe and J.R. Whiting facilities, the existence of coastal wetland preservation and restoration programs in many Great Lakes states, and the prior knowledge that many of the fish species with quantified age 1 equivalent I&E losses at the Monroe facility have readily available information describing their abundance in Great Lakes' coastal wetlands which can be used as a proxy for increased production benefit estimates.

I5-3 Quantify the Benefits for the Prioritized Habitat Restoration Alternatives (Step 5)

A literature search revealed a study (Brazner, 1997) that provides fish capture data by species from sampling efforts conducted at a series of Green Bay (Lake Michigan) coastal wetland and sand beach sites. No other studies provide more direct measures of increased fish species production following Great Lakes coastal wetland restoration, or fish capture data in wetlands closer to the Monroe facility. However, the Brazner study sampled wetlands in the warmer, shallower, more eutrophic waters of southern Green Bay, which are similar to the waters of western Lake Erie. After examining the data from the Brazner study and discussing them with the author, EPA dropped less similar sites from northern Green Bay. For almost all of the species with quantified I&E losses at the Monroe facility, a match was found with a species, or combination of species, among those captured at the southern sites in the Brazner study. Table I5-2 shows the species caught in the Brazner study that were paired with the species being lost at the Monroe facility (this represents only a fraction of the species caught in these southern locations in the Brazner study).

Because of the similarity between the physical habitats of southern Green Bay and western Lake Erie and the confirmed presence of similar species in both locations, EPA estimated densities for each southern Green Bay species and used them as a proxy for direct measurements of potential increased production following wetland restoration. This approach assumed that additional wetland habitat restored near the Monroe facility would provide similar densities of each species as the wetland habitats sampled in Green Bay. Direct measurements of densities of each species before and after actual wetland habitat restorations in western lake Erie could test this assumption and improve the reliability of the HRC valuation for the Monroe facility.

Table I5-2: Species with I&E Loss Estimates at the Monroe Facility and the Corresponding Species Captured in Green Bay Wetland Sampling

Species with I&E Loss Estimates at the Monroe Facility	Corresponding Species Caught in Sampling of Green Bay Coastal Wetlands (Brazner, 1997)
Alewife	Yes
Bluegill	Yes
Bullhead spp.	Yes (as sum of black, brown, and yellow bullhead)
Burbot	No
Carp	Yes
Channel catfish	Yes
Crappie spp.	Yes (as black crappie)
Freshwater drum	Yes
Gizzard shad	Yes
Logperch	Yes
Muskellunge	Yes
Shiner spp.	Yes (as sum of common, emerald, golden, spotfin, and spottail shiner)
Smallmouth bass	Yes
Smelt	Yes (as rainbow smelt)
Suckers spp.	Yes (as white sucker)
Sunfish	Yes (as green sunfish)
Walleye	Yes
White bass	Yes
Whitefish	No
Yellow perch	Yes

EPA developed the density estimates for each species for each site using aggregate sampling results provided by the author (J. Brazner, U.S. EPA, Duluth Lab, personal communication, 2001). Table I5-3 provides a summary of the Green Bay capture data (J. Brazner, U.S. EPA, Duluth Lab, personal communication, 2001) for each species that has quantified I&E losses at the Monroe facility for which a matching species or groups of species was available. Data for each of four Green Bay sites are presented, as are the average and maximum of all four sites.

The raw capture data were converted to density estimates for each species by assuming that each sampling event of 100 m of linear coastal wetland frontage corresponded to an average of 100 m of perpendicular width of connected coastal wetlands (i.e., each sampling event included fish from an assumed 100 m x 100 m area of wetlands). This assumption is based on discussions with the author about the likely perpendicular width of the sampled wetlands that was being used as habitat by the sampled species (J. Brazner, U.S. EPA, personal communication, 2001). A further adjustment was then made to the raw capture data to recognize the fact that shoreline sampling would capture only a portion of the fish actually using the 100 m x 100 m wetland habitat. After discussions with the author, the capture data were increased by a factor of 100 (1/0.01), based on the assumption that only 1% of the fish present or relying on the wetland habitat were captured in the sampling event.

The resulting per acre average density estimates for each species was used in the HRC equation as the measure of increased production that would most likely be provided by wetland habitat restoration near the Monroe facility. The maximum per acre density estimate for each species was used as an upper bound estimate of fish density that would result from wetland restoration near the Monroe facility.

Brazner (1997) captured young-of-year (younger than age 1), age 1 fish, and adult fish (older than age 1) in the Green Bay wetlands. In this evaluation, the capture data were treated as if it represented age 1 fish, which eliminated the need to apply mortality rates to adjust for survival between life stages for each species, as was done for I&E losses. Since Brazner (1997) reports a high percentage of young-of-year fish captured at all Green Bay sites, this assumption most likely results in a slight overestimation of age 1 fish densities, and therefore potentially underestimates the scale of restoration required to offset the average annual I&E loss for each species (i.e., it underestimates baseline losses from I&E).

Table I5-3: Green Bay Wetland Abundance Data

Species Name for HRC Analysis	Number Captured: Lower Green Bay Wetland Locations[a]				Summary Statistics	
	Long Tail Point Wetland	Little Tail Point Wetland	Atkinson Marsh	Sensiba Wildlife Refuge	Average	Maximum
Yellow perch	3,525	942	333	1,108	1,477	3,525
Shiner spp.[b]	1,202	499	526	769	749	1,202
Gizzard shad	384	264	160	137	236	384
Alewife	265	142	92	124	156	265
White bass	52	226	106	9	98	226
Sucker spp.[c]	14	10	1	103	32	103
Carp	19	10	3	1	8	19
Sunfish [d]	3	5	22	2	8	22
Bluegill	18	3	0	6	7	18
Freshwater drum	4	4	7	1	4	7
Bullhead spp.[e]	9	4	0	2	4	9
Crappie spp.[f]	1	2	1	1	1	2
Channel catfish	0	0	3	0	1	3
Muskellunge	2	0	0	0	1	2
Smallmouth bass	0	0	0	2	1	2
Logperch	0	0	0	1	0	1
Smelt.[g]	0	1	0	0	0	1
Walleye	1	0	0	0	0	1
Burbot	not captured in Green Bay wetlands				n/a	n/a
Whitefish	not captured in Green Bay wetlands				n/a	n/a

[a] Number captured in samples of 100 meters linear coastal wetland frontage. Reflects age 1 fish (not eggs and larvae).
[b] Shiner spp. values are the sum of the common, emerald, golden, spotfin, and spottail shiner values at each location.
[c] Sucker spp. values are those reported for white sucker.
[d] Sunfish values are those reported for green sunfish.
[e] Bullhead spp. values are the sum of the black, brown, and yellow bullhead values at each location.
[f] Crappie spp. values are those reported for black crappie.
[g] Smelt values are those reported for rainbow smelt.

I5-4 Scale the Habitat Restoration Alternatives to Offset I&E Losses (Step 6)

EPA calculated the amount of Great Lakes coastal wetland restoration required to offset I&E losses for each species at the Monroe facility by dividing the combined average annual I&E loss for each species in the baseline scenario by its per-acre estimate of increased production of age 1 equivalents. The results of this scaling are presented in Table I5-4.

Whether using average or maximum production values, over half of the species listed in Table I5-4 would require that hundreds or thousands of acres of wetland habitat be restored to fully offset the I&E losses caused by the Monroe facility's CWIS. If Great Lakes coastal wetland restoration is the best natural restoration alternative for offsetting losses for each of these species, then approximately 26,900 acres of coastal wetland restoration is required to fully offset all I&E losses under the baseline scenario using the average adjusted per acre density estimates (because restoring logperch would require that much wetland restoration, and all other species would be fully restored as well). However, without further discussions with local experts, and perhaps additional investigation of the relationship between feasible restoration activities and per-acre production benefits (particularly for the species driving the highest acreage needs), these assumptions may not be valid. On the other hand, the benefit of any given restoration program should always vary among species, and species with relatively high productivity or low I&E losses cannot drive the HRC results without sacrificing necessary offsets for other species with lower productivity or higher I&E losses. As seen in the results in Table I5-4, a large restoration requirement can reflect either low productivity of the restored habitat for the species (e.g., logperch and smelt) or very large I&E losses (e.g., gizzard shad).

Table I5-4: Wetland Restoration Required to Offset Combined I&E Losses at the Monroe CWIS

Species	Average Annual Age 1 Equivalents Lost to I&E	Per-Unit Production Benefit (age 1 fish per restored coastal wetland acre)		Required Acres of Wetland Restoration to Offset I&E Loss (rounded to nearest acre)	
		Average Value	Maximum Value Across Sites	Based on Average Production Value	Based on Maximum Production Value
Logperch	272,166	10	40	26,901	6,725
Smelt	94,675	10	40	9,358	2,339
Gizzard shad	43,070,247	9,561	15,540	4,505	2,771
Walleye	39,407	10	40	3,895	974
Smallmouth bass	48,424	20	81	2,393	598
Freshwater drum	291,729	162	283	1,802	1,030
Carp	398,445	334	769	1,193	518
Sunfish	317,267	324	890	980	356
Channel catfish	21,453	30	121	707	177
Crappie spp.	24,310	51	81	481	300
White bass	1,434,630	3,976	9,146	361	157
Suckers spp.	94,075	1,295	4,168	73	23
Shiner spp.	490,247	30,312	48,645	16	10
Yellow perch	831,474	59,774	142,657	14	6
Bullhead spp.	1,007	152	364	7	3
Bluegill	447	273	728	2	1
Muskellunge[a]	4	20	81	0	0
Alewife[b]	156	6,303	10,725	0	0
Burbot	1,765	n/a			
Whitefish	81	n/a			

[a] The exact requirement for restored wetland acreage for muskellunge is 0.20 acres under the average production value estimate and 0.05 acres under the maximum production value estimate. Both values are rounded to 0 acres for presentation.
[a] The exact requirement for restored wetland acreage for alewife is 0.02 acres under the average production value estimate and 0.01 acres under the maximum production value estimate. Both values are rounded to 0 acres for presentation.

Table I5-4 also shows that both the scale and distribution of the estimates of required wetland restoration change when maximum species density estimates are substituted for the averages. EPA used average species density estimates as the primary source of information because they are more representative of wetland productivity in the Brazner study, and more accurately reflect the difficulties of achieving full function in restored versus native habitats.[1]

Since a rigorous investigation of the relationship between feasible restoration alternatives and per-unit production estimates was not completed under the streamlined approach, using the highest restoration requirement (for logperch) may not be justified. Therefore, the restoration requirements were ordered for all of the species so that percentiles could be calculated. Using the 100th percentile (logperch) would offset losses for all of the species, as appropriate under a complete HRC analysis. However, the 90th and 50th percentiles (corresponding to smelt and channel catfish, respectively) were used to bound the estimate of the required scale of restoration. Using a lower percentile than the 100th recognizes that further analyses (or monitoring) might identify restoration programs more efficient and less costly than wetland restoration for species with the highest wetland restoration needs, or might produce better and higher wetland restoration productivity estimates (lower cost) for those same species. Nevertheless, using lower percentiles risks underestimating the costs of needed restoration because most species benefit from wetland restoration, and wetland restoration could easily prove to be the best alternative for those species with the greatest wetland restoration needs. Further, improved analysis and monitoring are as

[1] The maximum species-density-based estimates are included only as a sensitivity analysis and reflect a minimal scale of restoration that would be required if Lake Erie wetland restorations were much more highly successful then EPA anticipates. Detailed, repeated monitoring of I&E species in areas where restoration has occurred will increase the accuracy of future analyses.

likely to lower productivity estimates as they are to raise them. Therefore, percentiles less than the 50th were rejected as unreasonable.[2]

Table I5-5 presents the 90th and 50th percentile results from the distribution of required Great Lakes coastal wetland restoration calculated using the average species density estimates as a proxy for increased species production for the baseline scenario and combined average annual I&E losses of age 1 equivalent fish. Table I5-5 also presents the results using the maximum species density estimates as a sensitivity analysis.

Table I5-5: Acres of Coastal Wetland Restoration Required under Different I&E Scenarios with Alternative Increased Production Benefits Assumptions

I&E Scenario	Acres of Required Wetland Restoration with Average Species-Specific Density Estimates (preferred alternative)		Acres of Required Wetland Restoration with Maximum Species-Specific Density Estimates (sensitivity test)	
	90th Percentile Result	50th Percentile Result	90th Percentile Result	50th Percentile Result
Baseline	9,358	707	2,771	300

I5-5 ESTIMATE "UNIT COSTS" FOR THE HABITAT RESTORATION ALTERNATIVES (STEP 7)

EPA calculated annualized per-acre costs for restoring coastal wetlands in a Great Lakes ecosystem from the information in the Restoration and Compensation Determination Plan (RCDP) produced for the Lower Fox River/Green Bay Natural Resource Damage Assessment (U.S. Fish and Wildlife Service and Stratus Consulting, 2000), which incorporated a similar program of Great Lakes wetland restoration as a restoration alternative. The RCDP's per-acre cost included expenses for the restoration implementation (fieldwork), project administration, maintenance, and monitoring.

The RCDP's wetland restoration program focused on acquiring lands around Green Bay that are currently in agricultural use and that are located on hydric soils (an indicator of a wetland area). These former wetlands were generally brought into agricultural production through the draining or tiling of the land. Therefore, most of the expense (63%) in the RCDP's per-acre cost estimates was for land acquisition and restoration actions necessary to re-establish functioning wetlands. Maintenance costs (9%) consisted of expenses for periodic mowing and burning to maintain the dominance of wetland vegetation. The remaining expenditures (28%) covered anticipated administrative expenses for the program. The per-acre cost estimates for the various components of the wetland restoration program as presented in the Lower Fox River/Green Bay RCDP are provided in Table I5-6 along with the equivalent annualized per-acre cost that is used to value the required scale of wetland restoration in this streamlined HRC (the development of this annualized value is discussed in the following paragraph).

In annualizing the RCDP's unit costs for this streamlined HRC, EPA made a distinction between expected initial one-time program outlays (expenditures for land, transaction costs, restoration actions, contingency, and agency overhead) and anticipated recurring annual expenses (project maintenance and monitoring). Those costs that were viewed as initial program outlays were treated as a capital cost and annualized over a 20-year period at a 7% interest rate providing an annualized value of $882 from their initial combined value of $9,360. EPA then estimated the present value (PV), using a 7% interest rate, of the recurring annual expenses for 10 years as this is the length of time incorporated for monitoring in the complete HRC valuations conducted for the Brayton Point and Pilgrim facility case studies. This PV for the recurring annual expenses was then annualized over a 20 year period, again using a 7% interest rate resulting in an annualized expense of $658. This process effectively treats the monitoring expenses associated with the wetland restoration consistently with the annual operating and maintenance costs presented in the costing, economic impact, and cost-benefit analysis chapters. The annualized recurring expenses were then added to the annualized initial program outlays resulting in a total annualized cost for the wetlands restoration alternative of $1,540 per acre.

[2] For instance, using the 25th percentile restoration requirement from Table I5-4 (14 acres for yellow perch) would be valid only if further analysis produced superior (cheaper or more productive) restoration alternatives, or superior wetland productivity estimates that were higher for most of the species, including logperch, smelt, gizzard shad, walleye, smallmouth bass, freshwater drum, carp, sunfish, channel catfish, crappie, white bass, suckers, and shiner spp. Even the 50th percentile value that we use as a lower bound estimate assumes that eight of these species could each be produced more effectively with different restoration alternatives, or that wetland productivity is actually higher for all eight species.

Table I5-6: Wetland Restoration Costs (2000 dollars)

Restoration Program Component	$/Acre	Cost Method
Land acquisition	3,000	Survey of land prices
Land transaction costs	600	20% of land price, reflects agency (U.S. FWS) experience
Restoration action	2,600	Project experience (See Table Source)
Contingency on restoration action	260	10% of restoration actions, consistent with standard practice
Project maintenance	590	Project experience (See Table Source)
Monitoring	340	5% of total of land acquisition, land transaction, restoration action, and maintenance
Agency (landowner) overhead (project administration)	2,900	38.84% of sum of all other cost, reflects agency (U.S. FWS) experience
Total Cost	10,300	
Total Annualized Cost	**1,540**	

Source: U.S. Fish and Wildlife Service and Stratus Consulting, 2000.

However, these unit costs probably understate the cost of monitoring that would be sufficient to measure per-unit production benefits in restored wetlands, which could then improve future HRC calculations. In the RCDP's wetland restoration monitoring program, the emphasis was on evaluating whether the hydrology of the former wetlands and the associated vegetation were returning over time, activities that could be achieved with relatively minimal effort. In contrast, a monitoring program capable of addressing whether anticipated increases in the production of certain species were being achieved in the restored wetland areas would require a far more significant commitment of time and resources, resulting in commensurately larger expenditures.

I5-6 Develop Total Cost Estimates for I&E Losses (Step 8)

EPA estimated the total annualized cost to offset the average annual I&E losses at the Monroe facility by multiplying the 50th percentile and 90th percentile results of the required acreage of wetland restoration (see Table I5-5) by the annualized per-acre wetlands restoration costs from the RCDP (see Table I5-6). These results are presented in Table I5-7.

Table I5-7: Total Annualized Costs for a Wetland Restoration Program to Offset I&E Losses (millions of 2000 dollars)

I&E Scenario	Cost of Required Wetland Restoration with Average Species-Specific Density Estimates (preferred results)		Cost of Required Wetland Restoration with Maximum Species-Specific Density Estimates (sensitivity test)	
	90th Percentile Result	50th Percentile Result	90th Percentile Result	50th Percentile Result
Baseline	$14.4	$1.1	$4.3	$0.5

The results of the streamlined HRC provide an annualized present value estimate of roughly $14.4 million for a program of Great Lakes coastal wetland restoration that would offset the average annual age 1 equivalent losses from the baseline period in perpetuity using the 90th percentile results and average species density estimates. Incorporating the maximum observed species density from any of the sampled wetlands in Green Bay reduces the value of the 90th percentile scenario results to between one-third and one-fourth the average species density results.

Table I5-8 shows the results of the streamlined HRC analysis for impingement losses, entrainment losses, and total I&E losses separately.

Table I5-8: Annualized Results for the Monetization of I&E Losses at the Monroe Facility Incorporating Average Species-Specific Density Estimates (millions of 2000 dollars)

I&E Scenario	Component of I&E Loss	Annualized Value	
		90th Percentile	50th Percentile
Baseline	Impingement	$5.5	$0.0[a]
	Entrainment	$13.6	$1.4
	I&E total[b]	$14.4	$1.1

[a] The exact value of $24,141 is rounded to $0.0 when rounded to millions of dollars for presentation.
[b] The total is not equal to the sum of the results from the I&E components because of different numbers of species in these components as well as different rankings of the species based on the extent of required restoration in these components.

I5-7 Strengths and Weaknesses of the Streamlined HRC Analysis

The fundamental appeal of the HRC is its ability to incorporate and value environmental losses that are either undervalued or ignored by traditional valuation approaches, such as recreational and commercial fishing valuation (see Chapter A11 in Part A of this document for additional discussion). The primary advantage of the streamlined HRC is the limited effort and time required to provide regulators with an initial assessment of whether a complete HRC is justified. For facilities like Monroe with relatively large I&E impacts and I&E impacts to many species not targeted by anglers, a complete HRC is likely to be worthwhile, even given budgetary and time constraints associated with permit re-issuance cycles. In addition, the streamlined HRC provides regulators with a framework to evaluate mitigation proposals put forth by industry to address residual I&E losses associated with the permitted BTA.

The primary weakness of the streamlined HRC is the uncertainty resulting from limited opportunities to access local resource experts and unpublished primary data in the selection of a preferred restoration alternative, the development of per-unit production benefits for each species, and the estimation of restoration unit costs.

For these reasons, streamlining an HRC may be most appropriate when:

- a limited number of species experience I&E losses or the majority of I&E losses are realized by a small number of species
- the regulator is familiar with, or can quickly determine, the preferred restoration alternative for these critical species
- benefits information from evaluations of local habitats is available, and extrapolations do not lead to extreme variability
- published sources of information allow estimation of all important aspects of the restoration costs.

If these conditions are absent, a complete HRC analysis will provide a more comprehensive estimate of the losses associated with I&E than provided by traditional valuations.

In conclusion, the streamlined HRC method provides regulators, industry, and the public with an important method to quickly estimate the likely value of I&E losses at § 316(b)-regulated facilities. Further, because regulators and local experts can often quickly assess whether appropriate and necessary information exists for the valuation of I&E resources, streamlining may offer many opportunities to broaden the evaluation of I&E to include ecological and related public services, even when facing significant time and budgetary constraints.