APPENDIX G

ENVIRONMENTAL

APPENDIX G-1

HABITAT EVALUATION AND QUANTIFICATION (PEORIA LAKE)

PEORIA RIVERFRONT DEVELOPMENT (ECOSYSTEM RESTORATION) STUDY, ILLINOIS

FEASIBILITY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

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2. HABITAT EVALUATION METHODOLOGY

The methodology used in this evaluation was a modified form of HEP, the Wildlife Habitat Appraisal Guide (WHAG).[1] The HEP were developed to aid in land management planning and require the selection and evaluation of a single target species for each computer generated evaluation. The WHAG program takes a broader approach and evaluates for a range of target species within a specified habitat type.

The WHAG was developed by the Missouri Department of Conservation and the U.S. Department of Agriculture, Soil Conservation Service (now NRCS). It is a field evaluation procedure designed to estimate habitat quality and account for changes due to land management practices. Checklist-type appraisal guides are used for upland, wetland, and aquatic habitats. Computer programs are used to analyze field data in terms of habitat suitability for various evaluation species. This analysis employed a multi-agency approach with representatives from the Corps of Engineers and the Illinois Department of Natural Resources. The U.S. Fish and Wildlife Service, while not able to be directly involved in the WHAG evaluation, was supplied with all field sheets and results of the computer generated information for review and comment.

The WHAG analysis is a numerical system for evaluating the quality and quantity of particular habitats for target species within the WHAG. The qualitative component of the analysis is known as the habitat suitability index (HSI) and is rated on a 0.1 to 1.0 scale. The suitability of a given habitat type for a set of evaluation species is determined by the qualitative characteristics of the habitat type. The WHAG procedures include the use of limiting factors, which is a habitat requirement for an individual species during a critical time of the year. Absence of that habitat characteristic makes the habitat unsuitable and results in the lowest HSI value of 0.1. Habitat quality ratings can be improved by: (1) increasing acreages for particular habitat types that may be limited or lacking; (2) altering a limiting factor, such as unpredictable water levels; (3) altering a management strategy, such as cropping practice or cover crop composition; or (4) a combination of the preceding, depending on management goals, target species requirements, or available funds.

The quantitative component of the WHAG analysis is the measure of the acres of habitat that are available for the selected species. From the qualitative and quantitative determinations, the standard unit of measure, the habitat unit (HU), is calculated using the following formula: HSI x Acres = HUs. For project planning and impact analysis, project life was established as 25 years. To facilitate comparison, target years were established at 0 (existing conditions), 1 year after, 5 years after, and 25 years after project construction. HSI and AAHUs for each evaluation species were calculated to reflect expected habitat conditions over the life of the project.

For the evaluation process, the study team reviewed aerial photography, GIS and topographic data, and preliminary design drawings. The members of the team were also familiar with the project area and most had direct knowledge of existing conditions. During the evaluation process, assumptions are developed regarding existing conditions and probable post-project conditions relative to limiting factors and/or proposed management practices.

3. EVALUATION SPECIES SELECTION

Table G-1-1 lists the evaluation species used in this analysis. These species are part of an established set in the WHAG model. Although a set list of species is used, each species represents

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[1] D. L. Urich and others, "Habitat Appraisal of Private Land in Missouri," *Wildlife Society Bulletin* 12 (1984): 350-356.

a guild of other similar species that utilize the same habitat in similar ways. In essence, each species represents an array of habitat variables for the species being evaluated. These species represent key goals and objectives for the proposed project.

TABLE G-1-1. Evaluation Species for Habitat Analysis

Species	Scientific Name	Habitat Evaluated
Channel Catfish	*Ictalurus punctatus*	aquatic
Gizzard Shad	*Dorosoma cepedianum*	aquatic
L. Mouth Bass	*Micropterus salmoides*	aquatic
Bluegill	*Lepomis macrochirus*	aquatic
Crappie (WH-BL)	*Pomoxis spp.*	aquatic
Carp	*Cyprinus carpio*	aquatic
Black Bullhead	*Ameiurus melas*	aquatic
Mallard	*Anas platyrhynchos*	nonforested wetland
Lesser Yellowlegs	*Tringa flavipes*	nonforested wetland
King Rail	*Rallus elegans*	nonforested wetland
Green-Backed Heron	*Butorides striatus*	nonforested wetland
Muskrat	*Ondatra zibethicus*	nonforested wetland

Seven fish species were used to evaluate the aquatic habitat (dredging) improvements proposed by the project. Project designs for lower Peoria Lake would produce a wide diversity of aquatic habitat that currently does not exist. Channel catfish, and gizzard shad are fish that commonly inhabit main channel and channel boarder habitats. Largemouth bass, bluegill, and crappie are centrarchids that inhabit side channels and backwaters, and are important sport fish species. Carp and black bullhead are common and abundant in backwater habitats. All seven species utilize backwater areas as spawning habitat.

Five wildlife species were used to evaluate the terrestrial component (island construction) of the project. Mallard is a migratory waterfowl that utilizes early successional wetland habitat and has socioeconomic importance as a game species. Lesser Yellowlegs is a wading bird found in initial successional wetland habitat. King rail is a rare species of wading bird that prefers permanent sedge dominant wetland habitat. Green-backed heron is a wading bird found in mid-successional herbaceous and shrub dominated wetland habitat. The muskrat is a resident furbearing mammal that utilizes mid successional herbaceous wetland habitat.

4. ASSUMPTIONS

Several assumptions have been made in regards to current conditions, model performance, and changes in habitat conditions over time. Because the water level within Peoria Lake frequently fluctuates, an elevation for differentiating terrestrial and aquatic components needed to be established for the evaluation process. Flat pool is 440-msl (mean sea level) and is the lowest regulated (for navigation) water level that Peoria Lake would be allowed to reach. That elevation was selected as the dividing line between the terrestrial and aquatic habitat components proposed by the project.

a. Current Conditions. Current conditions within Peoria Lake in and around the proposed project area provide limited habitat value for most species associated with open-water habitats. The majority of the area is covered in 12-18 inches of murky water with a substrate of up to 4 feet that is best described as "pudding." There is essentially no aquatic plant life supported by this substrate. Water quality in the lake is frequently poor and has high turbidity. Realizing that even with the generally poor habitat quality of the proposed project area, there is still some minor habitat value and some species can be found to survive under the minimal conditions provided. However, for the purposes of the evaluation, the lowest habitat value of 0.1, in essence a "0" value, was used as the baseline, or existing, condition.

While sedimentation is a major concern for the area, some recent Corps studies indicate that a trend toward reduced sedimentation rates or even equilibrium may be developing within this reach of the river. If such is the case, the prospect for dramatic changes or naturally occurring habitat improvements within the lake over the next 25 years is very low. It was therefore assumed that at year 25, "without-project" conditions would also be at or near "0" habitat value.

b. Model Performance. The WHAG was designed to be applied to many different types of habitat. In order to evaluate potential project aquatic benefits, a field data sheet was prepared using the aquatic (MOFISF) matrix for overflow water habitat. The non-forested wetland field data sheet was used in order to evaluate the island construction or wetland component of the project. It was felt that the questions asked by these types of habitat evaluation field sheets would best cover a wider range of habitat characteristics proposed by the project.

WHAG team members completed field data sheets for the Overflow Water matrix and the Non-Forested Wetland matrix in order to evaluate "without-project" and "with-project" conditions for the sediment removal (dredging) and the island construction features. This evaluation process was performed for each of the four proposed island alternatives. As the baseline and future "without-project" were assumed to be "0" habitat value, habitat evaluations for either aquatic or terrestrial project features would always be calculated against zero habitat.

There were also minor modifications made when answering some of the questions on the field data sheets. This was done to account for project changes that would provide habitat benefits but that the WHAG evaluation was too broad to pick up. An example would be large areas that the project proposes to dredge to 6 feet. Since the model looks for overwintering habitat for fish, it only addresses depths of 8 feet or greater. To account for other habitat benefits provided by dredging to 6 feet, a 10-acre area dredged to 6 feet was considered to have a similar value as 5 acres dredged to 8 feet or 6 feet of dredging would produce at least one-half the habitat value of the same area dredged to 8 feet.

Some questions on the field sheets did not precisely address changes proposed by the project. However, because habitat benefits of a similar nature would be provided by the project, the values of those benefits were considered and counted (i.e., considering riprap as comparable to natural bank structure). Also, because of the broad nature of the model, it is not sensitive enough in some instances to account for natural resource benefits that the project is anticipated to provide. Therefore, a few of the answers on the field sheets were weighted to show benefits from project features that would not have otherwise shown up in the WHAG analysis.

c. Changes in Habitat Conditions Over Time. Habitat conditions are not usually static. Either through natural processes or human activity, habitat generally evolves and may change in quality and/or quantity. Imbedded in each cover type evaluation, change has been added to the model. To assess the change over the period of analysis, target years have been defined. At each target year, a change in the habitat variables may be noticed. Noticeable changes can be characterized by a change in habitat benefit output.

Target years of 0 (baseline condition), 1, 5, and 25 (future "without-project" and future "with-project" conditions) are sufficient to analyze HUs and characterize habitat changes over the estimated project life. Hydrologic flow models and sedimentation rate models were run to indicate sustainability of project features and provide support for the project assumptions that follow.

Evaluation of the aquatic restoration features assumed that under "without-project" conditions, there would essentially be no change to the area over the 25-year span of the project. While this is not the usual situation for many habitats, there is some evidence from recent studies of the area that this is very likely the case for the project area being investigated. Under "with-project" conditions, radical changes would take place and maintain the majority of those basic project features over the 25-year life of the project. Deepwater habitat would be developed by dredging channels deep enough to maintain at least 8 feet of depth by year 25. There would also be several deep holes at various depths, some of which would be monitored to determine sedimentation rates for a variety of conditions. Additionally, broad areas would be dredged to around 6 feet deep and are anticipated to retain at least 4 feet of water depth after 25 years.

For the terrestrial/wetland component of the island features, the difference between "with-project" and "without-project" conditions is expressed by the conversion of open water aquatic habitat into island or terrestrial wetland habitat. Because of the similarity and proximity of this project to the Peoria Lake EMP project, it is assumed that constructed features would respond similarly to that project. Areas from 440 to 445-msl would be frequently inundated and would likely develop shoreline with scattered herbaceous vegetation toward the upper elevations. Around 446-msl and above (450-msl), herbaceous vegetation would develop more thickly and eventually succeed to woody growth.

d. <u>General Assumptions</u>. No special management of the project area would take place. While some natural bank structure may occur over the life of the project, it would contribute very little to habitat values. It is unlikely that trees would grow close enough to shore to provide any aquatic tree shading. Plant diversity at year 25 "with-project" was weighted to show a reduction of plant species by woody invasion.

5. RESULTS OF HABITAT ANALYSIS

This section describes the benefits in AAHUs for island alternatives discussed in detail in the feasibility report. These alternatives are the different sized islands and various quantities of sediment dredged to construct the islands and are shown as AlternativesA1, A2, B1 and B2. The amount of aquatic habitat restored would be proportional to the size of the islands created by the project. The construction activities would create features such as the channels around the islands and include deep holes to provide fisheries habitat. Placement of riprap on the islands would help sustain areas that may be subject to erosion and also provide fisheries benefits.

Alternatives A1 and A2 are single islands located in the same vicinity above McCluggage Bridge. Alternative A1 proposes the conversion of 22 acres of shallow open water pool by removing sediments over a 13-acre area to construct an island with 9 acres of terrestrial habitat. Alternative A2 proposes the conversion of 74 acres of shallow open water pool by removing sediments over a 55-acre area to construct an island with 19 acres of terrestrial habitat.

Alternatives B1 and B2 are both located downstream of the McCluggage Bridge and are much larger construction efforts within the same area. Alternative B1 proposes the conversion of 288 acres of shallow open water pool by removing sediments over a 219-acre area to construct two islands with a total of 69 acres of terrestrial habitat. Alternative B2 proposes the conversion of 174 acres of shallow open water pool by removing sediments over a 128-acre area to construct an island with 46 acres of terrestrial habitat.

Results of the habitat analysis for individual species are expressed in total AAHUs in the following tables. Table G-1-2 shows AAHUs for the aquatic habitat created for the four alternatives considered as most operable and feasible to pursue for consideration of the preferred alternative. Table G-1-3 shows AAHUs for the non-forested wetland habitat created for the four alternatives considered. Since the baseline HUs for the project are "0" and it is assumed they would not significantly change over the 25-year life of the project if no action were taken, a comparison of baseline HUs to future "without-project" over time is not needed. (Detailed results of the WHAG data can be found in figures G-1-1 thru G-1-8 at the end of this appendix.)

TABLE G-1-2. Aquatic Habitat AAHUs

Species	Dredging Alternative A1	Dredging Alternative A2	Dredging Alternative B1	Dredging Alternative B2
Channel Catfish	5.8	23.7	108.2	58.1
Gizzard Shad	5.3	32.5	146.2	78.5
L. Mouth Bass	1.3	0	23.1	0
Bluegill	1.3	0	21.9	0
Crappie (WH-BL)	1.4	5.4	24.6	13.2
Carp	6.3	25.7	111.8	59.8
Black Bullhead	7.3	28.3	123.2	66.0
Total AAHUs	**28.7**	**115.6**	**559.0**	**275.6**

TABLE G-1-3. Wetland Habitat AAHUs

Species	Island Alternative A1	Island Alternative A2	Island Alternative B1	Island Alternative B2
Mallard	2.4	4.0	16.1	10.6
Lesser Yellowlegs	0	0	17.5	11.1
King Rail	3.2	5.6	22.3	15.9
Green-Backed Heron	3.8	6.7	29.9	19.7
Muskrat	1.7	2.9	20.3	8.2
Total AAHUs	**11.1**	**19.2**	**106.1**	**65.5**

Dredging to create the desired aquatic habitat would also provide the material to construct the island's terrestrial habitat. Therefore, the aquatic habitat AAHUs were added to the terrestrial habitat AAHUs for each alternative to provide an overall quantification of total AAHUs for each alternative being considered. Then, total AAHUs for each alternative would be:

- Alternative A1 39.8 AAHUs
- Alternative A2 134.8 AAHUs
- Alternative B1 665.1 AAHUs
- Alternative B2 341.1 AAHUs

Because two different areas of construction are being evaluated, there is potential for various combinations of island construction to be considered. In this instance, Alternative A1 orA2 could be combined with Alternative B1 or B2 to provide a much larger complex of islands, but also at greater cost. If this were done, the total AAHUs for each alternative would be added to determine the overall project AAHUs for island combinations.

It is anticipated that the natural characteristics, and thus the habitat, of the project islands would change over time. This would occur as vegetation establishes itself and gradually develops into a forestry component on the island(s). This change would be most noticeable with the largest island(s) construction or Alternative B1 (two islands). This means that the HSI (habitat suitability index) for each target species may change somewhat over the life of the project. This change shows most dramatically for the target species yellowlegs, mallard and heron. The WHAG data showed a decline in yellowlegs habitat by changing from 0.58 HSI at year 1 to 0.1 HSI at year 25 and for mallard habitat by changing from 0.49 HSI at year 1 to 0.18 HSI at year 25. This is understandable, as the development on trees on the island(s) would reduce the habitat requisites for these target species.

On the other hand, HSI values for the target species heron rose over time from 0.58 at year 1 to 0.72 at year 25. HSI values for the target species king rail and muskrat remained the same or changed only marginally.

Changes over time in the aquatic reaches of the project were also accounted for in the WHAG model. Sedimentation in the lake is not going to stop. However, island orientation and configuration were considered to provide the most sustainable channel options with the most favorable aquatic habitat for the life of the project. Over dredging of the deep and shallow water areas was incorporated to maintain these areas so that there would still be 4 to 8 feet of water depth at the end of the 25-year project life. Because of this, HSI values for many target species changed very little or not at all. On average, the HSI values for all 4 alternatives considered ranged between 0.4 and 0.7 with virtually no change over time. Only the number of species (terrestrial or aquatic) changed with each alternative considered. Alternative A1 hit 4 of 5 terrestrial species and all 7 fish species while alternative A2 hit 4 terrestrial and only 5 fish. Alternative B1 hit all 5 terrestrial and all 7 fish species, while alternative B2 hit 5 terrestrial and only 5 fish species.

6. INCREMENTAL ANALYSIS OF ALTERNATIVES

Two analytical processes are employed to meet Federal environmental planning requirements for project decision makers. "Cost Effective Analysis" is conducted to ensure that the least cost solution is identified for each possible level of environmental output. Then, "Incremental Cost Analysis" of the least cost solutions is conducted to reveal changes in costs for increasing levels of environmental outputs. The specific numbers generated by this process are less important than the relative relationships among potential solutions provided by the analyses; which one will produce the greater output or which one is more likely to be more costly. While these analyses do not usually lead (nor are they intended to lead) to a single best solution, they aid to improve the quality of the decision making by ensuring that a rational, supportable, focused and traceable approach is used for considering and selecting alternative methods to produce environmental outputs.

Cost effectiveness and incremental analysis is basically a three-step procedure: (1) calculate the environmental outputs of each feature; (2) determine a cost estimate for each feature; and (3) combine the features to evaluate the best overall project alternative based on habitat benefits and cost. While cost and environmental output are necessary factors, other factors such as constructibility, significance of the resources, sustainability of the project, and acceptability to the sponsor are very important in deciding on the preferred alternative.

The environmental benefits (outputs) and costs of each feature are summarized in Table 2-5 in the feasibility report. A total of nine potential combinations may be formulated with the identified increments of feasibility project features. Table G-1-4 displays these combinations in ascending order based on output. Alternative increments of each feature were then analyzed to identify the most cost-effective increments of each feature included in the selected plan. The results are summarized below.

TABLE G-1-4. Potential Combinations of Alternatives Ranked by Output

No.	Island Alternatives	Symbol	Output (AAHUs)	Construction Costs	Annualized Costs
1	No action	A0+B0	0.0		
2	Small Upper Island – No Lower Island	A1+B0	39.8	$2,102,174	$170,351
3	Large Upper Island – No Lower Island	A2+B0	134.8	$3,750,379	$303,915
4	No Upper Island – Single Lower Island	A0+B2	341.1	$6,252,267	$506,657
5	Small Upper Island – Single Lower Island	A1+B2	380.9	$8,354,441	$677,008
6	Large Upper Island – Single Lower Island	A2+B2	475.9	$10,002,646	$810,571
7	No Upper Island – Two Lower Islands	A0+B1	665.1	$9,956,668	$806,846
8	Small Upper Island – Two Lower Islands	A1+B1	704.9	$12,058,842	$977,197
9	Large Upper Island – Two Lower Islands	A2+B1	799.9	$13,707,047	$1,110,760

* Outputs are calculated as Average Annual Habitat Units (AAHUs).
** All costs in $1,000s. Represents initial construction costs only.
*** Annualized cost is initial construction cost based on a 25-year project life, 6-3/8% interest rate.

Environmental outputs were calculated as AAHUs. The annualized costs were calculated by applying a 6-3/8% interest rate to the construction costs over the 25-year life of the project. The incremental analysis for each feature was accomplished using the methodology described in Robinson *et al.*[2]

7. DISCUSSION

This section is intended to interpret the numerical results of the WHAG analysis into a narrative format that will provide insight as to how the numbers were derived and what they mean in terms of the predicted outcome of the project. [All WHAG field data sheets and output sheets are on file at the Rock Island District.]

Results of the WHAG application for the proposed alternatives were compared as increments to costs associated with the implementation of each alternative plan. This incremental cost analysis is discussed above and in Section 2 of the main report under "*Incremental Cost/Cost Effectiveness Analysis.*"

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[2] Ridgley Robinson, et al., *Evaluation of Environmental Investments Procedures Manual - Interim: Cost Effectiveness and Incremental Cost Analysis, Report No. 95-R-1* (U.S. Army Corps of Engineers, Water Resources Support Center, Institute for Water Resources, Alexandria, Virginia, 1995).

Because of the urban/industrial setting surrounding much of the lake, natural resources in the area are not as abundant as they could be. Habitat values for Peoria Lake are also limited by the lack of rooted aquatic vegetation and deepwater habitat. The bottom substrate for the lake is a thick layer (4-6 ft) of amorphous muck that few living creatures find adequate or desirable for living conditions. Heavy sedimentation, along with wind and wave action, contributes to both mechanical and physiological inhabitation of aquatic life in the lake and general low water quality. This is reflected in the extremely low HSI values used in the matrix evaluation for present conditions. Under without-project condition, these values would remain essentially unchanged over the 25-year project life as the constant wave action and shallowness of the lake keeps the bottom sediments in turbid suspension and continues to limit aquatic life in the lake.

Removing sediments and constructing one or more islands within the lake would result in a significant reduction of the amount of wind-generated waves and associated turbidity. It would also provide a large tract of wetland habitat for waterfowl as well as providing deepwater habitat for fisheries. Other aquatic life would benefit from the dredged areas through generally improved water quality within the lake. The deepwater and shallower dredged areas would remove old sediments from close association with the lake's surface and wave action. This spacing would provide a buffer area between sediment coming into the lake and the general wave action that keeps it in suspension. The dredged areas would allow that sediment to settle to the bottom where it would consolidate to form a more stable substrate and provide better conditions for aquatic life.

Terrestrial habitat gained from the island construction would provide additional diversity to the area while attracting waterfowl for nesting, feeding and loafing. The face of the island(s) would change from herbaceous vegetation to more substantial woody vegetation increasing habitat value over time. This would provide even greater diversity as the project matures and provide habitat for many more species in the future, including neo-tropical migrant birds.

Hydraulic modeling was performed to aid in the alignment of the islands for sustainability and to help indicate where erosion may pose potential problems. Rock placed along portions of the island shoreline would provide protection from erosion and also additional aquatic habitat. To aid in decreasing potential erosion and increase habitat values even more, rock in the form of jetties is proposed to be placed at select locations around the islands.

As explained earlier, the WHAG process takes these project components into account through the evaluation of information requested on the field data sheets for specific habitat types. Group discussion by the team weighs factors for project components, and relative values are assigned using professional judgment of the team and extrapolating for probable future conditions. This information is input into the program along with present conditions (baseline) and comparisons are made for projected future with- and without project conditions. HSI values are established with this data, which then provide a measure for "quality" of habitat for each project condition being evaluated. Once the habitat quality value is assigned, the WHAG can then calculate HUs by multiplying by the <u>*quantity*</u> of habitat produced, in this case, acres of wetland (island) and aquatic (dredged) habitat produced.

Because of the number and variety of indicator species used by the WHAG program, a broad range of habitat criteria are considered in the calculations. As most environments are dynamic systems, HSI values for a particular species may increase or decrease over time. These changes depend on species requirements and what the WHAG team determines to be an appropriate succession or evolution for the project and its components for future conditions. For instance, the WHAG calculations gave gizzard shad a 0.64 HSI at year 1 and by year 25 that HSI value had dropped to

0.10. This does not necessarily mean that the gizzard shad population will decline during the life of the project, but rather, conditions for optimal gizzard shad habitat would likely be reduced. This could be from a change in required habitat (a project feature) or increased competition (a system change) from other species moving into the area. The reverse is also true for HSI values of indicator species.

In general, though, the WHAG results showed that the project generated stable HSI values for most of the target species over the project life. The WHAG also found that dredging produced greater habitat benefits than island/wetland creation did. This may be due in part to the fact that the aquatic habitat value of Peoria Lake is so low in the project area that virtually any improvement proposed by the project raised habitat values for the project area dramatically. Also, production of wetland habitat requires time to mature to produce quality results, whereas dredging produces desired habitat almost immediately.

In conclusion, the WHAG evaluation showed a positive habitat gain for all project components reviewed. While dredging was shown to provide greater gains in habitat value than island construction, the potential for improved water quality from reduced wind/wave action in addition to the quality of wetland habitat gained makes islands a desirable feature. Because size is the limiting factor for this particular WHAG analysis and is directly proportional to the HUs produced by the project, the more acres dredged and the more acres of terrestrial habitat created, the more total habitat benefits the project would provide.

Figure G-1-1

Alternative A1 (Island Construction)

HABITAT TYPE ACRES				
HABITAT TYPE	PRESENT	TARGET YEARS		
		1	5	25
NonForested Wetland	0	9	9	3
Bottomland Hardwoods Wetland	0	0	0	6
Total	0	9	9	9

Species Abbreviations

MALL	Mallard
YLEG	Lesser Yellowlegs
MUSK	Muskrat
RAIL	King Rail
HERO	Green-backed Heron

MEAN HABITAT SUITABILITY INDEX (HSI)*				
SPECIES	PRESENT INDEX	TARGET YEARS		
		T-YR 1	T-YR 5	T-YR 25
MALL		0.48	0.46	0.17
YLEG				
MUSK		0.28	0.26	0.25
RAIL		0.53	0.56	0.43
HERO		0.48	0.62	0.62

*Where no values are shown, assume 0.1

Habitat Units for Target Years and Annual Average Habitat Units for Future With Project Conditions				
SPECIES	HU* T YR 1	HU* T YR 5	HU* T YR 25	ANNUAL AVERAGE HU*
MALL	4.3	4.1	0.5	2.4
YLEG				
MUSK	2.5	2.4	0.8	1.7
RAIL	4.5	5.0	1.3	3.2
HERO	4.3	5.6	1.9	3.8

*Where no values are shown, assume 0.1

Per discussion in the text (Sec 4a, Current Conditions), a baseline of 0.1 or "0" habitat is assumed for the project area. Therefore, no table for "Present Condition" is shown.

Figure G-1-2

Alternative A2 (Island Construction)

HABITAT TYPE ACRES				
HABITAT TYPE	PRESENT	TARGET YEARS		
		1	5	25
NonForested Wetland	0	19	12	9
Bottomland Hardwoods Wetland	0	0	7	10
Total	0	19	19	19

Species Abbreviations

MALL	Mallard
YLEG	Lesser Yellowlegs
MUSK	Muskrat
RAIL	King Rail
HERO	Green-backed Heron

MEAN HABITAT SUITABILITY INDEX (HSI)*				
SPECIES	PRESENT INDEX	TARGET YEARS		
		T-YR 1	T-YR 5	T-YR 25
MALL		0.48	0.46	0.17
YLEG				
MUSK		0.28	0.26	0.25
RAIL		0.50	0.56	0.43
HERO		0.48	0.62	0.62

*Where no values are shown, assume 0.1

Habitat Units for Target Years and Annual Average Habitat Units for Future With Project Conditions				
SPECIES	HU* T YR 1	HU* T YR 5	HU* T YR 25	ANNUAL AVERAGE HU*
MALL	9.1	5.5	1.5	4.0
YLEG				
MUSK	5.3	3.2	2.3	2.9
RAIL	9.5	6.7	3.9	5.6
HERO	9.2	7.5	5.6	6.7

*Where no values are shown, assume 0.1

Figure G-1-3

Alternative B1 (Island Construction)

HABITAT TYPE ACRES				
HABITAT TYPE	PRESENT	TARGET YEARS		
		1	5	25
NonForested Wetland	0	69	55	25
Bottomland Hardwoods Wetland	0	0	14	44
Total	0	69	69	69

Species Abbreviations

MALL	Mallard
YLEG	Lesser Yellowlegs
MUSK	Muskrat
RAIL	King Rail
HERO	Green-backed Heron

MEAN HABITAT SUITABILITY INDEX (HSI)*				
SPECIES	PRESENT INDEX	TARGET YEARS		
		T-YR 1	T-YR 5	T-YR 25
MALL		0.49	0.47	0.18
YLEG		0.58	0.55	
MUSK		0.49	0.48	0.46
RAIL		0.51	0.57	0.44
HERO		0.58	0.72	0.72

*Where no values are shown, assume 0.1

Habitat Units for Target Years and Annual Average Habitat Units for Future With Project Conditions				
SPECIES	HU* T YR 1	HU* T YR 5	HU* T YR 25	ANNUAL AVERAGE HU*
MALL	33.5	25.7	4.4	16.1
YLEG	39.8	30.4		17.5
MUSK	34.1	26.2	11.5	20.3
RAIL	35.5	31.4	11.1	22.3
HERO	39.8	39.5	17.9	29.9

*Where no values are shown, assume 0.1

Figure G-1-4

Alternative B2 (Island Construction)

HABITAT TYPE ACRES				
HABITAT TYPE	PRESENT	TARGET YEARS		
		1	**5**	**25**
NonForested Wetland	0	46	38	18
Bottomland Hardwoods Wetland	0	0	8	28
Total	0	46	46	46

Species Abbreviations

MALL	Mallard
YLEG	Lesser Yellowlegs
MUSK	Muskrat
RAIL	King Rail
HERO	Green-backed Heron

MEAN HABITAT SUITABILITY INDEX (HSI)*				
SPECIES	PRESENT INDEX	TARGET YEARS		
		T-YR 1	T-YR 5	T-YR 25
MALL		0.47	0.45	0.17
YLEG		0.53	0.51	
MUSK		0.29	0.28	0.26
RAIL		0.53	0.59	0.46
HERO		0.54	0.68	0.68

*Where no values are shown, assume 0.1

Habitat Units for Target Years and Annual Average Habitat Units for Future With Project Conditions				
SPECIES	HU* T YR 1	HU* T YR 5	HU* T YR 25	ANNUAL AVERAGE HU*
MALL	21.5	17.0	3.0	10.6
YLEG	24.4	19.2		11.1
MUSK	13.3	10.5	4.8	8.2
RAIL	24.3	22.3	8.2	15.9
HERO	24.9	25.9	12.3	19.7

*Where no values are shown, assume 0.1

Figure G-1-5

Alternative A1 (Dredging)

HABITAT TYPE ACRES				
HABITAT TYPE	PRESENT	TARGET YEARS		
		1	5	25
Pool	13	0	0	0
Overflow Waters	0	13	13	13
Total	13	13	13	13

Species Abbreviations

CATF	Catfish	CARP	Carp
CRPP	Crappie (Wh-Blk)	BLUE	Bluegill
LMBA	L. Mouth Bass	BUHD	Black Bullhead
GISH	Gizzard Shad		

MEAN HABITAT SUITABILITY INDEX (HSI)*				
SPECIES	PRESENT INDEX	TARGET YEARS		
		T-YR 1	T-YR 5	T-YR 25
CATF		0.49	0.49	0.41
CRPP		0.11	0.11	
LMBA				
GISH		0.64	0.64	
CARP		0.53	0.53	0.44
BLUE		0.11	0.11	
BUHD		0.61	0.61	0.53

*Where no values are shown, assume 0.1

Habitat Units for Target Years and Annual Average Habitat Units for Future With Project Conditions				
SPECIES	HU* T YR 1	HU* T YR 5	HU* T YR 25	ANNUAL AVERAGE HU*
CATF	6.4	6.4	5.3	5.8
CRPP	1.5	1.5		1.4
LMBA	1.4	1.4		1.3
GISH	8.3	8.3		5.3
CARP	6.9	6.9	5.7	6.3
BLUE	1.4	1.4		1.3
BUHD	8.0	8.0	6.9	7.3

*Where no values are shown, assume 0.1

Per discussion in the text (Sec 4a, Current Conditions), a baseline of 0.1 or "0" habitat is assumed for the project area. Therefore, no table for "Present Condition" is shown.

Figure G-1-6

Alternative A2 (Dredging)

HABITAT TYPE ACRES				
HABITAT TYPE	PRESENT	TARGET YEARS		
		1	5	25
Pool	55	0	0	0
Overflow Waters	0	55	55	55
Total	55	55	55	55

Species Abbreviations

CATF	Catfish	CARP	Carp
CRPP	Crappie (Wh-Blk)	BLUE	Bluegill
LMBA	L. Mouth Bass	BUHD	Black Bullhead
GISH	Gizzard Shad		

MEAN HABITAT SUITABILITY INDEX (HSI)*				
SPECIES	PRESENT INDEX	TARGET YEARS		
		T-YR 1	T-YR 5	T-YR 25
CATF		0.44	0.44	0.44
CRPP				
LMBA				
GISH		0.61	0.61	0.61
CARP		0.48	0.48	0.48
BLUE		0.53	0.53	0.53
BUHD				

*Where no values are shown, assume 0.1

Habitat Units for Target Years and Annual Average Habitat Units for Future With Project Conditions				
SPECIES	HU* T YR 1	HU* T YR 5	HU* T YR 25	ANNUAL AVERAGE HU*
CATF	24.3	24.3	24.3	23.7
CRPP	5.6	5.6	5.6	5.4
LMBA				
GISH	33.4	33.4	33.4	32.5
CARP	26.4	26.4	26.4	25.7
BLUE				
BUHD	29.1	29.1	29.1	28.3

*Where no values are shown, assume 0.1

Figure G-1-7

Alternative B1 (Dredging)

HABITAT TYPE ACRES				
HABITAT TYPE	PRESENT	TARGET YEARS		
		1	**5**	**25**
Pool		219	0	0
Overflow Waters		0	219	219
Total		219	219	219

Species Abbreviations

CATF	Catfish	CARP	Carp
CRPP	Crappie (Wh-Blk)	BLUE	Bluegill
LMBA	L. Mouth Bass	BUHD	Black Bullhead
GISH	Gizzard Shad		

MEAN HABITAT SUITABILITY INDEX (HSI)*				
SPECIES	PRESENT INDEX	TARGET YEARS		
		T-YR 1	T-YR 5	T-YR 25
CATF		0.54	0.54	0.47
CRPP		0.12	0.12	0.11
LMBA		0.11	0.11	
GISH		0.73	0.73	0.63
CARP		0.56	0.56	0.48
BLUE		0.11	0.11	
BUHD		0.61	0.61	0.53

*Where no values are shown, assume 0.1

Habitat Units for Target Years and Annual Average Habitat Units for Future With Project Conditions				
SPECIES	HU* T YR 1	HU* T YR 5	HU* T YR 25	ANNUAL AVERAGE HU*
CATF	117.5	117.5	102.1	108.2
CRPP	26.8	26.8	23.2	24.6
LMBA	25.1	25.1		23.1
GISH	158.8	158.8	138.0	146.2
CARP	121.7	121.7	105.1	111.8
BLUE	23.0	23.0		21.9
BUHD	134.0	134.0	115.9	123.2

*Where no values are shown, assume 0.1

Figure G-1-8

Alternative B2 (Dredging)

HABITAT TYPE ACRES				
HABITAT TYPE	PRESENT	TARGET YEARS		
		1	5	25
Pool	128	0	0	0
Overflow Waters	0	128	128	128
Total	128	128	128	128

Species Abbreviations

CATF	Catfish	CARP	Carp
CRPP	Crappie (Wh-Blk)	BLUE	Bluegill
LMBA	L. Mouth Bass	BUHD	Black Bullhead
GISH	Gizzard Shad		

MEAN HABITAT SUITABILITY INDEX (HSI)*				
SPECIES	PRESENT INDEX	TARGET YEARS		
		T-YR 1	T-YR 5	T-YR 25
CATF		0.47	0.47	0.47
CRPP		0.11	0.11	0.11
LMBA				
GISH		0.63	0.63	0.63
CARP		0.48	0.48	0.48
BLUE				
BUHD		0.53	0.53	0.53

*Where no values are shown, assume 0.1

Habitat Units for Target Years and Annual Average Habitat Units for Future With Project Conditions				
SPECIES	HU* T YR 1	HU* T YR 5	HU* T YR 25	ANNUAL AVERAGE HU*
CATF	59.7	59.7	59.7	58.1
CRPP	13.5	13.5	13.5	13.2
LMBA				
GISH	80.6	80.6	80.6	78.5
CARP	61.4	61.4	61.4	59.8
BLUE				
BUHD	67.8	67.8	67.8	66

*Where no values are shown, assume 0.1

APPENDIX G-2

HABITAT EVALUATION AND QUANTIFICATION (FARM CREEK)

PEORIA RIVERFRONT DEVELOPMENT (ECOSYSTEM RESTORATION) STUDY, ILLINOIS

FEASIBILITY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

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FARM CREEK, ILLINOIS SITE

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APPENDIX G-2
HABITAT EVALUATION AND QUANTIFICATION
FARM CREEK, ILLINOIS SITE

1. INTRODUCTION

A habitat analysis was conducted to evaluate potential benefits of habitat improvement features for the Farm Creek site portion of the Peoria Riverfront Development (Ecosystem Restoration) Study. Biologists from the Rock Island District of the U.S. Army Corps of Engineers (Corps) used a modified form of the Habitat Evaluation Procedure (HEP) program called EXHEP (EXpert Habitat Evaluation Procedures). For a more detailed explanation of the HEP evaluation process and its general application, please refer to Appendix G-1 of this document.

EXHEP is a Microsoft Access© '97 package developed by the U.S. Army Corps of Engineers Waterways Experiment Station (WES) Experimental Lab in Vicksburg, Mississippi, to automate standard HEP calculations and facilitates large-scale HEP assessments efficiently and effectively. EXHEP uses Microsoft® Windows-compatible programming to: (1) solve complex mathematical calculations quickly and (2) provide a highly intuitive, visual interface to facilitate communication between the system and the user. As with any sophisticated mathematical evaluation, a well-tested, efficiently written, standard software package is a critical tool that saves time and improves the reliability and repeatability of the results. However, this software cannot replace the user's understanding of the conceptual basis of HEP, or its application to the decision making process. EXHEP should not be viewed as the end-all means to provide the only predictive environmental response to project development. Rather, the program should be viewed as a tool that can provide a rational, supportable, focused, and traceable evaluation of environmental effects.

EXHEP was designed to process a large amount of data quickly and efficiently, handling a large number of HSI (Habitat Suitability Index) models simultaneously. Each HSI model can incorporate any number of cover types. Each cover type can include a large number of variables, and the user can incorporate as many life requisites within each model as necessary. These capabilities support the examination of complex studies with large numbers of permutations. In some studies, it is not unusual to evaluate 10-15 HSI models (with more than 25 cover types) in an attempt to describe complex interrelationships within the ecosystem. The staggering amount of tedious mathematical calculations necessary to compute HEP at this level requires a powerful tool to evaluate environmental output. EXHEP, enhanced by its ability to communicate these activities in an organized fashion, can quickly accomplish this task. The number of permutations, processing speed, and EXHEP performance are limited only by the capacity of the user's hardware, where data storage becomes the limiting factor.

2. HABITAT EVALUATION METHODOLOGY

The information contained in the habitat evaluation for the Farm Creek project site evaluation was used to support the application of HEP in the Peoria Riverfront Development (Ecosystem Restoration) Study. The HEP Team was facilitated by the professional biological opinions of Corps staff. For the evaluation process, the study team reviewed aerial photography, GIS and topographic data, and preliminary design drawings. The members of the team were also familiar with the project area and most had direct knowledge of existing conditions.

The methodology used in this evaluation was a modified form of HEP, the Expert Habitat Evaluation Process or EXHEP. The HEP models were developed to aid in land management planning, and require the selection and evaluation of a variety of target species for each computer-generated evaluation. The EXHEP program takes a rather specific approach and evaluates target species that are assumed to be representative of habitat quality. EXHEP also evaluated a broad range of target years for each species within a specified habitat type. By doing this, habitat benefits gained and/or lost throughout the life of the project can be shown.

The U.S. Army Engineer and Research Development Center, Environmental Laboratory, recently developed the EXHEP software. It is a field evaluation procedure designed to estimate habitat quality and account for changes due to land management practices. For the Farm Creek project site, species were chosen to evaluate four separate cover types: open water, palustrine scrub shrub wetland, palustrine emergent wetland, and successionally developing grassland. This analysis employed the professional opinion of Corps staff biologists.

EXHEP is a species-driven evaluation process that involves mathematical associations between environmental cover types and the individual variables that compose each of those cover types. During the evaluation process, each variable of a cover type was calculated on a 0.1 to 1.0 index. This evaluation was done using suitability graphs created by the U.S. Fish and Wildlife Service (USFWS) for the Habitat Suitability Index Models Series. This series was researched and created by the USFWS to provide habitat information useful for impact assessment and habitat management. The variable suitability outcomes were then inserted into a Habitat Suitability Equation (also taken from the USFWS Habitat Suitability Series). The Habitat Suitability Equation is an evaluation that combines all Life Requisites of the specified wildlife and designates it a suitability index number. This final suitability number was then used to calculate final with- and without-project Average Annual Habitat Units (AAHUs).

3. EVALUATION SPECIES SELECTION

Several habitat types represented by species-driven HSI models were evaluated in this document. Although a particular species is used, each species represents required habitat for many other similar species that utilize the same habitat in similar ways. In essence, each species represents an array of habitat variables for the species being evaluated. These species represent key goals and objectives for the development of specific habitat types proposed by project.

The use of this information is required to derive quantitative relationships between key environmental variables and habitat suitability within the immediate study area (i.e., within the Farm Creek watershed). This document provides the foundation for the HEP application for the six species-based Habitat Suitability Index (HSI) models. The HSI models selected for this project were: Marsh Wren (*Cistothorus palustri*), Mink (*Mustela vison*), Wood Duck (*Aix sponsa*), Chorus Frog (*Pseudacris triseriata*), Eastern Meadowlark (*Sturnella magna*), and Field Sparrow (*Spizella pusilla*). Table G-2-1 shows all species with applicable cover types and associated variables.

The marsh wren is an abundant breeding bird species of freshwater and saltwater marshes and requires emergent vegetation with shallow standing water. The mink is a predatory, semi-aquatic mammal that is generally associated with streams, riverbanks, and freshwater marshes. The wood duck is a waterfowl found around wetland areas with open water and nests in tree cavities or nest boxes. The chorus frog prefers grassy areas from dry to marsh to agricultural; also suburbs where pollution and pesticides are not a problem; as well as woodlands and river wetlands. The eastern meadowlark is an omnivorous ground feeding bird that nests in open fields. The field sparrow prefers old fields with scattered woody vegetation.

4. ASSUMPTIONS

Assumptions have been made regarding current conditions, model performance, and changes in habitat conditions over time. These assumptions are made using best available data.

a. Current Conditions. Due to concerns over flooding, the city of Washington purchased this tract of land along Farm Creek just east of the city for potential wetland restoration and stormwater storage. The project site is agricultural farm field and has been intensively rowcropped for several years. The likelihood of residual pesticides and herbicides is high.

b. Model Performance. The quantitative component of the EXHEP analysis is the measure of the acres of habitat that are available for the selected species. From the qualitative and quantitative determinations, the standard unit of measure, the habitat unit (HU), was calculated using the formula (HSI x Acres = HUs). For project planning and impact analysis, project life was established as 30 years. To facilitate comparison, target years were established at 0 (existing conditions), 1 year after, 5 years after, 10 years after, and 30 years after project construction. HSI and AAHUs for each evaluation species were calculated to reflect expected habitat conditions over the life of the project.

c. Changes in Habitat Conditions Over Time. Habitat conditions are not usually static. Either through natural processes or human activity, habitat generally evolves and may change in quality and/or quantity. Imbedded in each cover type evaluation, change has been added to the model. To assess the change over the period of analysis, target years have been defined. At each target year, a change in the habitat variables may be noticed. Noticeable changes can be characterized by a change in habitat benefit output.

d. General Assumptions. Some maintenance of the project area would be required, with more intensive management being required over the first 5 years of the project to allow the planted vegetation to get established. If the city had not purchased the land, it would continue to be farmed and habitat value would be maintained at its current level.

TABLE G-2-1. Species Selected
(with Applicable Cover Types and Variable Associations)

FARM CREEK PROJECT SITE		
Species	**Cover Types**	**Associated Variables**
Marsh Wren	PEM	Percent Emergent Canopy
		Classification of Plant Growthform
		Percent Tree and Shrub Canopy
		Mean Water Depth
	PSS	Percent Emergent Canopy
		Classification of Plant Growthform
		Percent Tree and Shrub Canopy
		Mean Water Depth
Mink (Cover)	PEM	Percent Emergent Canopy
		Tree and Shrub Canopy
	PSS	Percent Emergent Canopy
		Percent Shrub Canopy
		Percent Tree Canopy
		Percent Tree and Shrub Canopy
Mink (Water)	PEM	Percent of Year with Surface Water
	PSS	Percent of Year with Surface Water
Chorus Frog	PEM	Water Clarity
		Percent Area with Suitable Water Depth
		Distance to Suitable Depth
		Distance Around Perimeter of Pond
		Amount of Suitable Depth
	PSS	Water Clarity
		Percent Area with Suitable Water Depth
		Distance to Suitable Depth
		Distance Around Perimeter of Pond
		Amount of Suitable Depth
Eastern Meadowlark	Grassland	Average Height of Herbaceous Canopy
		Distance to Perch Site
		Percent Canopy Cover of Grass
		Percent Herbaceous Canopy Cover
		Percent Shrub Crown Cover
Field Sparrow	Grassland	Average Height of Herbaceous Canopy
		Percent Canopy Cover of Grass
		Percent Shrub Crown Cover
		Percent of Total Shrubs < 1.5m (4.9 ft) tall
Wood Duck (Nesting)	PEM	Potential Nest Sites in Project Area
	PSS	Potential Nest Sites in Project Area
Wood Duck (Brood Cover)	PEM	Percent of Water Surface Covered by Potential Brood Cover
	PSS	Percent of Water Surface Covered by Potential Brood Cover
PEM=Palustrine Emergent Wetland		
PSS=Palustrine Scrub Shrub Wetland		
Grassland=Successional Grassland		

5. RESULTS OF HABITAT ANALYSIS

This section describes the benefits in AAHUs for the constructed wetlands and plantings associated with the Farm Creek project site. The alternatives considered were variations of one or two ponds constructed with various shoreline and prairie plantings schemes proposed and evaluated. The three alternatives evaluated in detail were:

- **Alternative 1**- a 4-acre pond with 1 row each of terrestrial and aquatic plantings and 20 acres of prairie plantings
- **Alternative 2**- a 3-acre and a 4-acre pond both with 1 row each of terrestrial and aquatic plantings and 35 acres of prairie plantings
- **Alternative 3**- a 3-acre and a 4-acre pond both with 3 rows each of terrestrial and aquatic plantings and 35 acres of prairie plantings

The proposed selected alternative would create 2 ponds—one 4 acres and the other 3 acres. The perimeter of each pond would be planted with 6 rows of vegetation—3 rows of aquatic and 3 rows of terrestrial plant species. An additional 35 acres of the farm field would be planted with native prairie plants to develop a total project area of roughly 45 acres.

The project would provide a combination of upland and wetland habitat features that include open water, seasonally wet areas, emergent vegetation, scrub/shrub woody vegetation, and open meadow/prairie. The habitat evaluation process utilized two types of species models: the single life requisite model and the multiple life requisite model. The multiple life requisite model looks at a species using more than one habitat feature that is required for different life stages. The overall outputs for the models selected show that the project area would provide a total of approximately 92 AAHUs. A breakdown of the model outputs is shown in Table G-2-2. A summary of individual species outputs for the three alternatives considered in detail can be found at the end of this appendix in Figures G-2-1 through G-2-3.

TABLE G-2-2. Overall Model Outputs

Model	Type of Model (SM / MM)*	AAHUs
Chorus Frog	SM	1.4
Eastern Meadowlark	SM	37.5
Field Sparrow	SM	49.1
Marsh Wren	SM	0.6
Mink	SM	2.3
Wood Duck	MM	0.9

*SM= single life requisite model
MM= multiple life requisite model

Once the AAHUs were computed, the environmental outputs for each potential measure were calculated and their cost was annualized. Table G-2-3 summarizes the outputs and costs associated with each component considered for the proposed project.

TABLE G-2-3. Farm Creek Environmental Output and Costs of Each Measure

Potential Measure	Symbol	Output AAHUs*	Cost**	Annualized Cost***
Watershed Wetland Restoration	**E**			
No Action	E0	0	$0	$0
4-Acre Wetland Pond (no shoreline or terrestrial plantings)	E1	1	$295,000	$23,900
4-Acre Wetland Pond (1 row each shoreline and terrestrial plantings)	E2	3	$306,000	$24,800
4-Acre Wetland Pond (3 rows each shoreline and terrestrial plantings)	E3	5	$328,000	26,600
4-Acre and 3-Acre Wetland Ponds (no shoreline or terrestrial plantings)	E4	2	$528,000	$42,800
4-Acre and 3-Acre Wetland Ponds (1 row each shoreline and terrestrial plantings)	E5	6	$549,000	$44,500
4-Acre and 3-Acre Wetland Ponds (3 rows each shoreline and terrestrial plantings)	E6	10	$623,000	$50,500
Prairie Plantings	**F**			
No Action Prairie	F0	0	$0	$0
20 Acres Prairie Plantings	F1	32	$29,000	$2,400
35 Acres Prairie Plantings	F2	56	$51,000	$4,100

* Outputs are calculated as Average Annual Habitat Units (AAHUs).
** Represents initial construction costs only.
*** Annualized cost is initial construction cost based on a 25-year project life, 6-3/8% interest rate.

After the environmental outputs and annualized costs were calculated, the incremental analysis of alternatives was completed.

6. INCREMENTAL ANALYSIS OF ALTERNATIVES

Changes in the quality and/or quantity of HUs occur as a habitat matures naturally or is influenced by development. These changes influence the cumulative HU derived over the life of the project. Cumulative HUs are annualized and averaged. This determines what is known as the Average Annual Habitat Units (AAHUs). AAHUs are used as an output measurement to compare all the features and project as a whole. Table G-2-4 summarizes the outputs and costs associated with all alternatives.

TABLE G-2-4. Farm Creek Alternative Evaluation

No.	Alternatives	Symbol	Output (AAHUs)*	First Cost Const. **	Annualized Cost ***	Annualized Cost/AAHUs
1	No Action	E0+F0				
2	4-Acre Wetland Pond + no prairie plantings	E1+F0	1	$295,000	$23,900	$23,900
3	4-Acre and 3-Acre Wetland Ponds + no prairie plantings	E4+F0	2	$528,000	$42,800	$21,400
4	4-Acre Wetland Pond (1 row each shoreline and terrestrial plantings) + no prairie plantings	E2+F0	3	$306,000	$24,800	$8,265
5	4-Acre Wetland Pond (3 rows each shoreline and terrestrial plantings) + no prairie plantings	E3+F0	5	$328,000	$26,600	$5,315
6	4-Acre and 3-Acre Wetland Ponds (1 row each shoreline and terrestrial plantings) + no prairie plantings	E5+F0	6	$549,000	$44,500	$7,415
7	4-Acre and 3-Acre Wetland Ponds (3 rows each shoreline and terrestrial plantings) + no prairie plantings	E6+F0	10	$623,000	$50,500	$5,050
8	4-Acre Wetland Pond + 20 acres prairie plantings	E1+F1	33	$324,000	$26,300	$795
9	4-Acre Wetland Pond (1 row each shoreline and terrestrial plantings) + 20 acres prairie plantings	E2+F1	35	$335,000	$27,100	$775
10	4-Acre Wetland Pond (3 rows each shoreline and terrestrial plantings) + 20 acres prairie plantings	E3+F1	37	$357,000	$28,900	$780
11	4-Acre and 3-Acre Wetland Ponds + 35 acres prairie plantings	E4+F2	58	$579,000	$46,900	$810
12	4-Acre and 3-Acre Wetland Ponds (1 row each shoreline and terrestrial plantings) + 35 acres prairie plantings	E5+F2	62	$600,000	$48,600	$785
13	4-Acre and 3-Acre Wetland Ponds (3 rows each shoreline and terrestrial plantings) + 35 acres prairie plantings	E6+F2	66	$674,000	54,600	$830

* Outputs are calculated as Average Annual Habitat Units (AAHUs).
** Represents initial construction costs and real estate costs.
*** Annualized cost is initial construction cost based on a 25-year project life, 6-3/8% interest rate.

While the previous table lists all the alternatives available for consideration, not all are feasible. Some alternatives will not stand alone to produce adequate habitat benefits and/or are too costly to consider without combining with other alternatives. Also, while prairie planting by itself is less costly per acre and produces more habitat benefits than wetland construction, it does not meet the requirements of the project undertaking. A combination of wetland construction and prairie planting meets the project requirements and provides a synthesis of habitat benefits that is more desired than either component alone.

All alternatives involving the 4-acre wetland provided cost-effective outputs. Three plans were considered "best buy" plans—Alternatives 9, 12, and 13. Table G-2-5 shows the best buy plans for the project. The No Action plan is always considered a best buy, as well as the largest proposed project, because it costs nothing and is the largest project because it provides the maximum habitat benefits.

TABLE G-2-5. Incremental Cost Analysis of Best Buy Plans for Farm Creek

No.	Alternatives	Symbol	Output AAHUs*	Annual Cost **	Avg. Annual Cost/AAHU	Inc. Cost **	Inc. Output*	Inc. $/ AAHU
1	No Action	F0	0	0.0	0	0	0	0
9	4-Acre Wetland Pond (1row each shoreline and terrestrial plantings) + 20 acres prairie plantings	F8	35	$27,100	$775	$27,100	35	$775
12	4-Acre and 3-acre Wetland Ponds (1 rows each shoreline and terrestrial plantings) + 35 acres prairie plantings	F11	62	$48,600	$785	$21,500	27	$796
13	4-Acre and 3-Acre Wetland Ponds (3 rows each shoreline and terrestrial plantings) + 35 acres prairie plantings	F12	66	$54,600	$830	$6,000	4	$1,500

* Outputs are calculated as Average Annual Habitat Units (AAHUs).
** Annualized cost is initial construction cost based on a 25-year project life, 6-3/8% interest rate.

These plans provide the greatest increase in benefits for the least increase in costs. In a general sense, this conveys the fact that for the aquatic areas the 4-acre wetland pond creates habitat at a lower incremental cost than the 3-acre wetland pond. Increasing wetland plantings provides additional habitat benefits, but at a higher incremental cost. For the prairie planting areas, the larger the area planted the better, since the cost is relatively low when compared to the increase in benefits.

7. DISCUSSION

This section interprets the numerical results of the analysis into a narrative format that will provide insight as to how the numbers were derived and what they mean in terms of the predicted outcome of the project. [All EXHEP field data sheets and output sheets are on file at the Rock Island District.]

Results of the evaluation for the proposed alternatives were compared as increments to costs associated with the implementation of each alternative plan. This incremental cost analysis is discussed above and in Section 2 of the main report under "Results of Incremental Cost/Cost Effectiveness Analysis."

The project site is located on the east edge of Washington, Illinois, in a predominately rural, agricultural area. Because of the nature of the farm community, habitat values are not necessarily low, but they are biased. While the human population in these areas has a low density and is scattered over a large area, intensive farming activities disrupt the plant and animal communities of these areas. These natural resource populations must deal with large tracts of mono-cultured habitat as well as physical disruptions of the soil and the application of chemicals used to maintain the high levels of production desired by today's farmer. While many modern species have adapted to this disturbed environment, it is not the optimal setting that they need to thrive.

The proposed project, although small in scale, would provide a measure of relief to many area species that currently contend with the altered resources of this agricultural environment. The proposed restoration project would provide resources that once occurred naturally over the length of Farm Creek long before the settlement of the area, emergent vegetation, scrub-shrub, and prairie. Individually, the project components provide small-scale benefits, but when combined, their benefits become much larger because of the ecosystem they create.

The evaluation process took into account these project components through the assessment of information requested by, and input into, the EXHEP program. The project biologists discussed the factors for project components and assigned relative values using professional judgment and extrapolating for probable future conditions. This information was input into the EXHEP program along with present conditions (baseline), and comparisons were made for projected future with- and without-project conditions. HSI values were established with these data, which then provided the measure for "quality" of habitat for each project condition being evaluated. Once the habitat quality value was assigned, the EXHEP software then calculated habitat units by multiplying by the *quantity* of habitat produced, in this case size of ponds, associated wetland perimeter created and prairie planted.

Because the HSI models selected for this evaluation cover the life requirements of a broad range of species, the HSI values generated by the program apply to many other species than just the models evaluated. The model is in effect evaluating each species in relation to a cover type that the project proposes to generate and the succession of that cover type over the length of the project life. The cover types being evaluated are palustrine emergent wetland, palustrine scrub shrub wetland, and grassland. Within the program various life requisites and variables are looked at. Some of the items considered are emergent, grass, shrub and tree canopy covers; average height of herbaceous canopy; pond perimeter; % of year with surface water available; water clarity and amount of suitable depth; potential brood cover and much more. The complete list can be found in table G-2-1, following Section 3 earlier in this appendix.

Also, because the values of the habitat evaluated fluctuate over time, the HSI values vary as the target years are examined. Figures G-2-1 thru G-2-3, found at the end of this appendix, show that for all alternatives evaluated in detail, virtually no HUs were produced for the first 5-10 years of the project's life. Much of this is due to the small size of the wetlands being constructed and the fact that the plantings would take some time to establish and begin producing adequate habitat for the species being evaluated. This is not to say that there would be no benefits from the project for those first few years. It's just that they would be extremely limited until the wetlands develop. Over time the habitat of the project area would change as the plants spread and build their own niche in the developing ecosystem. This maturing of the project's habitat is reflected in the HEP numbers by the increase of HUs over time.

In a few cases, the HU increase over time levels out or begins to decline. This indicates that the cover type or habitat that has established for a particular species has been optimized or limited in some way; or the cover type would not provide any further improvement. This may arise because of limitations in the plan (i.e. size of project) or other changes that occur naturally over time (e.g., vegetation maturing and dying out). Some of this may be the result of other more aggressive species stalling the spread of other less aggressive species or actually reducing an area of a particular cover type.

A way to even out the HUs over the life of a project is to annualize the habitat units. By annualizing these values, an AAHU can be found and used in the calculation for the cost of the project over time. These changes depend on species requirements and what is determined to be an appropriate succession or evolution for the project and its components for future conditions.

The habitat evaluation results showed that this project generated stable HSI values for target species over the project life. The output values also showed that the prairie planting produced greater habitat units per acre than wetland creation alone. This is understandable when considering that wetland systems are much more complex and generally work best on a larger scale than those being proposed by this project. Even with the limitation of land available for the project, the optimum size wetlands for the area available to the project were designed. Other limitations are land contours and restrictions of the area for allowable impacts resulting from the impoundment of water during flood conditions in the upper reaches of the unnamed watershed to Farm Creek where the project is located. It was therefore determined that the best approach to increase habitat value for the area was to incorporate ecosystem design and enhance the wetland habitat by association with prairie habitat. This was done, and results of the habitat evaluation showed that the habitats provided not only complemented each other, but also produced a functioning system with improved habitat benefits over time.

Figure G-2-1

Alternative 1

AAHU Calculation Summary - With Project							
Species	**TY 0 HUs***	**TY 1 HUs**	**TY 6 HUs**	**TY 11 HUs**	**TY-31 HUs**	**Cumulative HUS** (at TY 31)	**Net AAHUs**
Chorus Frog	0	0	0	0.12	.20	4.9	0.16
Eastern Meadowlark	0	0	0	0.34	0.39	729.5	26.32
Field Sparrow	0	0	0	0.45	0.82	1261.2	44.3
Marsh Wren	0	0	0	0.19	0.21	6.1	0.21
Mink	0	0	0	0.23	0.33	8.58	0.29
Wood Duck	0	0	0	0.2	0.3	7.67	0.26
					Total Net AAHUs		**71.54**

*All calculations are assumed against a baseline of minimal habitat or 0 HU value.

Figure G-2-2

Alternative 2

AAHU Calculation Summary - With Project							
Species	**TY 0 HUs***	**TY 1 HUs**	**TY 6 HUs**	**TY 11 HUs**	**TY-31 HUs**	**Cumulative HUs** (at TY 31)	**Net AAHUs**
Chorus Frog	0	0	0.22	0.27	0.54	20.89	0.75
Eastern Meadowlark	0	0	0	0.34	0.39	323.93	11.69
Field Sparrow	0	0	0	0.45	0.82	559.9	19.67
Marsh Wren	0	0	0.22	0.22	0.3	12.93	0.48
Mink	0	0	0.28	0.37	0.71	27.46	0.98
Wood Duck	0	0	0.2	0.3	0.4	17.67	0.64
					Total Net AAHUs		**26.52**

* All calculations are assumed against a baseline of minimal habitat or 0 HU value.

Figure G-2-3

Alternative 3

AAHU Calculation Summary - With Project							
Species	**TY 0 HUs***	**TY 1 HUs**	**TY 6 HUs**	**TY 11 HUs**	**TY-31 HUs**	**Cumulative HUS** (at TY 31)	**Net AAHUs**
Chorus Frog	0	0	0.27	0.44	0.63	37.91	1.38
Eastern Meadowlark	0	0	0.46	0.46	0.36	817.02	37.52
Field Sparrow	0	0	0	0.58	0.82	1377.34	49.06
Marsh Wren	0	0	0.23	0.26	0.2	15.95	0.62
Mink	0	0	0.46	0.77	0.98	61.85	2.26
Wood Duck	0	0	0.2	0.3	0.4	24.67	0.90
						Total Net AAHUs	**91.74**

*All calculations are assumed against a baseline of minimal habitat or 0 HU value.