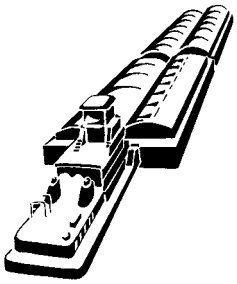
ENV Report 7

Upper Mississippi River - Illinois Waterway System Navigation Study

SITE-SPECIFIC HABITAT ASSESSMENT



INTERIM REPORT

May 1998

US Army Corps of Engineers

Rock Island District
St. Louis District
St. Paul District

Upper Mississippi River - Illinois Waterway
System Navigation Study

ENV Report 7
May 1998

Site-Specific Habitat Assessment

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PREFACE

The work reported herein was conducted as part of the Upper Mississippi River-Illinois Waterway (UMR-IWW) System Navigation Study. The information generated for this interim report will be considered as part of the plan formulation process for the System Navigation Study.

The UMR-IWW System Navigation Study is being conducted by the Rock Island, St. Louis, and St. Paul Districts of the U.S. Army Corps of Engineers under the authority of Section 216 of the Flood Control Act of 1970. Commercial navigation traffic is increasing and, in consideration of existing system lock constraints, will result in traffic delays that will continue to grow into the future. The System Navigation Study scope is to examine the feasibility of navigation improvements to the Upper Mississippi River and Illinois Waterway to reduce delays to commercial navigation traffic. The study will determine the location and appropriate sequencing of potential navigation improvements on the system, prioritizing the improvements for the 50-year planning horizon from 2000 through 2050. The final product of the System Navigation Study is a Feasibility Report that is the decision document for processing to Congress.

The work for this interim effort was performed by staff of the Rock Island, St. Louis and St. Paul Districts of the U.S. Army Corps of Engineers and the U.S. Geological Survey, Mid-Continent Ecological Science Center, Ft. Collins, Colorado. The Habitat Assessment Team (HAT) leader was Richard Fristik, Rock Island District (CEMVR-PD-E). The HAT included Scott K. Estergard, Rock Island District (CEMVR-PD-E); Brian L. Johnson, St. Louis District (CEMVS-PD-A); and the U.S. Fish and Wildlife Service-Rock Island Field Office. In addition to their regular study coordination, numerous State and Federal agency personnel assisted in field data collection.

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers is currently conducting a feasibility study to assess the need for navigation improvements and the impacts of providing any improvements on the Upper Mississippi (UMR) and Illinois (IWW) Rivers. Improvements are being considered for 14 locks on the UMR and 8 locks on the IWW.

Consideration of potential environmental impacts is required under the National Environmental Policy Act of 1969 (NEPA) and other Federal or agency regulations. To address potential site-specific construction impacts, a Habitat Assessment Team (HAT) was formed with representatives from the Rock Island and St. Louis Districts of the U.S. Army Corps of Engineers; the U.S. Fish and Wildlife Service-Rock Island Field Office; and the Mid-Continent Ecological Science Center-Biological Resource Division (U.S. Geological Survey), Ft. Collins, Colorado. The HAT regularly coordinated with State and Federal resource agencies and other interested parties.

The objective of the site-specific analyses was to evaluate potential impacts of the proposed construction measures at locks and dams (L/Ds) on the UMR-IWW System. These are L/Ds 11-25 on the Mississippi River, and Lockport, Brandon Road, Dresden Island, Marseilles, Starved Rock, Peoria and La Grange on the Illinois Waterway. The primary purpose was to assist the study team in formulating a recommended plan by providing quantitative measure or qualitative evaluation of environmental impacts and estimated habitat replacement costs. These analyses will also identify possible alternatives that avoid and minimize impacts or provide opportunities for restoration. Detailed analysis of site-specific impacts, based on any recommended/authorized measures, will not be possible until detailed design information for those measures is available. The quantitative evaluation (at those locks and dams lower on the system) was accomplished using the Habitat Evaluation Procedures (HEP), while a qualitative evaluation was made at the remaining locks and dams and through evaluation of potential endangered species impacts, socio-economic impacts, and mussel surveys.

The HEP, a nationally recognized evaluation method, was developed to quantify the impacts of habitat changes made by land and water development projects. It provides information to compare the relative value of different areas at the same point in time and the relative value of the same area at future points in time. Documented Habitat Suitability Index (HSI) models are used in HEP to determine the quality portion of the formula. The HSI values are multiplied by area to calculate Habitat Units (HUs). The changes in HUs for species and their habitats are reported as the results in an HEP evaluation. For this project, a spreadsheet version of HEP was used to simplify the management of large amounts of data and of multiple evaluation sites. The HEP process includes a set of formulas and techniques that provide a framework for appraisal of habitat and project impacts. Included in that process are creation of a study team, formation of objectives and selection of evaluation species, followed by inventory design and data gathering. A group of 27 species was chosen to represent those aquatic and terrestrial habitats that may be impacted by the project. The HAT coordinated each step of the process with interested

parties and included State and Federal biologists in species selection and data gathering. Results of the HEP are discussed within this report.

Certain impacts cannot be quantified and were dealt with separately. Potential endangered species, freshwater mussels, and socio-economic impacts were also evaluated and are discussed in this report. Potential impacts to endangered species are being evaluated separately from this report in a Biological Assessment (BA) and Section 7 Consultation. Potential impacts and measures that may avoid or minimize impacts are discussed within this report but will be incorporated into the BA and conclusions made therein. Existing information was gathered and mussel surveys were conducted to determine the presence of mussels and potential for mussel beds in the zones of impact.

This site-specific report and results will be incorporated into the systemic Environmental Impact Statement. If navigation improvement measures are recommended, further detailed site-specific evaluations will be conducted and incorporated into supplemental NEPA documents.

UPPER MISSISSIPPI RIVER - ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY
ENVIRONMENTAL IMPACT STATEMENT

SITE-SPECIFIC HABITAT ASSESSMENT

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SITE-SPECIFIC HABITAT ASSESSMENT

I. DESCRIPTION OF PROJECT

A. Overall Study Description. The Upper Mississippi River - Illinois Waterway System Navigation Study ("Navigation Study") is a feasibility study addressing the need for navigation improvements for the Upper Mississippi River - Illinois Waterway (UMR-IWW) System for the years 2000-2050. The study encompasses 29 locks on the Upper Mississippi and 8 locks on the Illinois Waterway (Figure 1). Specifically, the principal problem being addressed is the potential for significant traffic delays on the system over the 50-year planning horizon, resulting in economic losses to the nation. The study will determine whether navigation improvement measures are justified and, if so, the nature of and appropriate sequencing of these measures over the 50-year planning horizon.

The environmental impacts of the measures under consideration are being addressed on a system-wide basis (traffic impacts on specified resources of concern) and a site-specific basis (localized impacts within the immediate vicinity of a lock and dam). This report covers the latter. Overall objectives of the environmental component and pertinent Corps of Engineers guidance and Federal regulations may be found in the Navigation Study Project Study Plan (June 1997).

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B. Site-Specific Analyses. The objective of the analyses is to conduct initial assessments of impacts at each of the locks and dams (L/Ds) being evaluated for potential construction of navigation improvements. These are Mississippi L/Ds 11-25 and Illinois Waterway L/Ds at Lockport, Brandon Road, Dresden Island, Marseilles, Starved Rock, Peoria and La Grange. The primary purpose is to assist the study team in formulating a recommended plan by providing quantitative measure or qualitative evaluation of environmental impacts and estimated habitat replacement costs. Detailed analysis of site-specific impacts, based on any recommended/authorized measures, will not be possible until detailed design information for those measures is available.

Based on information from other study work groups and planning efforts during both the reconnaissance and feasibility phases of the Navigation Study, it was determined that seven lock and dam sites (on the lower portion of the system) have the greatest potential to be recommended for navigation improvements. These sites (L/Ds 20-25 on the Mississippi and Peoria and La Grange on the Illinois) were assessed in greater detail, using quantitative habitat assessment methods. The remaining sites were assessed in a qualitative manner, utilizing in part results obtained at the lower sites. While the upper site assessments are included here, the bulk of this report deals with the detailed quantitative assessments.

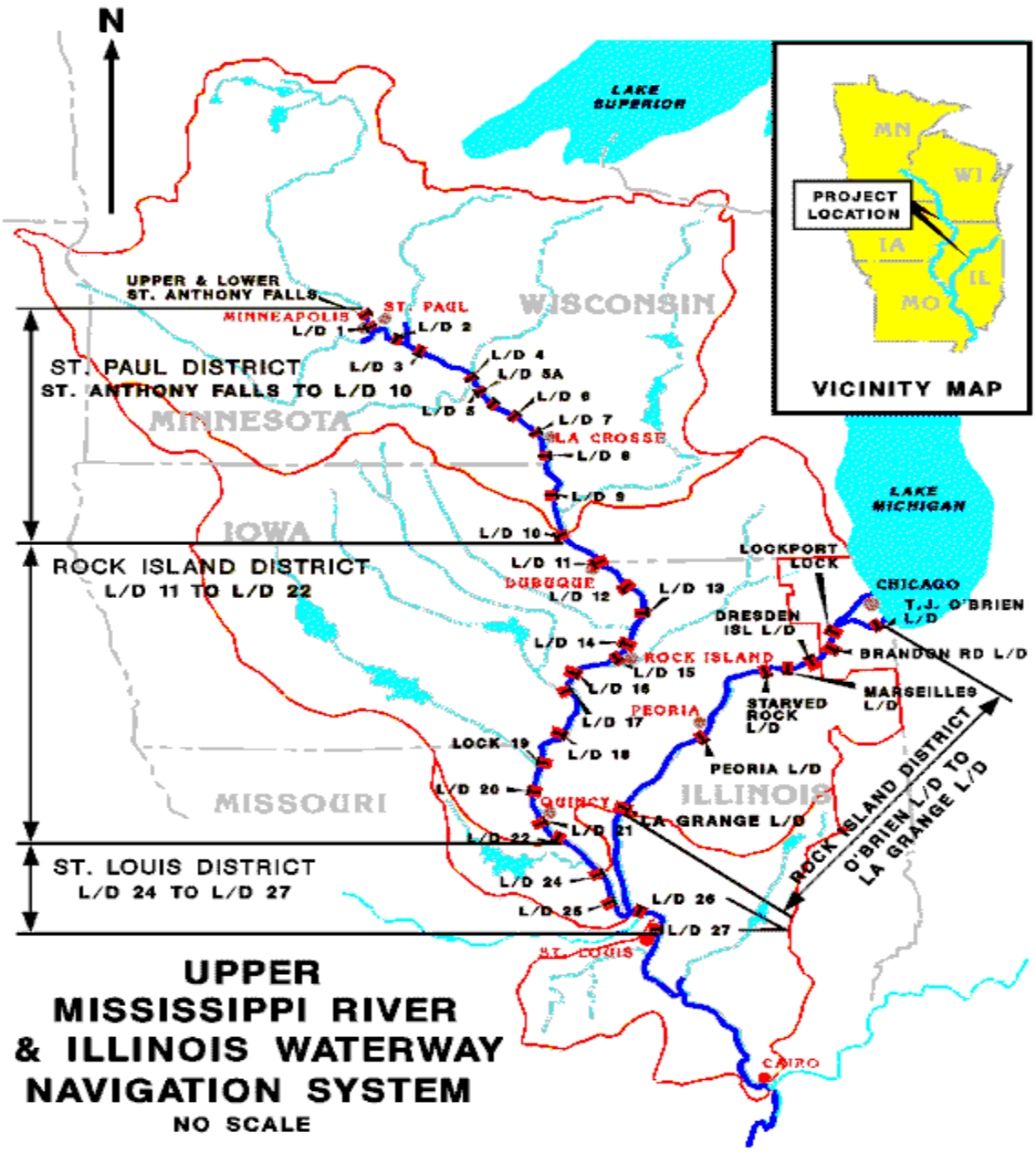

Figure 1. Study Area.

C. Study Area Description. The broad geographic area of the study encompasses the states of Minnesota, Wisconsin, Illinois, Iowa and Missouri. The lower sites studied in most detail border Illinois and Missouri. At each lock and dam, an area within a one-mile radius of the center-point of the dam was delineated as the analysis area for the site-specific studies. Site maps were prepared that incorporated Geographic Information Systems (GIS) coverages of land cover/land use, aerial photography, National Wetlands Inventory (NWI) data, and overlain locations of proposed engineering measures (see

Appendix A). Sections III and IV of this report more thoroughly describe the individual sites. The following paragraphs explain the potential changes common to all sites and how they are depicted on the maps.

1. Areas Affected by Lock Changes. The composite extent of these areas is bounded by a solid red line. A selected alternative would consist of some portion of this area. Generally, lock changes would entail downstream extensions of existing lock chambers and extension/construction of guidewalls both upstream and downstream. Total upstream length (from the centerline of the dam) is typically 1,500 feet, and downstream length is 2,900 feet. Total width of a given lock location would be 250 feet. Locations 2 and 3 utilize the existing and auxiliary chambers, respectively, while Location 4 is through the gated section of the dam, with the red line indicating its farthest riverward extent for this location (see Figure 2 for lock locations). Location 4 would require replacement of lost flow, and this would most likely be in the form of additional gates near or adjacent to the storage yard area at the end of the gated section (except at L/D 20; see Sections I.D. and IV.B. for further explanation; L/Ds 24 and 25 could have a replacement gate placed in the existing auxiliary lock). For the few sites where a Location 1 is still being evaluated, this would entail constructing an entirely new 1,200-foot chamber.

2. Areas Affected by Construction/Landside Impacts. These areas are delineated by a green line and/or cross-hatching. Included here would be construction staging areas and any shoreline excavation that would be required for lock construction or channel realignment. Extent of these areas is based on a projected need of 8 to12 acres for staging. A concrete batch plant, if necessary, would require an additional 1 to 2 acres.

3. Areas Affected by Channel Changes. Channel realignments are shown in dark blue. Line segments indicate the boundaries of a given channel, while cross-hatched areas represent new channel excavation. The extent and alignment of these new channels was determined by considering documented problems with tow approaches and how these approaches could be made more efficient. Some alignments may serve more than one location, while others are specifically tied to a given location. Where necessary, this is indicated by numbers that correspond to a given lock location.

4. Dredged Material Placement Sites. Possible placement sites are indicated by magenta cross-hatching. Size of these areas was determined by assuming that material would be stacked to a height of 12 feet, which equates to 19,400 cubic yards/acre. Location was guided by several factors. These include the reach limits of dredging equipment (~1 mile) and the assumption that agricultural fields would be the preferred placement sites. Truck hauling is assumed for distant sites. Size of these sites can be determined with relative certainty based on estimated quantities of material. Geographic location is much less certain, and the currently mapped locations should be considered as "best guesses" for current planning purposes. Final location of these sites depends on a variety of factors that would be formally evaluated during the detailed site-specific assessment phase.

D. Description of Engineering Measures to Reduce Traffic Congestion.

1. Large-Scale Measures. These measures entail extending the existing lock or constructing a second lock elsewhere at the existing lock and dam site. The primary benefit of large-scale measures is to provide a lock chamber long enough (1,200 feet in length) to eliminate the necessity of double lockages, thus creating significant time savings. The Navigation Study team evaluated an array of alternative lock placement sites, different design types, and lock sizes. A lengthy qualitative and quantitative screening process reduced this matrix considerably, and the survivors underwent further detailed analysis and screening. For purposes of the site-specific assessments, only lock location was evaluated in terms of potential impacts. Variation in lock size or construction type was not considered to have any appreciable environmental consequences (only 600-foot x 110-foot and 1,200-foot x 110-foot locks were carried forward for detailed analysis). Three construction types were considered, as described below (see also Table 1). Type A was eliminated due to cost.

TABLE 1: Locations and Types Surviving After Lock Type Screening

Lock and Dam Site	Location Number and Viable Types					
	1	2[1]	3	4	5	6
L/D 11		B, C	B, C			
L/D 12		B, C	B, C	B, C		
L/D 13		B, C	B, C	B, C		
L/D 14		B, C		B, C		
L/D 15		B, C	B, C			
L/D 16		B, C	B, C	B, C		
L/D 17	C	B, C	B, C	B, C		
L/D 18		B, C	B, C	B, C		
L/D 19			B, C			
L/D 20		B, C	B, C	B, C		
L/D 21		B, C	B, C	B, C		
L/D 22		B, C	B, C	B, C		
L/D 24		B, C	B, C	B, C		
L/D 25	C	B, C	B, C	B, C		
Peoria	C	B, C				
La Grange	C	B, C				

[1] There are no new 600-foot lock alternatives at Location 2. Therefore, the Location 2 column is blank for the 600-foot lock case (the 1,200-foot lock case is shown). All other columns are the same for both lock sizes.

a. Type A. A "Type A" conceptual lock design is a lock designed according to current design standards and traditional construction methods for locks. It would be

constructed within a dewatered cofferdam, as were all the existing locks and dams on the Mississippi River and Illinois Waterway. This lock type would typically have concrete gravity or U-frame walls, a side port filling and emptying system, and a downstream miter gate and either an upstream miter gate or a lift gate. A Type A lock would be expected to have the highest performance levels and durability, but also the highest first cost. Construction risks would be low for this type of lock.

b. Type B. A "Type B" conceptual lock design is a lower cost lock utilizing construction techniques proven in marine construction that heretofore have not commonly been used in lock construction. Use of these construction techniques, float-in and lift-in, would be innovative in the lock construction arena. A Type B lock would present slight reductions in performance but similar durability compared to a Type A lock. A Type B lock would present the highest risks to construct of the three types.

c. Type C. A "Type C" conceptual lock design is the lowest first cost design, cellular sheet pile construction with precast concrete lockwall panels, that still is safe with predictable performance. This lock type would be expected to be less durable and less reliable than Type A and B locks. To accomplish the cost savings, certain design standards were relaxed with resulting tradeoffs in performance (sill depths, filling and emptying, etc.). A Type C lock would typically present low to moderate risks to construct.

Six lock locations were initially considered: Location 1, landside of the existing lock; Location 2, extension of the existing lock; Location 3, in the auxiliary lock chamber; Location 4, in the gated section of the dam; Location 5, in the overflow section of the dam; and Location 6, landside on the opposite shoreline (Figure 2).

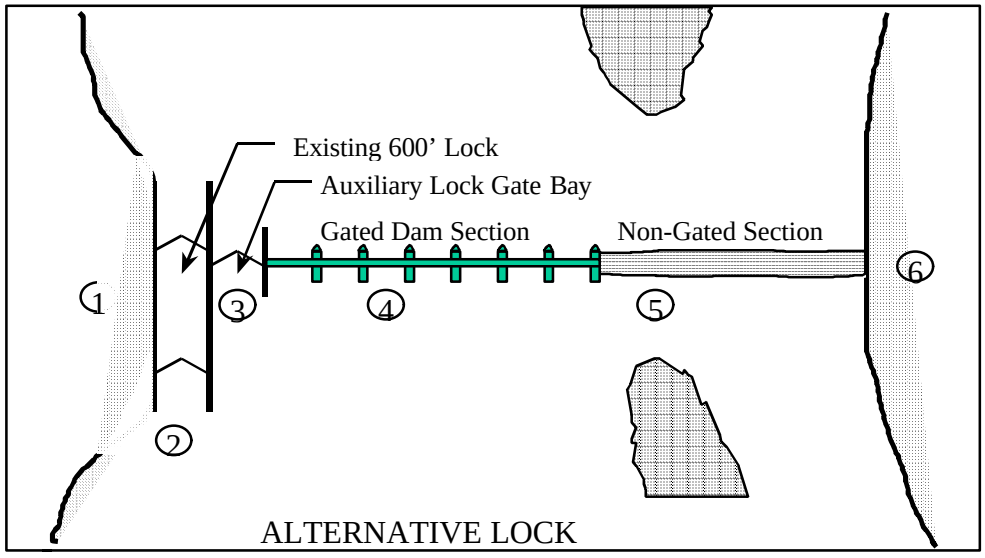

Figure 2. Alternative New Lock Locations at a Typical Existing Lock and Dam Site.

The initial screening process quickly eliminated all Locations 5 and 6 due to unfeasibility of engineering, construction or operation, as well as serious environmental impacts. Nearly all of the Location 1 locks were also screened out for similar reasons; exceptions are at Locks 17, 25, Peoria and La Grange. The majority of potential locations for new lock construction are at Locations 2, 3, and 4 (Table 1). The particular siting of these possible lock locations, at each lock and dam, was depicted on the planning maps used in the site-specific habitat evaluations. In addition to potential new lock construction, an option carried forward for Locks 17 and 20 was that of providing for navigable pass through the dam. This would allow tows to bypass the lock and traverse the dam via wicket gates during certain periods of high flow. These gates would require new construction and placement, with attendant channel changes, and were evaluated as a separate large-scale measure.

2. Small-Scale Measures. These measures are broadly defined as any navigation improvement that is less costly than constructing a new lock. They are divided into structural (requiring some amount of construction) and non-structural (essentially operational or policy changes). The small-scale measures are aimed at reducing the total time to complete the lockage process, particularly those elements that require the most time, such as approach/exit and breaking, remaking and reconfiguring tows. It is possible that a recommended set of measures could include a combination of large- and small-scale measures.

After initial identification of a "universe" of possible small-scale measures, a similar evaluation and screening process was conducted to narrow the list of possible measures. From an initial list of 92 measures, qualitative and quantitative screening resulted in 8 measures being carried forward for detailed consideration. Two of these measures, adjacent mooring facilities and approach improvements, are structural in nature and have the greatest potential for environmental impacts. In addition, the use of switchboats and industry self help are likely to require guidewall extensions or remote moorings, which may have some environmental impacts. None of the small-scale measures were evaluated using HEP, although the approach channel improvements and guidewall extensions would be nearly identical in nature if implemented as small-scale measures and thus the HEP results could be applicable. The remaining measures were evaluated qualitatively based on proposed location (e.g., mooring cells or other remote remake sites) or other potential impact, where applicable. Further descriptions of the large- and small-scale engineering measures and screening processes are found in the Navigation Study Engineering Appendix (Engineering Work Group, Draft 1998) and are summarized below.

a. Switchboats with Extended Guidewalls. Switchboats in the 1,800 to 2,000 hp range were determined to be able to safely extract the unpowered first cut of double lockages out along an extended guidewall. This process represents the major additional time savings, since it provides a faster extraction than the existing tow haulage and allows the next waiting tow (traveling in the same direction) to use the lock while the first tow remakes its couplings. Switchboats can also assist tows in approaching the locks in adverse conditions and by moving ice and debris from around the chamber. Moving the cuts farther down along the extended guidewall can also reduce chambering times for

downbound tows by allowing faster releases of water from the chamber due to the reduced potential to snap a line. To fully implement this measure, the guidewalls must be extended roughly 600 feet (providing 1,200 feet total) using either cellular sheet pile construction or spud barges.

b. Switchboats with Remote Mooring Facilities. Somewhat larger switchboats, in the 2,200 to 2,400 hp range, were determined to be necessary to safely extract the unpowered first cut and push it to a remote mooring under all flow conditions. Adequate mooring sites out of the approach path are required to fully implement the measure. In addition, due to safety concerns, switchboats would not be used to back cuts upriver, above the dam. Instead, a short guidewall extension, roughly 300 feet long, would be provided allowing the switchboat to extract the cut, tie it off, uncouple from the cut, move to the downstream end, recouple, and then push upstream to the remote mooring. This allows both exchanges and turnbacks lockage types to use the chamber while the previous tow is remaking. Switchboats can also assist tows in approaching the locks in adverse conditions and by moving ice and debris from around the chamber. Using switchboats in combination with remote remake areas can also reduce downbound chambering times by allowing faster releases of water from the chamber.

c. Industry Self Help. Already put in place on occasion, this measure relies on navigation industry tows to help one another extract unpowered cuts without the assistance of lock personnel or equipment when there is significant congestion at a lock. When used, a towboat would not just wait in line for its turn to lock; instead, it would act similar to a switchboat, removing an unpowered cut from the lock and taking it away from the guidewall for recoupling along a waiting tow traveling in the opposite direction. This procedure leaves the lock open for the next waiting tow. It also eliminates the need to use tow haulage equipment and provides for faster extraction. The addition of guidewall extensions and/or mooring cells would make this a safer and more efficient option.

d. Congestion Tolls. Tolls could be collected to alter the distribution of towboat traffic on the system, reducing delays at the locks. This measure could be implemented only if a current Federal law is changed that prohibits charging of tolls for watercraft passing through locks. If implemented, tolls would be collected from tows, and possibly from recreational craft, using congested locks. It assumes that a fee could be charged at locks experiencing significant delay or that a licensing fee would be charged for use of the system. The goal would be to shift potential traffic away from congested locks to alternative modes of transportation or other portions of the inland waterway system.

e. Lockage Time Charges. This measure seeks to charge all vessels based on the length of time the lock is in use. While similar to congestion tolls, these charges would be set at a lower level in an effort to create an incentive to improve efficiency rather than reduce the use of a congested lock. However, tows would not be charged for lockage elements that they can not control, such as gate opening, closing, and chamber filling and emptying time.

f. Adjacent Mooring Facilities. New mooring facilities above or below the lock could consist of mooring cells or buoys attached to a mooring line. These structures, which provide waiting areas where tows can be tied off, can improve efficiency in two ways. They can provide a waiting area closer to the lock where a tow can safely wait clear of a narrow approach, allowing a tow exiting in the opposite direction to pass. By waiting closer, the exchange approach and exit times can be reduced. In addition, when used with a switchboat or an industry self-help process (as described earlier), properly placed, adequate moorings provide a place where tows can remake, making the lock available sooner for the next tow waiting in either direction.

g. Power Ratchet on Tows. This device uses a 4-horsepower gas engine to power a hydraulic drive system, which operates a specially designed wrench head to engage the barge (steamboat) ratchets. The device would be stationed on a center barge at the break couplings. It would improve efficiency and cut down on a double lockage time by increasing the speed of the recoupling process. It may also improve safety and generally requires less physical labor than the current way the barges are reconnected after a double lockage.

h. Channel Improvements. This measure includes a variety of possible modifications including dike fields, submerged dikes, vane dikes, dredging, bank filling, bank excavation and channel relocation, all designed to control channel currents and improve the path of a tow as it enters a lock. Such improvements have been found to significantly reduce approach times and make conditions safer, depending upon the location, combination of improvements, and river conditions at the time.

II. PURPOSE OF HABITAT ANALYSES

A. Legislative and Policy Requirements. Legislative requirements under the National Environmental Policy Act (NEPA) and pertinent Corps of Engineers regulations require that the environmental impacts of major Federal actions be fully assessed and that reasonable alternatives be put forward to avoid or minimize adverse impacts. The purposes of the site-specific analyses were to evaluate potential site-specific construction impacts of the proposed alternatives and to identify possible avoid and minimize measures or opportunities for restoration.

B. Objectives. The study objectives were defined as follows:

1. Determine resources of concern within the study area (UMR-IWW System) and those of concern by site (lock and dam).

2. Quantify aquatic and terrestrial impacts from construction of small-scale, large-scale or associated measures.

3. Identify restoration and enhancement opportunities.

4. Determine a preliminary, general approach and costs for habitat replacement.

C. Nature of Anticipated Impacts. In addition to the "footprint" impacts of major construction measures, the following potential impacts were also evaluated:

1. Loss of benthic and riparian habitat in and adjacent to the construction site.

2. Changes in the lock and/or dam structure that could alter tailwater velocities, depth or substrate composition.

3. Changes in lock approach patterns that could cause towboats to increase bank erosion or benthic disturbance, or require dredging for new channel alignment.

4. Changes to terrestrial or shoreline areas due to bankline excavation, borrow or staging area placement.

Dredged material placement sites were not evaluated because potential locations at the time of the analysis were very speculative. Currently, upland placement in agricultural fields is sought to help avoid environmental impacts. It is anticipated that a selection and evaluation process similar to current Corps of Engineers long-term dredged material planning would be utilized at the time of detailed analysis following a recommended plan.

III. ASSESSMENT APPROACH

A. Study Team Formation. A core Habitat Assessment Team (HAT) was formed at the outset of the study in May 1995. This team consisted of representatives from the U.S. Fish and Wildlife Service-Rock Island Field Office; the Rock Island and St. Louis Districts of the U.S. Army Corps of Engineers; and the National Biological Service (now U.S. Geological Survey), Ft. Collins, Colorado. The team coordinated on a regular basis with State and Federal resource agencies and other interested parties.

B. Available Assessment Tools/Selection. A number of habitat evaluation tools were considered for use in this study. These were Habitat Evaluation Procedures (HEP), Instream Flow Incremental Methodology (IFIM), Wildlife Habitat Appraisal Guide (WHAG), and Aquatic Habitat Appraisal Guide (AHAG). Mr. Richard Stiehl of the U.S. Geological Survey (USGS) compared these methods for applicability to this study and recommended the use of HEP. Appendix B contains the full text of his comparison. Briefly, HEP was chosen because of its rich base of species evaluation (blue book) models, the robustness of its variable aggregation formulas, and its ability to be reconfigured into a spreadsheet format for ease of calculation and scenario running.

C. Agency Coordination. Extensive coordination was conducted with resource agency personnel throughout the study, while direct agency participation varied by study phase. The main types of coordination activities included formal and informal meetings, initial site visits and field data collection, ongoing correspondence, and progress reports given to coordination groups such as the Navigation Environmental Coordination Committee (NECC) or Governors' Liaison Committee (GLC). These activities are too numerous to adequately summarize in a single section; as such, they will be included and summarized in pertinent sections of this report. In addition to documentation based on agency coordination, the HAT compiled a Reference Book comprised of frequently used study information such as the study plan, species model information, analysis area maps, and field sampling information. This book serves as additional documentation of the study process and will be incorporated in this report by reference. Pertinent portions of that book related to species models, including citations, have been included within Appendix C.

D. Resources of Concern/Evaluation Species Selection. The HAT set out to conduct a biologically sound assessment while realizing that constraints on time and resources would limit the number of species evaluated. Evaluation species were selected through a process similar to that described in Chapter 4 of the Habitat Evaluation Procedures Workbook (National Biological Survey, 1994). In a series of multi-agency meetings lasting over a period of months, lists of fish and wildlife resources of concern, species, and habitats were discussed, evaluated, and debated. Although a ranking process was utilized to select evaluation species, the agencies involved did not concur with each species chosen by the ranking criteria. Therefore, changes to that species list were made through recommendations from participating agencies. For example, the nature of the ranking criteria placed scarce species at the top of the list. Scarcity, though an important consideration in impact assessment, does not necessarily select species suitable to reflect

habitat impacts. The selection process provided direction and a thought process for selecting evaluation species, and enabled initial lists to be developed for consideration by the agencies. Groups of species were chosen to represent each of the habitat types of concern and were agreed upon by the multi-agency team.

As a starting point, the HAT developed a preliminary list of resources of concern within the study area. That list was then coordinated with the other participating agencies. The initial list of resources of concern consisted of:

1. Native Mussels
2. Backwater/Side Channel Habitat
3. Wetlands
4. Bottomland Forests
5. Migratory Waterfowl
6. Neotropical Migrants
7. Commercial/Recreational Fishes and Fish Species of Concern

Further discussion of this list in a brainstorming session resulted in its expansion as well as the addition of associated species (Table 2).

This list was accepted as the starting point for consideration by the cooperating agencies and was presented to the NECC on June 27, 1995, with a request for review and comment by the next meeting in August. No comment was received until the September 20, 1995, meeting in Burlington, Iowa. The goal of that meeting was to gain consolidated input on the species list and begin the process of refining and focusing the list. The list that resulted from the September meeting is shown as Table 3.

Initial site visits were conducted in October 1995. Those visits included discussion of evaluation species (Table 3) appropriate to individual lock and dam sites. Each of these lock-specific lists added and deleted some species; however, the focus was kept on the originally identified resources of concern to guide the decision-making process. Simultaneously, the HAT conducted an extensive exercise to develop a list of evaluation criteria to aid in evaluating and further refining the list of species. The HAT applied six criteria based on existing information on resource significance and evaluation. Those criteria were scarcity, population trend, susceptibility, recoverability, recreational importance, and commercial importance. Using these criteria, a ranking process was conducted, and the ranked list was then cross-referenced with available model variables, habitat types, and the identified resources of concern to produce a list deemed to best represent each of these categories. The species list resulting from this process was then presented at a second meeting with agency personnel on February 6, 1996. Table 4 shows that list with recommended changes noted.

TABLE 2: Initial List of Resources of Concern and Potential Evaluation Species Identified by the HAT

Resources	Species	Threatened & Endangered
Native mussels		Higgins' eye
-mussel bed habitat		fat pocketbook
*population density		
*species richness		
Zebra mussel habitat (neg.)		
Backwater lakes		
Side channel habitat		
Wetlands		
-backwater lakes		
-bottomland hardwoods		
*mast producers		
-forested		
-non-forested		
Migratory waterfowl	wood duck	
-reproductive/migration habitat		
-colonial nesting birds		
Shore/wading birds habitat		least tern
		piping plover
Neotropical migrants	prothonotary warbler	
-fragmentation		
Recreational fishes	walleye/sauger	
	centrarchids	
	catfish spp.	
Fish species of concern	sturgeon	pallid sturgeon
	paddlefish	
Commercial fish	buffalo/catfish/carp	
Fish passage		
Main channel border		
Water quality		
-contaminant load		
-dissolved oxygen		
-turbidity		
-flow regime		
-temperature		
Raptors	red-shouldered hawk	bald eagle
	osprey	peregrine falcon
Furbearers	river otter	
Shoreline erosion/accretion		
		Indiana bat
		gray bat
		decurrent false aster
		Iowa Pleistocene snail

TABLE 3: Interim List of Resources of Concern and Potential Evaluation Species Identified by the HAT and Agency Personnel in Burlington, Iowa, September 1995

SITE-SPECIFIC ASSESSMENT - RESOURCES OF CONCERN

Resource	Representative Species
Native mussels	because native mussels use a wide variety of habitats, conducting population surveys and developing SIs for such characteristics as population density and species richness may be preferable to selecting representative species and using habitat variables
Zebra mussel habitat (neg.)	
Backwater habitat	black crappie, paddlefish, Western painted turtle, bullfrog, great blue heron, mallard, beaver, muskrat
Side channel habitat	channel catfish, walleye, sauger, buffalo, flathead catfish, great blue heron, beaver
Backwater lakes	peeper, tree frog, bullfrog, sora, Virginia rail, marsh wren, mallard, great blue heron, muskrat, mink
Bottomland hardwood forest	tree frog, red-headed woodpecker, pileated woodpecker, turkey, wood duck, great blue heron, gray squirrel, Indiana bat, gray bat, deer
Non-forested wetland	sora, Virginia rail, mallard, meadow vole
Migratory waterfowl	canvasback, wood duck, mallard, lesser scaup
Colonial-nesting birds	great blue heron, great egret
Shore/wading bird habitat	least tern, piping plover, pectoral sandpiper
Neotropical migrants	prothonotary warbler
Recreational fish	walleye, sauger, bluegill, white bass, flathead catfish, channel catfish, blue catfish
Commercial fish	smallmouth buffalo, bigmouth buffalo, channel catfish, freshwater drum
Migratory fish/fish passage	lake sturgeon, paddlefish, skipjack herring
Other fish	blue sucker
Main channel border	mussels, walleye, sauger, channel catfish; representative minnow(s) will be added
Cutbanks	flathead catfish, smallmouth buffalo
Water quality	(covered in fish models)
Raptors	red-shouldered hawk, bald eagle, osprey, peregrine falcon, barred owl
Furbearers	muskrat, beaver, mink

TABLE 4: Interim List of Selected Evaluation Species with Recommended Changes

HAT Selected Species	Additions/Substitutions per 2/6/96 Meeting
Bottomland Hardwood Forest	
red-shouldered hawk	wood duck
pileated woodpecker	great blue heron
red-headed woodpecker	hairy woodpecker (replacement)*
wild turkey	herp. sp. *

***Hairy woodpecker** - This species was recommended as a replacement to red-headed woodpecker because of the similarity in their habitat requirements which will cover intermediate aged forest. Variables key on canopy cover, overstory dbh, and medium sized snags.

***Herp.** - If there is a need to evaluate the ephemeral pools/seasonal water levels, a representative will be selected.

Cutbank	
flathead catfish	
Main Channel	
paddlefish	lake sturgeon
sauger	walleye
	skipjack herring
Main Channel Border	
emerald shiner	
channel catfish	
Mudflat	
lesser yellowlegs	
Backwater	
marsh wren	great blue heron
black crappie	paddlefish
bullfrog	largemouth bass
Backwater Lakes	
bullfrog	lesser scaup
bluegill	muskrat
Sandbar	
least tern	representative turtle (replacement)*

***Representative turtle** - A turtle species was recommended to evaluate sandbar habitat. Model variables will be dependent upon the species selected and may include shrub and herbaceous vegetation cover, substrate type, and water availability.

Non-Forested Wetland	
mallard	
bullfrog	chorus frog (replacement)*

***Chorus frog** - This species was recommended as a replacement to bullfrog because of the emphasis of the bullfrog on the permanence and quality of water. Ephemeral wetlands are included in the non-forested wetland definition and the chorus frog will provide a suitable species to evaluate that component.

Side Channel	
channel catfish	river otter
beaver	representative minnow
smallmouth buffalo	

Following the February meeting, further input and justification for suggested changes to the evaluation species list was solicited from agency partners. Based upon this input, the list of evaluation species was finalized in late March, as shown in Table 5. The same list with habitat definitions and selection considerations explained can be found in Appendix C. Resource categories not carried forward in the evaluations include sandbar, mudflat, and cutbank habitats, as well as native mussels. Cutbank, mudflat, sandbar habitat and rookeries were not found in any of the analysis areas (as the analysis proceeded, this was found to be the case with backwater/backwater lake habitat as well). Native mussels, though discussed within this report separately, were not included in the HEP analysis.

TABLE 5: Final List of Evaluation Habitats and Associated Species

BOTTOMLAND HARDWOOD FOREST		
pileated woodpecker	prothonotary warbler	wild turkey
hairy woodpecker	wood duck	Western chorus frog
gray squirrel		
ROOKERY		
great blue heron		
MAIN CHANNEL/MAIN CHANNEL BORDER		
lake sturgeon	paddlefish	walleye
channel catfish	sauger	emerald shiner
NON-FORESTED WETLAND		
mallard	sora	Western chorus frog
muskrat		
CUTBANK		
flathead catfish		
BACKWATER / BACKWATER LAKE		
paddlefish	largemouth bass	black crappie
lesser scaup	sora	bullfrog
red-eared slider	muskrat	
SIDE CHANNEL		
channel catfish	smallmouth buffalo	emerald shiner
river otter	beaver	

E. Model Building/Review and Modification. The next major step in the evaluation process was to secure habitat models for the chosen evaluation species. Existing models were available for all but two of the chosen species. The two exceptions were the sora and the Western chorus frog. Species and HEP/modeling experts met in a workshop setting in early May 1996. Participants included recognized species experts from two regional universities and State/Federal agencies, as well as study participants from the U.S. Fish and Wildlife Service and U.S. Geological Survey, Biological Resources Division.

1. Model Workshops. Each workshop began with a discussion of the species' life history and habitat requirements. That information was then formulated into a series of variables representing the most important habitat requirements of the species. The variables were defined and suitability index curves were devised to demonstrate the relationship between the measured value of each variable and the corresponding rating of habitat quality based on that particular parameter. An aggregation formula was then constructed to mathematically combine the suitability values for the individual variables to arrive at a single rating for the overall suitability of the habitat. The resultant models were considered very basic, but workable, for the site-specific analyses. After a comment/revision process involving both workshop participants and resource agency personnel, the models were finalized in December 1996.

2. Model Review. Concurrent with the model-building process, efforts were under way to conduct a review of the existing models. Begun in early March 1996, State and Federal agency points of contact were provided models (as necessary, if they did not already have them on hand) and asked to facilitate their review by appropriate species experts within their respective agencies. Different batches of models were reviewed separately, as not all evaluation species were finalized at the outset of the review process. The review/comment process and necessary modification of the models were completed in late 1996. Although a formal comment/response summary was not prepared, these considerations are summarized in the "Species Models" section of the HAT Reference Book and Appendix C.

F. Data Collection. Due to the magnitude of this study and the number of alternatives and sites involved, the team did not set out to perform statistically rigorous sampling with precise measurements of each variable. The team did attempt to collect sufficient data within spatial and temporal restraints. Data were categorized as either pre-field or field, and forms listing all the species variables, by habitat type, were prepared for each category. Pre-field data included all that could be obtained from existing information such as geomorphic, planimetric or vegetation cover type data obtained from maps, stage/discharge records, and much of the water quality, water control, and hydraulics data. Field data included all which required collection at designated sample sites within each of the analysis areas. The bulk of the pre-field data consisted of water/quality and hydraulics data, and the sources of this information are described below.

1. Water Quality Data. Existing data sources were utilized to provide baseline values for those variables related to water quality parameters such as dissolved oxygen, turbidity, velocity and pH. Water quality data were obtained from two main sources: the Mississippi River Water Quality data base maintained by the Rock Island District of the U.S. Army Corps of Engineers; and the Long Term Resource Monitoring Program (LTRMP) Water Quality data base maintained by the USGS Environmental Management Technical Center (EMTC). The Rock Island District data base has a period of record of approximately 10 years and was used for the Mississippi River L/Ds 20-22. The LTRMP data base, which has a shorter period of record (approximately 5 years), was used for L/Ds 24, 25, Peoria and La Grange.

Sampling locations for these data were in the general vicinity of the pertinent lock and dam sites, but were confined to the main channel. Where model variables required information in off-channel areas, other data sources were used where available or correlations were developed based on main channel data.

2. Hydraulics Data. Flow velocity and depth information for L/Ds 20-25 was obtained from two-dimensional hydrodynamic models constructed as part of the Engineering Work Group effort to examine approach and exit conditions for the existing and alternative lock locations. The Environmental Work Group further extended the scope of this numerical modeling effort to aid in the assessment of site-specific environmental impacts associated with large-scale navigation improvements. Unless prohibited by conditions at a specific site, lock Locations 1 through 4 were investigated. All new locks modeled consisted of a 110-foot by 1,200-foot chamber, a 1,200-foot upstream ported guardwall, and a 1,200-foot downstream guidewall.[1]

For the purpose of the modeling effort, it was assumed that any loss in gated capacity due to construction of a Location 4 lock would be replaced by adding new gates, on a one for one basis, in the overflow section of the dam. The models were constructed based on the most recent hydrographic survey data available, as well as detailed scour surveys conducted in the vicinity of the dam and topographic information taken from USGS maps. A complete description of the numerical modeling effort is contained in an Engineering Work Group interim report entitled "Hydraulic Impacts of New Lock Construction" (July 1996).

Velocity and depth information was determined based on steady-state simulations of flows representing typical high and low flow conditions. The high flow represented typical flow conditions during spring (March-May) and the low flow represented conditions during the late summer months (June-August) as well as closely approximating the typical annual flow. The modeled flows were selected based on an elevation-duration analysis (period of record varies but approximately 60 years), with the modeled flow selected as that corresponding to the 50% elevation for the season of interest. The model output was provided to the study team in the form of velocity vector diagrams and maps of depth contours for base and with-project conditions for each lock and dam site. Using this information, a direct comparison of flow conditions between baseline and with-project conditions could then be made.

3. Field Data Collection. Prior to initiating fieldwork, a number of preparatory steps were necessary. These are summarized as follows:

a. Selection of Sampling Techniques. Existing literature and reference material (Schemnitz, 1980; U.S. FWS, 1980; Hays et al., 1981; Hamilton & Bergersen, 1984) were reviewed for potential methods. Emphasis was placed on simplicity, time-

[1] A guardwall is a wall extending upstream or downstream, riverside of the lock, which protects vessels from the force of river currents entering or discharging from the dam. A guidewall is a long wall extending upstream or downstream of a lock approach, located on the landside of the approach channel, used to guide tows into the lock chamber or temporarily moor tows or cuts.

effectiveness and consistency, while limiting bias and inaccuracy. Field data collection was carried out with an interagency and interdisciplinary team consisting of representatives from the Corps of Engineers, the U.S. Fish and Wildlife Service, the Missouri Department of Conservation, and the Illinois Department of Natural Resources.

b. Sample Sites. Sample sites were delineated on planning maps and marked in the field with flagging. The sites were chosen by an interagency team including Federal and State agency biologists familiar with the areas. Sites were visually surveyed and, when found homogenous, one transect or set of samples was deemed accurate to reflect the site conditions. If heterogeneity was detected or expected within the sample site, more samples were taken. Terrestrial data collection relied most heavily on accepted, standardized techniques; the approach chosen was to use a belted transect of approximately 0.1 ha [0.2471 acre] in total area. For example, herbaceous vegetative cover was sampled with a 1 m^2 [10.8 ft^2] frame, with 10 samples per transect; canopy height was measured with a clinometer at 10-meter [32.8-foot] intervals on a transect, etc. Aquatic variables required both collection and visual estimation of data not readily available. This included substrate sampling with a petite ponar, visual estimation of percent shoreline riprapped, and visual estimation/professional judgment of percent cover.

c. Rights of Entry. Coordination was necessary with the Rock Island and St. Louis Districts' Real Estate Divisions to secure permission for entry onto private land. This process involved providing real estate personnel with planning maps showing delineated sample sites, from which they determined ownership and secured written right-of-entry documentation via either telephone coordination or personal visits.

d. Sampling Protocol and Agency Coordination. A simple protocol was established for completion of data forms. This protocol included consistent listing of personnel, particularly the data recorder, general sampling location name (e.g., "L/D xx, River Island, RDB"), and specific sample location designation (a sequential number followed by "U" or "D" for upstream or downstream). Every effort was made to inform resource agency personnel in advance of the initiation of fieldwork. Given the fluid and busy nature of schedules, participation was generally good. Field data collection commenced on July 31st and was completed on September 12, 1996. A compilation of sample sites, by habitat type and sampling dates, is found on page 39 of the HAT Reference Book.

G. Future Prediction Exercises. Prediction exercises included participation of resource agency personnel to take advantage of on-the-ground knowledge of the sites as well as to assure critical, multi-agency input into the predictions. In the only case where agency participation was not possible due to a last-minute schedule conflict, completed sheets were provided for review. The actual process of making predictions relied heavily on the acquisition of as much background information as possible, as well as professional judgment.

Predictions were made of the future condition of these habitats, both with-project (as affected by a potential construction measure or measures) and without-project (under

natural conditions). Assembled information consisted of pertinent project or research reports, existing datasets, and consultation with in-house or outside agency personnel with specific areas of expertise. Hydraulic modeling data provided by the Rock Island District (essentially depth and velocity figures) consisted of both baseline conditions (values which were averaged over the period of record) and with-project conditions for various lock options. A "typical" low and high river discharge facilitated the exercises for main channel/channel border habitats. The collected field data, along with pre-field information, formed the "baseline" habitat condition for the species and habitats being evaluated.

Any HEP analysis requires the selection of target years (TYs) for which reasonable predictions as to changes in habitat conditions can be made. The following target years were chosen for this study: TY0, 1, 2, 5, 10, 25, and 50. Baseline is TY0, TY1 is the first year in which construction is expected to begin, and TY 50 is the end of the planning horizon on this study. It is projected that a new lock would require approximately 2 years to construct and therefore TY 2 was chosen to represent this. Years 5, 10, and 25 were selected to represent points in time that the team assumed habitat changes would become apparent within with- and without-project conditions.

To guide the discussions and facilitate record keeping, prediction spreadsheets were developed by habitat type and sample site. An example is provided in Table 6. Each sheet contained the appropriate species variables and units of measure, baseline (TY0) variable value, and columns to carry out the future predictions. If no change was predicted over the planning period, or portion thereof, "NC" was entered on the sheet. These sheets, along with the project planning maps, comprised the main "tools" upon which the discussions centered.

Numerous assumptions were made in making future predictions, many of which were very specific to a particular sample site or variable. These were recorded to the extent possible during each meeting, and though not included in this report, they constitute a large part of the project documentation and are available for review at the Rock Island District office. A set of general "systemic rules" (Table 7) was developed for the aquatic variables to allow quick consideration of those variables that were reasonably expected not to change or to change in a predictable, consistent manner. Many questions arose related to aquatic variables and often led to extensive discussion. The majority of the discussion pertained to perception of inaccuracies in hydraulic data. In most cases, data were re-calculated; in others, a simple confirmation of the data source or assumptions was all that was necessary.

Terrestrial variables were projected using estimated succession rates, growth rates, and site-specific conditions, including flood frequency and local management practices. They are also based upon site conditions such as forest age and composition. Examples of specific assumptions include the following: forest canopy cover generally increases to approximately 70% by TY 20 and stabilizes; frequent flooding will induce tree mortality, also increasing the number of snags available.

TABLE 6: Example of Future Prediction Sheet for Main Channel/Main Channel Border

Main Channel HABITAT Enter the future value for each variable for each target year

			TY	TY	TY	TY	TY	TY	TY
	Variable	**Units**	**0**	**1**	**2**	**5**	**10**	**25**	**50**
ls1	predominate substrate for foraging; adult	menu							
ls2	predominate substrate for foraging; juv	menu							
ls3	mean water depth for foraging; juv	m							
ls4	mean water velocity for foraging; juv	cm/s							
ls5	mean water temp. during spawning	deg. C.							
ls6	mean velocity during spawning	cm/s							
ls7	predominate substrate for spawning	menu							
ls8	mean water depth during spawning	m							
cc01	% pool during average summer flow	%							
cc02	% cover during summer in pools etc.	%							
cc04	food production potential	menu							
cc05	mean midsummer temp (pools - bkwater)	deg. C.							
cc06	length of agric growing season	days							
cc07	max monthly mean turbidity in summer	ppm							
cc08	mean min d.o. in pool/back/lit in summer	mg/l							
cc09	max salinity in summer	ppt							
cc10	mean water temp - p/b/l - spawn/embryo	deg. C.							
cc11	max salinity - spawn/ embryo	ppt							
cc12	mean midsummer temp pools - fry	deg. C.							
cc13	max salinity summer - fry	ppt							
cc14	mean midsummer temp in pools - juvenile	deg. C.							
cc18	mean velocity in cover areas-avg summ flow	cm/sec							
pa01	annual freq of incr water temp 10-17 C (21 days)	years							
pa02	annual frequency of 2 week dam open period	years							
pa03	accessible area of gravel/cobble substrate	hectares							
pa04	mag spr water rise over midwinter flow	meters							
pa05	mean velocity during spring water rise	m/sec							
pa06	min DO when air temp = 10-17C	mg/l							
pa07	area of possible summer & winter habitat	ha(10K)							
pa08	mean width of inhabited river	meters							
pa09	%of area in backwater	%							
pa10	No of eddies in summer & winter habitats	number							
sa01	% of 2 mi diam circle with water > 8ft deep	%							
sa02	% emerg, submerg, and floating veg	%							

TABLE 6 (Continued)

	Variable	Units	TY 0	TY 1	TY 2	TY 5	TY 10	TY 25	TY 50
sa03	substrate composition	menu							
sa04	submerged bank covered by rip-rap	%							
sa05	% of main channel < 8 ft deep	%							
sa06	mean velocity at normal flows	fps							
sa07	water level stability	menu							
sa08	mean non-flood turbidity	secchi in							
sa09	dist to gravel substrate or gravel shoreline	mi							
sa10	dist to emerg veg with 1-4 ft depth	mi							
wa01	mean transparency (summer)	m							
wa02	rel abund of small forage fish - spr/sum	mg/m3							
wa03	% of area w/ cover & D.O. spr/sum	%							
wa04	least suitable pH during the year	number							
wa05	min D.O. in pools & runs - summer	mg/l							
wa06	min D.O. sum/fall - shallow shorelines	mg/l							
wa07	min D.O. spawning areas - spring	mg/l							
wa08	mean weekly temp - pools - summer	deg. C.							
wa09	mean weekly temp shallow shore ltsp/sum	deg. C.							
wa10	mean weekly temp - spawning/spring	deg. C.							
wa11	deg-days (4-10C) - 10/30 - 04/15	number							
wa12	spawning habitat index	number							
wa13	water level - spawning & embryo devel	menu							
waw1	mean winter water temp.	deg. C.							
waw2	min. winter water depth	m							
waw3	winter water velocity	m/sec							
es01	mean water temperature	deg. C.							
es02	mean turbidity	JTU							
es03	minimum dissolved oxygen	mg/l							
es04	% of shoreline riprapped	%							
es05	dominant substrate	menu							
es06	% cover	%							
es07	degree of water level fluctuation	menu							
es08	mean water velocity	cm/sec							
es09	% of area <= 5 feet deep	%							
es10	% of backwater with suitable overwintering	%							

The exercises also pointed out gaps where data were unavailable or yet to be obtained, as well as certain variables that required collection in the late spring time frame, thus necessitating an additional round of fieldwork in May/June 1997. The future prediction exercises for the Mississippi River locks and dams were conducted between February and May 1997. Those for the Illinois River were concluded in mid-August 1997.

TABLE 7: UMRS Navigation Study HEP Forecasting Rules

THESE RULES DO NOT CHANGE WITH OR WITHOUT PROJECT:

1. Area of possible summer and winter habitat and accessible area of gravel/cobble substrate are always ok (all projects with or without condition). **pa03, pa07**

2. The annual frequency of 2-week dam open period will not change through time (all projects with or without condition). **pa02**

3. Degree days will not change (all projects with or without condition). **wa11**

4. Degree of water level fluctuation will not change because it is driven by floods or water level regulation, not site-specific impacts (all projects with or without condition). **wa13, es07**

5. Length of agricultural growing season will not change (all projects with or without condition). **cc06**

6. Salinity is always 0 (all projects with or without condition). **cc09, cc11, cc13**

THESE RULES DO NOT CHANGE IN THE WITHOUT-PROJECT CONDITION, AND UNLESS OTHER CHANGES ARE DETERMINED, THESE RULES ALSO APPLY IN THE WITH-PROJECT CONDITION:

1. The inhabited channel will decrease by 1% due to accretion at TY25 and 1% at TY50. **pa08**

2. Systemic turbidity will increase by 5% at TY25 and 5% at TY50. **cc07, es02**

3. Systemic water clarity will decrease by 5% at TY25 and 5% at TY50. **sa08, wa01**

4. Systemic water depths will increase 1% at TY25 and 1% at TY50. **1s3, 1s8**

5. Systemic velocities will increase 2.5% at TY25 and 2.5% at TY50. **1s4, 1s6, cc18, pa05, sa06, es08**

6. Systemic winter water velocities will increase 1% at TY 25 and 1% at TY50. **waw3**

7. *Systemic water temperatures will not change. **1s5, cc05, cc10, cc12, cc14, wa08, wa09, wa10, waw1, es01**

8. *Systemic DO levels will not change. **cc08, pa06, wa05, wa06, wa07, es03**

9. *Substrate will not change. **1s1, 1s2, 1s7, sa03, es05**

10. Systemic spring water rise will increase by .1m at TY25 and .2m TY50. **pa04**

* These rules are only for areas with flow and with no accretion greater than that expected for the entire system, i.e., directly downstream of the lock, directly upstream of the lock chamber, and in the overflow area near the last gate.

H. Spreadsheet Development/Computation. A Windows-based program, Spreadsheet HEP (SHEP), was used for all data accounting. SHEP is a spreadsheet version of the U.S. Fish and Wildlife Service's Habitat Evaluation Procedures (HEP) and Habitat Suitability Index (HSI), two commonly used and accepted DOS-based assessment programs. SHEP offers all the accounting tools of the older HEP program (which includes HSI), but in a much quicker and user friendly format. SHEP was designed for use with a single habitat type. For this project, individual spreadsheets were built for each type of habitat potentially impacted by lock improvements. Grouped within each habitat type was a set of species models selected by the HAT. Each species model has a unique set of variables that define the habitat requirements of the species. Species models were selected to assess variables considered important and relevant to the habitat type. Spreadsheets were developed for the following habitats: main channel/main channel border (6 species), backwater/backwater lake (8 species), non-forested wetland (4 species), bottomland hardwood forest (7 species), cutbank (1 species), and side channel (5 species). Spreadsheets were checked for accuracy by the author and then rechecked by a Corps of Engineers biologist.

Data collected during field visits and generated by the future prediction meetings were entered into the spreadsheets. The acreage of the impacted area, at each target year, was also entered. Using these data, SHEP produced two types of output—HSIs and Habitat Units (HUs). HSI values were produced for each species at designated target years. HSI values are a measure of the habitat quality of the potentially impacted area and range from one (optimal habitat) to zero (no available habitat). SHEP also computed HUs, which are determined using a formula incorporating the acreage of the impacted area and HSI values at the target years. Annual HUs were computed for each species and averaged over the 50-year life of the project (AAHUs). Net project impacts were determined by subtracting the with-project AAHU values from the without-project AAHU values. These net project impacts provide a way to quantify the change that occurs in a habitat due to lock improvements. Net project impacts, by species, were produced for each site potentially impacted by lock improvements (Appendix D).

IV. RESULTS AND DISCUSSION

A. Site-Specific Habitat Evaluations (HEP). Results of the HEP performed at L/Ds 20-25, Peoria and La Grange are shown below. Combinations of alternatives and the habitat impacts resulting from each lock location are discussed. AAHU changes at each site and each alternate lock location are summarized in tabular format.

AAHUs have been summed by lock location and habitat type. This summary is intended to clearly describe the relative change in habitat types resulting from construction in alternative lock locations. This summing of AAHUs assumes that HUs are equal within each habitat type. No trade-off between habitats or species is proposed with this representation. The results are being utilized to assist in selecting alternative lock locations during plan formulation. Though estimated habitat replacement costs are described later in this report, there is no mitigation planning taking place at this time and no proposed trade-off between habitats. Appendix D provides detailed results, and species-specific impacts are discussed in more detail below. Appendix D includes acres, HSI, and AAHU by species for both the with- and without-project conditions. Potential small-scale measures at each lock are discussed. However, small-scale measures were not evaluated with the use of HEP.

1. Lock and Dam 20.

a. Construction Alternatives. Alternatives at this site are described in detail in the Engineering Appendix (Engineering Work Group Draft, 1998) and include lock extensions (to 1,200 feet); 1,200-foot guardwall or guidewall construction at Locations 2, 3, or 4; and a wicket gate on the Illinois side of the dam.

Location 2 - The bankline would be straightened and channel widened above the existing lock following a straight extension of the landside guidewall. The Buck Run Creek outlet, which is downstream of the existing lower guidewall, would be relocated downstream to outlet below a new 1,200-foot guidewall. There would also be associated channel dredging downstream of the guidewall along the Missouri bank.

Location 3 - The bankline would be straightened above the existing lock similar to Location 2 but would involve less clearing and widening of the channel. The Buck Run Creek outlet would not be changed.

Location 4 - This alternative includes placement of a lock in the gated section of the dam. Existing dam/flow gates lost to new lock construction would possibly be replaced with new gates in the existing auxiliary gate bay (Location 3) since there is no overflow section at this dam. The Buck Run outlet would not be changed.

Open Pass with Wicket Gates - L/D 20 is one of the first dams to go to open river conditions (dam gates out of the water) during higher than normal river flows.

Wicket gates, which can be lowered as the head differential approaches zero between the upper and lower pools, would be incorporated into the dam structure on the Illinois side of the dam. This would allow tows to pass through the dam and bypass the locking process an estimated 30% of the time. The pass width would be 480 feet at the dam with the approach channel narrowing to 300 feet above and below the dam. This improvement would include removal of an island and side channel immediately below the dam, as well as dredging of a channel for over a mile below the dam.

Staging Area - The proposed staging area during construction includes an area along the Missouri shoreline from one-half mile above the lock to approximately one mile below the lock.

Small-Scale Measures - The site has relatively moderate outdraft conditions (outdraft is a current along the upstream guidewall that tends to pull a towboat away from the wall and towards the dam). Tows tend to be drawn into the riverbank on downbound approaches. All of the remaining small-scale measures (outlined in Section I.D.) are under consideration at this site. As is the case at all of the sites described in this section, approach improvements, adjacent mooring facilities, or remote remake areas are the only measures with potential environmental effects. Small-scale measures were not included in the HEP evaluations.

Summary of AAHU Changes at Lock and Dam 20

Habitat Type	Location 2	Location 3	Location 4	Wicket Gate
Bottomland Forest	-21.55	-10.05	No Evaluation	-16.00
Side Channel	3.22	3.22	3.22	-13.06
Main Channel Border	U = 73.68* D = -1.71	U = 32.38* D = -20.85	U = -3.56 D = -20.78	D = 68.09*

*Equates to an increase in AAHUs resulting from a habitat conversion from bottomland forest and side channel to main channel border.

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at L/D 20 include losses of bottomland forest and side channel habitats and alteration of main channel border. The results are summarized below and displayed in more detail in Appendix D (HEP outputs). These results are summarized by lock location and include staging areas. The wicket gate

measure is summarized separately. Mussels were located in most areas of impact at L/D 20; however, large concentrations that would suggest the presence of mussel beds were not found. Section V.C. of this report contains a more detailed description of the mussel survey and succeeding information on mussel resources.

Location 2

Bottomland Forest - Widening of the channel upstream would include the permanent loss of 15 acres of bottomland forest through conversion to main channel border. Impacts to bottomland forest include a loss of 21.55 AAHUs. The majority of this loss was one species—the hairy woodpecker (-13.36 AAHUs). Four other species, the pileated woodpecker, wood duck nesting, gray squirrel, and prothonotary warbler, also had small losses (<3 AAHUs each). The bottomland forest to be cleared consists of a strip of the existing forest adjacent to the river for approximately 2 miles upstream from the lock.

Side Channel - The outlet of Buck Run would be relocated downstream of the guidewall. Other than the temporary impacts caused by relocation of the outlet, there is no adverse impact to side channel by construction at Location 2. The HEP showed an increase of 3.22 AAHUs due to revegetation of the area used for staging. This increase resulted entirely from the beaver HSI, with the remaining species unchanged. The evaluation also assumed that an implemented Section 1135 Environmental Restoration project upstream would maintain flow in Buck Run.

Main Channel Border - Main channel border area upstream from the lock would increase by 15 acres due to the conversion of bottomland forest to aquatic habitat. That increase in area accounts for the majority of the 73.68 AAHU increase. Downstream, approximately 14 acres of main channel border would be deepened and another 8 acres would have velocities altered by the placement of the lock and guidewall. This accounts for a net loss of 1.71 AAHUs, the majority of which are for channel catfish (-1.1 AAHUs). Minor changes (<1 AAHU) would be seen in the remainder, including walleye reproduction, emerald shiner, and lake sturgeon reproduction AAHUs. The exception is sauger, which actually increases 0.24 AAHU downstream.

Location 3

Bottomland Forest - Widening of the channel upstream would include the permanent loss of 7 acres of bottomland forest through conversion to main channel border. Impacts to bottomland forest include a loss of 10.05 AAHUs, the majority of which were hairy woodpecker (-6.23 AAHUs). Four other species, the pileated woodpecker, wood duck nesting, gray squirrel, and prothonotary warbler, also had small losses (<2 AAHUs each).

Side Channel - The outlet of Buck Run would not be relocated downstream of the guidewall. The HEP analysis showed an increase of 3.22 AAHUs due to revegetation of the area used for staging. This increase resulted entirely from the beaver HSI, with the remaining species unchanged. The evaluation also assumed that an implemented Section 1135 Environmental Restoration project upstream would maintain flow in Buck Run.

Main Channel Border - Main channel border area upstream from the lock would increase by 7 acres due to conversion of bottomland forest to aquatic habitat. The increase in area accounts for an increase in 31.51 AAHUs. Specific species changes can be seen in Appendix D. An adjacent 12 acres of main channel border would be slightly deepened and have an increase of 0.87 AAHU made up of slight AAHU increases for lake sturgeon reproduction and channel catfish and a decrease for paddlefish spawning.

Downstream, approximately 14 acres of main channel border would be deepened and emerald shiner would lose 0.07 AAHU. None of the other species would be affected. Placement of the lock and guidewall extension would decrease velocities and presumably increase sedimentation behind the guidewall. The area includes approximately 17 acres inside the wall and 9 acres outside the wall. A total loss of 20.78 AAHUs results from the measure, the majority of which comes from paddlefish spawning losses (14.19 AAHUs). Lake sturgeon reproduction would have a 3.75 AAHU loss. The remaining species showed changes <3 AAHUs. Changes outside the wall resulted in a loss of 1.58 AAHUs. Specific species changes can be seen in Appendix D.

Location 4

Bottomland Forest - No upstream channel widening is required with this lock location and no bottomland forest impacts would result.

Side Channel - The outlet of Buck Run would not require relocation with this lock location. The HEP showed an increase in 3.23 AAHUs (beaver) due to revegetation of the area used for staging and assumption that the Section 1135 project upstream would maintain flow in Buck Run.

Main Channel Border - A total of 54 acres of main channel border area upstream from the lock would lose 3.56 AAHUs due to increased depth, velocity, and riprapping of the bank. The majority of that loss is due to sauger losing 3.55 AAHUs. The remaining species show changes $\pm$2 AAHUs or no change at all.

Placement of the lock and guidewall extension would decrease velocities and presumably increase sedimentation behind the guidewall. The area includes approximately 17 acres inside the wall and 9 acres outside the wall. A total loss of 20.78 AAHUs would result from the measure, the majority of which comes from paddlefish spawning losses (-14.19 AAHUs). Lake sturgeon reproduction would

have a 3.75 AAHU loss. The remaining species showed changes <3 AAHUs. Changes outside the wall resulted in a loss of 1.58 AAHUs. Specific species changes can be seen in Appendix D.

Wicket Gate

Bottomland Forest - The bottomland forest impacts are from the loss of an island immediately below the dam. Approximately 7 acres of bottomland forest would be permanently lost with the measure. The clearing would result in the loss of 16.00 AAHUs made up of pileated woodpecker (-5.21 AAHUs), hairy woodpecker (-4.99 AAHUs), and wild turkey (-3.32 AAHUs). The remaining species would lose <2 AAHUs.

Side Channel - In conjunction with removal of the island, the side channel (7 acres) between the island and the Illinois bankline would be permanently lost. A total of 13.06 AAHUs consisting of emerald shiner (-5.34 AAHUs), beaver (-3.24 AAHUs), channel catfish (-3.06 AAHUs), and river otter (-1.42 AAHUs) would be lost.

Main Channel Border - The combination of area converted from bottomland forest and side channel and the velocity and depth changes would create an increase of 68.09 AAHUs. Species-specific changes can be found in Appendix D, but those with large AAHU gains include walleye winter (11.41), paddlefish spawning (11.03), and emerald shiner (9.75).

c. Conclusions. Results of the HEP show that Location 4 has the least adverse environmental impacts. It does not impact bottomland forest habitat or negatively affect side channel habitat, but does include the loss of HUs in main channel border. Although a decrease in value of any habitat is undesirable, main channel border is considered abundant throughout the system. Loss of bottomland forest from construction at Locations 2 or 3 is permanent. The measure to construct a wicket gate has the most detrimental environmental effects. It includes the permanent loss of an island, which affects bottomland forest and side channel habitat.

Regarding small-scale measures, mooring cells are proposed both upstream and downstream. The downstream cells would be especially valuable in alleviating shoreline impacts from tows that currently push into the bank adjacent to Canton. If implemented, selected mooring cell locations would be evaluated in detail for potential environmental impacts. Remote remake areas would be in the same general locations as mooring cells, but would involve different structures. The nature of proposed dredge areas and lockwall extensions is virtually identical to those associated with the large-scale measures, thus habitat impacts to channel border and shoreline areas are expected to be similar. Three submerged wing dikes are also proposed upstream of the lock to help alleviate outdraft conditions. These wing dikes would require detailed evaluation if implemented, but their effects would probably mirror those predicted at other sites, likely increasing sedimentation and decreasing flow velocity.

2. Lock and Dam 21.

a. Construction Alternatives. Construction alternatives at this site are described in detail in the Engineering Appendix and include lock extensions (to 1,200 feet), and 1,200-foot guardwall or guidewall construction at Locations 2, 3, or 4.

Locations 2, 3, or 4 - The bankline would be straightened above the existing lock and a series of submerged wing dikes would be placed extending from the bankline to just beyond the far edge of the approach channel. These dikes would be spaced at 500-foot intervals with the top at least 15 feet below flat pool. They would be placed from the river with floating plant equipment. Their purpose is to reduce the magnitude of outdraft or flow from the bankline to the dam gates which misaligns downbound tows with the lock chamber. Placement of a new lock in Location 4 would involve replacing gates in the overflow section of the dam.

Staging Area - The staging area at this site includes the bankline from a point adjacent to the upstream bank excavation area to below the lock near the existing boat ramp. The staging area would involve some clearing of bottomland forest but the majority is already developed.

Small-Scale Measures - Significant outdraft conditions exist at this site, particularly on downbound approaches. All remaining measures are currently under consideration.

Summary of AAHU Changes at Lock and Dam 21

Habitat Type	Location 2	Location 3	Location 4
Bottomland Forest	-60.24	-60.24	-30.34
Main Channel	No Evaluation	No Evaluation	-0.23
Main Channel Border	U = 48.67* D = -59.78	U = 48.31* D = -23.12	U = 0.75 D = -27.45

* Equates to an increase in AAHUs resulting from a habitat conversion from bottomland forest to main channel border.

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at L/D 21 include losses of bottomland forest and alteration of main channel border. The results are summarized below and described in more detail in Appendix D. Results are reported by lock location and include some

discussion of species-specific results. Since there were previous surveys in the vicinity, no mussel surveys were conducted at L/D 21 in 1997. The entire right bank has a high potential for mussel beds.

Location 2

Bottomland Forest - Construction in Location 2 would require the permanent clearing of 8 acres of bottomland forest and subsequent conversion to main channel border habitat. An adjacent 4.5 acres would be cleared but re-planted after construction. A total of 29.90 AAHUs would be lost in that area and include hairy woodpecker (-11.61), prothonotary warbler (-10.43), and pileated woodpecker (-6.09). Wood duck nesting and gray squirrel would have losses <2 AAHUs. Wild turkey showed a slight increase (1.13 AAHUs). Staging area impacts downstream would include the temporary clearing of 11.3 acres of bottomland forest and result in a loss of 30.34 AAHUs. This includes pileated woodpecker (-7.62), prothonotary warbler (-7.73), hairy woodpecker (-6.52), wild turkey (-5.03) and the remaining species with losses <3 AAHUs.

Main Channel - There are no impacts to main channel with construction at Location 2.

Main Channel Border - Upstream, an 8-acre increase in main channel border habitat resulting from the conversion of bottomland forest, and changes in habitat provided by the wing dikes resulted in an increase of 48.56 AAHUs. With the exception of lake sturgeon (reproduction), which showed no increase in habitat, all of the other species exhibited an increase in AAHUs. Channel catfish would show the largest gains (10.56 AAHUs). The other species would gain anywhere from 0.36 to 6.87 AAHUs (Appendix D).

Downstream, an area of 12.5 acres behind the guidewall would be assumed lost to sedimentation and would result in a loss of 59.00 AAHUs. Those losses would include lake sturgeon forage (-9.70), emerald shiner (-9.58), and paddlefish spawning (-10.18), with other species showing losses ranging from -0.30 to -6.91 AAHUs. The area outside the wall would lose only 0.78 AAHU with all species changes less than 0.25 AAHU.

Location 3

Bottomland Forest - Construction in Location 3 would require the permanent clearing of 8 acres of bottomland forest. That area would be converted to main channel border. An adjacent 4.5 acres would be cleared but re-planted after construction. A total of 29.90 AAHUs would be lost upstream and consist largely of hairy woodpecker (-11.61), prothonotary warbler (-10.43), and pileated woodpecker (-6.09). The other species would lose <2 AAHUs. Wild turkey would show a gain of 1.13 AAHUs with the project.

Staging area impacts downstream would include the temporary clearing of 11.3 acres of bottomland forest and result in a loss of 30.34 AAHUs. This includes the pileated woodpecker (-7.62), prothonotary warbler (-7.73), hairy woodpecker (-6.52), and wild turkey (-5.03). All other species had losses <3 AAHUs.

Main Channel - There is no impact to main channel with construction at Location 3.

Main Channel Border - Upstream, an increase in 8 acres of habitat from the conversion of bottomland forest and the habitat provided by the wing dikes resulted in an increase in 48.56 AAHUs. Of this increase, channel catfish would gain 10.56 AAHUs and the other species would gain anywhere from 0.36 to 6.87 AAHUs. Lake sturgeon reproduction showed no change.

Downstream, an area of 27.4 acres behind the guidewall is assumed to be affected by velocity and depth changes, resulting in a loss of 19.24 AAHUs. Unlike Location 2, the assumption is that the area would remain aquatic. Gains were shown for walleye winter (14.96), walleye reproduction (0.19), and channel catfish (5.68). Losses occurred for the remaining species, with paddlefish spawning (-22.26), sauger (-6.54), and lake sturgeon (-5.51) losing the most AAHUs, followed by the other species with losses <2 AAHUs. The area outside the wall would lose 3.88 AAHUs, the majority of which (-2.67 AAHUs) would be attributed to lake sturgeon forage, with others losing <0.25 AAHU.

Location 4

Bottomland Forest - Construction in Location 4 would not require the permanent clearing of bottomland forest. Staging area impacts downstream would include the temporary clearing of 11.3 acres of bottomland forest and result in a loss of 30.35 AAHUs. This includes pileated woodpecker (-7.62), prothonotary warbler (-7.73), hairy woodpecker (-6.52), and wild turkey (-5.03) AAHU decreases. The other species would have losses of < 3 AAHUs.

Main Channel - Impacts to main channel habitat with construction would consist of dredging in an area of approximately 11 acres downstream from the lock at approximately River Mile 324. A temporary increase in turbidity and increased

depth result in a loss of 0.23 AAHU, with a slight gain for paddlefish adult and a slight loss for lake sturgeon reproduction.

Main Channel Border - The addition of submerged wing dikes upstream results in a gain of 5.39 AAHUs, the majority of which are seen in channel catfish AAHUs (4.44) with the other species showing changes ±2 AAHUs. Gate replacement in the overflow section of the dam would cause the loss of 4.39 AAHUs, including (-3.01) walleye winter with other species changing ±1.0 AAHU. In the immediate vicinity of a new lock, -0.25 AAHU would be lost.

Downstream, 27.4 acres behind the guidewall would be subjected to reduced velocity and increased turbidity. This would create a summed loss of -17.44 AAHUs. Species-specific results include AAHU gains for walleye winter (18.09) and channel catfish (2.17), and two other species gaining <1.0 AAHU. Species such as paddlefish spawning (-22.26), lake sturgeon forage (-7.63), and lake sturgeon reproduction (-4.24) account for the majority of the losses. Specific results are found in Appendix D. The area outside the wall showed a loss of 3.89 AAHUs. This includes lake sturgeon forage (-2.67), with changes of <1.0 AAHU for other species.

The increased velocity below the overflow section, where a new gate would be placed, has a -6.12 AAHU sum. This can be attributed to losses in walleye winter AAHUs (-3.01) and lake sturgeon forage AAHUs (-2.69), with others losing <1.0 AAHU. Three species also had small gains.

c. Conclusions. Location 4 at this site has the least adverse environmental impacts to bottomland forest; however, it does impact main channel border habitat. Gate replacement within the overflow section could also impact mussel beds on the right descending bank. Location 3 has fewer impacts to main channel border but includes twice the magnitude of impacts to bottomland forest.

Mooring or remote remake facilities are proposed both upstream and downstream of the lock. Currently, Orton Island, approximately 1.5 river miles downstream, experiences shoreline damage from mooring tows. Mooring cells would be beneficial at this location. With the exception of the downstream, mid-channel dredge area, proposed approach channel improvements are identical to those included in the large-scale measures. These improvements include bankline excavation and a series of five submerged dikes on the upstream approach. The SHEP analyses indicated a small gain in main channel border HUs, assuming reduced velocity due to the dikes, but at the same time a loss in bottomland hardwoods due to the excavation. Other velocity-related effects associated with new lock construction are projected to be similar with small-scale construction, as they are primarily related to guidewall or guardwall construction. Lockwall extensions are also included under the proposed approach improvement measures.

3. Lock and Dam 22.

a. Construction Alternatives. Construction alternatives at this site are described in detail in the Engineering Appendix and include lock extensions (to 1,200 feet) and 1,200-foot guardwall or guidewall construction at Locations 2, 3, or 4.

Location 2 - Upstream, a system of five emergent wing dikes would be constructed from the river using floating plant equipment. These rock dikes would be spaced about 1,000 feet apart with a top elevation 2 feet above flat pool. The dikes would extend from the riverbank to the near edge of the approach channel. Their purpose is to control the currents along the right descending bank, aligning them more with the lock chamber, which will benefit tows on their downbound approach.

Location 3 - The same dike system would be used upstream as described above for Location 2. The right descending riverbank immediately downstream of the existing lock would be straightened to reduce the size and intensity of eddy currents that may form between the downstream approach wall of the new lock and the right bank.

Location 4 - The same dike system would be used upstream as described for Location 2. The right descending riverbank would be straightened immediately downstream of the existing lock as described for Location 3.

Staging Area - The staging area at this site includes an area along the bankline both upstream and downstream from the existing facility. Temporary clearing of bottomland forest would be required for staging.

Small-Scale Measures - This site has some of the most severe outdraft conditions on the entire Upper Mississippi. Downbound tows fight a severe outdraft and helper boat assistance is often needed. These conditions also force tows to wait almost 3 miles upstream to allow passage of upbound tows. All small-scale measures are currently under consideration.

Summary of AAHU Changes at Lock and Dam 22

Habitat Type	Location 2	Location 3	Location 4
Bottomland Forest	-48.90	-48.90	-48.90
Main Channel	No Evaluation	No Evaluation	U = -0.29 D = 1.38
Main Channel Border	U = -284.07 D = -33.22	U = -284.42 D = -31.96	U = -292.44 D = -41.61

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at L/D 22 include clearing of bottomland forest for staging, impacts caused by the placement of wing dikes in the main channel border upstream from the lock and by channel changes/dredging in locations upstream and downstream. A known mussel bed and State-designated sanctuary exist downstream from the lock outside the impact area. Additional surveys were conducted within proposed construction areas in October 1997. Those surveys found a possible mussel bed located on the right descending bank upstream from the lock where the series of wing dikes is proposed. Mussels were collected in other areas but not in large concentrations or in densities that would suggest a bed exists.

Location 2

Bottomland Forest - Construction would involve the clearing of approximately 22 acres of bottomland forest for staging and equate to a total loss of 48.90 AAHUs. This would include impacts to two separate areas of bottomland forest. The upstream area is approximately 12 acres and loses 32.66 AAHUs. The majority of losses would be for hairy woodpecker (-10.34), prothonotary warbler (-11.35), and pileated woodpecker (-5.99). Of note at this location is wood duck brood rearing with a result of -3.68 AAHUs. This is one of the few bottomland forest sites in the analysis where the brood rearing habitat was impacted. The 10 acres downstream that would be cleared for staging would lose 16.24 AAHUs. This loss is made up of pileated woodpecker (-5.42), hairy woodpecker (-4.36), and wild turkey (-3.91), and other species losing <2.0 AAHUs.

Main Channel Border - It was projected from looking at TABS models that the impacts to the main channel border from the upstream wing dikes would include the transition to frequently inundated and moving sand substrate but not creation of land. Given this assumption, a total of 73 acres of main channel border would be affected, resulting in a loss of 284.04 AAHUs. Species with the largest AAHU losses would be paddlefish spawning (-41.02), emerald shiner (-39.03), and walleye winter (-36.43) AAHUs. Only one species, walleye reproduction (-2.41 AAHUs), would have losses less than 15 AAHUs. Complete results can be found in Appendix D. An additional 0.03 AAHU would be lost due to the upstream guidewall where sauger shows a minor loss while channel catfish shows a minor gain.

Downstream, an area of 6.5 acres behind the guidewall would be filled and result in a loss of 31.19 AAHUs. This includes paddlefish spawning (-5.30), lake sturgeon forage (-5.04), and emerald shiner (-5.18), with other species losing from 0.10 to 3.9 AAHUs. An additional 2.02 AAHUs would be lost due to the effect of the lock itself on a 7-acre area. Walleye winter (-1.93) contributes the majority of that loss.

Location 3

Bottomland Forest - Impacts are identical to those described for Location 2 as the same staging area would be required for each.

Main Channel Border - Upstream, the changes are identical to those described for Location 2.

Downstream, an area of 6.8 acres behind the guidewall would be altered by decreased velocity and increased turbidity but would not result in an area loss. This causes the loss of 25.77 AAHUs. Contributing to this are gains for walleye winter (12.49) and channel catfish (4.36), and losses for paddlefish spawning (-18.82) and lake sturgeon reproduction (-12.57). An additional 6.19 AAHUs are lost due to the effect of the lock itself on 11 acres. Contributing to this are walleye winter (-3.14) and lake sturgeon forage (-2.51) AAHU losses.

Location 4

Bottomland Forest - Impacts are identical to those described for Location 2 as the same staging area would be required for each.

Main Channel Border - The upstream impacts due to the dike field are the same as for Locations 2 and 3. The need to replace gates in the overflow section of the dam would cause a loss of 7.69 AAHUs. This loss would be made up of lake sturgeon forage (-2.71), walleye winter (-2.33), and channel catfish (-1.14). The other species would have changes <1.0 AAHU. The lock upstream causes a <1.0 AAHU loss.

On the downstream side below that new gate, 12.41 AAHUs would be lost, with the largest losses seen in walleye winter (-4.16) and lake sturgeon forage (-3.77) AAHUs. Downstream, an area of 23.1 acres behind the guidewall would be altered by decreased velocity and increased turbidity resulting in a loss of 24.63 AAHUs. Walleye winter shows a 15.13 AAHU increase. Channel catfish, paddlefish, and emerald shiner also would show small gains (<3 AAHUs). Losses would be seen in paddlefish spawning AAHUs (-18.82) and lake sturgeon forage AAHUs (-12.57). Smaller losses were seen in the remaining species. An additional 4.57 AAHUs would be lost due to the effect of the lock itself, of which (-3.27) would come from walleye (winter).

Main Channel - Areas of main channel both upstream and downstream would require deepening and result in -0.29 AAHU upstream (walleye winter, lake sturgeon forage) and a gain of 1.39 AAHUs downstream (lake sturgeon forage, paddlefish adult).

c. Conclusions. Each lock location alternative has equal HU impacts for bottomland forest because each includes impacts to the same areas for staging. If the staging area were relocated or reduced in size, those impacts could be avoided or

minimized. Upstream impacts to main channel border are quite large due to the dike field proposed for the area and occur equally for each proposed lock option. In addition to the large number of HUs lost from that measure, a mussel bed would potentially be impacted. Downstream impacts to main channel border are similar and all result from the guidewall extension and reduced velocities associated with it. Unlike Locations 2 or 3, the Location 4 alternative includes impacts to main channel habitat with a downstream increase in AAHUs and minor upstream loss.

Pertinent small-scale measures include mooring cells or remote re-make facilities both upstream and downstream. Shoreline damage would be particularly alleviated along the Missouri shoreline downstream of the lock. If proposed for implementation, these facilities would be evaluated in detail. Approach improvements duplicate those proposed as large-scale measures, but do not include the main channel dredge areas. Hence, estimated habitat impacts would likely be the same for the upstream dike field (a large loss due to eventual conversion to semi-terrestrial habitat) and lockwall extensions (velocity reductions landside of the wall).

4. Lock and Dam 24.

a. Construction Alternatives.

Locations 2, 3, or 4 - Construction alternatives at this site are described in detail in the Engineering Appendix and include lock extensions (to 1,200 feet), 1,200-foot guardwall construction, and 1,200-foot guidewall construction at Locations 2, 3, or 4. Placement of a new lock in Location 4 would involve the removal of two existing gates and subsequent gate replacement in either the overflow section of the dam or in the auxiliary lock, or both. **NOTE**: The series of upstream wing dikes depicted on the site map (Appendix A) is no longer under consideration.

Staging Area - The staging area at this site includes the bankline below the lock. The staging area would involve some clearing of bottomland forest, but the majority is already developed for municipal or residential use.

Small-Scale Measures - Severe outdraft conditions exist in the upper lock approach, but this problem is currently being addressed as part of major rehabilitation work at this site. Therefore, the series of wing dikes proposed as both a large- and small-scale measure is no longer under consideration. All other small-scale measures are being evaluated for this site.

Summary of AAHU Changes at Lock and Dam 24

Habitat Type	Location 2	Location 3	Location 4 with Gate in Auxiliary Bay	Location 4 without Gate in Auxiliary Bay
Bottomland Forest	-4.71	-4.71	-4.71	-4.71
Main Channel Border	U = 0.08 D = -29.47	U = 0.11 D = -44.19	U = -7.84 D = -34.97	U = -5.24 D = -59.10

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at L/D 24 include losses of bottomland forest and alteration of main channel border. Initially, placement of "L" dikes along the upstream right descending bank was evaluated for non-forested wetland impacts. However, these measures have been removed from consideration. The results are summarized in general below and described in more detail in Appendix D (SHEP outputs). The following results are summarized by lock location and all include staging areas. A concentration of mussels was found downstream of the lock near the Clarksville, Missouri, shoreline.

Location 2

Bottomland Forest - Staging area impacts would include the temporary clearing of a 5.84-acre strip of bottomland forest and result in a loss of 4.71 AAHUs. These impacts would include pileated woodpecker (-3.07), hairy woodpecker (-2.42), and an increase in gray squirrel AAHUs (1.60). Other changes were <1.0 AAHU. Gray squirrel increases can be attributed to the low HSI in without-project conditions and projected habitat value after 25 and 50 years of regeneration.

Main Channel Border - The presence of a new upstream guardwall resulted in an increase of 0.08 AAHU for paddlefish spawning.

Downstream, an area of 14.67 acres behind the guidewall would be impacted by decreases in velocity and increases in sedimentation, resulting in a loss of 19.4 AAHUs. Walleye winter AAHUs increase with this change and have an increase of 5.22 AAHUs. Losses include paddlefish spawning (-12.31) and lake sturgeon forage (-7.05). All other species had changes <3.0 AAHUs. The 9.5-acre area affected by the lock and riverward of the guidewall would lose 10.07 AAHUs, the majority of which would be lake sturgeon forage (-6.55) and walleye winter (-2.54) AAHUs.

Location 3

Bottomland Forest - Staging area impacts with this lock location are identical to those described above in Location 2.

Main Channel Border - The presence of a new upstream guardwall resulted in an increase of 0.11 AAHUs with losses in channel catfish habitat and gains in lake sturgeon forage habitat.

Downstream, an area of 33.62 acres behind the guidewall would be impacted by decreases in velocity and increases in sedimentation and result in a loss of 31.52 AAHUs. Walleye winter habitat would have a gain of 11.97AAHUs and channel catfish would have a gain of 1.11 AAHUs. Paddlefish spawning would have a loss of -28.22 AAHUs, lake sturgeon reproduction -6.82 AAHUs, and sauger -6.59 AAHUs. Other species record changes of <3 AAHUs. The 8.5-acre area riverward of the guidewall would lose 12.67 AAHUs, of which the majority would be lake sturgeon forage (-5.90) and walleye winter (-4.62) AAHUs, with the other species recording changes <1.0 AAHU.

Location 4 with Gate in Auxiliary Bay

Bottomland Forest - Staging area impacts would be the same as those described above in Location 2.

Main Channel Border - Upstream changes in velocity and depth resulting from construction of a replacement gate in the overflow section of the dam resulted in a decrease of 4.68 AAHUs. Lake sturgeon (-1.47) and channel catfish (-1.02) contributed to this, as did other species with changes <1.0 AAHU. The presence of a new upstream guardwall resulted in a decrease of 3.16 AAHUs, of which the majority were walleye winter AAHUs (-1.91) with others registering changes <1.0 AAHU.

Downstream from the replacement gate within the overflow section, 10.68 AAHUs would be lost in a 7-acre area. Lake sturgeon forage (-6.92) and walleye winter (-6.38) registered the largest losses, while changes in the other species were < 1.0 AAHU. Lake sturgeon reproduction (2.35) and paddlefish spawning (1.63) registered gains with the new gate. An area of approximately 34 acres would have altered velocity landward of the downstream lock and guardwall. This area would lose 11.93 AAHUs, of which lake sturgeon forage (-8.53) and walleye winter (-5.43) contributed the majority. Channel catfish (2.44) and walleye summer (1.93) registered AAHU gains in the area. The area of approximately 9 acres affected by the lock and guardwall lost a sum of 12.36 AAHUs. The majority of these were lake sturgeon forage (-5.9) and walleye winter (-4.62) AAHUs.

Location 4 without Gate in Auxiliary Bay

Bottomland Forest - Staging area impacts would include the same impacts as described above in Location 2.

Main Channel Border - Upstream changes in velocity and depth resulting from construction of a replacement gate in the overflow section of the dam resulted in a decrease of 4.68 AAHUs. Lake sturgeon (-1.47) and channel catfish (-1.02) AAHUs contributed to this, as did other species with changes <1.0 AAHU. The presence of a new upstream guardwall resulted in a loss of 0.56 AAHU. That includes loss of emerald shiner AAHUs (-2.28) and gains in walleye winter (1.18) and lake sturgeon reproduction (0.52) AAHUs.

Downstream, due to velocity changes behind the guidewall, an area of approximately 34 acres would lose 36.07 AAHUs. Similar to other sites where this occurs, walleye and channel catfish register increases in AAHUs while paddlefish spawning (-28.22), lake sturgeon reproduction (-16.15), sauger (-7.63), and lake sturgeon forage (-4.12) show AAHU losses. The area impacted by the lock and guidewall is approximately 8.5 acres and shows a loss of 12.36 AAHUs. This is mainly made up of walleye winter (-4.62) and lake sturgeon forage (-5.90) AAHUs, with others registering changes <1.0 AAHU. Downstream from the replacement gate within the overflow section, 10.68 AAHUs would be lost in a 7-acre area. Lake sturgeon forage (-6.92) and walleye winter (-6.38) registered the largest AAHU losses while other changes were < 1.0 AAHU. Lake sturgeon reproduction (2.35) and paddlefish spawning (1.63) AAHUs registered gains with the new gate.

c. Conclusion. Each lock location has the same impact to bottomland forest resulting from the staging area. If the staging area could be relocated or reduced in size, those impacts could be avoided or minimized. Location 2 has the fewest impacts to main channel border resulting from impacts behind the guidewall, but these could potentially be decreased by measures to provide flow behind that wall.

Mooring facilities are generally adequate upstream. Downstream mooring cells would be beneficial on the Clarksville riverfront and on the opposite shoreline along Clarksville Island. These and any remote re-make facilities would be evaluated on a case-by-case basis. Remaining channel improvements include lockwall extensions and re-shaping of the bankline immediately above the existing guidewall. Loss of AAHUs would be expected due to velocity reductions and sedimentation behind the walls. The bank excavation would primarily be in a developed area, and impacts would likely be minimal.

5. Lock and Dam 25.

a. Construction Alternatives. Construction alternatives at this site are described in detail in the Engineering Appendix and include a new 1,200-foot lock at Location 1 and lock extensions (to 1,200 feet) at Locations 2, 3, or 4. All locations include construction of a 1,200-foot guidewall downstream of the lock and a 1,200-foot guardwall upstream of the lock.

Location 1 - At this location, a 1,200-foot lock would be constructed through the downstream tip of Sandy Island adjacent to the lock. This location would require extensive channel excavation upstream and downstream of the island, as well as extensive excavation of the island itself. The wing dam upstream of the lock would be removed. The upstream levee would have to be realigned. Creating a downstream approach would require both channel and land excavation.

Location 2 - No land excavation would be required upstream but some land excavation, though not to the extent as for Location 1, would be required to improve the downstream lock approach. No channel excavation is needed.

Location 3 - Neither channel nor bankline excavation is required. The removal of the existing downstream landside guidewall would be needed to provide access to the existing lock.

Location 4 - No excavation for the lock would be required. Placement of a new lock in Location 4 would involve the removal of two existing gates and subsequent gate replacement in either the overflow section of the dam or in the auxiliary lock, or both. Placement of the gate would require some dredging in the overflow area.

Staging Area - The proposed construction staging area includes the existing lock island and an agricultural field just west of the adjacent Sandy Slough bridge.

Small-Scale Measures - Outdraft varies from moderate to severe and is aggravated by trash accumulation in the ports of the upper guardwall. All measures are currently under consideration.

Summary of AAHU Changes at Lock and Dam 25

Habitat Type	Location 1	Location 2	Location 3	Location 4 with Gate in Auxiliary Lock	Location 4 without Gate in Auxiliary Lock
Bottomland Forest	-51.61	-5.39	-13.57	-14.56	-14.56
Main Channel Border	U = 40.96* D = 78.13*	U = -0.02 D = -36.08	U = -0.25 D = -41.30	U = -2.2 D = -15.52	U = -1.52 D = -28.01
Non-Forested Wetland	No Evaluation	No Evaluation	No Evaluation	-.04	-.04
Side Channel	-3.79	No Evaluation	No Evaluation	No Evaluation	No Evaluation

*Equates to an increase in AAHUs resulting largely from a habitat conversion from bottomland forest to main channel border.

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at L/D 25 include losses of bottomland forest and non-forested wetland habitats, as well as alteration of side channel and main channel border habitat. The results are summarized below and described in more detail in Appendix D (SHEP outputs). The following results are summarized by lock location and all include staging area impacts. A mussel survey located a possible bed on the right descending bank that would be impacted by construction at Location 1. There was also a concentration of mussels found near the first dam gate upstream from the overflow section of the dam; this area would be impacted by a replacement gate.

Location 1

Bottomland Forest - Construction of a new lock in Location 1 would include the permanent loss of 24 acres of bottomland forest. Most of it would be converted to main channel border or the lock itself. The clearing in the immediate vicinity of the lock facility includes approximately 15 acres and the loss of nearly 30 AAHUs. This can be seen in the Appendix D (sites 6U and 7U). The majority of those AAHU losses are for hairy woodpecker (-14.31), pileated woodpecker (-7.67), and wood duck nesting (-5.7).

An additional 8.83 acres adjacent to the river approximately 1/2 mile downstream from the lock would be cleared and converted to main channel border for the lock approach. That clearing would cause a loss of 22.15 AAHUs made up of hairy woodpecker (-6.75), pileated woodpecker (-4.56), wild turkey (-4.30), wood duck nesting (-4.10), gray squirrel (-2.32), and prothonotary warbler (-0.12) AAHUs.

Side Channel - The upstream levee would be relocated along the east bank of Sandy Slough. The SHEP output showed a decrease of 3.79 AAHUs due largely to loss of streamside shrub and tree canopy cover. The majority of this loss (-3.78) would be for beaver.

Main Channel Border - Construction in Location 1 causes a large increase in main channel border habitat area resulting from the conversion of bottomland forest. Upstream impacts include the removal of an "L" dike for creation of the lock approach. Two sample areas were evaluated, one upstream of the dike and one downstream. The upstream area exhibited a loss in 1.42 AAHUs. This is made up of changes <1.0 AAHU per species and can be seen in Appendix D. Downstream of the "L" dike, there is a gain of 3.15 AAHUs. This change is made up of a combination of gains [lake sturgeon reproduction (5.97) and gains of <1.0 AAHU for sauger, walleye reproduction, and emerald shiner] and losses [lake sturgeon forage (-2.37), channel catfish (-1.29), with other species losing <1.0 AAHU]. Significant gains (39.23 AAHUs) would be seen in the area where 8.6 acres of terrestrial habitat would be converted to the channel approach. This includes walleye winter (7.70), emerald shiner (7.67), lake sturgeon forage (6.67), and sauger (5.91) AAHUs, as well as gains by other species.

Downstream, the gain of 78.13 AAHU can largely be attributed to the 15-acre gain in aquatic habitat. The conversion of bottomland forest to aquatic area for a lock approach downstream contributes 45.93 AAHUs, of which paddlefish spawning (7.81), walleye winter (7.91), and lake sturgeon forage (6.85) show the largest increases. Immediately adjacent to the lock where 6.9 acres would be converted to aquatic habitat, a gain of 29.63 AAHUs is seen. Walleye winter (6.18), lake sturgeon forage (5.35), and emerald shiner (4.93) AAHUs show the largest gains in this area. An additional area between the two described above would be deepened and would account for a 2.57 AAHU increase. At this site, the majority of change is in lake sturgeon reproduction (3.48), with the other species showing smaller changes.

Location 2

Bottomland Forest - With construction in Location 2, the bottomland forest adjacent to the existing facility would be cleared for staging. Staging area impacts would include the temporary clearing of 15.5 acres of bottomland forest and result in a loss of 13.57 AAHUs. This consists of losses for pileated woodpecker (-5.73), hairy woodpecker (5.74), and wood duck nesting (-4.52). Increases would be seen in gray squirrel AAHUs (2.67). Other species showed changes <2.0 AAHUs.

Immediately downstream, predicted changes in habitat from main channel border to bottomland forest 25 years after project completion, due to a loss of velocity and subsequent increases in sedimentation behind the guidewall, resulted in an increase of 8.18 AAHUs. This includes hairy woodpecker (2.53), pileated woodpecker (1.71), wild turkey (1.60), and wood duck nesting (1.32) AAHUs. Overall, bottomland forest AAHUs decreased by 5.39 at Location 2.

Main Channel Border - Main channel border habitat upstream from the lock would decrease by a very modest 0.02 AAHU, all from channel catfish. Downstream main channel border habitat decreased by 36.08 AAHUs. Most of this decrease (-30.41 AAHUs) was caused by the aforementioned conversion of 4.96 acres of main channel border to bottomland hardwood forest 25 years after project completion. This change includes paddlefish spawning (-6.28), walleye winter (-5.96), and lake sturgeon forage (-4.85) AAHUs. The result of a slight increase in depth and velocity riverward of the guidewall caused a loss of 2.77 AAHUs made up of small decreases <1.0 AAHU per species. Downstream of the guidewall, 2.9 AAHUs were lost, with walleye winter (-1.93) making up the majority.

Location 3

Bottomland Forest - Staging area impacts would be the same as those described above in Location 2 (-13.57 AAHUs). There would, however, be no other bottomland forest impacts.

Main Channel Border - The presence of a new upstream guardwall resulted in a minor decrease of 0.25 AAHU. Sauger (-0.73) made up the majority of this loss, while several other species showed minor gains of <0.5 AAHU.

Downstream, an area of 14.81 acres behind the guidewall would be impacted by decreases in velocity and increases in sedimentation, resulting in a loss of 14.07 AAHUs. Of this, paddlefish spawning (-13.10) showed the largest loss, while an increase was seen for walleye winter (3.35) AAHUs. The area (15.22 acres) riverward of the guidewall would lose 24.66 AAHUs due to increases in velocity and depth. Lake sturgeon forage (-11.81), and walleye winter (-7.54) made up the majority of this AAHU loss, with other species showing changes of <2.0 AAHU. Similar increases in velocity and depth resulted in a loss of 2.57 AAHUs downstream of the guidewall on the right descending bank. Of this change, walleye winter (-1.93 AAHUs) made up the majority. Overall main channel border habitat decreased downstream by 41.3 AAHUs.

Location 4 with Gate in Auxiliary Bay

Bottomland Forest - Staging area impacts would be the same as those described above in Location 2. For the replacement of gates in the overflow section, a 2.2-acre area of bottomland forest would be removed. This forest was low quality and had little habitat value to begin with due to frequent flooding and heavy erosion. However, 0.99 AAHUs would be lost from a combination of hairy woodpecker, prothonotary warbler, and gray squirrel AAHUs.

Non-Forested Wetland - This 0.65-acre area is adjacent to the bottomland forest to be cleared for the replacement gates. Again, this location is subjected to water level fluctuations and flooding and has little existing habitat value. The evaluation showed that a loss of 0.04 AAHU would occur in mallard habitat.

Main Channel Border - The presence of a new upstream guardwall resulted in a decrease of 0.65 AAHU. This includes small losses for lake sturgeon and channel catfish, with a slight gain for paddlefish, all of which are <1.0 AAHU. Upstream changes in velocity and depth resulting from construction of a replacement gate in the overflow section of the dam resulted in a decrease of 1.55 AAHUs. The majority of those were for channel catfish (-0.72) and lake sturgeon reproduction (-0.50) AAHUs.

Downstream, a decrease of velocity landward from the guidewall caused a loss of 2.52 AAHUs. Walleye winter (-2.98) and lake sturgeon reproduction (-1.06) AAHUs accounted for the majority of this loss, with gains of <1.0 AAHU seen for several species. Increases in velocity and depth riverward of the guidewall caused a loss of 26.75 AAHUs. Lake sturgeon forage (-11.91) and walleye winter (-9.35) AAHUs made up the majority of this loss, while others would lose <2.0 AAHUs. Construction of a new overflow gate resulted in an increase of 13.75 AAHUs, of which lake sturgeon reproduction (3.70), emerald shiner (2.27) and paddlefish spawning (2.43) would make up the majority. This increase was due to a change of

2.2 acres of bottomland forest and 0.65 acre of non-forested wetland to main channel border habitat. Overall, there was a 15.52 AAHU loss downstream of the lock and dam.

Location 4 without Gate in Auxiliary Bay

Bottomland Forest - Staging area impacts would include the temporary clearing as is described above in Location 2. For the replacement of gates in the overflow section, a 2.2-acre area of bottomland forest would be removed. This forest was low quality and had little habitat value to begin with due to frequent flooding and heavy erosion. However, 0.99 AAHU would be lost from a combination of hairy woodpecker, prothonotary warbler, and gray squirrel AAHUs.

Non-Forested Wetland - The impacts would be the same as those described above in Location 4 without the gate in the auxiliary bay.

Main Channel Border - Upstream changes in velocity and depth resulting from construction of a replacement gate in the overflow section of the dam resulted in a decrease of 1.55 AAHUs. The majority of those were for channel catfish (-0.72) and lake sturgeon reproduction (-0.50) AAHUs. The presence of a new upstream guardwall resulted in a minor increase in lake sturgeon reproduction (-0.03) AAHUs.

Downstream, changes in velocity and depth behind the guidewall caused a decrease of 15.01 AAHUs. The majority of this would be paddlefish spawning (-13.10) and lake sturgeon reproduction (-7.06). However, lake sturgeon forage, channel catfish, and walleye winter exhibited gains. Increases in velocity and depth riverward of the guidewall caused a decrease of 26.75 AAHUs. The majority of this was lake sturgeon forage (-11.81) and walleye winter (-9.35) AAHUs. Construction of a new overflow gate resulted in an increase of 13.75 AAHUs. This increase was largely due to a change of 2.2 acres of bottomland forest and 0.65 acre of non-forested wetland to main channel border habitat. Lake sturgeon reproduction (3.70), emerald shiner (2.27), and channel catfish (1.85) AAHUs were the largest gains.

c. Conclusions. Location 1 has the most extensive impacts resulting from lock construction landward of the existing lock. Impacts to bottomland forest would be the greatest with construction at Location 1 and include removal of trees utilized by the bald eagle during feeding. That measure also impacts the side channel (Sandy Slough) and impacts the mussel bed located upstream. There are increases in main channel border AAHUs, however, they are the result of the conversion from bottomland forest to main channel border. Of the alternative lock locations, Location 4 with gate replacement through the auxiliary lock is the least environmentally damaging. It has the least impacts to bottomland forest and no side channel impacts. Impacts to bottomland forest could be minimized through relocation of the staging area. Non-forested wetland impacts are minimal, and losses to main channel border could be minimized.

Regarding small-scale measures, mooring and remote re-make facilities are proposed both upstream and downstream. The Missouri shoreline downstream of the lock would be spared damage with mooring cell placement. Channel excavation would be significantly reduced, particularly upstream, due to the absence of new lock construction at Location 1. Lockwall extensions are proposed, as well as a small area of bank re-shaping adjacent to the upstream guardwall. Downstream wall extension and bank excavation would likely result in the same negative impacts as observed in the large-scale analysis.

6. Peoria Lock and Dam.

a. Construction Alternatives. Alternatives at this site are described in detail in the Engineering Appendix and include new lock construction or lock extension (to 1,200 feet), as well as an upstream guardwall and downstream guidewall.

Location 1 - The upstream riverward approach wall would begin about 400 feet upstream of the I-474 Bridge. This would locate the upper lock gates about 800 feet downstream of the bridge. A 200-foot-wide canal would be excavated starting just upstream of the bridge and would narrow to 150 feet wide at the lock. The I-474 Bridge piers just landward of the canal would be reinforced and the landward slope of the canal riprapped. Downstream, the existing navigation channel would be widened from the lower lock gates downstream for a distance of about 3,600 feet back to the existing channel and the landward slope would be riprapped. This location impacts pipeline crossings and three commercial docks.

Location 2 - An upstream lock extension gives a better open pass condition and requires no dredging above or below the lock. A downstream extension requires about 30,000 cubic yards of channel dredging just below the lock.

Staging Area - The area required for staging at this site extends in a strip from just upstream from the I-474 Bridge to downstream of the lock at approximately River Mile 157. It includes both bottomland forest and developed (commercial/ industrial) areas.

Small-Scale Measures - Open pass conditions exist approximately 40% of the time. At low to normal flows, approach conditions are good. Most small-scale measures are under consideration here.

Summary of AAHU Changes at Peoria Lock and Dam

Habitat Type	Location 1	Location 2
Bottomland Forest	-14.45	-14.45
Main Channel Border	U = -0.28 D = 0.34	U = -0.04 D = -12.68

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at Peoria Lock and Dam include the temporary clearing of bottomland forest for staging and main channel border impacts due to placement of the lock. Existing mussel surveys were not available for the immediate vicinity. Rock Island District staff conducted exploratory brail surveys but did not find any concentrations in the area.

Location 1

Bottomland Forest - A total of approximately 12.5 acres would be temporarily cleared for staging and result in the loss of 14.45 AAHUs. The majority of losses would be in hairy woodpecker (-9.83) and pileated woodpecker (-5.67) AAHUs. With the regeneration of the habitat, wild turkey (3.12) and prothonotary warbler (0.66) would gain AAHUs.

Main Channel Border - Construction would convert land to a lock but still result in a minor loss in main channel border habitat value. Upstream, a loss of -0.28 AAHU would result from velocity changes induced by the lock and guidewall. These are made up of small losses to sauger, walleye, and emerald shiner. Downstream, placement of riprap on the bank resulted in a 0.34 AAHU increase, mainly a result of sauger AAHU increases (0.55).

Location 2

Bottomland Forest - Bottomland forest impacts would be the same as those discussed with Location 1.

Main Channel Border - Construction would affect main channel border habitat upstream by altering velocities around the lock and guardwall, resulting in a loss of 0.40 AAHU. These consist of small losses to sauger, walleye, and emerald shiner. Downstream, the lock, guardwall, and dredging would result in a loss of 12.68 AAHUs. The majority of this AAHU loss would be in lake sturgeon reproduction (-5.13) and paddlefish spawning (-5.50).

c. Conclusions. Impacts to bottomland forest habitat are the same for both alternatives and are a result of staging area requirements. The impacts could be avoided or minimized with relocation or resizing of the staging area. Location 2 has greater impacts to main channel border due to velocity changes behind the guidewall downstream of the lock. Those impacts may be minimized by maintaining flow in that area.

Upstream of the lock there are limited opportunities for mooring or re-make facilities. The downstream bankline would be protected from current damage with the placement of mooring cells. Guidewall extensions are limited upstream due to the highway bridge; there is the possibility of constructing wing or vane dikes in this area to re-align currents and protect the bridge piers. These would need further environmental evaluation if implemented. There is no proposed channel realignment related dredging.

7. La Grange Lock and Dam.

a. Construction Alternatives. Construction alternatives at this site are described in detail in the Engineering Appendix and include new lock construction or lock extensions (to 1,200 feet), an upstream guardwall, and a downstream guidewall. Extensive channel work would be needed upstream of the lock to provide an efficient approach to the lock, particularly if a riverside approach wall is used above the lock to increase safety as tows approach to the lock. The dredging depth would be 12 feet below flat pool.

Location 1 - Shifting the lock downstream approximately 200 feet in relation to the existing lock would reduce the channel work somewhat, but dredging would still be extensive and require a longer 200-foot-wide approach canal to the upper lock gates. Approximately five river training structures (wing dikes) would be required along the left descending riverbank above the lock to direct river current to the right bank. These dikes would be about 200 feet long and spaced at 500-foot intervals. The dikes would have a top elevation 2 feet above flat pool and would be constructed from the river with floating plant equipment. Downstream, the existing navigation channel would be widened at the lower lock gates and return to the existing channel. The landward slope of the navigation channel and canal would be riprapped.

Location 2 - Upstream, with a 1,200-foot approach wall on the river side of the lock, extensive channel widening would be required, though not to the extent as for Location 1. The five wing dikes described in Location 1 would be needed along the left descending riverbank. Channel widening downstream of the lock is not required.

Staging Areas - Staging would take place in a narrow strip adjacent to the existing lock that is now under cultivation.

Small-Scale Measures - Approach conditions are generally good, although tows can be pinned to the bank by natural currents since the lock is on an outside bend. Most small-scale measures remain under consideration.

Summary of AAHU Changes at La Grange Lock and Dam

Habitat Type	Location 1	Location 2
Bottomland Forest	-61.15	-50.98
Main Channel Border	U = 104.32* D = 65.48*	U = 29.36* D = -0.08
Non-Forested Wetland	-9.57	-9.57

* Equates to an increase in AAHUs resulting from a habitat conversion from bottomland forest.

Detailed reporting of results including acreage, HSI, and AAHU by species and sample site is available in Appendix D.

b. Habitat Impacts. Impacts at this site include extensive clearing of bottomland forest and conversion to main channel border, a levee setback that impacts wetlands, and conversion of agricultural fields to main channel border. No known mussel beds exist in the area.

Location 1

Bottomland Forest - Construction at Location 1 would include the permanent clearing of approximately 24 acres and temporary clearing of 19 acres. The area permanently cleared would be converted to main channel border and the remainder was assumed to regenerate to bottomland forest. The result is a loss of 61.15 AAHUs. These results are from a combination of three different sampling areas, each of which is detailed in Appendix D. Impacts to wild turkey (-18.02), wood duck nesting (-19.5), and hairy woodpecker (-19.14) AAHUs comprise the majority of those losses.

Non-Forested Wetland - A total of 16 acres would be affected by the project; 9.5 acres would be permanently lost due to widening of the navigation channel and associated levee setback. The remainder was assumed to eventually revert to wetland habitat. This would result in a loss of 9.57 AAHUs including sora rail (-4.37), mallard (-2.06), Western chorus frog (-1.79), and muskrat (-1.35) AAHUs.

Main Channel Border - Due to channel widening and conversion of bottomland forest to main channel border, approximately 24 acres would be gained equating to a gain of 100.76 AAHUs. Species with large AAHU gains include: lake sturgeon forage (19.14), paddlefish spawning (19.35), and walleye winter (17.96). The wing dikes placed on the opposite bank would result in an increase of 3.56 AAHUs, most of which would be lake sturgeon forage AAHUs (2.39).

Downstream, approximately 18 acres would be converted from agricultural to main channel border and cause a gain of 65.48 AAHUs. The largest gains would be in paddlefish spawning (17.86), lake sturgeon forage (10.71), and sauger (9.96) AAHUs.

Location 2

Bottomland Forest - Construction at Location 2 would include the permanent clearing of approximately 5 acres and temporary clearing of 37 acres. The area permanently cleared would be converted to main channel border and the rest was assumed to regenerate to bottomland forest. The result of these actions would be a loss of -50.98 AAHUs, including wood duck nesting (-19.49), wild turkey (-14.27), and hairy woodpecker (-15.76).

Non-Forested Wetland - Habitat impacts would be identical to those described for Location 1.

Main Channel Border- Upstream main channel border area will be increased due to widening and conversion from bottomland forest. Approximately 5 acres will be gained through construction in Location 2, resulting in a gain of 25.85 AAHUs. The majority of this increase would be in walleye winter (7.96), paddlefish spawning (4.23), and lake sturgeon forage (4.19) AAHUs. The proposed wing dikes on the opposite bank would result in an increase of 3.56 AAHUs, mainly as a result of gains in lake sturgeon forage (2.39) and channel catfish (0.70) AAHUs. The placement of the upstream guardwall results in a small loss of 0.05 AAHUs.

Downstream, the acreage does not change, but decreased velocity from the guardwall causes a loss of 0.08 AAHUs. This change is made up of an increase for walleye winter (8.37) and loss for paddlefish spawning (-8.31), with other species registering changes of <1.0 AAHU.

c. Conclusions. Due to the extensive channel changes proposed, both construction alternatives at this site include extensive impacts to bottomland forest and non-forested wetlands. Location 2 has slightly fewer impacts to bottomland forest. The increases seen to AAHUs of main channel border species are largely driven by the losses of other habitat types. It should be noted that this is the only location where suitable water conditions for Western chorus frog were located during sampling. Habitat was located in the non-forested wetland.

Mooring facilities would be beneficial downstream to alleviate damage on the right descending bank where the bank is presently eroding; some sites are also under consideration upstream. Opportunities for remote re-make facilities are limited. The large channel excavation area upstream would remain as a small-scale measure, along with the series of dikes on the opposite shoreline. The SHEP evaluation showed large habitat impacts to bottomland forest. No channel changes are proposed downstream.

B. Estimated Habitat Replacement Costs. Though no mitigation is being planned at this time, potential measures to replace the impacts and costs of those measures have been estimated. While not mitigation planning, the process of replacing habitat impacts followed both U.S. Army Corps of Engineers guidance for mitigation planning (ER 1105-2-100, pp. 7-35) and U.S. Fish and Wildlife Service Mitigation Policy. The amount of effort expended to protect habitats is proportional to their value and scarcity. As with any project, measures that avoid and minimize impacts should be sought prior to attempting to replace the habitat impacted. Mitigation planning may also result in the recommendation to acquire and preserve existing habitat.

The U.S. Fish and Wildlife Service Mitigation Policy identifies four resource categories. Within this project, habitats were considered to fall within Categories 2, 3, or 4. Resource Category 2 is defined as high value habitat that is scarce or becoming scarce, Resource Category 3 is habitat with high to medium value and abundant, and Resource Category 4 is medium to low habitat value and abundant.

Habitats identified as Resource Category 2 are bottomland hardwood forest, non-forested wetland, and side channels. The goal is to have no net loss of in-kind habitat value for those identified as Resource Category 2. However, to determine the habitat replacement cost it is assumed that those habitats will be replaced in-kind (same kind of habitat value and functions). Replacement for habitats considered Resource Category 2 will be calculated at a 3:1 ratio. By providing three AAHUs for every one lost, this ratio provides compensation for the time that it takes the replacement habitat to become fully functional and assumes that some portions of the measures may not be fully successful. Main channel border and main channel habitat may be considered within Category 3, high to medium habitat value and abundant, with the goal of no net loss in habitat value while minimizing the loss of in-kind habitat value. It may also be within Category 4, medium to low habitat value and abundant, with the goal of minimizing loss of habitat value. Trade-off between main channel habitat and other habitat types may be considered during detailed mitigation planning. For replacement cost estimation, a 1:3 ratio was assumed. This ratio accounts for the trade-off in replacement of an abundant habitat (main channel border) with one that is high value and becoming scarce (side channel).

Traditional HEP requires that a habitat replacement location be chosen and evaluated for mitigation planning. Due to the magnitude of this project and uncertainty of exact site-specific habitat impacts, it was cost and time prohibitive to choose habitat replacement sites at this time. Instead, for each habitat type impacted by the project, replacement measures were considered and the resulting habitat changes projected through use of the HEP spreadsheet program. Trends used to project future habitat changes reflect those used in evaluation of project impacts and known effects of certain measures. The required acreage and restoration measures to achieve habitat replacement were used to estimate a dollar cost to compensate for each habitat type impacted.

Measures required to replace AAHUs lost due to proposed navigation improvements were developed using known habitat restoration measures such as those within EMP-Habitat Restoration and Enhancement projects, UMRS Section 1135 projects, and other environmental restoration projects. Habitat improvements resulting from those measures were determined and projected using the HEP spreadsheet. Acreage required to adequately replace AAHUs lost due to project impacts was determined from the equation of (HSI * Acre = HUs). With the known factors being the quality of habitat (HSI) over the life of the project and the replacement goal (HU or AAHUs), the acreage of compensation area was increased until the replacement goal (AAHUs) was met. HUs were annualized over the 50-year project life.

Costs reflect estimates to compensate for the HU value and are based on the best available information with a 25% contingency (fall 1997 dollars). Planning, engineering and design (PED), supervisory and administrative (SA), and plans and specifications (P&S) costs are all included and calculated at 25% for projects over $1 million and 40% for projects under $1 million. This is based upon guidance for Section 1135 Environmental Restoration projects and discussion with Rock Island District Environmental Engineering staff. Site-specific planning may change the cost or the measure required for habitat replacement, which could increase or decrease costs significantly.

1. Bottomland Hardwood Forest Habitat Replacement. Habitat Replacement for bottomland forest impacts will ensure that the biological productivity of bottomland forests is replaced in-kind (ER 1105-2-100, P.L. 98-662). In order to ensure replacement of bottomland forested wetland functions and values, this replacement area should be within the floodplain and accessible to flooding.

It was assumed that a non-forested or previously cleared area would be utilized to carry out the needed habitat creation. In order to estimate the replacement cost of AAHUs lost in any one impact area, forest replacement was estimated using the same bottomland forest species models as were used in performing HEP. Projection of the succession of the area was estimated using assumptions of what would be planted or constructed and those applicable assumptions made during the HEP analysis.

Bottomland hardwood forest habitat creation would include the following:

- Creation of potholes or other low areas within area to be planted to forest. Assume that wetland plant species will occupy the area when the necessary hydrology is returned.
- Establishment of high areas to be planted with mast-producing trees such as swamp white oak, northern pecan, pin oak, burr oak, and walnut.
- Soft mast will include natural generation of silver maple. However, to diversify the presence of soft mast trees, sycamore, hackberry, persimmon, and mulberry should also be planted. Cottonwood should be included to provide large nesting or roost trees for bald eagle.
- All trees should be balled and burlapped and approximately 3 to 6 feet in height. This will increase the survival of the trees and improve chances of success.
- Seed with acorns throughout the area.
- A ground cover such as red top should be planted to reduce erosion and the amount of encroachment by weedy species.
- Shrubs and other ground cover will generate naturally.
- Wood duck nest boxes will be placed on the site.

Though not included in this estimate, an alternative for planting would include a combination of balled and burlapped trees, 12- to 18-inch seedlings, and acorns throughout the area.

The following costs were located in the Cottonwood Island HREP Project and Mast Tree Section 1135 Project and estimated as follows:

Hard mast trees (B&B) - $140/tree at 75 trees/acre = $10,500
Acorn seeding dispersed throughout - $100/acre
Soft mast trees (B&B) - $100/tree at 50 trees/acre = $5,000
Ground cover (red top) - $240/acre

Potholes - $14,000/acre with one pothole for every 10 acres

Land Acquisition - $3,000/acre

Total $18,840/acre plus $14,000 for every 10 acres (potholes) = ~$20,240
With 25% Contingency = **$25,300**
Levee Work - $425/linear foot
Construction/Setback - $425/linear foot

Ranges are included at some sites. Those ranges reflect that land may be available between levees (low cost) or that there may not be land available and it would need to be connected to the river (high cost). Levee cost depends on replacement site and amount of area needed for replacement. To estimate costs, sample areas adjacent to the river that may provide suitable land for compensation were used.

2. Side Channel Habitat Replacement. Replacement of AAHUs representing the biological productivity of side channel habitat was estimated from the cost to restore and maintain a side channel. Since side channels on the Upper Mississippi River System are being filled due to sedimentation, replacement of the habitat will be in-kind with no loss of habitat value (AAHUs).

Restoration of a side channel may include the following measures: tree clearing, grading and shaping, and dredging. This depends on the side channel selected to restore. Maintenance of a side channel may include wing dikes or other structures to reduce sediment input and direct flow to the side channel. Deep holes and rock structures within the channel are also measures that would add to the habitat value.

Side channel restoration at the Cottonwood HREP was estimated to cost $40,000/acre of side channel restored. This included clearing, grading and shaping, dredging, and deep hole creation.

Total $40,000/acre
25% Contingency **$50,000/acre**

3. Non-Forested Wetland Habitat Replacement. Wetlands are of high value and are becoming scarce. In order to accomplish the goal of no net loss of wetland habitat values and functions, they will be replaced in kind. It was assumed that a non-wetland or previously converted wetland would be utilized in habitat creation.

Wetland restoration costs are extremely variable and difficult to estimate. Costs for wetland restoration/mitigation were taken from the literature for estimation.

Fischenich et al. (1995) discussed costs ranging from $30,000-$50,000 per acre to restore emergent wetlands. King and Bohlen (1994) described a study of wetland restoration projects where the average cost of wetland mitigation was $49,000/acre; however, that included pre-project planning and post-project monitoring. For estimation purposes, the

average cost of $40,000 dollars per acre will be required to replace non-forested wetland habitat. With 25% Contingency **$50,000/acre.**

4. Main Channel Border/Main Channel Habitat Replacement. Due to its abundance, main channel and main channel border habitat has been classified as Resource Category 3 or Category 4. Since it is relatively abundant throughout the system, measures will be sought to minimize the loss in habitat value but not necessarily seek replacement. If habitat replacement is deemed necessary during detailed site-specific evaluations and mitigation planning, habitat losses may be replaced out of kind. This will be accomplished by replacing habitat that is currently scarce or becoming scarce such as side channel or backwaters.

Measures that will minimize habitat impacts may include wing dam notching, off-bank revetment, chevron dikes, or other innovative techniques. Potential measures to replace main channel/main channel border habitat include enhancement of existing habitat through wing dam notching, off-shore revetment, creation of deep holes, or additional rock placement. Out-of-kind habitat replacement may include side channels, backwaters or other habitats that are scarce or becoming scarce within the system.

Replacement costs have been estimated assuming out-of-kind replacement with the available replacement plan and costs for side channels. Since habitats being replaced or enhanced are more scarce, and thus more valuable biologically, than main channel border, this was calculated at a 1:3 ratio. This estimation is considered a most costly scenario and does not preclude measures that minimize impacts to the habitat.

5. Estimated Site-Specific Habitat Replacement Costs.

These estimates are not to be considered as actual value of these habitats. They are merely a best available estimate of cost to compensate for the habitat impacted. In no way can all habitat functions or values be replaced. Compensation measures and costs are also subject to change after further review.

Where a 0 is given for main channel border habitat, it reflects a gain in habitat and no replacement required. That gain resulted from a loss in other habitats and therefore does not accurately reflect habitat impacts.

Lock and Dam 20 Habitat Replacement Costs

Habitat Type	Location 2	Location 3	Location 4	Wicket Gate
Bottomland Forest	$1,062,600 - $2,223,750	$495,880 - $1,717,750	No Impacts	$779,240 - $1,970,750
Main Channel Border	0	0	$450,000	0
Side Channel	0	0	0	$2,750,000
Mussels	No known concentrations	No known concentrations	No known concentrations	No known concentrations
Endangered Species	bald eagle, Indiana bat (minimized without wicket)	bald eagle, Indiana bat (minimized without wicket)	bald eagle, Indiana bat (minimized without wicket)	bald eagle, Indiana bat (minimized without wicket)

* The 0 in side channel reflects a slight increase in habitat value resulting from the project and no habitat replacement is required.

Lock and Dam 21 Habitat Replacement Costs

Habitat Type	Location 2	Location 3	Location 4
Bottomland Forest	$2,593,250 - $5,398,250	$2,593,250 - $5,398,250	$1,328,250 - $2,730,750
Main Channel Border	$70,000	0	$210,000
Mussels	Potential beds right bank upstream and downstream	Potential beds right bank upstream and downstream	Potential beds right bank upstream and downstream
Endangered Species	bald eagle, Indiana bat, 2 mussels potential	bald eagle, Indiana bat, 2 mussels potential	bald eagle, Indiana bat, 2 mussels potential

Lock and Dam 22 Habitat Replacement Costs

Habitat Type	Location 2	Location 3	Location 4
Bottomland Forest	$2,087,250 - $4,079,438	$2,087,250 - $4,079,438	$2,087,250 - $4,079,438
Main Channel Border	$2,250,000	$2,250,000	$2,370,000
Mussels	Bed upstream in proposed wing dam field	Bed upstream in proposed wing dam field	Bed upstream in proposed wing dam field
Endangered Species	Indiana bat, bald eagle, mussels	Indiana bat, bald eagle, mussels	Indiana bat, bald eagle, mussels

Lock and Dam 24 Habitat Replacement Costs

Habitat Type	Location 2	Location 3	Location 4	
Bottomland Forest	$247,940	$247,940	$247,940	
Main Channel Border	$280,000	$350,000	Without Gate $560,000	With Gate $350,000
Mussels	Potential mussel bed downstream	Potential mussel bed downstream	Potential mussel bed downstream	
Endangered Species	Indiana bat, bald eagle, decurrent false aster, fat pocketbook; avoid bald eagle perch trees during staging	Indiana bat, bald eagle, decurrent false aster, fat pocketbook; avoid bald eagle perch trees during staging	Indiana bat, bald eagle, decurrent false aster, fat pocketbook; avoid bald eagle perch trees during staging	

Lock and Dam 25 Habitat Replacement Costs

Habitat Type	Location 1	Location 2	Location 3	Location 4	
Bottomland Forest	$2,213,750	$283,360 Minimizable	$708,400 Minimizable	$708,400 Minimizable	
Side Channel	$910,000	Side channel impacts avoidable	Side channel impacts avoidable	Side channel impacts avoidable	
Non-Forested Wetland	No gate replacement	No gate replacement	No gate replacement	$70,000 Gate replacement impact	
Mussels	Mussel bed upstream	Mussel bed is avoidable	Mussel bed is avoidable	Potential mussel bed upstream	
Main Channel Border	0	$350,000	$350,000	Without Gate $280,000	With Gate $140,000
Endangered Species	bald eagle perch trees, Indiana bat	Potentially avoid impacts	Potentially avoid impacts	Potentially avoid impacts	

La Grange Lock Habitat Replacement Costs

Habitat Type	Location 1	Location 2
Bottomland Forest	$2,624,875 - $5,485,656	$2,213,750 - $5,074,531
Main Channel Border	0	0
Non-Forested Wetland	$1,190,000	$1,190,000
Mussels	No known concentrations	No known concentrations
Endangered Species	Indiana bat, decurrent false aster, bald eagle	Indiana bat, decurrent false aster, bald eagle

Peoria Lock Habitat Replacement Costs

Habitat Type	Location 1	Location 2
Bottomland Forest	$506,000	$506,000
Main Channel Border	$70,000	$140,000
Mussels	No known concentrations	No known concentrations
Endangered Species	Indiana bat, decurrent false aster	Indiana bat, decurrent false aster

V. ASSOCIATED ANALYSES

A. Upper Site Assessments. As noted in the "Project Description" section of this report, less detailed, qualitative assessments were conducted for the upper UMR-IWW lock and dam sites. Separate assessments, each somewhat different in character, were conducted for the Mississippi and Illinois.

1. Mississippi Locks and Dams 11-19. Two 1-day meetings were held in June 1997 with pertinent resource agency personnel to discuss resources of concern and potential construction impacts at these locks. The approach taken was to utilize planning maps similar to those used at the lower sites (illustrating proposed locations of large-scale measures - Appendix A), other existing information, and resources of concern originally identified at initial site visits conducted in 1994. Agency participants were asked to update the latter pieces of information as appropriate, and all the assembled information was then used to make a general determination of impacts. Our intention was also explained to extrapolate information from the lower site assessments, in terms of AAHUs and habitat replacement costs, to similar impact situations at these areas.

a. L/D 19, Keokuk, IA. The existing lock is one of only two 1,200-foot locks on the system, but its inherent capacity is compromised by severe approach conditions due to its location on the inside of a sharp bend. Approach conditions are further complicated by severe upstream cross-currents and two bridges just downstream of the lock. Only Location 3 is a feasible placement for a new lock. The primary footprint impacts here are due to lock construction and downstream dredging to improve the approach (Appendix A). The dredging, along with guidewall extensions, are proposed as small-scale improvements. The dredging would impact an area of rock/rubble bottom that is a known walleye spawning area; the adjacent near-shore area has been identified as a potential mussel bed. Recreational fishing areas adjacent to the lock chamber and power plant would also be affected, and it would be desirable to provide fishing access to or around any new lock facility. Landside impacts appear to be minimal, though part of the proposed staging area may affect a field that has reverted from agricultural use. General points made were that there is considerable silting in and hence shallowing upstream of the lock. It was suggested that a beneficial use for dredged material would be for island construction upstream of the lock.

b. L/D 18, Burlington, IA. Existing approach conditions are considered to be good at this site. Possible new lock construction would be at Locations 2, 3, or 4 (Appendix A). Due to the marshy nature of the area adjacent to the lock, staging areas are immediately adjacent to the lock or some distance upland on the Illinois side. Structural small-scale measures include guidewall extensions and a small dredging area upstream of the lock (would also be dredged as part of any large-scale measure). Illinois officials voiced concerns with the loss of a downstream boat access, as well as impacts to the Oquawka State Refuge, particularly with lock Location 2. Flows introduced by gate replacement for lock Location 4 would impinge on a small island, with potential shoreline impacts to bottomland hardwoods. A large area immediately downstream of the lock (approximately 4 river miles) has been identified as a potential mussel bed.

c. L/D 17, New Boston, IL. This lock has a relatively straight approach, though some outdraft problems exist. It is also one of the few sites where both a Location 1 and a wicket gate option remain under consideration. Lock Locations 2, 3, and 4 are also included (Appendix A). Proposed approach improvements (including dredging, bank excavation and re-configuration of wing dikes) pose major environmental impacts. Various combinations would apply to both large- and small-scale measures, as well as the wicket gate option. There is an identified mussel bed as well as secondary endangered mussel habitat just upstream of the lock; both would be impacted by proposed approach improvements. The complexity of this lock site necessitates that each possible lock location be discussed in turn.

For Location 1, the largest area of terrestrial (bottomland hardwood) habitat would be lost to excavation (approximately 40-45 acres; a similar-sized area at La Grange L/D resulted in an AAHU loss of 61.1) and a levee would require relocation. Two existing wing dikes upstream would be removed for this location. A somewhat lower acreage of bankline would require excavation for Location 2; the current wing dike configuration would remain unchanged. New wing dikes (5 total) would be required for Locations 3 and 4, and again a somewhat reduced landside area would be excavated as these locations are farther toward the channel. Any guidewall extensions done as a small-scale measure would require landside excavation (approximately 6 acres), and an upstream extension would require the dike field (5 dikes).

The wicket gate option requires extensive dredging both upstream and downstream. A popular walleye fishing area would be impacted downstream, and major agency opposition was expressed concerning the required closure of connecting channels in the area of Turkey Island and Turkey Chute.

d. L/D 16, Muscatine IA. Existing approach conditions at this site are relatively poor, particularly on the downbound approach. Upstream approach improvements would be required in the form of channel excavation and a series of wing dikes; two existing dikes would also be removed. The extent and alignment of the dredge areas varies by lock location, as indicated on the planning map (Appendix A). Upstream guide/guardwall extensions as a small-scale measure would also require the dredging of corresponding channels. The channel would go through a submerged island, which would be subject to re-filling; it is estimated that the channel would establish itself within 5 years. The dredged area would potentially impact plant beds and duck blind locations; this requires confirmation from area waterfowl/wildlife biologists. The proposed filling of a deep hole just below the dam and adjacent to a Location 4 lockwall may impact an existing fishery. Mussel beds have been documented both upstream and downstream of the lock within the analysis area; these locations would require confirmation. Terrestrial impacts are limited at this site; approximately 7 acres of forest and wetland would be lost on the gate replacement area.

e. L/D 15, Rock Island, IL. L/D 15 is located in a highly urbanized area between the cities of Davenport, IA and Rock Island, IL. Several physical constraints limit

the available options here to a lock extension at Locations 2 or 3, extending in the upstream direction only (Appendix A). Outdraft conditions (a situation where tows are pulled away from the lock chamber by currents flowing towards the dam) can be severe at this site, and the entire Pool 15 (the pooled area above the lock and dam) is one of the most congested on the system. Proposed approach improvements consist of five submerged wing dikes upstream and a deflection dike downstream at the mouth of Sylvan Slough (the large side channel behind Arsenal Island); there is no dredging proposed. The forebay upstream of the lock would be used for staging, thus limiting terrestrial impacts; however, a portion of the island near the opening of this bay would need to be cut back.

Two major resource concerns were identified. One is the potential presence of a rich mussel bed upstream of the lock. This bed would fall directly under the lock footprint as well as be affected by the wing dike placement. Downstream, a known walleye spawning area occurs near the tip of Arsenal Island, and this could potentially be impacted by any lockwall extensions as well as the planned deflection dike.

f. L/D 14, Le Claire, IA. Due to the lock's location on a bend and existing flow conditions, considerable maneuvering is required on approaches here. The lock is adjacent to Smith's Island, which in turn separates it from the Le Claire Canal, a historically and environmentally sensitive side channel area (Appendix A). A small lock at the downstream end of the canal serves recreational and Corps maintenance fleet traffic. An additional complication at this site is a proposed hydropower project, which has been under consideration for some time but still awaits a final decision. If this proposal were implemented, all flow would need to be diverted when it is in operation.

Considerable dredging is proposed to alleviate the approach problems; the majority would be upstream. A portion of the upstream dredging coincides with identified secondary habitat for the endangered Higgins' eye mussel; possible presence of this species, as well as other mussel resources in the area, would need to be confirmed with detailed surveys. More detailed impact assessments would also require information on fisheries. The upstream tip of Smith's Island would also be lost to the dredging; this portion is non-forested wetland. Resource agency personnel also pointed out that a large portion of the island is proposed for staging or placement, and this would be unacceptable due to wetland impacts. The agencies also suggested rock placement at various locations in the main channel and in Le Claire Canal itself to provide submerged structure and flow diversion.

g. L/D 13, Fulton, IL. Approach conditions are generally good at this site, but wind can be a problem as the pool is quite wide (Appendix A). Resource concerns were considered to be minimal. A popular sport fishery (walk-in and boat) would be lost in the Location 4 gate replacement area, along with approximately 4 acres of forested area. Any new lock construction itself was not considered to have any potential fisheries impacts; however, a possible exception is a Location 2 downstream guidewall extension (proposed as both a large- and small-scale measure) interfering with a stream confluence. Also, the proposed filling of a deep hole (for Location 4) in the tailwater is a concern; such holes are especially favored by paddlefish. There is no existing information on mussel resources at this site. It was suggested that material from the upstream dredge cut be used

to extend the existing rock wall and create a protective barrier for the adjacent backwater area. The downstream dredging would remove a large (~12 acres) swath of bottomland hardwoods, with the acreage becoming aquatic area. Similar situations at the lower lock sites resulted in bottomland hardwood habitat losses of as much as 40 AAHUs. Again, it was suggested that the dredged material could be placed in the channel to provide additional structure.

h. L/D 12, Bellevue, IA. Outdraft can be a problem here on the upstream approach. The downstream exit can also be problematic as tows have a difficult time getting off the wall and avoiding a protruding wing dam; dredging is proposed to help alleviate this problem (Appendix A). Similar to L/ D 13, two large deep holes exist below the dam, and again one would be filled in the event of Location 4 lock construction. Both holes are valuable areas for fish. Also related to a Location 4, gate replacement and the removal of wing dams downstream would severely impact popular sport fishing areas. In terms of the downstream lock footprint, the entire area is considered good fish habitat (suspected walleye and sauger spawning sites), and two boat ramps also would be affected. These ramps provide important access points to local residents, given their immediate proximity to the city of Bellevue. The resource agencies emphasized the recreational and public use importance of this area, noting that the city relies heavily on the river and its resources. They also suggested a good enhancement opportunity would be to place the replacement gates at the mouth of a major side channel near the end of the overflow section of the dam; this would avoid fishery impacts while introducing flow into the backwater complex. A major concern also exists in terms of mussel impacts, since at least three beds have been identified in the analysis area; one of these would be directly impacted by downstream lock extensions.

i. L/D 11, Dubuque, IA. This lock is situated on the inside of a bend, and there is a substantial outdraft problem on the upper approach. For large-scale measures, only a Location 2 or 3 lock extension remains under consideration. Additional measures under consideration consist primarily of various dike configurations upstream and downstream (small-scale would only be upstream) of the lock to train new channel alignments (Appendix A). Some existing dikes would also be removed on the left descending bank downstream of the dam. There is no dredging proposed. A deep hole in the tailwater would be filled, but no immediate concern was raised with this as had been at other sites. Agency personnel also felt that a downstream wall extension may actually enhance fisheries by creating more slackwater habitat. Information on mussel resources is limited, but the endangered Higgins' eye is known to occur below the dam on the left bank; this area is not likely to be affected by any measure. Additional surveys would be needed for the area in general prior to any identified construction.

2. Upper Illinois River Locks and Dams (Lockport to Starved Rock). Initial Navigation Study planning determined that large-scale measures would not be warranted above Peoria Lock and Dam on the Illinois River, due primarily to current and projected commercial traffic levels. Thus, consideration of possible improvements at sites above La Grange focused on small-scale measures, and these are primarily non-structural. One exception would be extensive dredging under consideration above the Marseilles lock to

alleviate congestion due to a narrow, shallow channel. Consideration of these measures took place at a series of on-site meetings on December 10-11, 1996. In attendance at these meetings were study team members, lockmasters, an industry representative, and a representative from the Illinois Department of Natural Resources. The discussions focused on existing approach conditions and other time-consuming elements of the lockage process at each site. Natural resource concerns were generally limited, but a brief site-by-site summary is presented as follows:

a. Lockport Lock, Lockport, Illinois. Approach conditions are generally good, but a canal width restriction upstream requires tow re-configuration. Physical limitations do not allow guidewall extensions either upstream or downstream. Additional tow assistance may be helpful, as well as a pair of downstream mooring cells. No resource concerns were identified.

b. Brandon Road Lock and Dam, Joliet, Illinois. The major concern upstream is wind; even a relatively light wind can affect tow entry and exit. Downstream, a shallow, rock bottom canal makes tow passage difficult. No structural measures were considered aside from mooring cells (two below the lock and one above). Again, no resource concerns were voiced at this site.

c. Dresden Island Lock and Dam, Morris, Illinois. Approach conditions are generally good, but upbound tows have difficulty with a narrow railroad bridge opening. This bridge actually is a major impediment, and consideration has been given by other agencies to its removal or replacement. Additional mooring cells were again recommended as the most useful measure at this site. These would be particularly beneficial upstream where tows presently push into the bank near I&M Canal Preserve lands, with resultant resource damage.

d. Marseilles Lock, Marseilles, Illinois. This site is generally considered as the major bottleneck on the entire Illinois due to the narrow, shallow 2.5-mile approach canal above the lock. Downstream, existing mooring cells are considered a hazard because they are improperly located; a similar situation also occurs above the lock. Industry would consider removal of these cells beneficial, and strategic placement of new cells upstream and downstream would lessen resource damage to banklines. Extended guidewalls are also considered as a potential benefit at this site; exact length and position are yet to be determined. The other major structural improvement recommended at Marseilles is channel improvements in the upstream canal. The current approach would be to excavate specific passing areas rather than dredge the entire canal; the latter would be problematic due to costs as well as limitations imposed by considerable rock substrate. Preliminary studies have been done on this proposal, including planning for dredged material placement. Environmental studies would need to be expanded or supplemented. The general area was identified during the site visit as a world class walleye/sauger fishery, and concerns were voiced on the impact of any channel alterations as well as ongoing siltation in the canal.

e. Starved Rock Lock, Utica, Illinois. The upstream approach is considered good at Starved Rock; downstream, a narrow channel that is subject to silting in makes the

approach difficult. A recommendation will be carried forward that a submerged dike or similar structure be considered to remedy this situation; if siltation can be limited, placement of a mooring cell here would also help bankline impacts to Plum Island. Discussion of additional tow assistance revealed that any consideration of a remote mooring facility upstream would need to consider potential impacts on submerged historic properties (the submerged Delbridge Island). No other structural measures were considered, other than those immediately associated with the lock facility.

B. Tailwater Impact Analysis. The U.S. Fish and Wildlife Service voiced concern that the HEP procedures used in this study would not adequately evaluate the impacts resulting from construction-induced changes in the tailwaters, mainly those changes occurring in the main channel. To address those concerns, available aquatic habitat in the tailwater was determined using output from calibrated depth and velocity models. Description of this modeling effort can be found in Appendix E. The effect of new construction was determined by comparing the amount of available habitat before construction with the amount of habitat available after construction. This type of analysis has been used in past studies (dealing with both regulatory dams and hydropower generation) by melding depth, velocity, and substrate parameters into a grid, matrix or contour diagram(s) (Wilcox D.B., 1987). A similar approach was employed for this study using depth and velocity data. Initially, substrate data (when available) were also included in this analysis but were later removed due to concerns about extrapolating the data. Using the known habitat requirements of selected fish species, output from the models was used to determine increases and decreases in habitat. It was determined that of the remaining construction alternatives, lock Location 4, with a replacement of a gate in the overflow section, would be the alternative most likely to cause changes in the tailwater. Consequently, that alternative was modeled and evaluated at each lock and dam.

The models were developed using velocity and depth information from existing sources. Substrate information was collected in 1997 at Locks and Dams 22, 25, and La Grange. At the time of substrate sampling, prototype velocity data were collected to allow further model calibration. This sampling was specifically designed to match the draft outputs of the hydraulic modeling, so transect and sample point spacing was concentrated in areas of predicted velocity change. Descriptions of the substrate sampling and hydraulic modeling are included below. Additional substrate information was incorporated from ponar samples taken during mussel surveys performed in 1997.

Substrate, velocity, and bathymetric data were imported into Arc Info to identify and quantify existing habitat and to determine changes in habitat with construction of a 1,200-foot lock and guidewall at Location 4. With the input of biologists from the U.S. Fish and Wildlife Service, Illinois Department of Natural Resources, and Missouri Department of Conservation, a group of fishes was chosen to reflect habitat changes in the tailwaters. The known habitat requirements (velocity and depth) of those species were used to determine available habitat. Substrate data were not extensive enough to allow incorporation into a grid or accurate extrapolation throughout the entire tailwaters, but are generally discussed relative to habitat gains and losses. Evaluations were conducted for Locks and Dams 20-25 on the Upper Mississippi River. Appendix F illustrates and summarizes changes in available habitat by species and by lock and dam. Results are presented in Section 6 of

this report. Though substrate data were collected at La Grange, complete analyses were not performed at this site or at Peoria Lock and Dam. For Peoria, only a 1-dimensional hydraulic model exists, and no models were ever developed for La Grange. There is no Location 4 lock option at either of these sites, and recent (preliminary) economic and traffic forecast information indicates that recommendation of large-scale measures at these sites is unlikely in the foreseeable future. Thus, model development or detailed analyses were not considered appropriate.

Table 8 shows the fishes and habitat variables evaluated in this study. The information included came from Habitat Suitability Index Models (Blue Books) and from Instream Flow Incremental Methods (IFIM) published by the U.S. Fish and Wildlife Service.

TABLE 8: Habitat Variables Used in Tailwater Analysis

Species	Velocity(cm/sec)	Depth (m)	Flow (cfs)	Substrate*
Lake sturgeon forage	2-58	.23-10.5	50,000-75,000	silt, sand, gravel, cobble
Lake sturgeon spawning	6-150	.15-6	95,000-120,000	gravel, cobble, boulder
Channel catfish general	0-26	Any	50,000-75,000	logs, boulders, brush, debris
Paddlefish spawning	25-No limit	No limit	95,000-120,000	gravel, cobble
Paddlefish foraging	0-38	2.4-No limit	50,000-75,000	any
Sauger/walleye spawning	42-115	Any	95,000-120,000	gravel, cobble, boulder, bedrock
Sauger/walleye winter	0-11	1.4-No limit	50,000-75,000	any
Emerald shiner general	0-50	Any	high and low flows	any
Largemouth bass general	0-13	Any	50,000-75,000	vegetation, logs, debris
Largemouth bass spawning	0-4	Any	95,000-120,000	sand, silt, clay, gravel
Largemouth bass winter	0-1.2	Any	50,000-75,000	cover

*** Substrate was not used as a variable in the model. Substrate information, when available, was added to and evaluated with the modeling results.**

1. Description of Substrate Sampling. The majority of existing substrate data have been collected for very limited and specific project locations, primarily maintenance dredging. To extend data coverage in the tailwater areas under study and to complement other information on depth and velocity, substrate information was collected in 1997 at

three lock and dam sites—L/Ds 22, 25 and La Grange. The sampling design consisted of individual sample sites arranged in a grid system, and concentrated in areas where structural changes are proposed and where hydraulic models in turn predicted changes in velocity to occur. The majority of samples were collected downstream of the dam; upstream, safety was a major concern, and flow changes were predicted to be very localized.

The survey boat was equipped with differential Global Positioning System (GPS), allowing recording of coordinates for each site and ready import into GIS coverages of the overall tailwater. The sampling device was a 2-inch-diameter core sampler, and core lengths ranged from 1 inch to 10 inches. Field observations of samples were made and other pertinent information recorded at the time of sample collection. Sample sizes were as follows: L/D 22 - 53; L/D 25 - 22; and La Grange - 17. Samples were analyzed by the Rock Island District's Geotechnical Laboratory for grain size distribution (minus #200 sieve size) and D_{10} particle size. Classification of samples was in accordance with the "Unified Soils Classification System" (U.S. Bureau of Reclamation). All data were then color coded onto six broad categories and overlaid on existing GIS coverages of velocity and depth information.

2. Results. Areas of suitable velocity and depth for each species were calculated and are portrayed on the figures located in Appendix F. Summary changes in available habitat are also included. Habitat losses were defined as areas that, without the project, were suitable habitat for the species, but with the project would become unsuitable habitat. Habitat gains represent the change from unsuitable habitat before the project to suitable habitat after the project. Suitable velocity, depth, and substrate requirements for each species were determined utilizing the suitability index curves that were used in the site-specific HEP analysis. Values of 0.5 to 1 (on a 0-1 scale) were considered suitable. Values below 0.5, while still having some value to the species, were not considered suitable for this exercise.

As indicated in Table 8, low-flow conditions ranged from 50,000 to 75,000 cfs and high flow conditions ranged from 95,000-120,000 cfs. As mentioned in the introductory section, substrate information was not included in the actual analyses, but is discussed in a general manner.

It is important to remember that in this analysis only depth and velocity were modeled, and that other factors like substrate, turbidity, disturbance, and the availability of cover, to name a few, also influence the presence of particular species. Adequate depths and velocities do not ensure that a species will occur in areas that appear as suitable habitat. Instead, these analyses should be used as a general overview of the changes that are expected to occur at each lock and dam but do not indicate absolute gains or losses in habitat.

Lock and Dam 20

Lake Sturgeon - At low flows, most of the area landward of the proposed 1,200-foot lock would become unsuitable lake sturgeon foraging habitat. Discussions with the Missouri Department of Conservation indicated that some habitat might be enhanced in the eddy created near the end of the guidewall. Substrate in the area is suitable for lake sturgeon foraging, varying from silt and sand to gravel and cobble. The predominate substrate appears to be sand.

At high flows, the same area landward of the proposed lock becomes unsuitable spawning habitat, as do some areas adjacent to the small island on the left descending bank. Lake sturgeon require gravel, cobble, or boulders as spawning substrate. According to the lake sturgeon HSI model, sand is a poor spawning substrate. Ponar samples collected in 1997 showed that most of the area downstream of the gates on the left descending bank (indicated as suitable or lost habitat) does not have the substrate required for spawning. Samples collected downstream and near shore of the present lock revealed a high percentage ($\geq$50%) of suitable spawning substrate. The area directly downstream of the auxiliary lock bay, indicated as lost habitat, does not have suitable spawning habitat.

Channel Catfish - At low flows, there is an increase in available habitat landward of the lock and guidewall. Substrate sampled in the area ranged from gravel to silt, but consisted mostly of sand. A small area (approx. 1.5 acres) directly below the existing gates would become unsuitable habitat. These results are a good example where the model's output may not reflect actual gains and losses in habitat. Channel catfish have a strong association with cover (logs, debris, riprap, cavities), and areas without this cover will likely not provide high quality suitable habitat, regardless of velocity. This type of habitat, in association with the tailwaters, is usually found only along the banks of the river.

Paddlefish - At low flows, the model shows a mid-channel decrease in suitable paddlefish foraging habitat. Some small patches below the existing auxiliary lock bay also show a decrease in foraging habitat. Substrate in these areas is predominantly sand. Substrate, according to the paddlefish HSI model, is not a variable in determining foraging habitat.

At high flows, the area inside and downstream of the lockwall would become unsuitable spawning habitat. Based on ponar samples, some of the substrate in this area could be suitable for spawning (gravel, cobble). An area adjacent to the small island on the left descending bank also becomes unsuitable. The substrate within that area is a mixture of sand and gravelly sand and would not be suitable spawning substrate. The model indicates that most of the tailwater area (515 acres) is suitable spawning habitat. In actuality, most of this area probably does not have suitable spawning substrate.

Sauger/Walleye - At winter flows, the area inside the lockwall would become suitable overwintering habitat. The actual value of the habitat would likely be compromised by potential ice flushing through the lock and winter tow or recreational craft passage. Substrate at that site varies from sand to gravel and cobble.

During high flows, approximately 20 acres along the main channel border become unsuitable spawning habitat. Ponar samples collected along the right descending bank found some gravel and cobble in those areas of lost habitat. Most of the area indicated as suitable spawning habitat probably does not have suitable substrate (gravel, cobble, or rubble).

Emerald Shiner - At low flows, the entire tailwater shows a minor decrease in available habitat. This change is not large enough to appear on the figure (Appendix F). At high flows, a narrow strip along the new 1,200-foot lockwall and an area on the left descending bank become suitable emerald shiner habitat. Substrate in these areas varies from sand to gravel and cobble. A small area immediately below the dam would become unsuitable habitat.

Largemouth Bass - Like the channel catfish, largemouth bass have a strong association with bottom cover. Areas without cover may not be used, even with appropriate depths and velocities. Changes in these areas (the main channel and directly behind and below the proposed lock) are not as important as changes in areas with cover (the main channel border). Most of the changes in habitat at L/D 20 occur landward of the new lock and probably would not impact largemouth bass habitat. Very few habitat changes occur along the main channel border.

Lock and Dam 21

Substrate information from Lock and Dam 21 was not available.

Lake Sturgeon - With construction of the 1,200-foot lock, an area on the left descending bank adjacent to the existing boat ramp would become unsuitable spawning habitat at high flows. The results of the model also showed increases in suitable spawning habitat near the mouth of Monkey Chute and the replacement gate (on the right descending bank). Further discussions with the Missouri Department of Conservation indicated that neither area likely contained suitable spawning substrate.

At low flows, the model showed that a large area landward from the 1,200-foot lock and guidewall would become unsuitable lake sturgeon forage habitat. A large area below the gates in the main channel also becomes unsuitable. The area below the mouth of Monkey Chute and the replacement gate appears to become suitable lake sturgeon forage habitat. The types of substrates typically found in Mississippi river tailwaters are suitable for lake sturgeon foraging.

Channel Catfish - At low flows, most of the area landward and downstream of the 1,200-foot lock and guidewall (approx. 26 acres) would become suitable for catfish. A narrow band along the right descending bank, below the replacement gate, would become unsuitable catfish habitat (approx. 9 acres). The actual habitat value of these sites would likely relate to the amount of cover present. Given the location of the changes, it is not likely that either site in its entirety provides, or provided, good catfish habitat.

Paddlefish - At low flows, the area landward of the 1,200-foot lock would become unsuitable paddlefish forage habitat, while an area downstream of the lock would become suitable habitat. An area on the right descending bank, below the last existing gate, would also become unsuitable forage habitat.

At high flows, the area landward of the lock and guidewall becomes unsuitable for paddlefish spawning. An area downstream from the replacement gate on the right descending bank would become suitable for spawning. Discussions with the Missouri Department of Conservation indicated that essentially no suitable spawning habitat was available below L/D 21.

Sauger/Walleye - At low flows, a sizeable area (approx. 30 acres) landward and downstream of the 1,200-foot lock and guidewall becomes suitable wintering habitat. Similar to L/D 20, the value of the overwintering habitat would likely be a result of the regularity of ice flushing through the lock and winter tow or recreational craft passage. Small pockets of habitat (approx. 7 acres) throughout the tailwater become unsuitable wintering habitat.

At high flows, a large area (>30 acres) landward and downstream of the 1,200-foot lock and guidewall becomes unsuitable spawning habitat. Approximately 13 acres directly downstream from the proposed replacement gate would become unsuitable spawning habitat.

Emerald Shiner - The model results indicate that at low flows nearly 37 acres in the main channel would become unsuitable emerald shiner habitat. At high flows, 19 acres extending downstream from the replacement gate would become unsuitable habitat for emerald shiner. Approximately 30 acres of suitable habitat would be created behind and below the new lock and guidewall.

Largemouth Bass - Like the channel catfish, largemouth bass have a strong association with bottom cover. Areas without cover may not be used, even with appropriate depths and velocities. Changes in these areas (the main channel and directly behind and below the proposed lock) are not as important as changes in areas with cover (the main channel border). Most of the low-flow changes in habitat do not occur in these areas with cover. Those changes that do occur in the main channel border appear to be equally split between gains and losses in habitat. Adult overwintering and fry development habitat gains and losses are nearly equal, with 9.4 acres lost below the replacement gate and 9 acres gained landward of the guidewall.

At high flows, almost 6 acres below the replacement gate would become unsuitable spawning habitat. Approximately 21 acres landward of the 1,200-foot lock and guidewall would become suitable largemouth bass spawning habitat. Neither area likely provides, or provided, much suitable spawning habitat.

Lock and Dam 22

Lake Sturgeon - With construction of a 1,200-foot lock and guidewall, the area landward of the structures would become unsuitable foraging habitat at low flows according to the model. Substrate in the area, largely sands, provides suitable foraging substrate. A large area extending outside and downstream of the lockwall and guidewall would also become unsuitable forage habitat. Substrates in that area are also primarily sand. Near the overflow section of the dam there is an area that, based on Missouri Department of Conservation fish sampling data, is confirmed lake sturgeon habitat. This area shows both increases and decreases in available habitat at low flows. An area approximately 0.5 acre in size appears to become unsuitable forage habitat, while immediately downstream of the area a 0.9-acre area becomes suitable habitat. Substrate in that area consists of silts and sands.

At high flows, the area landward of the new 1,200-foot lock becomes unsuitable for lake sturgeon spawning. Substrate in the area is predominately sand, a poor spawning substrate. In fact, most of the area indicated as spawning habitat in the tailwater does not have a suitable spawning substrate (per substrate samples collected below L/D 22 and discussions with the Missouri Department of Conservation). Some small pockets below the overflow section are also projected to become unsuitable, while other small pockets in the same area are projected to become suitable spawning habitat. The model also indicated that the area inside the new lock chamber would become suitable spawning habitat. The location of this habitat, however, essentially negates its value.

Channel Catfish - At low flows, an area (approx. 30 acres) landward of the 1,200-foot lock and extending downstream becomes suitable habitat. A section extending downstream from the replacement gate (approx. 13 acres) becomes unsuitable habitat. Most of these changes occur in the main channel border where the chances of suitable cover are good.

Paddlefish - At low flows, the area landward of the 1,200-foot lock would become unsuitable paddlefish forage habitat. An area immediately downstream of the new lock and extending along the right descending bank would become suitable. On the opposite shoreline, extending downstream from the replacement gate, there is a loss of foraging habitat.

During high flows, a 30-acre area landward and downstream of the 1,200-foot lockwall and guidewall would become unsuitable spawning habitat. Substrate in that area is primarily coarse sand. Downstream from the replacement gate, approximately 12 acres of suitable spawning habitat is created. Substrate varies from rock to sand and silt. Substrate sampling actually indicated that very little suitable spawning substrate (gravel, cobble, and boulder) was present in the tailwater and that those areas with suitable substrate were not affected.

Sauger/Walleye - During low flows, the model indicated that an area extending downstream from the replacement gate would become unsuitable wintering habitat. A

moderately sized area landward and downstream of the 1,200-foot lock and guidewall becomes suitable wintering habitat. The value of the overwintering habitat would likely be a result of the regularity of ice flushing through the lock and winter tow or recreational craft passage.

At high flows, a large (>40 acre) area along the Missouri side of the river becomes unsuitable spawning habitat. Substrate samples showed that most of the area lost was sand, a poor spawning substrate. Some gravel was also found. Approximately 12 acres of habitat was created downstream of replacement gate. This area is mostly clays and sands, which are not good spawning substrates.

Emerald Shiner - At low flows, a slender area immediately landward and downstream of the 1,200-foot lock would be suitable emerald shiner habitat. A moderately sized (approx. 28 acres) mid-channel area becomes unsuitable habitat. Substrate in the area consists mainly of sand. At high flows, a long, slender main channel border area, landward and downstream of the 1,200-foot lock and guidewall, becomes suitable emerald shiner habitat. Substrate in this area is primarily coarse sand but includes some gravel. A slender section extending downstream from the replacement gate would become unsuitable for the species. Substrate varies from rock to silt and sand.

Largemouth Bass - At low flows, an area landward of the 1,200-foot lock near the existing auxiliary lock bay becomes unsuitable habitat. Substrate in the area is sand and silt. An area below the 1,200-foot lock and along the shoreline would become suitable habitat. Substrate in that area is primarily coarse sand but also contains some gravel. A section downstream from the replacement gate also becomes unsuitable largemouth bass habitat. Substrates in that section vary from rock to silt and sand. Discussions with the Missouri Department of Conservation revealed that most of these areas lack the necessary cover to be suitable largemouth bass habitat. Only those areas on the bank edge of the main channel border provide suitable cover. Those areas were largely unaffected.

Fry development and wintering habitat for largemouth bass increase immediately below and landward of the 1,200-foot lock and guidewall. This area probably has very little actual habitat for fry development (lack of cover), but may serve as overwintering habitat for adult fish. Substrates in that area consist of sand with some gravel. Habitat losses are clustered in small areas throughout the tailwater.

The area landward of the 1,200-foot lock and guidewall becomes suitable spawning habitat during high flows. Lack of cover and potential traffic disturbance make the value of this increased habitat questionable. Substrates in the area vary from silt to sand and gravel. Losses in spawning habitat occur in small patches throughout the tailwaters and in small areas along Cottell Island.

Lock and Dam 24

Lake Sturgeon - The model indicated that at low flows the area landward of the 1,200-foot lock and guidewall would be unsuitable lake sturgeon forage habitat. Further

discussions with the Missouri Department of Conservation indicated that some habitat might be created or enhanced in the eddy created near the end of the guidewall. A large mid-channel area from the lockwall to the head of Clarksville Island would also become unsuitable. Overall, 95 acres of forage habitat would be lost. Downstream, a narrow strip of area (approx. 7 acres) along the right bank would become suitable habitat.

At high flows, an area landward of the lock and guidewall would become unsuitable for spawning. That area is predominately coarse sand and small gravel. Other small areas near Clarksville Island and downstream on the right descending bank also become unsuitable spawning habitat. Substrate in those areas is unknown. Several small areas, totaling only 1.5 acres, would become suitable spawning habitat.

Channel Catfish - During low flows, the area landward of the 1,200-foot lock and guidewall becomes suitable channel catfish habitat. Substrates in the area are predominately medium to coarse sand and gravel. Losses in habitat are seen below the replacement gate, near the mouth of the Clarksville Island side channel. Losses are also seen throughout the side channel. Substrate near the mouth is primarily silt and fine sand. Substrate composition is not known in the side channel.

Paddlefish - The results of the model indicated at low flows that the lock chamber and an area downstream and landward would become suitable paddlefish forage habitat. Substrates in the area are believed to be predominately medium to coarse sand and gravel. The area immediately adjacent to the existing lock and auxiliary lock bay would become unsuitable habitat. In addition, two areas directly below the replacement gate would become unsuitable forage habitat. Substrates in these areas are primarily silt and fine sand.

At high flows, approximately 48 acres landward and downstream of the lock and guidewall would become unsuitable spawning habitat. Most of the area does not provide suitable spawning substrate. A small 7-acre area in the side channel, near the replacement gate, becomes suitable spawning habitat. Substrates in that area are primarily sand and are not suitable for spawning. Based on available ponar samples and Missouri Department of Conservation information, most of the area indicated as suitable spawning habitat does not have appropriate substrate.

Sauger/Walleye - At low flows, the model indicated that the area landward and downstream of the 1,200-foot lock and guidewall would become suitable wintering habitat. The same area also becomes unsuitable spawning habitat during high flows. Substrates in the area are believed to be predominately medium to coarse sand and gravel. Several areas downstream of the replacement gate would become suitable spawning habitat. Most of the area appears to be sand, a poor spawning substrate. Two large areas in the side channel also become suitable habitat. Substrate in those two areas is not known.

Emerald Shiner - At low flows, a strip along the right descending bank would become suitable emerald shiner habitat. The model also indicated that habitat would be lost immediately below the replacement gate and along Clarksville Island, extending into the main channel. At high flows, the strip of suitable habitat along the right descending bank

nearly doubles in size. Losses in emerald shiner habitat at high flows are seen at the mouth of the side channel and throughout the side channel adjacent to Clarksville Island.

Largemouth Bass - Approximately 36 acres landward and downstream of the 1,200-foot lock and guidewall becomes suitable habitat at low flows. Substrates in the area range from medium and coarse sand to gravel. Discussions with the Missouri Department of Conservation suggest that only the habitat near the bank could actually be suitable. The area immediately below the replacement gate (6 acres) becomes unsuitable largemouth bass habitat. Substrates were predominately silt and fine sand. Fry development and overwintering habitat increase landward of the guidewall. Again, most of this area would not be used by largemouth bass fry due to lack of cover. The area could provide overwintering habitat. Almost no fry development and overwintering habitat is lost (> 1 acre). The results for spawning habitat are similar. At high flows, almost 23 acres of habitat is created. All of these acres are landward of the 1,200-foot lock and guidewall. Sedimentation and tow passage could greatly diminish the value of this new habitat. No spawning habitat would be lost.

Lock and Dam 25

The model for L/D 25 was different from the other models. At high flows, the L/D 25 model had a gate placed in the auxiliary lock bay, landward of a Location 4 lock and guidewall. At low flows, the standard replacement gate position (in the overflow area) was modeled.

Lake Sturgeon - At low flows, the model showed a loss (10 acres) in foraging habitat. Most of these losses would be associated with the footprint of the new lock or area landward of the lock. There would also be habitat lost downstream in the main channel. Substrates immediately near the lock vary from fine to medium sand and some gravel. A small area immediately downstream of the existing lock would become suitable forage habitat. At high flows, an area directly below the mouth of Sandy Slough, along the right descending bank, becomes unsuitable spawning habitat. Substrates in the area range from fine to coarse sand, which are not suitable spawning substrates. Along the left descending bank, two thin ribbons of suitable habitat would be created. Substrates in those areas are believed to be predominately sand, an unsuitable spawning substrate.

Channel Catfish - At low flows, the area below the auxiliary lock bay becomes unsuitable catfish habitat, as does a small strip of habitat along the main channel border on the left descending bank. The predominate substrate below the auxiliary lock bay is sand. The model indicated that habitat would be created in the new lock chamber. This habitat in reality has little value. There would be an increase in habitat along the right descending bank below the mouth of Sandy Slough. Substrates in this area vary from sand to gravel and cobble.

Paddlefish - At low flows, foraging habitat would be lost within and landward of the 1,200-foot lock. A thin strip of habitat would also be lost along the left descending bank.

An area of suitable forage habitat would be downstream of the new lock and extending along the right descending bank. Substrates in that area are medium to coarse sands.

At high flows, paddlefish spawning habitat would be lost landward and downstream of the 1,200-foot lock and guidewall. Substrates in the area are mainly medium to coarse sands, but also include a small patch of gravel and cobble that would provide suitable spawning substrate. Small slender patches of spawning habitat would be created along the left descending bank. Substrate in the area is predominately sand, which is not a suitable spawning substrate. Discussions with the Missouri Department of Conservation suggest that most of the area that the models indicated was suitable habitat did not have appropriate spawning substrates.

Sauger/Walleye - Overwintering habitat at low flows would be created within the 1,200-foot lock chamber (low value habitat), immediately downstream of the lock, and along the right descending bank below Sandy Slough. Overwintering habitat would be lost immediately below the auxiliary lock bay.

At high flows, there is a loss of spawning habitat immediately downstream of the lock and in a sizable area below the mouth of Sandy Slough. Substrates throughout the area range from medium to coarse sands to gravel and cobble. There are also several long patches of suitable spawning habitat, the largest occurring below the overflow section along the left descending bank. Substrates in that area vary from silt and clay to sand.

Emerald Shiner - At low flows, there would be large areas of suitable habitat lost in the main channel. There would also be a loss of habitat directly below the auxiliary lock bay. At high flows, a sizable area landward and downstream of the 1,200-foot lock and guidewall becomes suitable habitat. Losses in habitat were seen along the left descending bank and in the main channel directly below the dam.

Largemouth Bass - During low flows, suitable habitat for adult and juvenile largemouth bass would be lost immediately below the auxiliary lock bay. This area probably would not provide suitable cover. Increases in suitable habitat would occur below the lock (adjacent to the guidewall), which would not provide suitable cover, and along the right descending bank near the mouth of Sandy Slough, which is likely to have suitable cover. Substrate in that area is medium to coarse sand.

Overwintering and fry habitat is almost non-existent in the tailwater and would slightly increase with a new lock and guidewall. Most of these areas would not be used by largemouth bass fry due to lack of cover. These areas could provide overwintering habitat.

At high flows, the lock chamber becomes suitable spawning habitat, but in reality has no spawning value. Spawning habitat would be created along the shoreline below Sandy Slough. Substrates in the area vary from medium and coarse sand to some gravel and cobble. A small amount of spawning habitat would be lost along the right descending bank.

3. Discussion. The habitat changes described previously are based on velocity and depth. Substrate information, when known, was included in the results. As stated earlier, many other factors and variables affect the suitability of habitat for the different species. Adequate depths and velocities do not ensure that a species will occur in areas that appear to be suitable habitat. Instead, these analyses should be used as a general overview of the changes that are expected to occur at each lock and dam and do not indicate absolute gains or losses in habitat. However, some conclusions can be drawn.

As in many large river systems, velocity appears to drive changes in habitat. In general, the placement of a 1,200-foot lock in Location 4 and the associated guidewall would cause a decrease in velocity landward of the structures. Replacement of the gates in the overflow section of the dam would increase velocities. Consequently, the area below the gate should scour and deepen, resembling the conditions below existing gates. **Conclusions should be made cautiously when evaluating these data.** They give a general idea of where velocity and depth have changed, but not that the habitat was suitable in the first place.

Lake Sturgeon - All five tailwaters examined in this analysis had net losses in forage habitat with the project. By percentage, losses in habitat in the tailwater ranged from 1.3% to 13.3%. Lake sturgeon are known to forage over a range of substrates (silt to cobble), most of which occurred in the analysis areas. Because substrates in the tailwater are suitable for foraging, it is likely that these losses in habitat are genuine. However, the significance of these losses is relatively small, as most of the Mississippi River provides suitable forage habitat. Net losses is spawning habitat were seen at every site except L/D 25, which showed a 2% increase in habitat. Losses at the other locks and dams ranged from 1.1% to 5.1%. Losses in habitat tended to occur landward and downstream of a new lock and guidewall. In most cases, the areas that became suitable spawning habitat were located along the bank opposite the new lock. It is difficult to determine if these changes (losses/gains) are real. Lake sturgeon spawn over a variety of substrates, with gravel, cobble, and boulder being the preferred (suitable) substrates according to the HEP model. These types of substrate are found, but are not abundant, in the tailwaters. Because these substrates are not abundant in the tailwater, determining their presence while sampling is difficult, and consequently determining actual changes in habitat is difficult. Likely, much of the area that the model reported as suitable habitat, based on depth and velocity, does not provide a suitable spawning substrate.

Channel Catfish - Four of the five tailwaters showed an increase in channel catfish habitat (L/D 24 had no change) with the project. Increases ranged from 6.1% to 12%. Most of the gains occurred landward and downstream of the new lock and guidewall. Losses were generally located downstream of the replacement gates. It is likely that these reflect actual changes in habitat. At each L/D, most of the suitable habitat was confined to the main channel border. Channel catfish have a strong association with cover (logs, debris, riprap, cavities), and areas without this cover will likely not provide suitable habitat, regardless of velocity. On the river, these types of cover are most plentiful along the main channel border. Given that cover is available in the main channel border to attract catfish, changes in velocity in these areas would alter available habitat.

Paddlefish - Paddlefish forage habitat increased at three sites (L/D 22, 24, and 25) and decreased at two sites (L/D 20 and 21). Habitat increased as much as 21% and decreased as much as 13%. Losses were generally located landward of the new lock (likely depth-related) and downstream of the new replacement gate (likely velocity-related). Gains were largely located downstream of the new lock and guidewall. Velocity and depth are the two major determinants of paddlefish forage habitat so it is likely that the changes in habitat produced by the models were accurate. Spawning habitat decreased at all five locks. Losses ranged from 3.7% to 6.3%. Losses were largely confined to the area landward and downstream of the new lock and guidewall. Gains in spawning habitat were typically seen below the new replacement gate. Paddlefish typically move through the dams and tailwaters to more suitable spawning habitat within the navigation pools or in tributary rivers, but will spawn downstream of dams if an appropriate substrate is available. Other factors like temperature, dissolved oxygen levels, and rising water levels (all largely unaffected by construction) are important for paddlefish spawning success. Suitable substrate for spawning is gravel or cobble. Without exception, almost the entire tailwater below each lock and dam was considered suitable spawning habitat. In reality, only a small percentage of that habitat (that with gravel or cobble substrate) is actually suitable. Because these two substrates are not abundant in the tailwater, determining their presence while sampling is difficult, and consequently determining accurate changes in spawning habitat is difficult.

Sauger/Walleye - Overwintering habitat increased at all five sites with the project. Increases ranged from (32% to 741%). Most of the overwintering habitat was created landward and downstream of the new lock and guidewall. Losses in overwintering habitat usually occurred below the new replacement gate. Overwintering habitat at the locks and dams is generally very limited, and increases in available habitat are desirable. The value of this newly created habitat would be directly tied to the amount of disturbance it receives. During the winter, fish are in a very low state of activity, and even small levels of disturbance may induce enough stress to cause death. Most of the habitat is landward of the new lock and guidewall and would be isolated from winter tow traffic. Instead, disturbance at these sites would likely come from operation of the 600-foot lock or from operations practices like flushing ice through the 600-foot lock chamber. If these areas are not disturbed, they could provide suitable overwintering habitat. However, if they are disturbed infrequently during the winter, they could actually be very detrimental to fish by creating an attractive, yet potentially deadly, overwintering area.

Spawning habitat also decreased at almost every site. Decreases ranged from 4% to 7%. One site, L/D 24, increased less than 1%. Most of the losses in spawning habitat were landward and downstream of the new lock and guidewall. Gains in habitat were typically associated with the bank opposite the lock, usually downstream from the new replacement gate. Sauger and walleye use a variety of spawning substrates including cobble, gravel, boulder, or bedrock. The highest increases in overwintering (+741%) and spawning habitat (+979%) were seen at L/D 24. These unusual increases can be attributed to the existing homogeneity of habitat at that location. L/D 24 lies on a straight stretch of the

river with little quality habitat or aquatic diversity, so construction changes have a large effect on the area.

Emerald Shiner - At low flows, emerald shiner habitat decreased in every tailwater. Losses ranged from 0.01% to 9.7%. At high flows, emerald shiner habitat increased in every tailwater. Increases ranged from 4.9% to 15.4%. The difference between high and low flows can be explained by the fact that during high flows emerald shiner habitat is restricted to the main channel border. During low flows, shiner habitat extends farther into the main channel. Construction of a new lock and guidewall creates a suitable lower velocity shadow landward and downstream during high flows. This shadow provides suitable emerald shiner habitat. During low flows, losses in habitat occur largely in the main channel below the existing gates. During high flows, losses are generally confined to areas downstream of the replacement lock. Emerald shiners are considered habitat generalists, being found most everywhere in the river. Model results for this species should be accurate. Because of their generalist nature, loss of emerald shiner habitat in the tailwaters is likely not to be significant.

Largemouth Bass - At low flows, largemouth bass adult and juvenile habitat would be created at every lock except L/D 22, which had no change. Increases for the other four sites ranged from 8.4% to 265%. Most of the habitat would be created landward and downstream of the new lock and guidewall. Losses in habitat were concentrated near the existing lock or below the replacement gate. Like the channel catfish, suitable habitat for the largemouth bass would be confined to the main channel border. Largemouth bass have a strong association with bottom cover (logs, debris, aquatic vegetation) and areas without this cover will likely not provide suitable habitat, regardless of velocity. On the river, these types of cover are most plentiful along the main channel border. Given that cover is available in the main channel border, changes in velocity in these areas would alter available habitat.

Four of the five lock sites had an increase in fry development and adult overwintering habitat. Increases ranged from 15.8% to 2016%. One site, L/D 21, had a decrease in available habitat of 1.5%. Most of the overwintering and fry development habitat was created landward of the new lock and guidewall. Losses in habitat were generally small and had no pattern of occurrence. Similar to the walleye and sauger, overwintering habitat at the locks and dams is generally very limited, and increases in available habitat are desirable. Like those species, the value of this newly created habitat would be directly tied to the amount of disturbance it receives. Lack of appropriate cover at most locks greatly diminishes the value of any fry habitat.

Potential largemouth bass spawning habitat increased at every site in this study. Increases ranged from 21.5% to 1661%. Similar to other species, most of the gains in habitat come landward of the new lock and guidewall. Losses in habitat were confined to the bank opposite the lock, below the replacement gate. Largemouth bass spawn over a range of substrates, with silt being the notable exception. Given the location of most of the created habitat, it is possible that large amounts of silt would be present, making the true value of this habitat questionable.

L/D 24 again showed extremely large increases in adult juvenile habitat (+265%), overwintering and fry development habitat (+2016%), and spawning habitat (+1661%). Again, these increases can be attributed to the homogeneity of habitat at that location.

Largemouth bass are not usually found in high numbers in tailwater areas, preferring other more suitable areas on the Mississippi River like backwaters and side channels. While changes in largemouth bass habitat are important in the tailwater because they show general changes in velocity and depth resulting from construction, it is important to remember that those changes do not indicate that the largemouth bass actually occur in those areas (which in most cases they do not).

The HAT believes that this tailwater analysis provides a useful tool for estimating the extent of construction-induced velocity changes throughout the tailwaters. However, more confidence in estimating effects on individual species is given to the HEP evaluation because it has considered all of the life requisites required by the fishes that utilize the area. The results of this analysis shed light on potential measures to minimize velocity-induced habitat changes in the tailwaters or even enhance areas, but should not be used to estimate the extent of fisheries impacts without further study.

C. Evaluation of Mussel Resources. Existing literature was reviewed to determine known mussel concentrations within potential impact areas at L/D 11-25 on the Mississippi River and Peoria and La Grange on the Illinois River (Table 9). At L/Ds 20, 22, 24, and 25 on the Mississippi River and Peoria Lock on the Illinois River, there was insufficient information to determine the potential for mussel impacts. A brail survey was conducted by the Rock Island District's Environmental Analysis Branch staff at Peoria Lock and by QST Environmental at Mississippi River L/Ds 20, 22, 24 and 25. Existing information from L/Ds 11-19 is summarized here, but no surveys were conducted. Should future construction activities be proposed, surveys also will be required at those locks and dams.

Mussel surveys are typically undertaken for individual site-specific projects, surveys, or monitoring, and therefore data only exist where there has been a project or prior study. Existing surveys were located and examined for information pertinent to areas identified for potential construction measures within this study. Those studies, general location, and a summary of the results are included in Table 9. More specific information may be found within the survey reports listed in the literature cited. Areas not listed are not necessarily devoid of mussels but have not been surveyed.

TABLE 9: Known Mussel Concentrations within Vicinity of Locks and Dams, Various Surveys
(Does not Include 1997 Surveys)

Lock and Dam	Report or Study	Location of Mussels	Results
11	Wisconsin DNR	RM 583 L	Higgins' eye
12	Stanley Consultants	RM 557.4-557.6 L	12 sp., including Higgins' eye
14	Approach Improvement EA	494-496 L	"rich mussel bed"
15	Stanley Consultants	L Above lock	18 sp., 259 individuals
16	Stanley Consultants	Upstream	7 sp., 18 individuals
17	Stanley Consultants	Upstream	20 sp., 326 individuals
18	Approach Improvement EA	Downstream Bed	Higgins' eye
19	Stanley Consultants	Up/Downstream R	See report
21	Miller 1996, South Quincy levee	Up/Downstream R	
22	Missouri DOC	RM 300-299 R	Sanctuary
25	Miller 1996	RM 240	
IWW La Grange	Personal Comm. LTRM	No known concentration	

Important river reaches for freshwater mussels in the Upper Mississippi River are summarized in Table 10 below. These were taken from Miller, et al. 1997. Areas not listed below are not necessarily lacking in mussel resources but may not have been identified.

TABLE 10: Important Mussel Habitat within the Vicinity of Potential Construction

Lock and Dam			
12	**14**	**15**	**17**
RM 556.8-558.2 L, MS RM 556.0-556.8 R, MS	RM 494.0-496.4 L, SH RM 492.0-493.0 L, SH	RM 481.3-482.4, SH	RM 438.0-439.7 L, SH
18	**19**	**21**	**22**
RM 406.0-410.5 L	RM 364.6-364.8 R RM 361.5-364, MS	RM 325.2-328.5 R RM 324.2-324.9 R	RM 299.6-300.2 R, MS

L - Left Descending Bank, R - Right Descending Bank
MS - Mussel Sanctuary
SH - Secondary Habitat (*Lampsilis higginsi*)

The areas listed in Table 10 should be avoided. They are considered to be some of the most valuable mussel beds in the Upper Mississippi River, based not only on the presence of the endangered Higgins' eye pearly mussel (*Lampsilis higginsi*) but also total density and species richness (Miller et al., 1997). Project features with potential impacts to those sites will require formal consultation under Section 7 of the Endangered Species Act as they are likely to contain *L. higginsi*. They may contain State-listed species as well.

In an effort to fill data gaps at Locks and Dams 20, 22, 24, 25 on the Upper Mississippi River and Peoria on the Illinois River, exploratory brail surveys were conducted. QST Environmental was asked to perform exploratory surveys at identified locations upstream and downstream of each lock and dam. Areas identified for lock placement, channel improvement, gate replacement, and wing dam placements were identified as potential impact areas and thus were surveyed for existing mussel resources. Areas upstream at Locks and Dams 22 and 25 were found to contain mussel beds, and an area downstream of L/D 24 was found to contain a concentration of mussels. To better determine the numbers and species richness found in each of these areas, dive surveys would need to be conducted. Complete findings of the QST survey are available in the contractor's report (QST Environmental, 1997).

Potential site-specific mussel impacts at each lock and dam are discussed below. The potential for impacts was evaluated by using the above-listed sources and comparing location information to potential navigation improvement measures at each lock and dam.

1. Mississippi River.

Lock and Dam 11

The Wisconsin DNR reports a known location of Higgins' eye downstream from the dam at River Mile 583, left bank (Thiel, 1981). The area is not impacted by site-specific construction, but if gate replacement or flow changes are necessary, the site may be impacted. There is also an indication that there may be mussels in the downstream approach to the lock on the right bank.

Lock and Dam 12

River Miles 556.8 - 558.2 left bank and 556.0- 556-8 right bank are listed as mussel sanctuaries (Miller ,1997). Stanley Consultants found Higgins' eye in a mussel bed located above the dam at River Miles 557.4-557.6, left bank. There is potential for impacting the entire mussel sanctuary with lock extensions and gate replacement. This would include footprint and velocity change impacts.

Lock and Dam 13

No information is available for L/D 13. Surveys should be conducted if construction is proposed for this area to determine the presence of mussels.

Lock and Dam 14

The Higgins' eye Mussel Recovery Plan identifies River Miles 494.0-496.4, left bank and River Miles 492.0-493.0, left bank as Secondary Habitat for the species. An environmental assessment prepared for approach improvements at L/D 14 mentions a "rich mussel bed" at River Miles 494-496, left bank. Proposed improvements at this lock include extensive channel widening upstream as well as downstream of the lock. If the project is implemented, the area should be surveyed for mussels to determine the effect of sediment transport from dredging on any adjacent mussel beds.

Lock and Dam 15

Immediately above the lock on the left bank, Stanley Consultants (1987) reported a rich mussel bed. This would be potentially affected by both the footprint of a lock extension and associated placement of a series of weirs. Downstream from the lock from River Miles 481.3-482.4 is classified as Secondary Habitat for Higgins' eye.

Lock and Dam 16

Upstream of the lock on the left bank, Stanley Consultants (1987) reported a mussel bed in the approach to the lock. This would be impacted by both the footprints of new lock construction and by proposed weirs and extensive channel improvements. The Natural

Resource Inventory (COE/USFWS 1984) identifies both the areas immediately downstream of the lock and on the opposite shoreline as mussel beds. Perry (1979) and Lopinot (1977) both report mussel beds from River Miles 453.7- 456.5. The right bank is reported to be a commercial mussel bed. If a mussel bed still exists downstream from the lock and dam, it may be affected by the footprint of a lock and by increased flow from gate replacement.

Lock and Dam 17

Stanley Consultants (1987) reported a mussel bed above the lock in the approach area. This would potentially be impacted by proposed weirs and lock footprint. The Higgins' eye Mussel Recovery Plan identifies River Miles 438.0-439.7, left bank as Secondary Habitat. If further channel modifications are proposed, the area should be surveyed and measures evaluated for potential effects. There is extensive dredging and a wicket gate proposed for this location, which should all be surveyed to determine if other mussel concentrations are within the vicinity.

Lock and Dam 18

Miller et al. (1997) lists River Miles 406.0-410.5, left bank as containing a mussel bed and Cawley (1985) recorded Higgins' eye in the vicinity. Lock placement may directly impact a portion of this mussel bed at River Mile 410. Detailed surveys should be conducted prior to any construction to determine the extent of this mussel bed and presence of listed species.

Lock and Dam 19

Upstream of the lock at River Miles 364.6-364.8, right bank is identified in Miller et al. (1997) as an important mussel bed on the Upper Mississippi River. Stanley Consultants (1987) described the area and survey conducted at the site. Downstream, River Miles 361.5-364, right bank is defined as mussel sanctuary. Frietag (1978) and Fuller (1978) described mussel surveys between River Miles 360 and 364.1. Impacts at this site may include the footprint of a lock, channel widening downstream of the lock, and placement of bendway weirs upstream of the lock. Detailed surveys should be conducted prior to any construction to determine the extent of this mussel bed and presence of listed species.

Lock and Dam 20

There was no existing information pertaining to mussels at L/D 20. An exploratory brail survey was conducted in October 1997 to determine the presence of native mussels in the project area (QST Environmental, 1997). Areas of potential footprint impacts or that would be affected by velocity changes due to construction were surveyed with a total of 63 brail transects. An area downstream from the lock on the right descending bank from the vicinity of RM 342.7-342 was found to have the largest number of individuals and species. Four species and 12 individuals were collected in nine brail transects. Included in this was the Illinois State threatened butterfly (*Ellipsaria lineolata)* and Missouri watch list

hickorynut (*Obovaria olivaria)*. Hickorynut was also collected on the opposite side of the river in areas that would be dredged if a wicket gate were to be selected as an alternative; however, large concentrations of mussels were not present in these locations.

Lock and Dam 21

River Miles 324.2-324.9 and 325.2-328.5, right bank are identified as important mussel habitat in Miller et al. (1997). Additional information can be found in Ecological Analysts (1981d) pertaining to the area downstream from the lock where no concentrations of mussels were found. Numerous additional surveys are listed in the Natural Resource Inventory. The entire right descending bank is known to be rich mussel habitat. Impacts to the area should be avoided. Placement of a new gate on the right bank may affect the mussel beds and habitat by changing flow. If navigation improvements are chosen for this lock, additional surveys should be conducted.

Lock and Dam 22

Downstream from the lock between River Miles 299.6-300.2, right bank is a mussel sanctuary. The area is not affected by construction impacts, and hydraulic modeling shows that velocity should not change within the vicinity of the mussel sanctuary. Areas identified as potential impact areas resulting from navigation improvements were surveyed by brail in October (QST Environmental, 1997). A rich mussel bed was found on the right descending bank above the lock. The brail survey found 214 individuals (including 89 juveniles captured on the brail by byssal threads) consisting of 14 species. Included in this were the Illinois threatened butterfly, Missouri watch list hickorynut, and Missouri rare species rock pocketbook (*Arcidens confragosus*) and wartyback (*Quadrula nodulata*). The species diversity and number of juveniles located suggest a healthy mussel bed. Impacts to this area should be avoided. A series of emergent wing dikes is proposed for the vicinity. The mussel bed should be surveyed further through a dive survey to determine its extent and species composition. Different measures to reduce the outdraft problem for tow traffic and avoid impacts to the mussel bed should be sought. In addition to footprint impacts, velocity changes and associated sedimentation will affect this mussel bed. Two individuals were collected immediately downstream of the proposed gate replacement area, but no mussels were collected in any other survey locations.

Lock and Dam 24

No existing information was found within the project vicinity. Areas identified as potential impact areas resulting from navigation improvements were surveyed by brail in October (QST Environmental, 1997). Upstream of the lock, several mussels were found concentrated above the existing wing dam (8 individuals, 4 species) and in another area approximately 400 yards upstream (2 individuals, 2 species). A concentration of mussels was found downstream of the lock near the Clarksville, Missouri, shoreline. The concentration was found near shore in an area not within the footprint but may have increased sedimentation due to decreased flows behind the lockwall. Twenty-nine individuals, including the Illinois threatened butterfly, Missouri watch list hickorynut, and

Missouri rare species rock pocketbook and wartyback were collected. This area should be surveyed to determine the extent of the mussel concentration and determine if a bed is present.

Lock and Dam 25

No existing information was found for the project vicinity. Areas identified as potential impact areas resulting from navigation improvements were surveyed by brail in October (QST Environmental, 1997). A mussel bed was located immediately upstream from the lock on the right bank. Thirteen transects yielded 125 individuals consisting of 14 species, most of which were found in 4 brail transects within the upstream portion of the area. Placement of a 1,200-foot lock in Location 1 would require the mussel bed to be excavated for an approach channel. Immediately upstream of the overflow section of the dam adjacent to the first gate, 49 individuals consisting of 9 species were located with the brail. Both areas included Missouri watch list hickorynut, and Missouri rare species rock pocketbook and wartyback. If a lock is placed at Location 4, there may be a new gate placed in the overflow section of the dam. Placement of the gate would change the velocity and substrate found within the site. Dive surveys should be conducted at both locations to determine the extent and species composition of these areas.

2. Illinois River.

Peoria Lock and Dam

Although the LTRM conducts surveys in Peoria Pool and La Grange Pool upstream and downstream of the lock, they do not have information from the immediate vicinity. Rock Island District personnel conducted a brail survey at Peoria Lock on the Illinois River and did not find concentrations of mussels anywhere within the impact area. Results of the survey are summarized below.

Brail Survey at Peoria Lock and Dam, 16 September 1997

Upstream 1 - Upstream of Lock and Dam. River Mile 158.2, left descending bank from Standard Oil Dock to footings of the I-474 Bridge. Shoreline is mud, cobble, occasional trees and developed.

Substrate	Depth	Results
Run 1-Sand/silt	12-14 feet	0
Run 2-Sand/silt		0
Run 3-gravel/sand/shells		0

No mussels were found on the brail. Several dead shells were found in ponar grabs. They were identified as spike (*Elliptio dilitata*), deertoe (*Truncilla truncata*), ebony shell (*Fusconaia ebena*), and pigtoe (*Fusconaia flava*).

Upstream 2 - Underneath I-474 to upstream of lock, left descending bank.

Substrate	Depth	Results
Gravel/cobble	17-19 feet	Run 1- 0 Run 2- 0

Downstream 1 - Downstream of the mouth of Lick Creek. Left descending bank from the mouth of the creek to RM 156. Shoreline is sand with some gravel. Adjacent area forested.

Substrate	Depth	Results
Sand/silt, predominantly sand	5-9 feet	Run 1- Deertoe 1 ¾" Run 2- 0

Downstream 2 - Downstream from the Agrochem Dock (RM 157) to just upstream from Gas Line Warning Sign. Left descending bank. Shoreline is sand. Adjacent area forested.

Substrate	Depth	Results
Silt/sand	9-12 feet	Run 1- 1 Giant floater (*Anodonta grandis*) 5 ½" Run 2- 0

Downstream 3 - Left descending bank immediately below lock. Shoreline is sand, cobble, and forested. Extends from sewer outfall to Gas Line Warning Sign above Agrochem Dock.

Substrate	Depth	Results
Sand	Run 1- 17 feet Run 2- 10-11 feet	Run 1- 0 Run 2- 1 Giant floater*

**Fell from brail before measurements taken*

La Grange Lock and Dam

A dive survey was conducted at Illinois River Mile 80.0, left bank by the Illinois Natural History Survey (Whitney et al., 1997). The survey did not find any mussels. The right bank immediately below the lock was dredged in the summer of 1996 and therefore it is assumed that there are no mussels in the vicinity. Thus, the likelihood for finding concentrations of mussels within the vicinity of La Grange Lock is very low (Scott Whitney, INHS, personal communication).

D. Potential Site-Specific Endangered Species Impacts. This report does not constitute a Biological Assessment (BA), but portions of it will be utilized in the site-specific portion of the Biological Assessment. Potential impacts to endangered species are being evaluated in a BA and through ongoing Section 7 Consultation with the U.S. Fish and Wildlife

Service. The BA is being done in a tiered manner to coincide with the Systemic Environmental Impact Statement. The first tier will evaluate systemic impacts as well as potential impacts at L/Ds 20-25, Peoria and La Grange. If future construction is to occur, detailed site-specific evaluations will occur and include supplemental NEPA documents and second tiers to the BA, which will be site-specific. Potential endangered species impacts at L/Ds 20-25, Peoria, and La Grange are described here for planning purposes only. Recommendations for surveys and avoid and minimize measures are included, but determination of the potential effect on endangered species will be made in the BA. Compilations of federally listed species potentially occurring at L/Ds 11-19 on the Mississippi River are also included (see Appendix G) but are not discussed in detail. If measures are proposed for those sites, each will be addressed in detail as appropriate. State-listed species will be evaluated as part of the EIS but are listed in Appendix G for information.

Should federally listed species be found that are likely to be affected by any proposed measure, formal consultation under Section 7 of the Endangered Species Act will be initiated. This consultation will require a determination by the Corps as to the extent of site-specific impacts and their effect on the species. Measures to avoid or minimize impacts should be sought, with emphasis given to avoiding impacts altogether. These measures will be coordinated with the U.S. Fish and Wildlife Service and respective State agencies.

Lock and Dam 20

The following federally listed species are listed as occurring within the counties adjacent to the lock and dam and may occur in the project area:

Indiana bat (*Myotis sodalis*)
Bald eagle (*Haliaeetus leucocephalus*)
Higgins' eye pearly mussel (*Lampsilis higginsi*)
Fat pocketbook mussel (*Proptera capax*)

The alternative that includes placement of a wicket gate on the Illinois side of the dam would include removal of an island, which is made up of bottomland forest habitat. With this alternative, there may be impacts to the Indiana bat and bald eagle. This alternative should be avoided to avoid effects to these species. Large mussel concentrations were not located during brail surveys, and therefore endangered mussels are not likely to be impacted by channel alignment associated with the wicket gate.

Bat surveys will be required prior to clearing of the island and the forested area upstream from the lock. A habitat survey to determine suitability of the forest for Indiana bat roost habitat and a bat survey to determine usage by the species will need to be completed. If the area is to be cleared, it should only be cleared between September and April to avoid impacting roosting bats. If the area is found to contain suitable habitat, there may be a need to replace it by planting tree species that provide roost habitat.

During winter, bald eagles perch in the large trees found on the island and feed in the tailwaters of the dam. Removing those trees will require that eagles find other perch trees within the vicinity. There are not many large trees within that area that provide alternative perching sites for the species. Bald eagles are listed to breed and presumably nest somewhere nearby, but outside the project area. The project will not affect the nesting habitat. Clearing of perching habitat should be avoided. If this is not possible, the trees should be replaced. Replacement should be in close proximity to the dam and done as soon as possible as they will not be large enough to replace the habitat for at least 25 years. In addition to planting suitable trees to provide future perching areas, it is possible to construct eagle perches. Options for this include installing large, dead trees or telephone poles with platforms erected.

Brail surveys of the area downstream from the existing lock found 6 species and 12 individuals. Densities that would indicate the presence of mussel beds were not located and therefore it is not likely that endangered mussels would be affected by construction.

Lock and Dam 21

The following federally listed species are listed as occurring within the counties adjacent to the locks and dams and potentially occur within the project area:

Indiana bat
Bald eagle
Higgins' eye pearly mussel
Fat pocketbook mussel

Bald eagles are known to winter in the area and perch in trees adjacent to the lock and dam. The species commonly feeds in the tailwaters of the dam. Alternatives that require clearing of bottomland forest will potentially impact bald eagle perch trees and Indiana bat habitat. Although forest is to be cleared, there is other adjacent forest habitat that will not be impacted by the project. Therefore, perch trees are still available for the eagle. Impacts to the species will be temporary due to disturbance during construction. Bat surveys will be required prior to clearing. The area should only be cleared between September and April to avoid impacting roosting bats. If the area is found suitable for the species or if roost trees are found, impacts should be avoided.

Prior mussel surveys have found mussel beds located on the right descending bank of the river both upstream and downstream of the dam. In addition, the area downstream that may require dredging potentially contains mussels. Endangered species have been found in previous surveys, and therefore more detailed mussel surveys will be required prior to construction activities. They should be conducted in the above-mentioned locations as well as in areas proposed for placement of wing dams and the lock itself. These will both delineate the extent and species diversity of mussel beds and determine the presence of endangered species. Impacts to mussel beds should be avoided.

Lock and Dam 22

The following federally listed species are listed to potentially occur within the counties adjacent to the lock and dam and may occur in the project area:

Indiana bat
Bald eagle
Fat pocketbook mussel
Gray bat (*Myotis grisescens*)

Bald eagles are known to winter in the area and perch in trees adjacent to the lock and dam. The species commonly feeds in the tailwaters of the dam. Alternatives that require clearing of bottomland forest will potentially impact bald eagle perch trees and Indiana bat habitat. Although forest is to be cleared, there is other forest habitat adjacent that will not be impacted by the project. However, clearing of perch trees should still be avoided. Impacts to the species will be temporary due to disturbance during construction.

Bat surveys will be required prior to clearing. The area may only be cleared between September and April to avoid impacting roosting Indiana bats. Some of the bottomland forest to potentially be impacted by staging contains trees that may provide Indiana bat summer roost habitat. If not avoidable, there will be a need to restore it after construction by planting tree species that provide roost habitat. The gray bat potentially occurs in the area and potentially feeds over the edge of the forest canopy. There should be no impact to the species.

The fat pocketbook mussel is known to occur downstream of the lock on the right descending bank within a rich mussel bed. The area is a designated mussel sanctuary by the Missouri Department of Conservation. This area must be avoided. More detailed mussel surveys may be necessary immediately downstream of the dam if a lock is to be placed there. The Higgins' eye pearly mussel is also listed as potentially occurring in the area. Mussel surveys found a mussel bed upstream of the lock on the right descending bank. Thirteen species and 214 individuals were collected, including juvenile mussels, in brail surveys. Construction of a dike field is proposed for this area. More extensive mussel surveys, including dive surveys, should be conducted in this location to determine the extent of the mussel bed and presence of endangered species. Impacts to this bed should be avoided.

Lock and Dam 24

The following federally listed species are listed to occur in the counties adjacent to the lock and may exist within the vicinity of the project:

Indiana bat

Bald eagle
Fat pocketbook mussel
Gray bat
Decurrent false aster (*Boltonia decurrens*)

Bald eagles are known to winter in the area and perch in trees adjacent to the lock and dam. The species commonly feeds in the tailwaters of the dam. Alternatives that require clearing of bottomland forest will potentially impact bald eagle perch trees and potential Indiana bat summer roost habitat. The trees to be cleared adjacent to the lock for staging provide perch sites for large numbers of bald eagle during winter. Suitable trees are available across the river for the species to perch in. However, the city of Clarksville holds an annual Bald Eagle Days and the public may object to losing bald eagle viewing opportunities nearby. Clearing of bald eagle perch trees should be avoided. Bat surveys will be required prior to clearing. The area may only be cleared between September and April to avoid impacting roosting Indiana bats. If the area is found to be suitable for the Indiana bat or if roost trees are found, they should be avoided or impacts minimized.

If mussel concentrations are found within the locations proposed for dredging, more detailed mussel surveys will be required. These will both delineate the extent and species diversity of mussel beds and determine presence of endangered species. Impacts to mussel beds should be avoided.

The decurrent false aster is listed as potentially occurring in the area. A survey for the species may be required prior to construction to avoid impacts. Although this site is within the range of the species, it has never been located in the area.

Lock and Dam 25

The following federally listed species are listed to occur in the counties adjacent to the lock and may exist within the vicinity of the project:

Indiana bat
Bald eagle

The bald eagle is known to winter near the lock, and there is potential for the Indiana bat to be found there as well. With selection of lock Location 1, a large area of perch trees would be cleared. There are some suitable perch trees downstream in what is now a sanctuary owned by the Nature Conservancy and in forested areas across the river that will not be impacted. However, some of the largest trees in the area, and those preferred by bald eagles for perching, would be cleared. Clearing of those trees would displace the eagles and cause them to increase their use of alternative perching areas. Evaluation of bald eagle usage of the area is currently under way. The selection of Location 1 will initiate Formal Consultation under Section 7 of the Endangered Species Act. This consultation will either require the Corps to avoid impacting the area or replace the habitat to be lost. If avoidance is not possible, habitat should be replaced through planting of suitable perch trees. In addition to planting suitable trees to provide future perching areas, it is possible to construct eagle perches. Options for this include installation of large, dead trees or

telephone poles with platforms erected. This location is also a popular eagle watching area for visitors from St. Louis, Missouri.

A forested area downstream from the lock that may be cleared for lock Location 1 may be suitable for Indiana bat summer roost habitat. Bat surveys may be required prior to clearing. The area should only be cleared between September and April to avoid impacting roosting Indiana bats. If the area is found suitable for the species or if roost trees are found, they should be avoided or impacts minimized.

Brail surveys for mussels located a mussel bed upstream from the lock. Thirteen species and 125 individuals were found in the brail survey. This area would be dredged for a new channel alignment with lock Location 1. Diving surveys will be required on this location to more accurately determine the extent of the mussel bed and species diversity and determine the presence of federally or State-listed species.

Peoria Lock and Dam

The following federally listed species are listed to occur in the counties adjacent to the lock and may exist within the vicinity of the project:

Decurrent false aster
Indiana bat
Running buffalo clover (*Trifolium stoloniferum*)

The decurrent false aster is listed as occurring within Peoria and Tazewell Counties within the Illinois River floodplain. Surveys for the species may be required prior to construction to ensure that the species will not be impacted. If it is found, measures to minimize impacts or relocate affected populations may be necessary.

The running buffalo clover is listed as potentially occurring in Tazewell County. The species occurs in disturbed bottomland meadows, which are not found within the project area. Therefore, it is not likely that the project will affect the species.

The forested area downstream from the lock to be cleared for staging may be suitable for Indiana bat summer roost habitat. Bat surveys may be required prior to clearing. The area should only be cleared between September and April to avoid impacting roosting Indiana bats. If the area is found suitable for the species or if roost trees are found, they should be avoided.

La Grange Lock and Dam

The following federally listed species are known to occur in the counties adjacent to the lock and may exist within the vicinity of the project:

Decurrent false aster
Indiana bat
Bald eagle

The bald eagle winters along the Illinois River and may be found wintering in the forested area to be cleared upstream from the lock. It feeds commonly in dam tailwaters.

Present use of the forest by bald eagles is not recorded; however, they are known to be present throughout the Illinois River Valley. No nesting is recorded in the vicinity and therefore clearing of the forest will not likely affect the bald eagle at this location.

The forest upstream from the lock proposed for clearing within lock Locations 1 and 2 provides potential Indiana bat summer roost habitat. Bat surveys will be required prior to clearing. The area may only be cleared between September and April to avoid impacting roosting Indiana bats. If the area is found suitable for the species or if roost trees are found, they should be avoided or impacts minimized.

Specific Species Notes

Bald Eagle - Clearing of perching habitat should be avoided. If avoidance is not possible, the habitat will need to be replaced. This replacement should be in close proximity to the dam and done as soon as possible since trees will not be large enough to replace the habitat for at least 25 years. In addition to planting suitable trees to provide future perching areas, it is possible to construct eagle perches for short-term replacement. Options for this include installation of large, dead trees or telephone poles with platforms erected. The potential impacts on eagles and the nature of any replacement and will be determined in the endangered species consultation process with the U.S. Fish and Wildlife Service and State agencies.

Indiana Bat - If habitat suitable for Indiana bat roost colonies is to be impacted, it may only be cleared between September 1 and April 30. In order to replace Indiana bat habitat, planting of the following tree species will be required: shagbark and shellbark hickory, bitternut hickory, American elm, slippery elm, eastern cottonwood, silver maple, white oak, red oak, post oak, and shingle oak. Since the species requires trees of nearly 11 inches in diameter and with peeling bark, or dead trees, the replacement trees will not provide suitable habitat for some time.

E. Socio-Economic Analysis. This analysis addresses anticipated socio-economic impacts of reducing traffic congestion and increasing navigation capacity for Locks 11-25 on the Upper Mississippi River (UMR) and Locks 1-8 (Lockport to La Grange) on the Illinois Waterway (IWW). Large-scale measures for reducing congestion include extending an existing lock or providing a second lock at an existing lock and dam site. Six alternative locations for placement of new locks were considered in the initial investigation performed by the Engineering Work Group. After a screening process, some of the six locations proved to be infeasible. The surviving locations are addressed within the site-specific analysis for each lock site.

This analysis addresses the socio-economic impacts in two sections. Section 1 will look at the anticipated systemic impacts associated with increased capacity for UMR Locks 11-19

and IWW Locks 1-6. This section does not address construction impacts at these sites. (NOTE: This format was chosen to correspond with the general nature of the environmental evaluations done at these sites. A more complete socio-economic assessment will be completed for the system Environmental Impact Statement.) Section 2 will address in general the potential site-specific impacts for UMR Locks 20-25, plus Peoria and La Grange Locks on the IWW. These site-specific locations have been identified as the most likely locations for large-scale improvements at some time in the future.

Data sources for this analysis included existing socio-economic reports, information provided by the site-specific habitat assessment study team, and interviews with pertinent local officials and lockmasters.

1. General Systemic Assessment. Increasing the flow of traffic through the lower river locks could impact communities in the upper river corridor. More traffic on the river could stimulate community and regional growth throughout the river corridor, and could increase the economic viability of the river communities with the expansion of business and industry. Overall, impacts at the upper locks would be more positive than negative, especially since the surrounding urban or rural settings will not likely be interrupted by construction activities.

a. Community and Regional Growth. The existence of a cost-effective, efficient transportation system created by the locks and dams on the UMR-IWW System has provided stimulus for growth of river communities and the entire Midwest region. Midwest producers rely on low-cost river transportation to compete in-world markets. Large-scale improvements to the system would help to provide for continued growth opportunities at each individual site and allow the region to remain competitive in regional, national, and international markets.

b. Community Cohesion. No major impacts on overall community cohesion in the upper river corridor would be expected from the construction of large-scale improvements at the lower lock sites.

c. Displacement of People. No residential relocations would be necessitated in the upstream corridor by an increase in navigation capacity at lower locks.

d. Property Value and Tax Revenues. The proposed projects would have little impact on property values or resulting tax revenues. Any long-term effects on property values and tax revenues would be related to community and regional growth. Increasing traffic has the potential for affecting property values at sites where there are residential properties located adjacent to existing locks. Impacts will be based on perceptions that more traffic on the river may diminish the desirability of a riverfront property and, therefore, make the real estate less desirable in the eyes of prospective buyers.

e. Public Facilities and Services. The UMR-IWW System is a vital component of the national transportation infrastructure. With timely and appropriate improvements, it will continue to serve recreational, commercial and environmental interests over the long term. The system also provides recreation opportunities to residents of the states through which the rivers flow. These opportunities include boating, fishing, hunting, trapping, camping, sightseeing, swimming, skiing, sport fishing, and wildlife observation. Public access to these recreational events in the upper river corridor will not be hindered or interrupted by improving navigation capacity at downstream locks.

Swing-span vehicle bridges, located at some lock and dam sites, will open more frequently with an increase in navigation traffic, causing more delays for vehicles using the bridge to cross the river.

f. Life, Health, and Safety. Overall, the proposed projects would eliminate some of the hazards of transiting the river locks and congestion at the locks, thereby improving the safety conditions for towing industry and lock personnel. Improving navigation capacity would also reduce safety hazards for recreational vessels by minimizing the times when commercial and recreation crafts are using a lock at the same time.

Increased navigation capacity on the UMR-IWW System has the potential to increase hazardous spills on the river and to lead to more accidents between craft on the river.

g. Business and Industrial Growth. Expansion of the navigation capacity through large-scale improvements may allow for the development or expansion of businesses and industries, fleeting areas, and terminals in the river corridor. New terminal development could occur on undeveloped or open lands adjacent to urban areas.

h. Employment and Labor Force. Temporary increases in employment and labor force would be site-specific and are not anticipated in the near term in the upper reaches of the UMR-IWW System. The labor pool for communities on the lower portion of the system, and directly impacted by construction activities, is large enough to provide the temporary supply of workers needed, and the demand would not be expected to draw from the labor pool of upstream communities. Long-term impacts to employment and labor force in the upper river reaches would be related to business and industrial growth resulting from indirect positive impacts of improved efficiency of the Upper Mississippi navigation system as a whole.

i. Farm Displacement. No farmsteads would be affected by increased navigation capacity or large-scale improvements at lower lock sites. Potential use of agricultural land for dredged material placement would be addressed on a site-specific basis.

j. Noise Levels. Construction activities are limited to the lower river sites, so it is unlikely that the upper portion of the system would experience any impacts from

the increased noise levels due to the construction. Increased traffic through the upper locks could cause major noise impacts for homes that are located adjacent to existing lock sites.

k. Aesthetics. Construction of new lock facilities and the resulting increase in navigation traffic would not likely impact the aesthetics of the upper river corridor and would not diminish the viewscape of public areas or local communities. Potential fleeting area impacts will be addressed in the system EIS.

2. Specific Assessments for Lower Sites. This section addresses the potential site-specific socio-economic impacts associated with large-scale improvements at UMR L/Ds 20-25, and Peoria and La Grange L/Ds on the IWW. The assessment is directed toward the potential impacts resulting from the construction of new lock facilities (i.e., new 1,200-foot locks) or extending the existing lock chamber. References to placement sites (for borrow or dredged material) are for purposes of general socio-economic assessment only. These areas are not being addressed in the overall site-specific habitat analyses at this time.

a. Lock and Dam 20 - Canton, Missouri. (Locations 2, 3 or 4 under consideration, as well as a wicket gate option to allow open pass.)

(1) Community and Regional Growth. The existence of a cost-effective, efficient transportation system created by the locks and dams on the UMR-IWW System has provided stimulus for growth of river communities and the entire Midwest region. Overall, large-scale improvements at L/D 20 would help to provide for continued growth opportunities in Canton, Missouri. Community and regional growth are impacted directly and indirectly by the effects of construction activity, expansion of existing firms, and establishment of new firms within the region.

(2) Community Cohesion. Land use surrounding L/D 20 is shared by agricultural, industrial, residential, and recreational interests. A public park, an oil company loading dock, and a ferry crossing are located within a mile of the lock and dam. Several homes in Illinois and Missouri are located within a one-mile radius of the proposed construction locations. No significant negative impacts to community cohesion would be expected.

(3) Displacement of People. Construction of a new lock facility at any of the locations would not require any residential relocations.

(4) Property Values and Tax Revenues. Short-term impacts to tax revenues would result from the use of agricultural land for placement sites and staging areas during construction, which would temporarily remove the land from crop production. Long-term effects on property values and tax revenues would be related to community and regional growth.

(5) Public Facilities and Services. Use of Locations 2, 3, or 4 could require navigation interruptions during construction and relocation of the public ferry landing.

The ferry is used by residents who work in Illinois, as well as by trucks transporting grain to an upstream terminal.

Use of Locations 2 or 3 would adversely impact the public park, an oil company terminal, and the public ferry. If Location 4 is used, there would be adverse impacts to an upstream grain loading dock and public fishing area.

(6) Life, Health, and Safety. Overall, the proposed project would eliminate some of the hazards of transiting the river locks and congestion at the locks, thereby improving the safety conditions for towing industry and lock personnel. Improving navigation capacity would also reduce safety hazards for recreational vessels by minimizing the times when commercial and recreation crafts are using the lock at the same time.

(7) Business and Industrial Growth. A commercial dock for an upstream grain elevator may require relocation if Location 4 is selected, possibly interfering with business at the grain terminal. A lock extension could necessitate the relocation of a downstream oil company dock in order to provide adequate clearance for boats leaving the lock.

A short-term increase in business and industrial activity would be noticed in the project vicinity due to purchases made for construction work and purchases made by construction workers (i.e., meals and lodging). Expansion of the navigation capacity through large-scale improvements may allow for long-term business and industrial growth through the development or expansion of businesses and industries, fleeting areas, and terminals in the river corridor.

(8) Employment and Labor Force. As one of the potential sites being analyzed for new lock facilities, the area would experience a temporary increase in employment during project construction. It is estimated that an average of 300 workers would be employed during the construction effort. Workers would be hired through labor unions at Canton, Missouri, and other communities in the area. Between 1986 and 1994, rehabilitation efforts at L/D 20 employed a similar number of workers with similar impacts.

Long-term impacts to employment or the labor force in the Canton area would be related to business and industrial growth resulting from indirect positive impacts of improved efficiency of the navigation system as a whole.

(9) Farm Displacement. Depending upon the construction location selected, between 47 and 105 acres of agricultural land would be used for placement sites and staging areas; however, no farmsteads would be displaced as a result of new lock construction.

(10) Noise Levels. Heavy machinery would temporarily raise noise levels during project construction. Low-density residential development is located within one-

half mile from the proposed locations and would be affected by the increased noise levels. Use of Location 4 puts a new lock where there currently is none, and the increased traffic may change noise levels in the town of Meyer, Illinois.

A 1,200-foot lock positively impacts noise levels by eliminating the making and breaking of tows, thereby decreasing noise levels for the town of Canton.

(11) Aesthetics. The aesthetic appeal of any type of construction activity is low; however, construction would be temporary and would not permanently impair the aesthetic resources of the surrounding areas. Use of Location 4 would change the aesthetics of the area for residents of Meyer. Placing a new lock where there was none could change the view of the river; however, the impact would be minor because the town already is situated behind a levee.

b. Lock and Dam 21 - Quincy, Illinois. (Locations 2, 3 or 4 under consideration.)

(1) Community and Regional Growth. The existence of a cost-effective, efficient transportation system created by the locks and dams on the UMR-IWW System has provided stimulus for growth of river communities and the entire Midwest region. Overall, large-scale improvements at L/D 21 would help to provide for continued growth opportunities in Quincy, Illinois. Community and regional growth are impacted directly and indirectly by the effects of construction activity, expansion of existing firms, and establishment of new firms within the region.

(2) Community Cohesion. Land surrounding L/D 21 is primarily agricultural. Several commercial loading docks are located approximately 2 miles upstream of the lock and dam, and a small boat ramp is located about one-half mile downstream. No effect on community cohesion would be expected due to the limited residential development in the project vicinity.

(3) Displacement of People. Construction of a new lock facility at Locations 2, 3, or 4 would not require any residential relocations.

(4) Property Values and Tax Revenues. Short-term impacts on tax revenues would result from the use of agricultural land for placement sites and staging areas during construction, which would temporarily remove the land from crop production. Long-term effects on property values and tax revenues would be related to community and regional growth.

(5) Public Facilities and Services. The sewage treatment plant for the city of Quincy, Illinois, is located on the left downstream bank directly across from the proposed construction locations. Construction is not expected to interfere with the operation of the plant or the discharge line. The construction staging area would temporarily impact recreational fishing and access to the public boat ramp (the ramp would be lost with a Location 2 lock) located near the downstream end of the existing lock.

The South Quincy Levee and Drainage District is located next to the designated construction staging area. Use of this area would not impact the integrity of the levee system or diminish the effectiveness of this public facility.

(6) Life, Health, and Safety. Overall, the proposed projects would eliminate some of the hazards of transiting the river locks and congestion at the locks, thereby improving the safety conditions for towing industry and lock personnel. Improving navigation capacity would also reduce safety hazards for recreational vessels by minimizing the times when commercial and recreation craft are using the lock at the same time.

(7) Business and Industrial Growth. Possible impacts to business and industrial growth in the Quincy area could occur. Commercial loading docks and a barge dock located upstream of the site may require relocation in order to provide adequate clearance for boats leaving a longer lock.

A short-term increase in business and industrial activity would be noticed in the project vicinity due to purchases made for construction work and purchases made by construction workers (i.e., meals and lodging). Expansion of the navigation capacity through large-scale improvements may allow for long-term business and industrial growth through the development or expansion of businesses and industries, fleeting areas, and terminals in the river corridor.

(8) Employment and Labor Force. As one of the potential sites being analyzed for new lock facilities, the area would experience a temporary increase in employment during project construction. It is estimated that an average of 300 workers would be employed during the construction effort. Workers would be hired through labor unions at Quincy, Illinois, and other nearby communities. Between 1987 and 1990, rehabilitation efforts at L/D 21 employed a similar number of workers with similar impacts.

Long-term impacts to employment or the labor for in the Quincy area would be related to business and industrial growth resulting from indirect positive impacts of improved efficiency of the navigation system as a whole.

(9) Farm Displacement. No farmsteads would be displaced as a result of new lock construction at L/D 21. The South Quincy Levee and Drainage District is located on the downstream Illinois riverbank, directly across from the existing lock site and the proposed construction Locations 2, 3, and 4. The Levee District will allow two small placement sites to be placed directly behind the levee on agricultural land, removing between 6 and 15 acres from production.

(10) Noise Levels. Heavy machinery would temporarily raise noise levels during project construction. Since the project area is primarily rural in nature, no significant impacts from increased noise levels would result.

(11) Aesthetics. The aesthetic appeal of any type of construction activity is low; however, construction would be temporary and would not significantly diminish the aesthetic resources of the surrounding areas.

c. Lock and Dam 22 - Saverton, Missouri (Locations 2, 3, or 4 under consideration.)

(1) Community and Regional Growth. The existence of a cost-effective, efficient transportation system created by the locks and dams on the UMR-IWW System has provided stimulus for growth of river communities and the entire Midwest region. Overall, large-scale improvements at L/D 22 would help to provide for continued growth opportunities in Saverton, Missouri. Community and regional growth are impacted directly and indirectly by the effects of construction activity, expansion of existing firms, and establishment of new firms within the region.

(2) Community Cohesion. Land surrounding L/D 22 is primarily for agricultural or recreational use. No effect on community cohesion would be expected due to the limited residential development in the project vicinity.

(3) Displacement of People. There are some residential structures located across from the downstream end of the staging area; however, no relocations would be required.

(4) Property Values and Tax Revenues. Short-term impacts on tax revenues would result from the use of agricultural land for placement sites during construction, which would temporarily remove the land from crop production. Long-term effects on property values and tax revenues would be related to community and regional growth.

(5) Public Facilities and Services. The Park 'N Fish Public Use Area is located across the river from the existing lock and dam, but would not be significantly impacted by construction activities. An existing boat ramp on the Missouri side, near the end of the existing guidewall, would be lost with a lock Location 2; subsequent relocation would need to be considered.

(6) Life, Health, and Safety. Overall, the proposed projects would eliminate some of the hazards of transiting the river locks and congestion at the locks, thereby improving the safety conditions for towing industry and lock personnel. Improving navigation capacity would also reduce safety hazards for recreational vessels by minimizing the times when both commercial and recreation crafts are using the lock at the same time.

(7) Business and Industrial Growth. A short-term increase in business and industrial activity would be noticed in the project vicinity due to purchases made for construction work and purchases made by construction workers (i.e., meals and lodging).

Expansion of the navigation capacity through large-scale improvements may allow for long-term business and industrial growth through the development or expansion of businesses and industries, fleeting areas, and terminals in the river corridor. Construction activities at L/D 22 would not require any business relocations.

(8) Employment and Labor Force. As one of the potential sites being analyzed for new lock facilities, the area would experience a temporary increase in employment during project construction. It is estimated that an average of 300 workers would be employed during the construction effort. Workers would be hired through labor unions at Saverton, Missouri, and other communities in the area. Between 1987 and 1990, rehabilitation efforts at L/D 22 employed a similar number of workers with similar impacts.

Long-term impacts to employment or the labor force in the Saverton area would be related to business and industrial growth resulting from indirect, positive impacts of improved efficiency of the navigation system as a whole.

(9) Farm Displacement. Depending upon the location selected, between 5 and 24 acres of land would be used for staging area and placement sites; however, no farmsteads would be displaced as a result of new lock construction at location.

(10) Noise Levels. Heavy machinery would temporarily raise noise levels during project construction. The project area is basically rural in nature, featuring large spans of open fields and a public use area that has a relatively small number of visitors per day. While general construction noise potentially could disturb recreationists, it is unlikely that an increase in noise levels would have a significant negative impact on the surrounding area.

(11) Aesthetics. The aesthetic appeal of any type of construction activity is low; however, construction would be temporary and would not significantly diminish the aesthetic resources of the surrounding areas.

d. Lock and Dam 24 - Clarksville, Missouri. (Locations 2, 3, or 4 under consideration.)

(1) Community and Regional Growth. The existence of a cost-effective, efficient transportation system created by the locks and dams on the UMR-IWW System has provided stimulus for growth of river communities and the entire Midwest region. Overall, large-scale improvements at L/D 24 would help to provide for continued growth opportunities in Clarksville, Missouri. Community and regional growth are impacted directly and indirectly by the effects of construction activity, expansion of existing firms, and establishment of new firms within the region.

(2) Community Cohesion. Land surrounding L/D 24 is used for agricultural, industrial, residential, or recreational purposes. The city of Clarksville is

located next to the designated construction staging area. No significant impacts to community cohesion are anticipated.

(3) Displacement of People. Construction of a new lock facility at Locations 2, 3, or 4 would not require any residential relocations.

(4) Property Values and Tax Revenues. Short-term impacts on tax revenues would result from the use of agricultural land for placement sites and staging areas during construction, removing the cropland from production. Long-term effects on property values and tax revenues would be related to community and regional growth.

(5) Public Facilities and Services. The Mississippi River provides a wide variety of recreational opportunities for residents of the Clarksville area. Wintering bald eagles are a major tourist attraction in the city of Clarksville, including the Annual Bald Eagle Days celebration. The potential exists for adverse impacts to wildlife observation opportunities, recreational fishing and boating, and use of the Clarksville city park and public boat ramp if Locations 2 or 3 are used.

There are no anticipated impacts for Location 4.

(6) Life, Health, and Safety. Overall, the proposed projects would eliminate some of the hazards of transiting the river locks and congestion at the locks, thereby improving the safety conditions for towing industry and lock personnel. Improving navigation capacity would also reduce safety hazards for recreational vessels by minimizing the times when commercial and recreation crafts are using the lock at the same time.

(7) Business and Industrial Growth. A short-term increase in business and industrial activity would be noticed in the project vicinity due to purchases made for construction work and purchases made by construction workers (i.e., meals and lodging). Expansion of the navigation capacity through large-scale improvements may allow for long-term business and industrial growth through the development or expansion of businesses and industries, fleeting areas, and terminals in the river corridor. Construction activities at L/D 24 would not require any business or industrial relocations.

(8) Employment and Labor Force. As one of the potential sites being analyzed for new lock facilities, the area would experience a temporary increase in employment during project construction. It is estimated that an average of 300 workers would be employed during the construction effort. Workers would be hired through labor unions at Clarksville, Missouri, and other nearby communities.

Long-term impacts to employment or the labor force in the Clarksville area would be related to business and industrial growth resulting from indirect, positive impacts of improved efficiency of the navigation system as a whole.

(9) Farm Displacement. Depending upon the location selected, land would be used for a staging area and placement site; however, no farmsteads would be displaced as a result of the proposed lock construction.

(10) Noise Levels. Heavy machinery would temporarily raise noise levels during project construction. Low-density residential development and the business district of Clarksville are located within one-half mile from the proposed construction site. Increased noise levels would have a detrimental effect on the residents and business owners/patrons in the area. The remainder of the project area is rural in nature and would not be significantly affected by the increase in noise levels. No permanent impacts are evident.

A 1,200-foot lock positively impacts noise levels by eliminating the making and breaking of tows, thereby decreasing noise levels for the town of Clarksville.

(11) Aesthetics. The aesthetic appeal of any type of construction activity is low; however, construction would be temporary. Construction of a 1,200-foot lock at Locations 2 or 3 could result in a negative impact on area aesthetics. The new lock would be within the viewscape of the city residents and visitors, diminishing the aesthetic resources of the surrounding area. Eagle watching activities could also be affected. However, a new lock may become a tourist attraction, as has been the case with Melvin Price Lock and Dam.

e. Lock and Dam 25 - Winfield, Missouri. (Locations 1, 2, 3, or 4 under consideration.)

(1) Community and Regional Growth. The existence of a cost-effective, efficient transportation system created by the locks and dams on the UMR-IWW System has provided stimulus for growth of river communities and the entire Midwest region. Overall, large-scale improvements at L/D 25 would help to provide for continued growth opportunities in the area. Community and regional growth are impacted directly and indirectly by the effects of construction activity, expansion of existing firms, and establishment of new firms within the region.

Construction of a new lock facility at the land-based Location 1 has the potential for negative impacts to community and regional growth. Use of this location may necessitate the relocation of the grain elevator and the public ferry landing.

(2) Community Cohesion. The potential for relocating eight permanent residences exists with use of the land-based Location 1. The relocation option may be unfavorable as the long-time residents may not be willing to move, and the impact on community life could be negative as viewed by the residents involved. Pursuing the relocation of residents who do not wish to move would involve the condemnation process. This process involves considerable time and money and generally does not result in a favorable public opinion towards the Government.

(3) Displacement of People. Approximately eight residences are located along river in potential zone of footprint for construction at Location 1. Relocation of the homeowners would involve purchasing the existing structures. Locations 2, 3 and 4 are farther towards the channel and would not cause displacement of people.

(4) Property Values and Tax Revenues. Short-term effects on tax revenues would result from the use of agricultural land for placement sites and staging areas during construction. The relocation of residential structures removes the properties from the tax roles and decreases property tax revenues for Lincoln County.

Long-term effects on property values and tax revenues would be related to community and regional growth. Impacts to property values and tax revenues would depend on impacts to the public ferry and the grain elevator.

(5) Public Facilities and Services. Several negative impacts to public facilities and services would occur with the use of the right downstream bankline and agricultural land for a staging area during construction and lock construction itself. The public ferry landing would have to be moved or would go out of business if a Location 1, 2 or 3 lock were constructed. The ferry carries 300 vehicles per day and provides the only crossing along the Mississippi River for about 46 miles in either direction. A small marina that provides docking for about 10 recreational boats would need a new access channel or would have to be relocated. Recreational access to Sandy Slough, a significant eagle feeding area, would be blocked temporarily during construction. Bradley Island Public Use Area, located about one-half mile upstream of the existing lock and dam, has about 25 visitors per day that would lose access to the area during construction. The entire island would be lost with a Location 1 lock.

(6) Life, Health, and Safety. Overall, the proposed projects would eliminate some of the hazards of transiting the river locks and congestion at the locks, thereby improving the safety conditions for towing industry and lock personnel. Improving navigation capacity would also reduce safety hazards for recreational vessels by minimizing the times when commercial and recreation crafts are using the lock at the same time.

(7) Business and Industrial Growth. A short-term increase in business and industrial activity would be noticed in the project vicinity due to purchases made for construction work and purchases made by construction workers (i.e., meals and lodging). Business and industrial growth could be negatively impacted if the grain terminal on right downstream bank and the grain elevator dock would need relocation, and if the public ferry would go out of business.

Expansion of the navigation capacity through large-scale improvements may allow for long-term businesses and industrial growth through the development or expansion of business and industries, fleeting areas, and terminals in the river corridor.

(8) Employment and Labor Force. Many residents in Illinois communities across the river use the public ferry for crossing the river to save travel time and distance. Loss of the public ferry would require driving approximately 46 miles in either direction to cross the river to work.

As one of the potential sites being analyzed for new lock facilities, the area would experience a temporary increase in employment during project construction. It is estimated that an average of 300 workers would be employed during the construction effort. Workers would be hired through labor unions at Winfield, Missouri, and other communities in the area.

Long-term impacts to employment or the labor force in the Winfield area would be related to business and industrial growth resulting from indirect positive impacts of improved efficiency of the navigation system as a whole.

(9) Farm Displacement. Depending upon the lock location selected, between 8 and 125 acres of agricultural land would be used for construction staging areas and placement sites; however, no farmsteads would be displaced as a result of the proposed lock construction.

(10) Noise Levels. Heavy machinery would temporarily raise noise levels during project construction. Low-density residential development is located within one-half mile of the proposed construction site and would be affected by the increased noise levels. The remainder of the project area is rural in nature; therefore, it is unlikely that this noise level increase would significantly affect the surrounding population. No permanent impacts are evident.

(11) Aesthetics. The aesthetic appeal of any type of construction activity is low; however, construction would be temporary. A potential negative impact is that the construction staging area is within the viewscape of the residents, recreationists, and tourists, including eagle watching activities.

f. Peoria Lock and Dam - Peoria, Illinois. (Locations 1 or 2 under consideration.)

(1) Community and Regional Growth. The existence of a cost-effective, efficient transportation system created by the locks and dams on the UMR-IWW System has provided stimulus for growth of river communities and the entire Midwest region. Overall, large-scale improvements at Peoria Lock would help to provide for continued growth opportunities in Peoria, Illinois. Community and regional growth are impacted directly and indirectly by the effects of construction activity, expansion of existing firms, and establishment of new firms within the region.

Construction of a new lock facility at Locations 1 or 2 has the potential for negative impacts to community and regional growth. Use of these locations may necessitate the relocation of an upstream grain elevator and commercial docks. At the very downstream

end of the staging area is a loading area for agricultural chemicals that could require relocation.

(2) Community Cohesion. Land surrounding Peoria Lock is primarily light industrial with residential development nearby. A portion of the city of Creve Coeur is located on the bluff overlooking the river, approximately one mile north of the proposed construction location. A section of light industrial properties lies adjacent to the staging area, and another residential area of Creve Coeur is about one-half-mile south of the construction site. No significant impacts to community cohesion are anticipated.

(3) Displacement of People. Construction of a new lock facility at Locations 1 or 2 would not require any residential relocations.

(4) Property Values and Tax Revenues. Short-term effects on tax revenues would result from the use of agricultural land for placement sites and staging areas during construction. Long-term effects on property values and tax revenues would be related to community and regional growth.

(5) Public Facilities and Services. Public facilities negatively impacted by the proposed construction activities include a loading area for agricultural chemicals, a grain elevator, and commercial loading docks.

(6) Life, Health, and Safety. Overall, the proposed projects would eliminate some of the hazards of transiting the river locks and congestion at the locks, thereby improving the safety conditions for towing industry and lock personnel. Improving navigation capacity would also reduce safety hazards for recreational vessels by minimizing the times when commercial and recreation craft are using the lock at the same time.

(7) Business and Industrial Growth. A short-term increase in business and industrial activity would be noticed in the project vicinity due to purchases made for construction work and purchases made by construction workers (i.e., meals and lodging). Expansion of the navigation capacity through large-scale improvements may allow for long-term business and industrial growth through the development or expansion of businesses and industries, fleeting areas, and terminals in the river corridor.

(8) Employment and Labor Force. As one of the potential sites being analyzed for new lock facilities, the area would experience a temporary increase in employment during project construction. It is estimated that an average of 300 workers would be employed during the construction effort. Workers would be hired through labor unions at Peoria, Illinois, and other nearby communities. Between 1986 and 1991, rehabilitation efforts at Peoria Lock employed a similar number of workers with similar impacts.

Long-term impacts to employment or the labor force in the Peoria area would be related to business and industrial growth resulting from indirect, positive impacts of improved efficiency of the navigation system as a whole.

(9) Farm Displacement. There is little agricultural land in the project vicinity. No farmsteads would be displaced as a result of new lock construction.

(10) Noise Levels. Heavy machinery would temporarily raise noise levels during project construction. Low-density residential and industrial areas are located within one mile from the proposed locations; however, no permanent impacts to sensitive receptors would result.

(11) Aesthetics. The aesthetic appeal of any type of construction activity is low; however, construction would be temporary and would not significantly diminish the aesthetic resources of the surrounding areas.

g. La Grange Lock and Dam - La Grange, Illinois. (Locations 1 or 2 under consideration.)

(1) Community and Regional Growth. The existence of a cost-effective, efficient transportation system created by the locks and dams on the UMR-IWW System has provided stimulus for growth of river communities and the entire Midwest region. Overall, large-scale improvements at La Grange Lock would help to provide for continued growth opportunities in the La Grange, Illinois, area. Community and regional growth are impacted directly and indirectly by the effects of construction activity, expansion of existing firms, and establishment of new firms within the region.

(2) Community Cohesion. Land surrounding the La Grange Lock is agricultural and forested. No significant impact to community cohesion would be expected due to the limited residential development in the project vicinity.

(3) Displacement of People. Construction at this site will not require any residential relocations.

(4) Property Values and Tax Revenues. Short-term effects on tax revenues would result from the use of land for placement sites and staging areas during construction. Long-term effects on property values and tax revenues would be related to community and regional growth.

(5) Public Facilities and Services. Access to a recreational boat ramp upstream of the site will be negatively impacted by the proposed construction. A large wetland complex, which is privately owned and used for duck hunting, would be impacted by a Location 1 lock; approximately 6 acres would be lost. Much of the area adjacent to the lock is proposed for addition to the Illinois River National Wildlife Refuge complex; the fate of this proposal is unknown but will need to be considered in future planning.

(6) Life, Health, and Safety. Overall, the proposed projects would eliminate some of the hazards of transiting the river locks and congestion at the locks, thereby improving the safety conditions for towing industry and lock personnel. Improving navigation capacity would also reduce safety hazards for recreational vessels by minimizing the times when commercial and recreation crafts are using the lock at the same time.

(7) Business and Industrial Growth. A short-term increase in business and industrial activity would be noticed in the project vicinity due to purchases made for construction work and purchases made by construction workers (i.e., meals and lodging). Expansion of the navigation capacity through large-scale improvements may allow for long-term business and industrial growth through the development or expansion of businesses and industries, fleeting areas, and terminals in the river corridor. Construction at this site will not require any business or industrial relocations.

(8) Employment and Labor Force. As one of the potential sites being analyzed for new lock facilities, the area would experience a temporary increase in employment during project construction. It is estimated that an average of 300 workers would be employed during the construction effort. Workers would be hired through labor unions at La Grange, Illinois, and other communities in the area. Between 1986 and 1991, rehabilitation efforts at La Grange Lock employed a similar number of workers with similar impacts.

Long-term impacts to employment or the labor force in the La Grange area would be related to business and industrial growth resulting from indirect, positive impacts of improved efficiency of the navigation system as a whole.

(9) Farm Displacement. Use of Location 1 would require removal of approximately 118 acres of agricultural land from production; Location 2 requires the use of 21 acres. No farmsteads would be displaced.

(10) Noise Levels. The project area is rural in nature, featuring large spans of open fields. A temporary increase in noise levels during project construction will not significantly affect the surrounding area.

(11) Aesthetics. The proposed new lock construction at this site would not impact the aesthetic resources of the area.

VI. SUMMARY AND CONCLUSIONS

The objective of this site-specific analysis was to determine potential impacts from proposed construction measures using a habitat-based approach and, to the extent possible, quantify these impacts to assist in overall plan formulation for the Navigation Study. The analysis area was confined to the immediate vicinity of the existing lock and dam. Both large-scale (new lock construction) and small-scale (primarily non-structural or limited construction) measures were included in the discussion. Small-scale measures were not evaluated with SHEP. The lower seven sites on the system were studied in detail, while the remaining sites were examined in a qualitative fashion. Prior to any implementation, more detailed site-specific assessments will be completed. This should account for any site-specific changes that may occur between now and project implementation and will increase the detail of the assessment to thoroughly address potential site-specific impacts. As described within the mussel section of this report, dive surveys should be conducted at various locations to determine the extent of mussel beds and presence of any listed species. Surveys for species listed as federally endangered or threatened within other zones of impact may also be required.

Results of the SHEP analyses, by site, are provided in a general fashion in the body of the report, and detailed results are included as appendices. Site-specific variation due to physiography, engineering measures proposed, and the nature of existing resources make it impossible to draw any overall conclusions. However, some general site-specific conclusions are discussed within Section IV - Results and Discussion.

Bottomland hardwood forest exhibited the greatest losses in terms of habitat unit changes (considering only large-scale measures). In many cases, they would be cleared for use as staging areas and would be replaced after construction. In some cases, bottomland forest would be converted to either a lock facility or aquatic habitat. Bottomland hardwoods are considered a scarce and valuable resource on the UMR-IWW System, and impacts to them should be avoided or minimized to the extent possible.

Large gains in main channel border habitat units were often realized from the conversion of bottomland forest. Because acreage gains were often the driver for habitat unit gains, those gains should not be counted as benefits. This is not to imply that these habitats have no value; in fact, projected increases in depth and velocity in these areas could improve overall channel border conditions. It is important to emphasize, however, that main channel border is abundant on the system, and no trade-off in habitat value is being proposed where terrestrial habitat is lost and aquatic habitat gained.

In main channel border areas downstream of the lock, there was often a loss in habitat units. This occurred when the area landward of the proposed new lockwalls experienced decreased velocity and where, over time, siltation and sedimentation would likely occur. These conditions lowered the value of existing main channel border habitats, which in turn was reflected as habitat unit losses, particularly at the Mississippi sites. One notable main channel border impact was at L/D 22 where a proposed dike field upstream of the lock

caused a very large habitat unit loss. This was based on the assumption that the entire area would become terrestrial over time.

Implementation of small-scale measures by themselves would reduce potential impacts, primarily in three ways. First, bottomland hardwood impacts would be lessened by reduced staging area needs, and generally requiring less terrestrial excavation for lock construction. Secondly, dredging for channel improvements is, in some cases, not as extensive as for large-scale measures. Potential changes would, however, be similar to large-scale measures for guidewall extensions, i.e., reduced velocity landward of the wall, and for channel excavation, where velocity and depth would both likely increase. Finally, potential changes in tailwaters due to Location 4 lock construction would also be eliminated.

Both side channel and non-forested wetland habitat were of limited occurrence in the analysis areas, with one or both occurring only at L/D 20, 25, and La Grange. Habitat unit losses were relatively limited at L/D 25 and La Grange due to small acreages being impacted. An entire side channel is eliminated with the wicket gate option at L/D 20. These habitats are scarce on the system, and their loss should be avoided or minimized where possible. With the implementation of small-scale measures, wicket gate impacts at L/D 20 would not occur.

Habitat replacement costs were estimated for all sites (see Section IV) as a means of clearly separating or comparing the costs of one lock location to another. No trend emerged, and thus each lock and dam must be individually evaluated. One exception is the Location 1 at L/D 25, which clearly stands out in terms of its potential adverse habitat impacts. As mentioned above, costs for replacing bottomland hardwood habitats are the highest in total based on the number of total acres; but on a cost-per-acre basis, side channel and non-forested wetland habitats are the most expensive to replace. Again, the costs are the best available estimates at this time; the exact nature of mitigation and replacement costs will not be known until a recommended plan is selected and detailed site-specific planning is in turn conducted.

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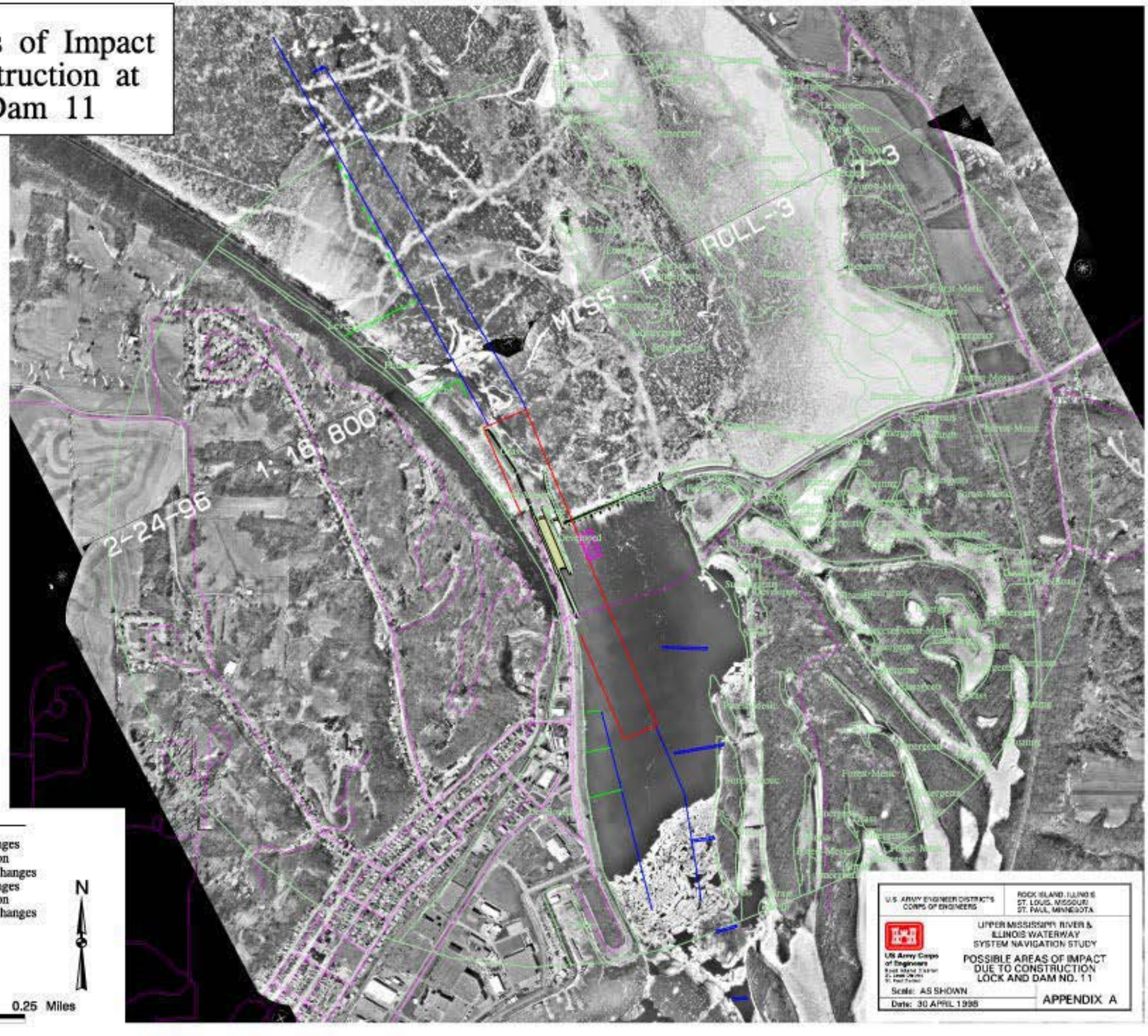
Appendix A

Project Planning Site Maps

Possible Areas of Impact Due to Construction at Lock & Dam 11



Legend

- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Submerged Construction
- Roads
- Placement Sites
- Vegetation Classification
- Lock & Dam 11

N

0.25 0 0.25 Miles

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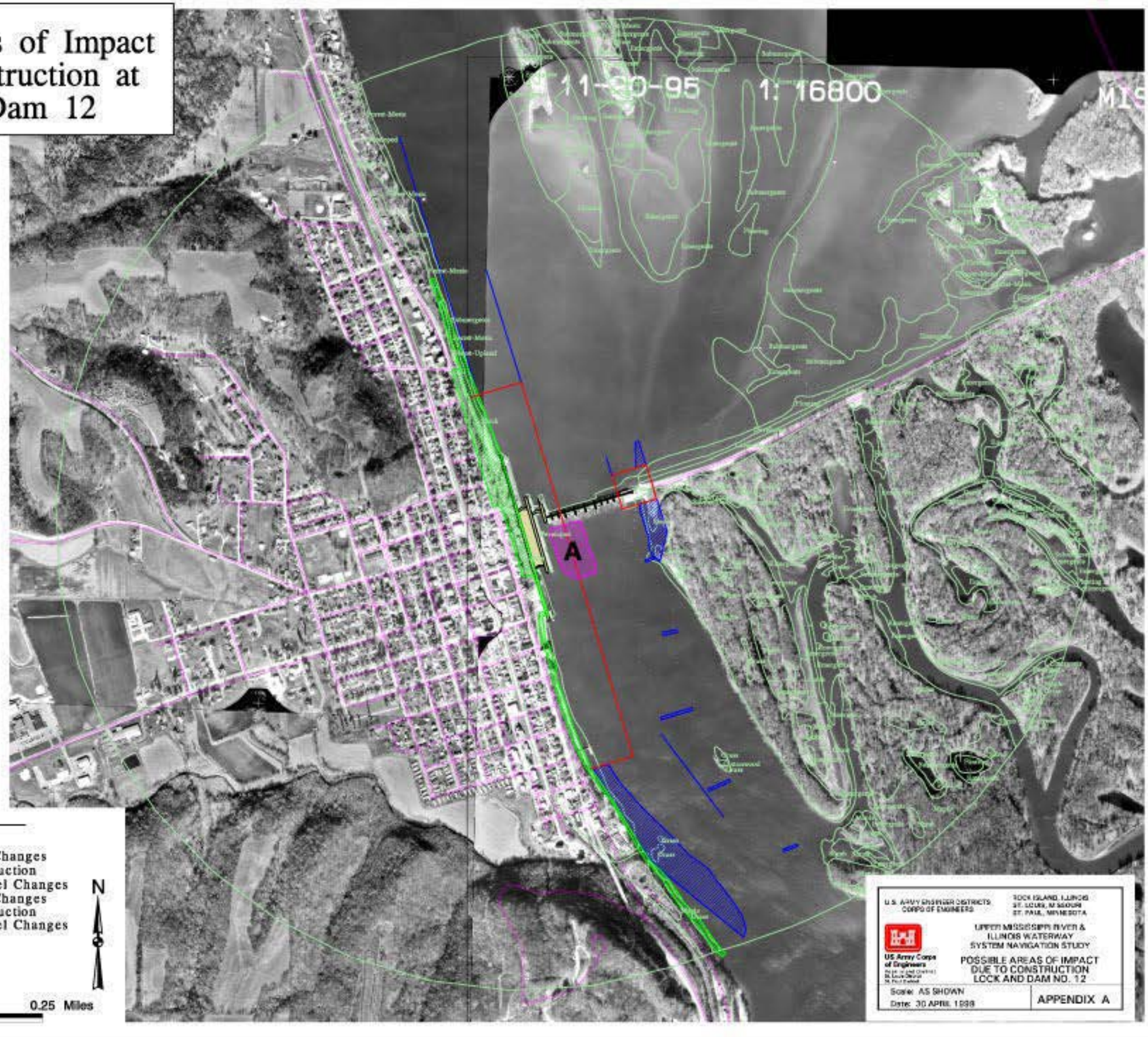
POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION LOCK AND DAM NO. 11

Scale: AS SHOWN

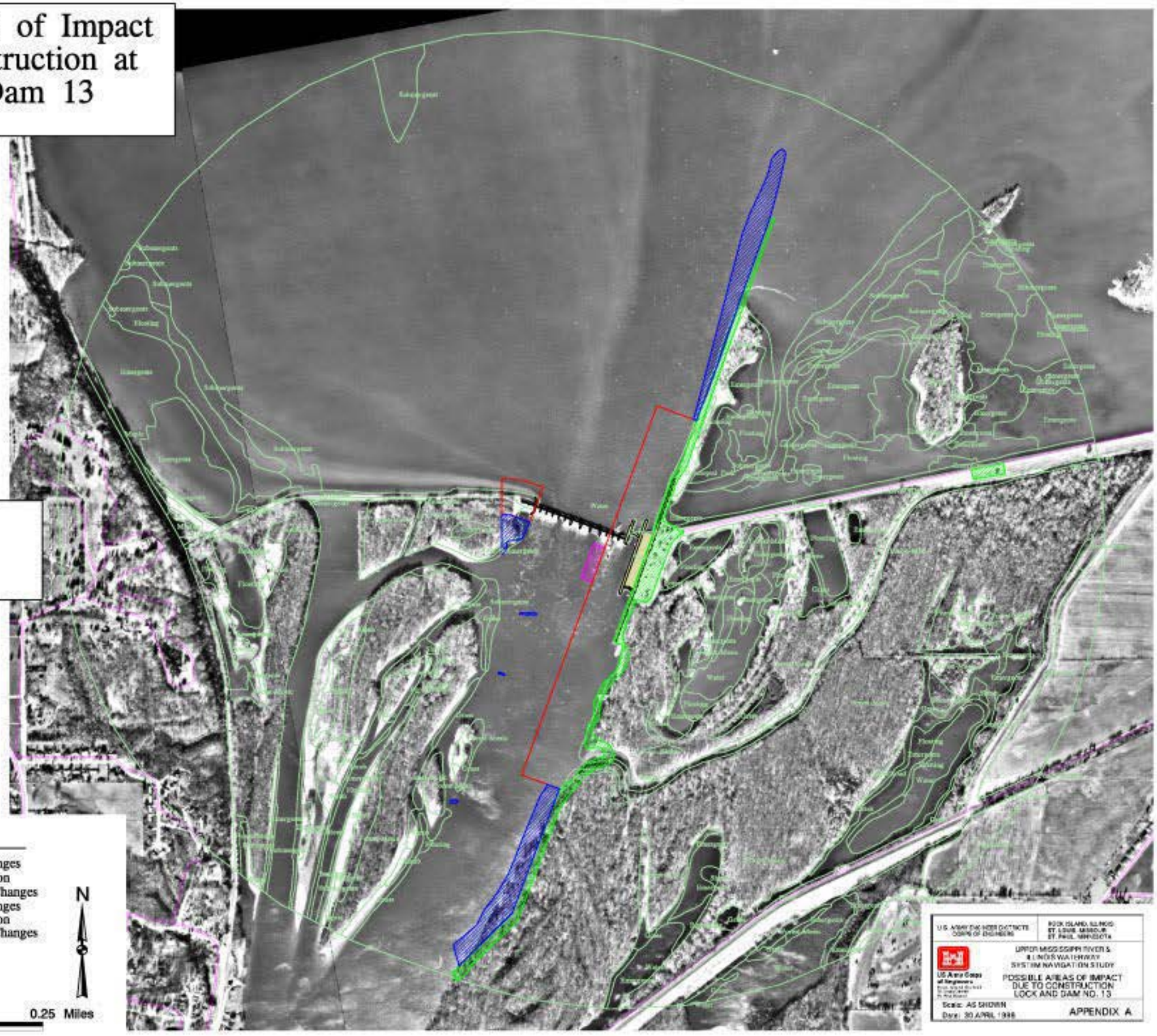
Date: 30 APRIL 1998

APPENDIX A

Possible Areas of Impact Due to Construction at Lock & Dam 12



Possible Areas of Impact Due to Construction at Lock & Dam 13



Placement Site Key

Legend

- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Placement Sites
- Vegetation Classification
- Roads
- Lock & Dam 13

N

0.25 0 0.25 Miles

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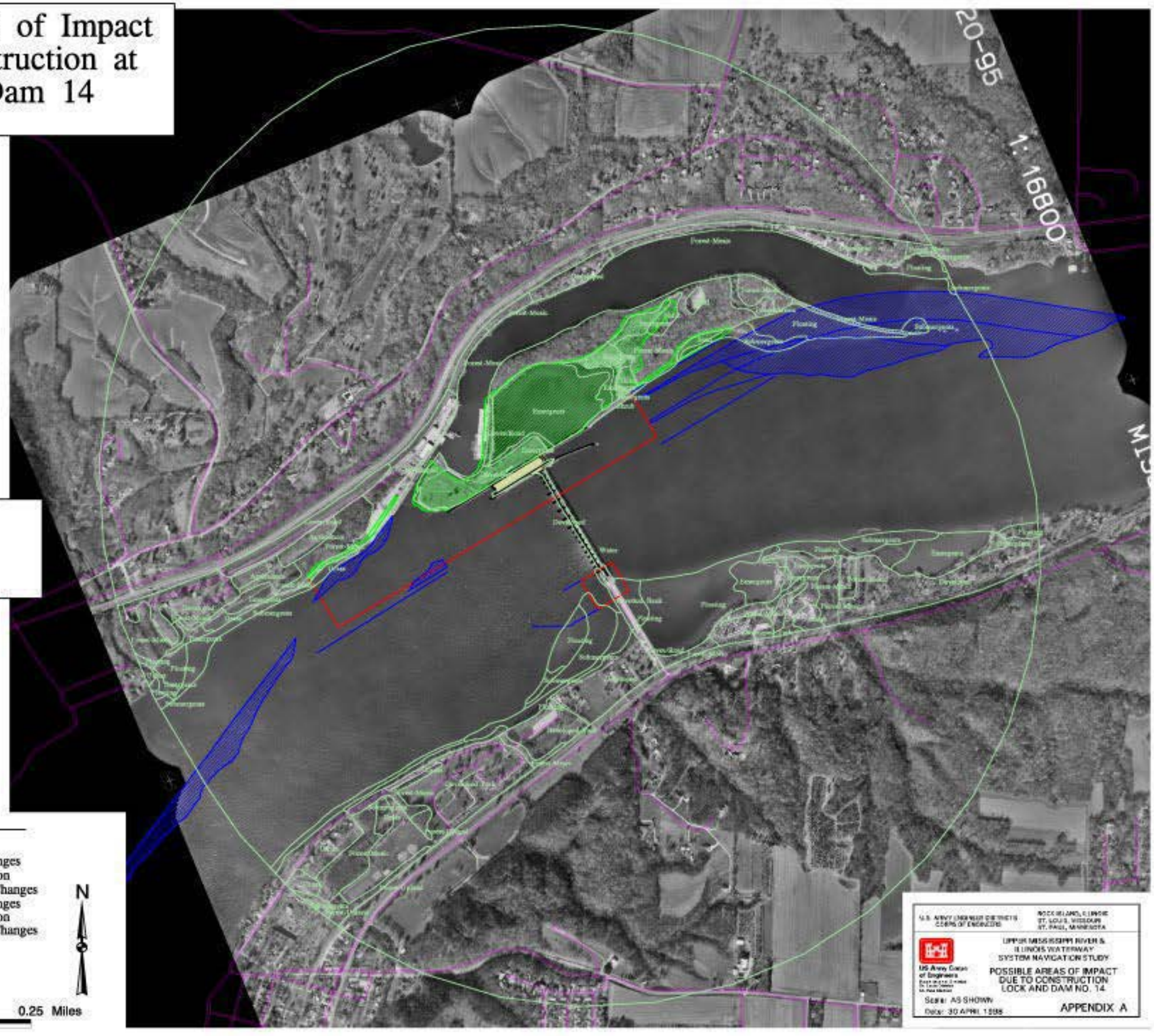
POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION LOCK AND DAM NO. 13

Scale: AS SHOWN

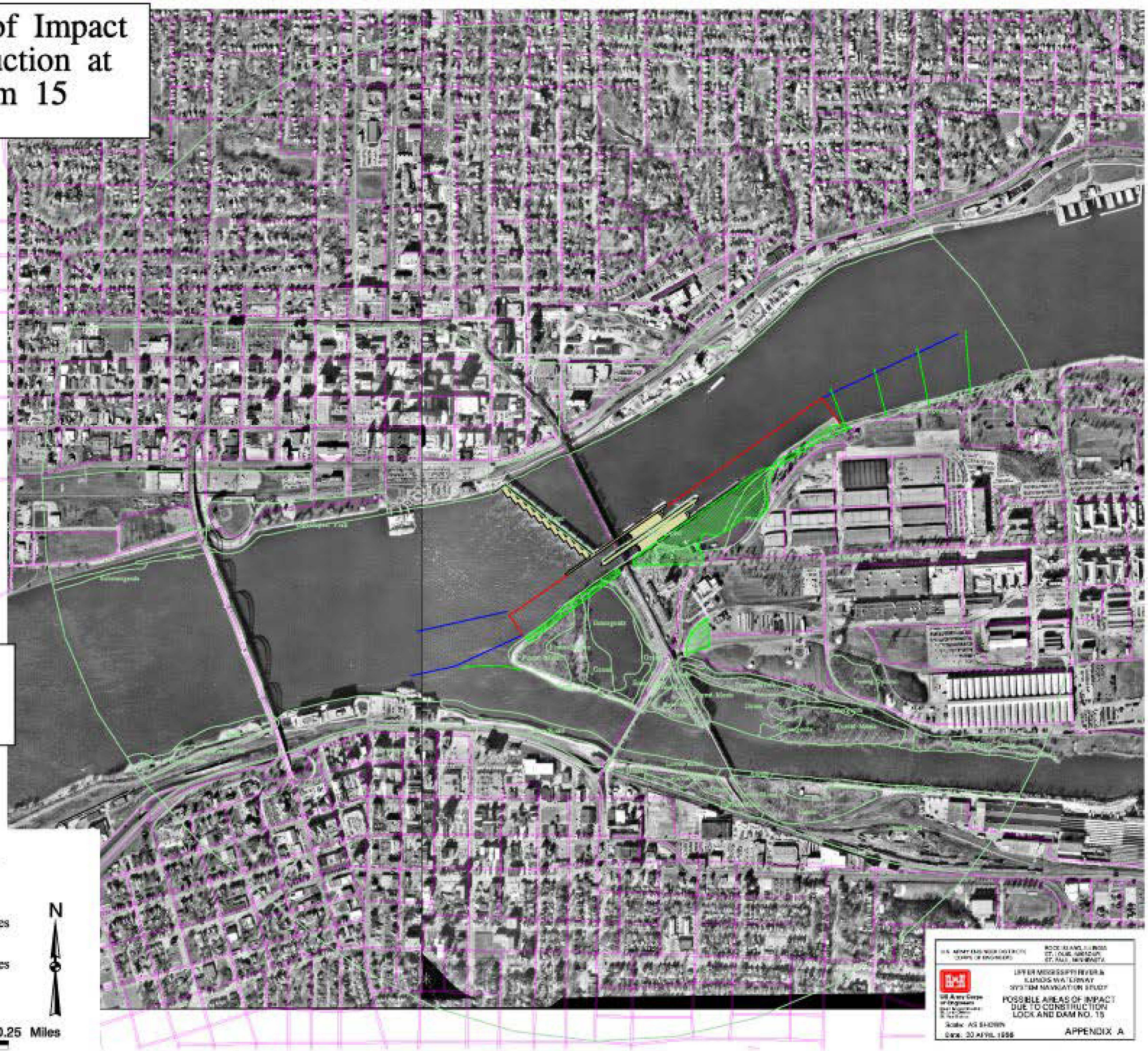
Date: 30 APRIL 1998

APPENDIX A

Possible Areas of Impact Due to Construction at Lock & Dam 14



Possible Areas of Impact Due to Construction at Lock & Dam 15



Placement Site Key

Legend

- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Vegetation Classification
- Roads
- Lock & Dam 15

N

0.25 0 0.25 Miles

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

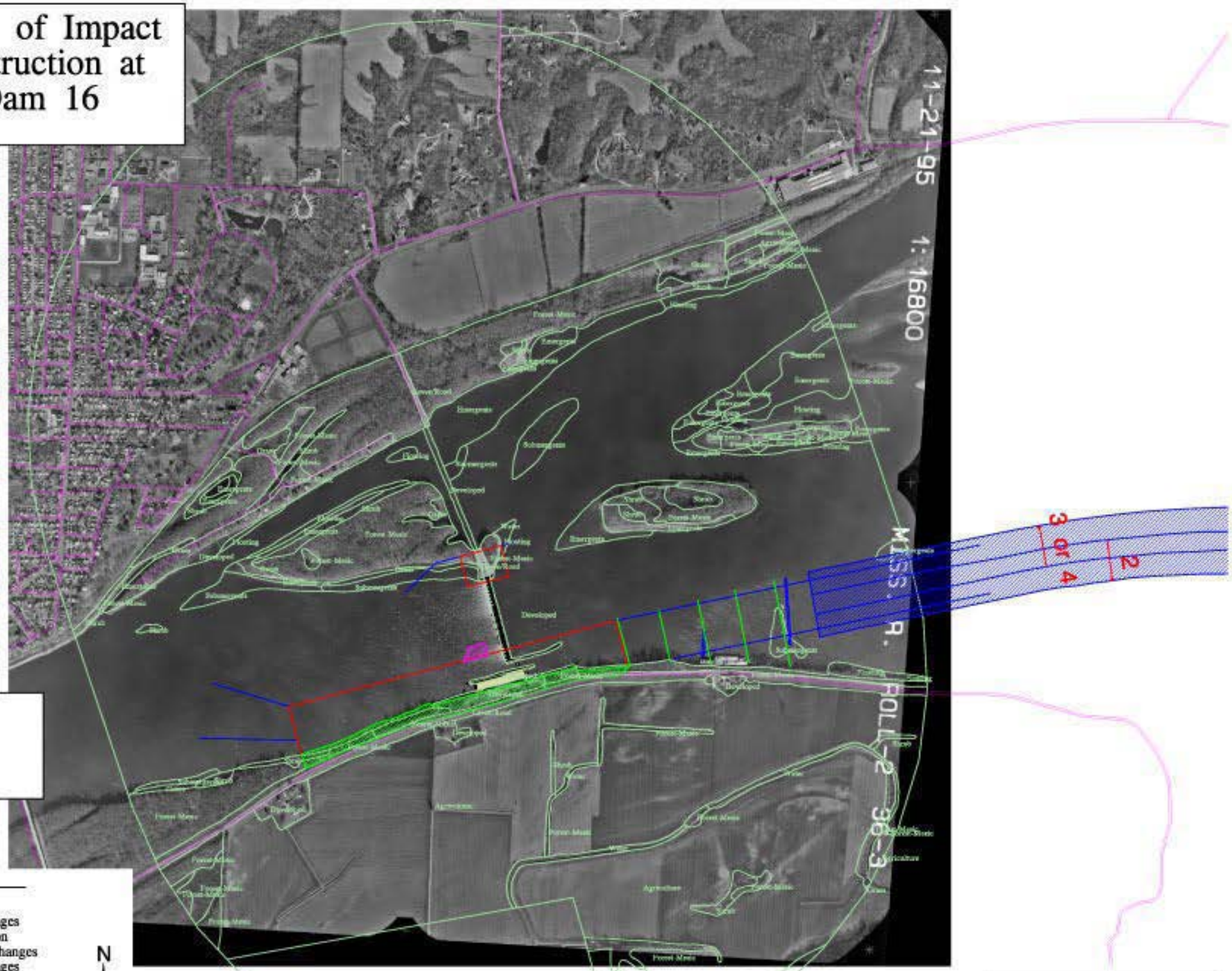
POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION LOCK AND DAM NO. 15

Scale: AS SHOWN

Date: 30 APRIL 1998

APPENDIX A

Possible Areas of Impact Due to Construction at Lock & Dam 16



Placement Site Key

Legend

- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Placement Sites
- Vegetation Classification
- Roads
- Lock & Dam 16

0.25 0 0.25 Miles

N

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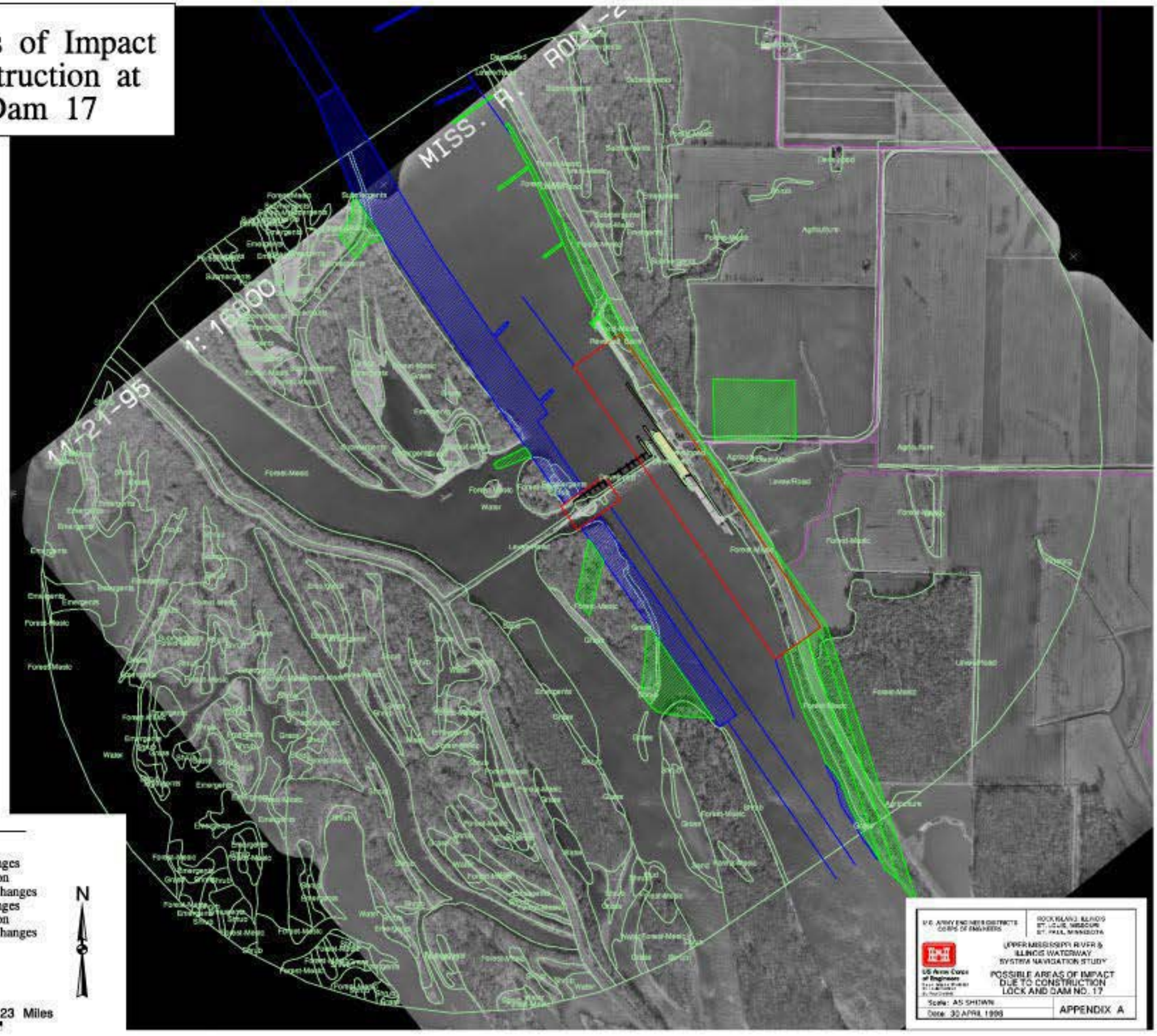
POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION LOCK AND DAM NO. 16

Scale: AS SHOWN

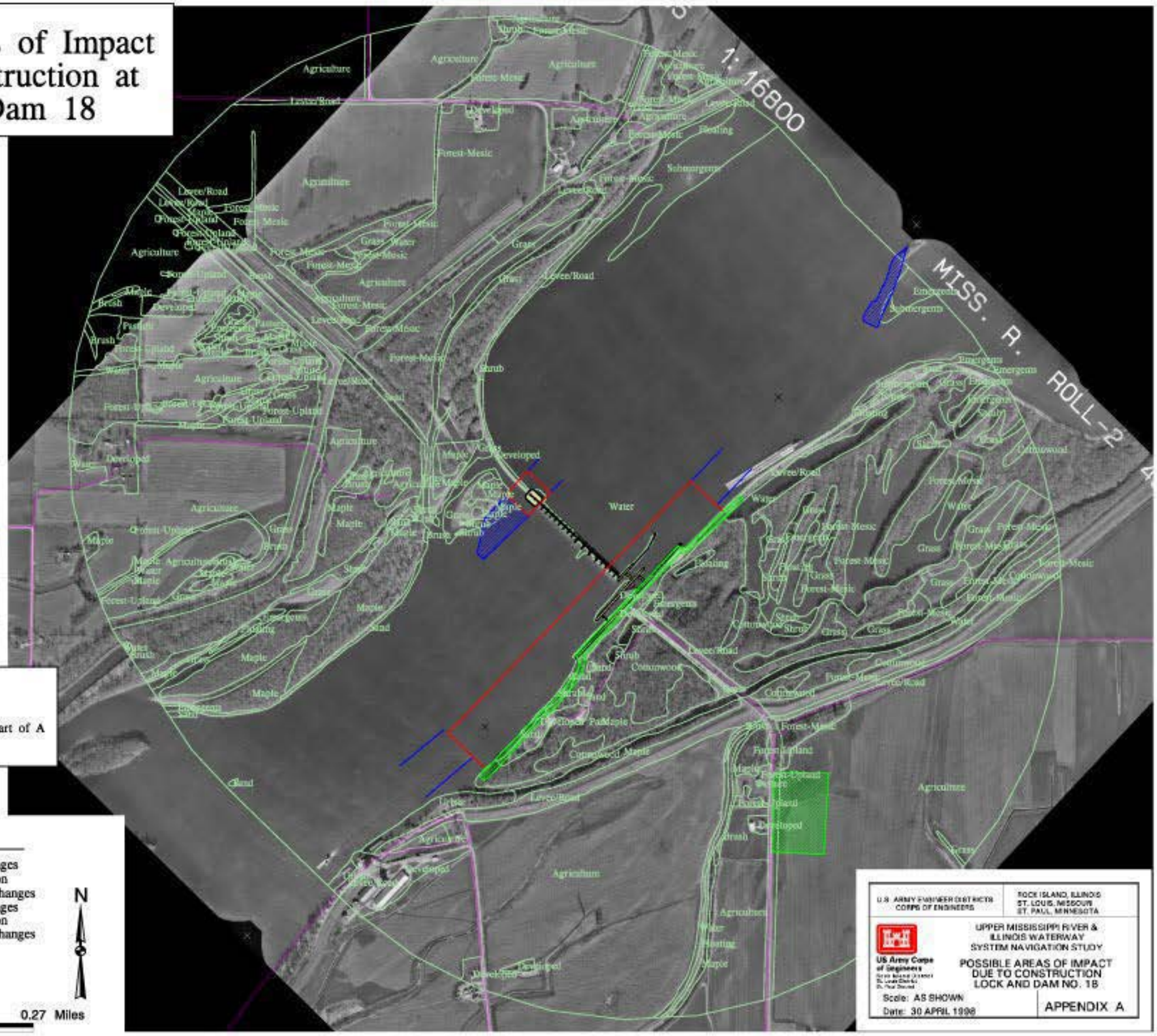
Date: 30 APRIL 1998

APPENDIX A

Possible Areas of Impact Due to Construction at Lock & Dam 17



Possible Areas of Impact Due to Construction at Lock & Dam 18



Placement Site Key

Location 2 = Placement Sites ABDF
Location 3 = Placement Sites BDF part of A
Location 4 = Placement Site B
Wicket = Placement Sites CDE

Legend

- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Placement Sites
- Vegetation Classification
- Roads
- Lock & Dam 18

N

0.27 0 0.27 Miles

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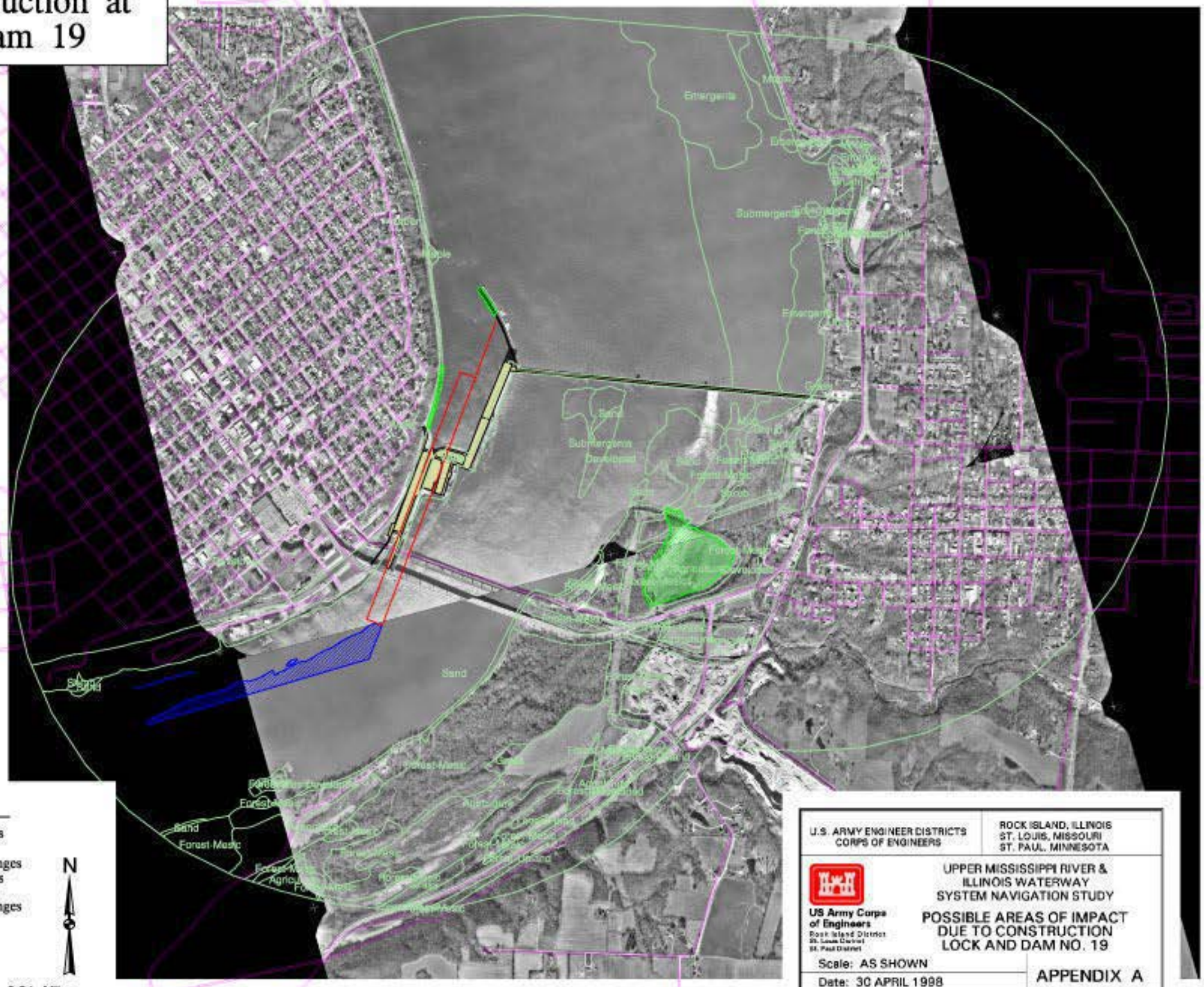
POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION LOCK AND DAM NO. 18

Scale: AS SHOWN

Date: 30 APRIL 1998

APPENDIX A

Possible Areas of Impact Due to Construction at Lock & Dam 19



Legend

- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Placement Sites
- Vegetation Classification
- Roads
- Lock & Dam 19

N

0.34 0 0.34 Miles

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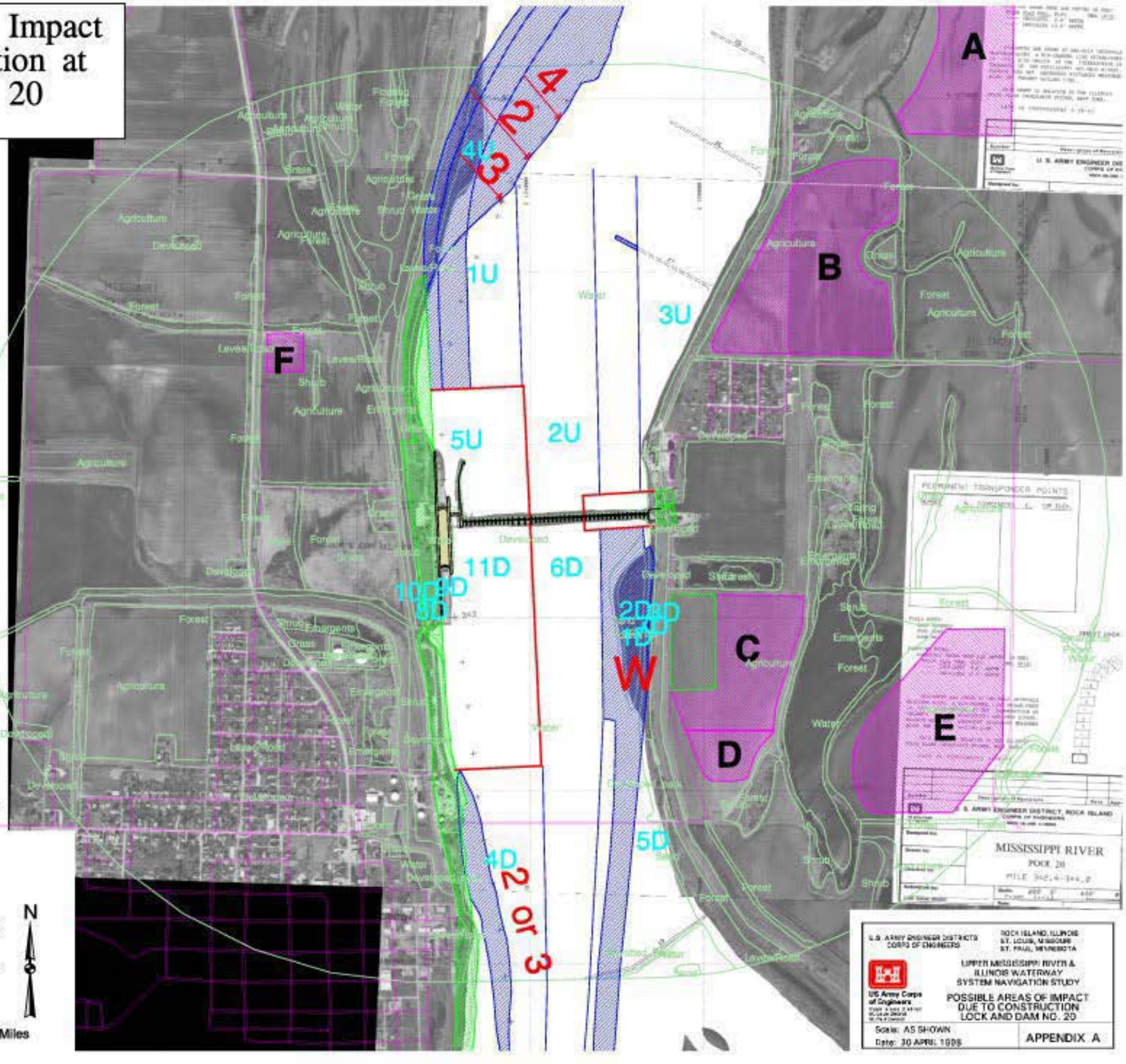
	POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION LOCK AND DAM NO. 19
Scale: AS SHOWN	
Date: 30 APRIL 1998	APPENDIX A

Possible Areas of Impact Due to Construction at Lock & Dam 20



Placement Site Key

Location 2 = Placement Sites ABDF
Location 3 = Placement Sites BDF part of A
Location 4 = Placement Site B
Wicket = Placement Sites CDE

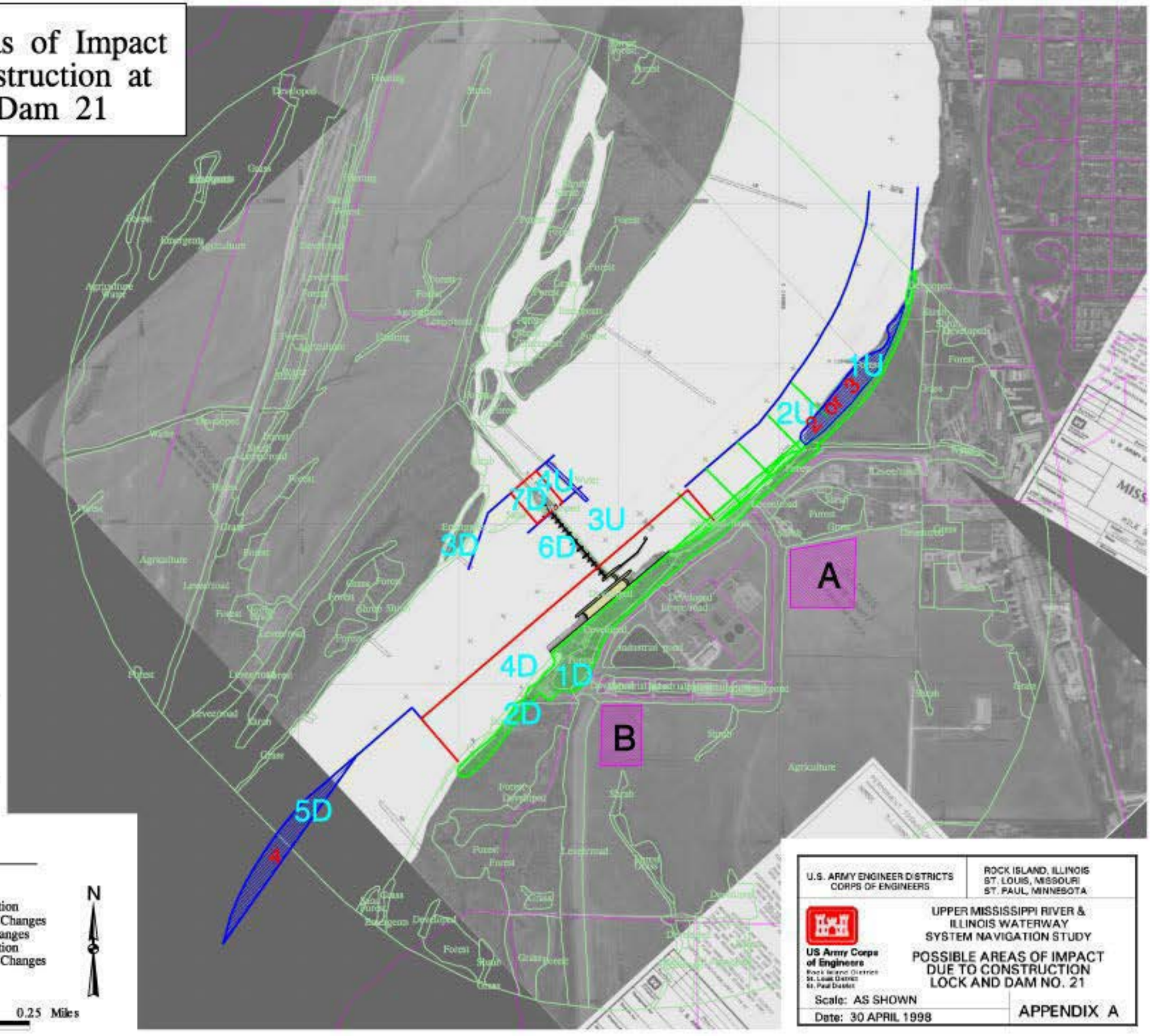
Legend

- 5D Sample Sites
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Placement Sites
- Roads
- Lock & Dam 20

N

0.25 0 0.25 Miles

Possible Areas of Impact Due to Construction at Lock & Dam 21



Placement Site Key

Location 2 = Placement Site A
Location 3 = Placement Site A
Location 4 = Placement Site B

Legend

- 5D Sample Sites
- Placement Sites
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Roads
- Lock & Dam 21

N

0.25 0 0.25 Miles

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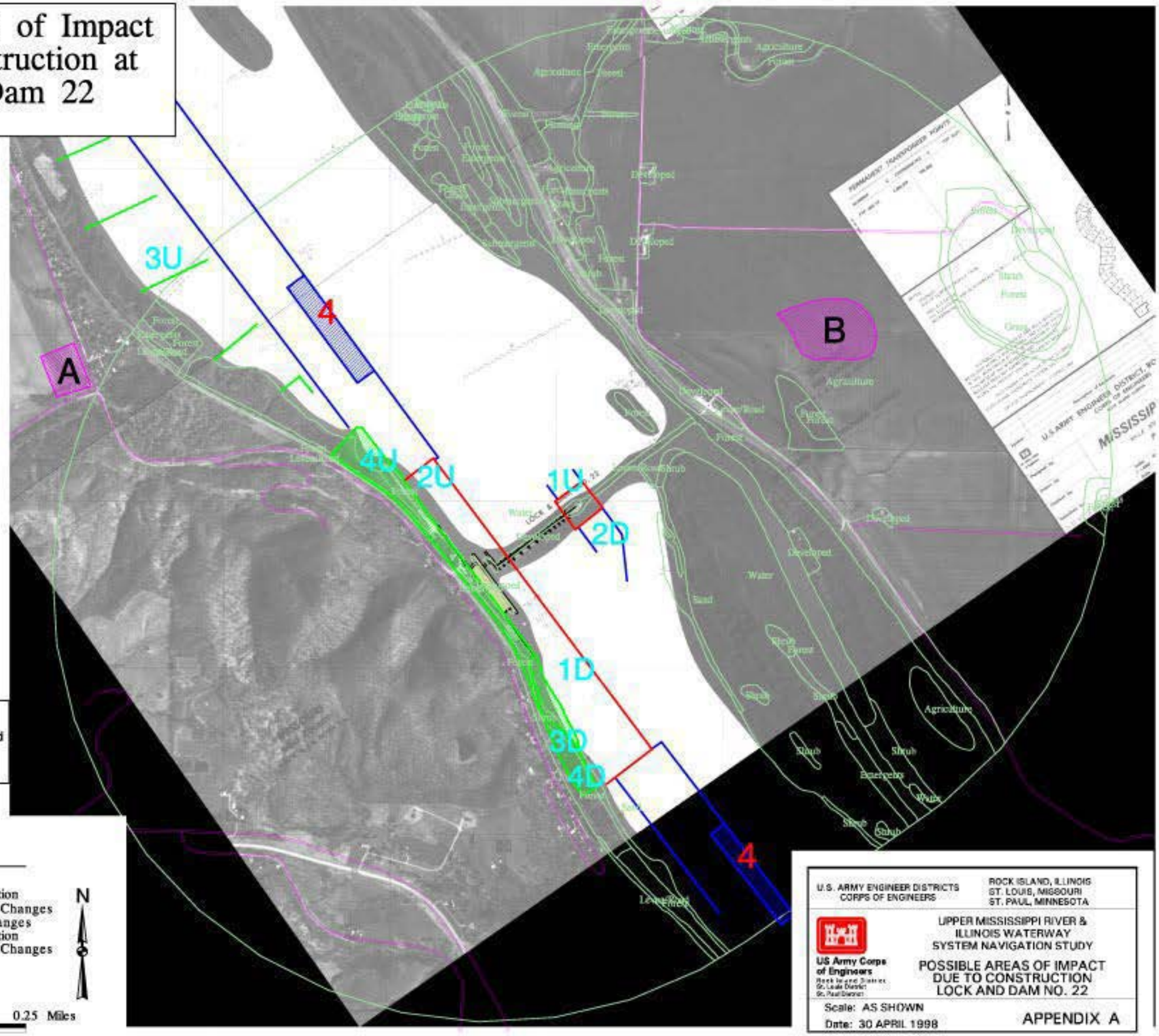
US Army Corps of Engineers Rock Island District St. Louis District St. Paul District	UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION LOCK AND DAM NO. 21
Scale: AS SHOWN Date: 30 APRIL 1998	APPENDIX A

Possible Areas of Impact Due to Construction at Lock & Dam 22



Placement Site Key

Location 2 = No Dredging Needed
Location 3 = Placement Site A
Location 4 = Placement Site AB

Legend

- 4D Sample Sites
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Placement Sites
- Roads
- Lock & Dam 22

N

0.25 0 0.25 Miles

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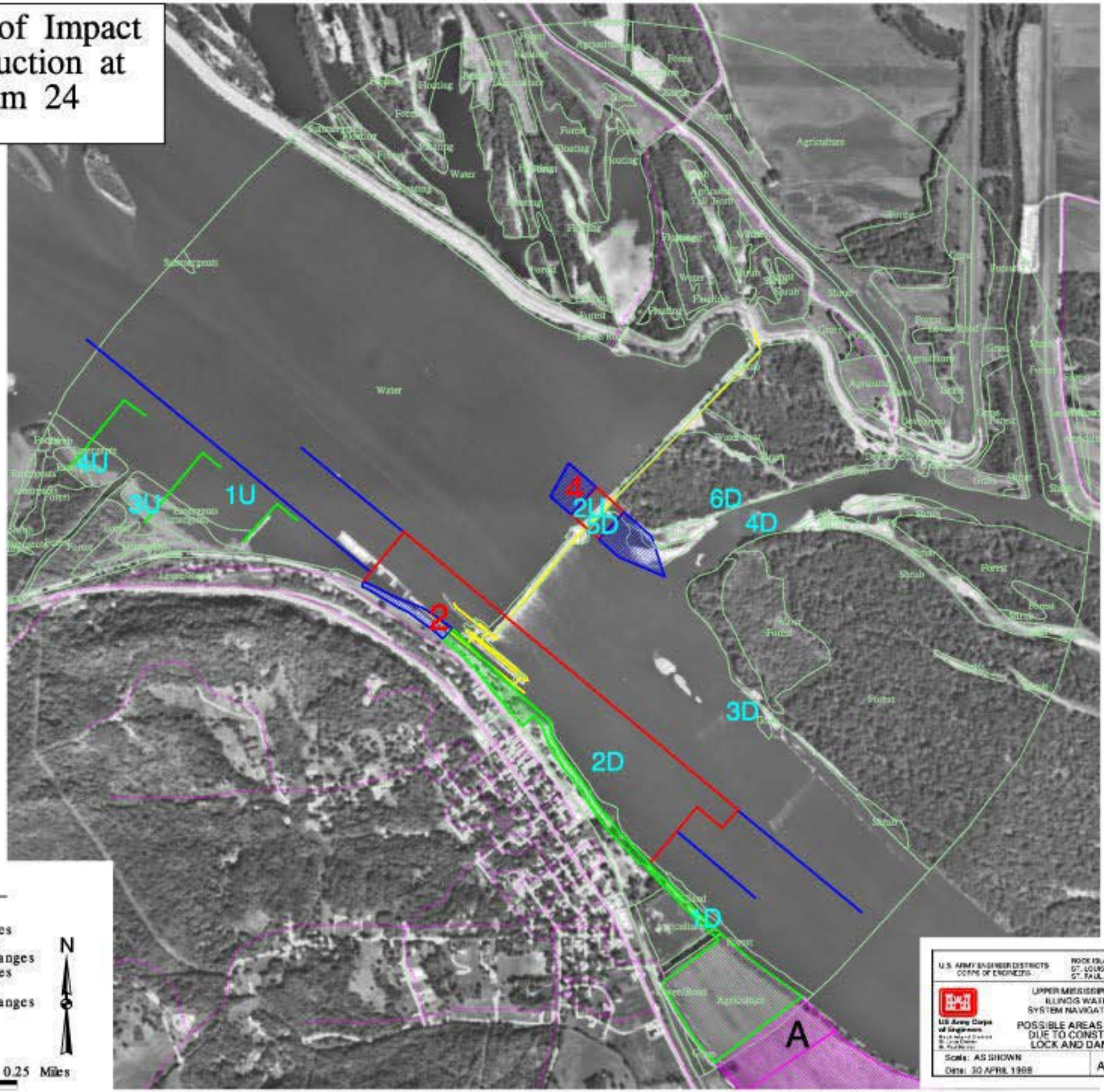
POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION LOCK AND DAM NO. 22

Scale: AS SHOWN
Date: 30 APRIL 1998

APPENDIX A

Possible Areas of Impact Due to Construction at Lock & Dam 24



Placement Site Key

Location 2 = Placement Site A
Location 4 = Placement Site A

Legend

6D Sample Sites
Areas Affected by Lock Changes
Areas Affected by Construction
Areas Affected by Channel Changes
Areas Affected by Lock Changes
Areas Affected by Construction
Areas Affected by Channel Changes
Placement Sites
Roads
Lock & Dam 24

0.25 0 0.25 Miles

N

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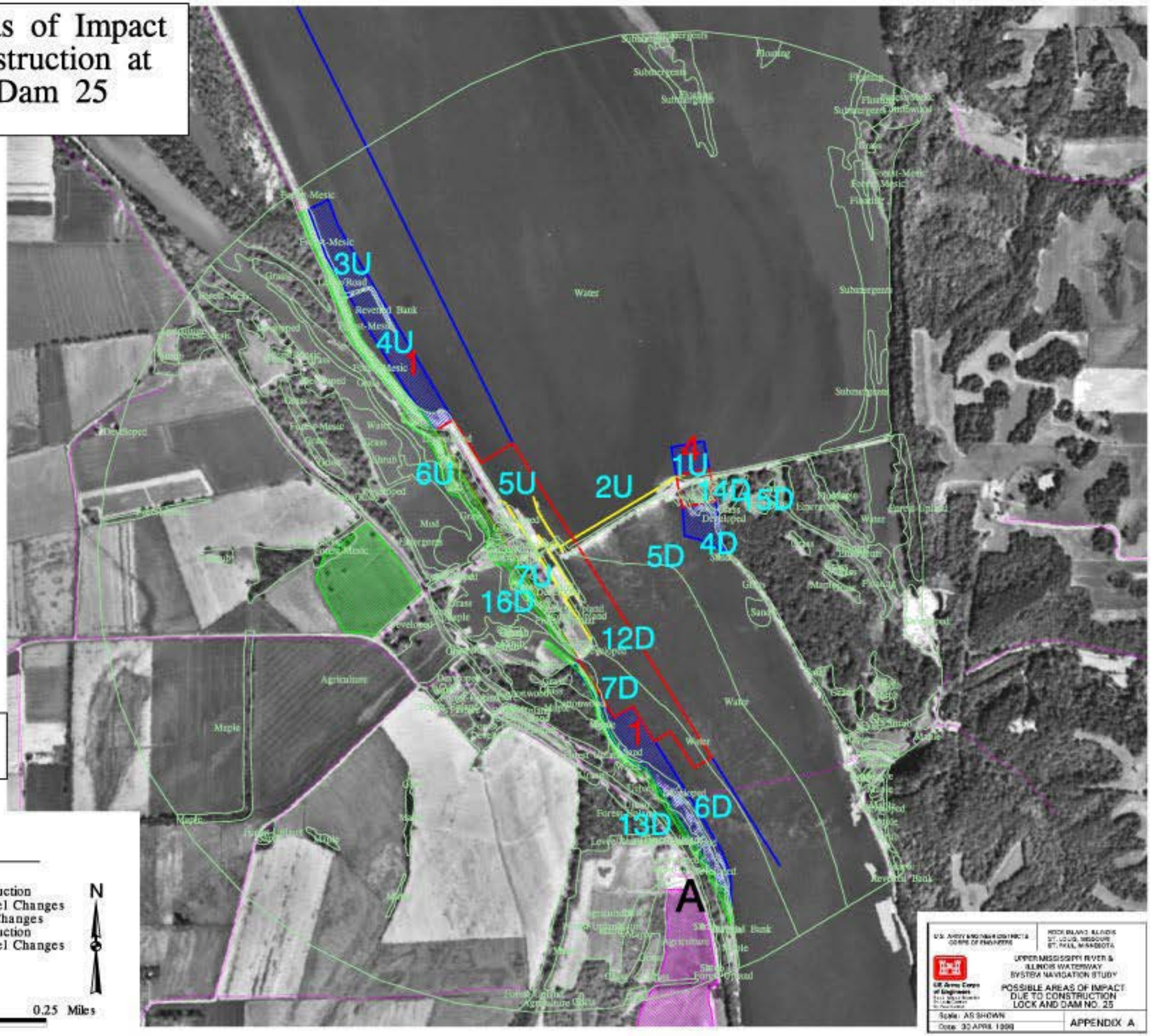
POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION LOCK AND DAM NO. 24

Scale: AS SHOWN
Date: 30 APRIL 1998

APPENDIX A

Possible Areas of Impact Due to Construction at Lock & Dam 25



Placement Site Key

Location 1 = Placement Site A
Location 4 = Placement Site A

Legend

- Sample Sites
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Placement Site
- Roads
- Lock & Dam 25

N

0.25 0 0.25 Miles

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US Army Corps of Engineers

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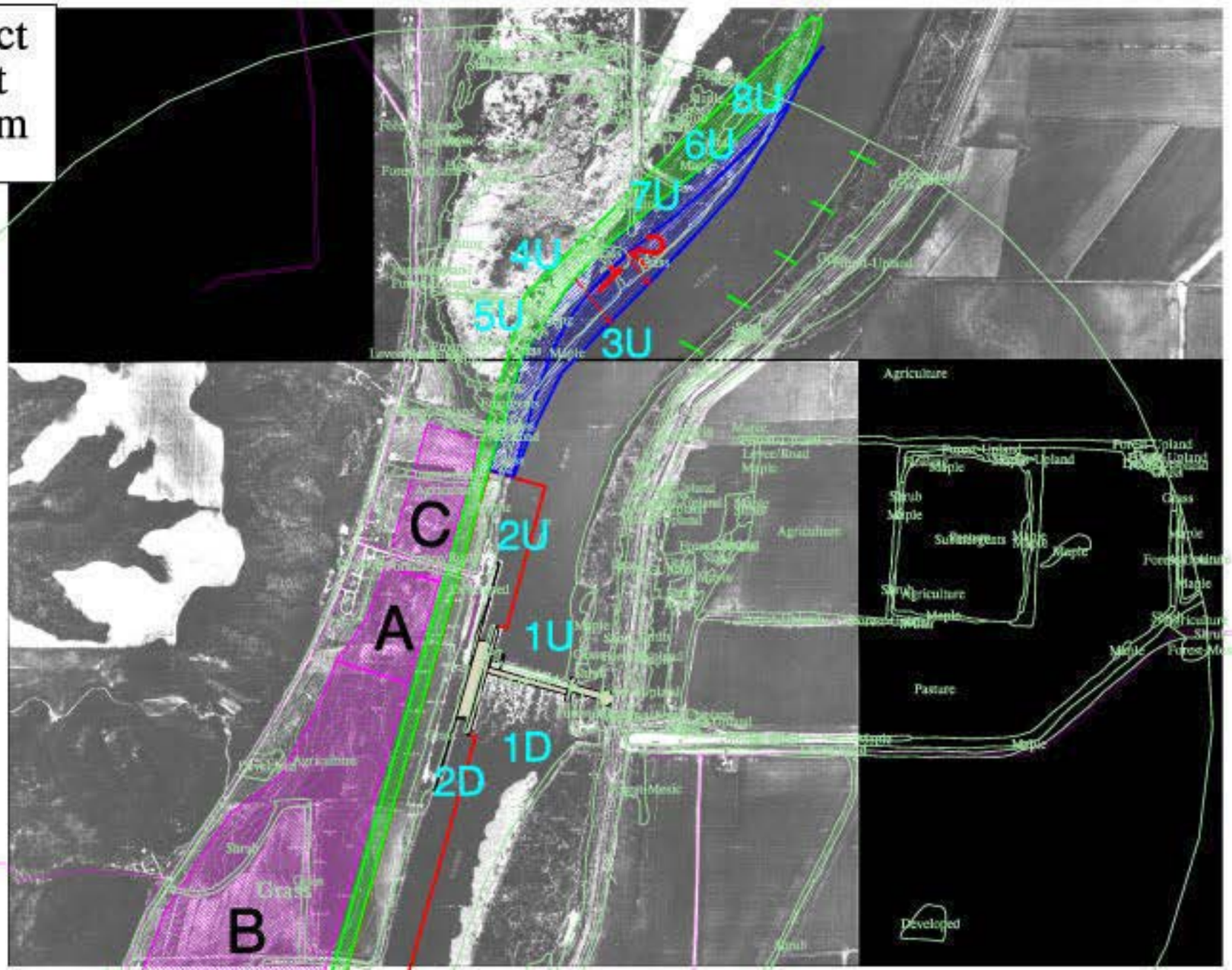
POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION LOCK AND DAM NO. 25

Scale: AS SHOWN

Date: 30 APRIL 1999

APPENDIX A

Possible Areas of Impact Due to Construction at La Grange Lock & Dam



Placement Site Key

Location 1 = Placement Sites ABC
Location 2 = Placement Site A

Legend

- 2D Sample Sites
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Roads
- Placement Sites
- La Grange Lock & Dam

N

0.25 0 0.25 Miles

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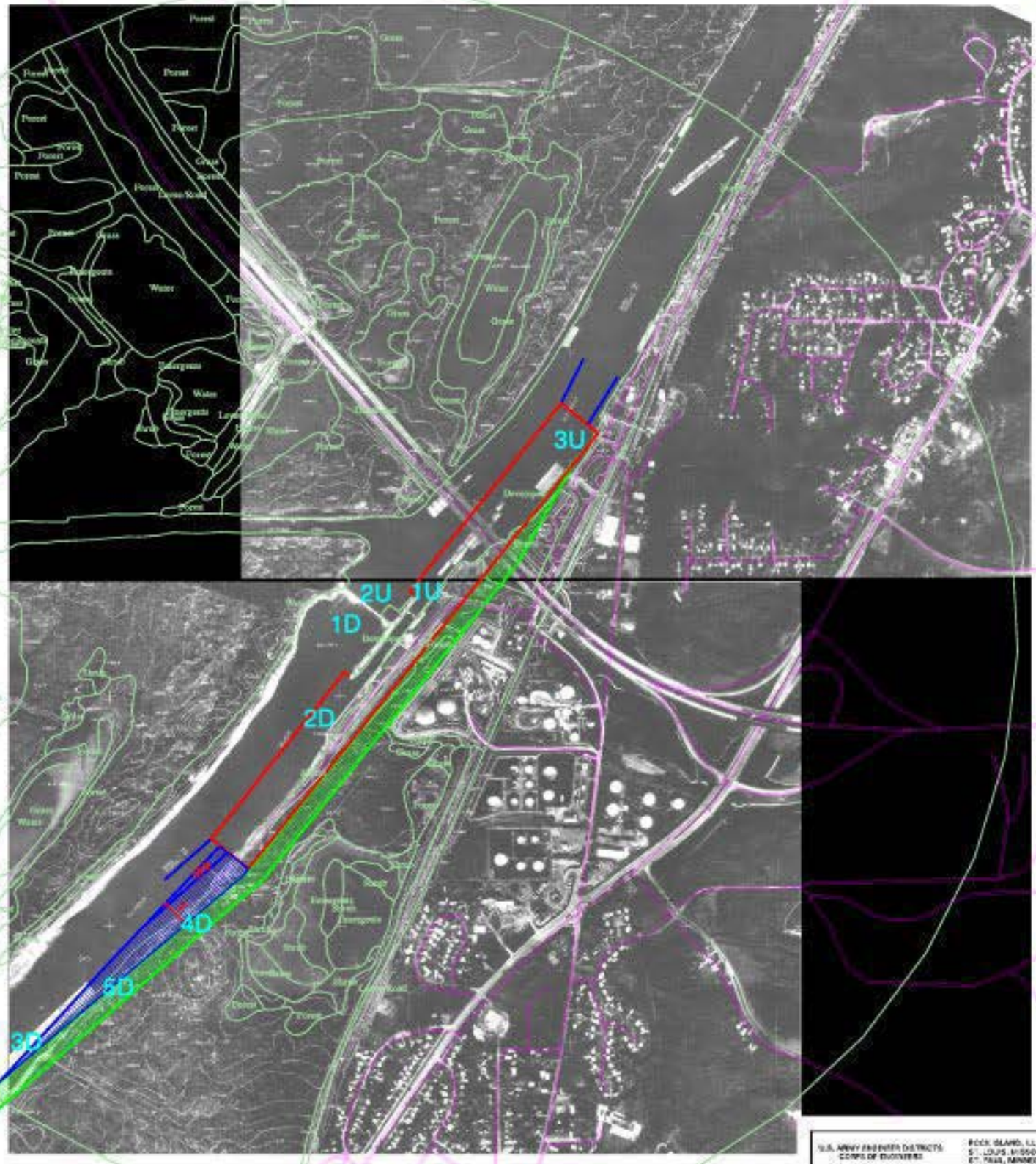
POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION LAGRANGE LOCK AND DAM

Scale: AS SHOWN

Date: 30 APRIL 1998

APPENDIX A

Possible Areas of Impact Due to Construction at Peoria Lock & Dam



Placement Site Key

Location 1 = Placement Site AB
Location 2 = Placement Site A

Legend

- Sample Sites
- Placement Sites
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Areas Affected by Lock Changes
- Areas Affected by Construction
- Areas Affected by Channel Changes
- Roads

N

0.25 0 0.25 Miles

Placement Sites A and B approximately 1/2 mile south of the study area

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POSSIBLE AREAS OF IMPACT DUE TO CONSTRUCTION PEORIA LOCK AND DAM

Scale: AS SHOWN
Date: 30 APRIL 1998

APPENDIX A

Appendix B

Comparison of Habitat Evaluation Methods

(Richard Stiehl)

Comparison of Evaluation Methods for Assessing Potential Environmental Impacts on the Upper River
Richard Stiehl

Wildlife Habitat Appraisal Guide (WHAG)

WHAG is comprised of a set of Habitat Suitability Index (HSI) models modified to improve reliability under Missouri field conditions. It was developed in 1991 by the Missouri Department of Conservation (MDOC) as a regional modification of the Habitat Evaluation Procedures. The WHAG format was adapted from US DOI Resource Publication No. 133 (1980), with draft (HSI) models applied to MDOC wildlife management areas (WMA), annual wildlife survey routes and other areas. None of the models were statistically validated, and all habitat characteristics are scored by visual estimation.

WHAG is organized into Habitat Matrices with the general classifications of Wetland and Upland. The Wetland matrix may be applied in four wetland habitat types: nonforested wetland, bottomland hardwoods-wetland, cropland-wetland, and grassland-wetland. Twelve species are included in the matrix (mallard, Canada goose, least bittern, lesser yellowlegs, muskrat, king rail, green-backed heron, wood duck, beaver, American coot, northern parula warbler, and prothonotary warbler), but the program allows changing of the species used in each habitat matrix. The species representation in each habitat matrix is not even. Nonforest wetlands have the highest species representation (8), followed by bottomland hardwood-wetland (6). Two species (mallard and Canada goose) represent cropland-wetland and Canada goose alone represents grassland-wetland habitat.

The wetland matrix is described by 54 habitat variables, although none of the variables may be applied to all four wetland habitats. Nonforested wetlands are described by evaluating 32 variables, while bottomland hardwoods-wetland has 27 variables. Cropland-wetland and grassland-wetland have 13 and 7 variables, respectively, perhaps reflecting the fewer species associated with each habitat.

Each habitat variable is scored by placing it into one of several (usually 4 or 5) categories. The category produces a single value for a range of conditions for the variable. Each value is either considered a multiplier (weighted) or (more frequently) a limiting factor for the species, with all of the variables aggregated as an arithmetic mean to produce a 0 to 1 measure of suitability for the species.

Attributes of WHAG:

Positive:
1. Models are modified for Midwestern conditions.
2. Both game and nongame species represented.
3. New models and custom matrices may be created.
4. Some acceptance in Midwest.
5. Uses HSI type variable input.

Negative:
1. Variable categories do not allow continuous variation.
2. New models or model modification must conform to program constraints.
3. Arithmetic mean aggregation may not be biologically appropriate in all cases.
4. Calculation of future target year habitat values is data and time intensive.

Conclusions:

The WHAG evaluation engine would be acceptable, but new models would need to be developed for the Upper Mississippi application. Existing WHAG models would need to be modified to be biologically logical. Applying the results of the method to predict future habitat values for additional target years would be data and time intensive.

I do not recommend this method, mainly due to the aggregation constraints concomitant with the program. I do not accept the mathematical constraints of arithmetic mean aggregation. I believe that arithmetic mean aggregation of variables may be biologically sound only if the variables and their weightings are carefully considered on a species by species basis. The universal application of arithmetic mean aggregation is unsound and may result in potentially undependable results.

Aquatic Habitat Appraisal Guide (AHAG)

AHAG was developed through the efforts of the U.S. Army Corps of Engineers Waterways Experiment Station and the U.S. Army Corps of Engineers Rock Island District as a tool to meet the habitat evaluation requirements associated with Habitat Rehabilitation and Replacement Projects (HREP) on the Upper Mississippi River System (UMRS). AHAG is particularly applicable to evaluate impacts from the removal of sediments from backwaters, the placement of water control structures to manage water levels in backwater areas, and restoring flows to side channels. AHAG is based on the concept of the Habitat Evaluation Procedures (HEP), uses HSI models, and follows the format of US DOI Resource Publication No. 133 (1980).

AHAG has three default matrices of sixteen habitat variables as they relate to eight fish species (white bass, emerald shiner, river darter, northern pike, smallmouth buffalo, walleye, largemouth bass and bluegill). Matrices may be used in current forms, or customized to meet specific needs by adding or deleting species, or modifying the variables, either by changes in value curves or relative importance in the model. AHAG requires user input of habitat values estimated from existing information or measured in the field. These field values are then converted to a numerical equivalent between 0.0 and 1.0 (as SI values in HSI models) and then aggregated to compute the HSI for each species. A matrix of variables (similar to the structure in WHAG) provides evaluation of several species from representatives developed from five reproductive guilds (lithophilos, pelagophilos, phytopylos, litho-psammophilos, and speleophilos) and five habitat guilds (lotic-large fishes, lotic-small fishes, lentic-large fishes, lentic-small fishes and generalists). Even with seven null cells, the eight evaluation species do not encompass all possible reproductive/habitat associations present.

Although the AHAG program may be modified, it permits a maximum of 30 habitat variables, three species and five life stages per species.

As in WHAG, each AHAG habitat variable is scored by placing it into one of several (usually four or five) categories. The category produces a single value for a range of conditions for the variable. Departing from WHAG, AHAG allows three forms of HSI aggregation. The suitability of the habitat for each species may be determined by the arithmetic-mean of all variable scores, or by the lowest variable score (limiting factor), or as an arithmetic mean of selected variable scores that are considered limiting. There is apparently no guidance as to which aggregation is more biologically correct, although the default matrix lists limiting factor and mean limiting factor as optional. The default matrix also proposes a Suitability Index Scoring Criteria as Excellent=1.0; Good=0.75; Fair=0.5; Poor=0.25; and Unusable=0.0.

Attributes of AHAG:

Positive:
1. Models are constructed for Midwestern conditions.
2. Both game and nongame species represented.
3. New models and custom matrices may be created.
4. Some acceptance in Midwest.
5. Uses HSI type variable input.

Negative:
1. Variable categories do not allow continuous variation.
2. New models or model modification must conform to program constraints.
3. Aggregation methods may not be biologically appropriate in all cases.

Conclusions:

The AHAG evaluation engine is unacceptable. Although the existing AHAG models may be biologically sound, an engine that allows three different aggregation methods using the same input data is fundamentally flawed. Any model has both implicit and explicit assumptions. A model converts these biological assumptions into a mathematical form. To conclude that three different mathematical aggregations have the ability to convert these biological assumptions with similar biological accuracy suggests that either at least some assumptions are being violated, or the models are so general they are inaccurate. The existing AHAG models would need to be modified to be biologically and mathematically logical. I strongly question the Suitability Index Scoring Criteria values as inherently not scientific, undependable, and without a biological basis.

I strongly recommend against this method. The “user choice” of the aggregation of HSI values in the program suggests a possibility of more serious biological errors. An acceptable evaluation method must be both biologically and mathematically sound. Allowing several alternative HSI values from one data set suggests that any HSI value is acceptable. This is not what an evaluation method should do. Rather, a method should

produce a value that is biologically accurate and logically defendable. I suggest that AHAG is unsound and may result in potentially undependable results.

Instream Flow Incremental Methodology (IFIM)

Instream flow methods have been developed predominantly by biologists and hydrologists working for agencies having regulatory responsibility related to water development and management to provide detailed ecological studies leading to a significant growth in the understanding of the relations between stream flow and aquatic habitats. Most of the empirical evidence gathered to date has focused on fish and benthic macro-invertebrate habitat requirements, with recent emphasis on the relation between stream flow and woody riparian vegetation and river-based recreation. Water management problem solving has matured from setting fixed minimum flows with no specific aquatic habitat benefit to incremental methods in which aquatic habitats are quantified as a function of stream discharge. Collectively, the efforts led to a general class of instream flow assessment techniques (models) meant to help reserve a specific amount of water within the channel for the benefit of fish and other aquatic life.

Methods capable of quantifying the effect of incremental changes in stream flow to evaluate a series of possible alternative development schemes led to the development of habitat versus discharge functions developed from life-stage-specific relations for selected species, that is, fish passage, spawning, and rearing habitat versus flow. Corroborating research took the form of analyses correlating the general well-being of fish populations (usually in terms of measured standing crop) with various physical and chemical attributes (water velocity; minimal water depths; instream objects such as cover, bottom substrate materials with particular emphasis on the amount of fines in the interstitial spaces within coarse bed elements; water temperature; dissolved oxygen; total alkalinity; turbidity; and light penetration through the water column) of the stream flow regime and its interaction with the stream channel structure. IFIM unfolded against the backdrop of minimum flow standards, quantitative impact analyses, water budgets, and interdisciplinary analyses. The specific impetus was the National Environmental Policy Act that mandated all federal water resource agencies to consider alternative water development and management schemes. This requirement placed increased responsibility on natural resource agencies for methods, evaluations, and recommendations related to reservoir storage and release and stream channel depletions. IFIM was developed by an interdisciplinary team and was founded on a basic understanding and description of the water supply and habitats within stream reaches of concern.

IFIM has been designed for river system management by providing an organizational framework for evaluating and formulating alternative water management options. It has been built on the philosophical foundation of hydrological analyses to understand the limits of water supply. Analysis offers a description, evaluation, and comparative display of water use throughout a river system. Emphasis is placed on the display of usable habitat across several years to capture the variability in both water supply and habitat. Such comparative information enhances negotiations in the planning and management of the riverine resources. Sharing limited water during drought cycles and the management of

timed releases contribute to compatibility between instream and out-of-stream user groups and allow for rapid recovery of aquatic populations during favorable conditions.

Tools that can be used to show the relation between the amount of habitat and stream flow fall into two groups. The first uses statistical analyses to correlate environmental features of a stream with fish population size. A Habitat Quality Index (HQI) is developed by regressing several habitat variables against the standing crop of fish. This procedure is stream-specific, and the recommendations are related to critical low flows. The second group of tools links open channel hydraulics with known elements of fish behavior. Examples include the Physical Habitat Simulation System (PHABSIM). An important explicit element of PHABSIM and HQI is an analysis of water supply. A water supply analysis should accompany any standard-setting technique to answer the question: What is the likelihood that water will be available to meet the standard? Many people confuse IFIM with PHABSIM. Where IFIM is a general problem solving approach employing systems analysis techniques, PHABSIM is a specific model designed to calculate an index to the amount of microhabitat available for different life stages at different flow levels. PHABSIM requires the collection of field data on stream cross sections and habitat features, hydraulic simulation to evaluate habitat variables at different flows, and species suitability criteria to calculate stream characteristics with available habitat at alternate flows. Depending on the complexity of the proposed project and the complexity of the stream under study, the collection of field data ranges from inexpensive and quick to costly and time consuming. Using PHABSIM enables the investigator to inform decision makers about the impacts on fish habitat of different flows for different life stages. Attention is typically given to the life stages of fish species that are of special concern for management, or that are thought to be most sensitive to change. The resulting relation between flow and habitat, generated by linking species criteria with flow-dependent stream channel characteristics, aids in negotiation by more clearly depicting the effect that less-than-optimum flow will have on habitat.

IFIM is one process designed to accomplish this intricate research based on knowledge of fish response to habitat features. In an approach such as IFIM, these predictions will typically require hydrologic analyses, habitat models, sediment transport, water quality, and temperature analyses, as well as trophic level studies, validation of species criteria, studies of biomass, and population dynamics.

Conclusions:

Based on the overall impacts of the proposed project, the use of IFIM is not the most appropriate tool to measure the impacts of any changes in the flows at the project sites. The second “I” of IFIM is incremental. The proposed projects will not alter the ability to regulate the flow incrementally. Although IFIM may be used on a large river system, the Mississippi River is at the upper limit of IFIM model reliability. If the primary function of a project would provide the capability of manipulating flow, then IFIM use would be appropriate on a large river system. I conclude that as the project will not effectively control the flows on the Mississippi River, the use of IFIM/PHABSIM would be inappropriate.

Habitat Evaluation Procedures (HEP)

HEP is a method that was developed to rate the quality and quantity of habitat in order to quantify the impacts of changes made through land and water development projects. It can also be used as a tool to document baseline information on habitats as a gauge for future habitat modification. HEP may be adapted to many different uses including project planning, impact assessment, mitigation and compensation, and habitat management by providing information for two types of wildlife comparisons: (1) the relative value of different areas at the same point in time, and (2) the relative value of the same area at future points in time.

Habitat suitability index models are used in HEP to estimate the value of the habitat within the study area for the selected evaluation species. By definition, any model is an abstraction of reality. Models are tools that can be used to improve our understanding of, and predictive capability about, functioning systems. In HEP, the "functioning system" is the relationship of a species to its habitat.

Documented models are used in HEP to determine the quality portion in the formula used in the calculation of Habitat Units (HUs). HUs are the basic accounting unit used in HEP. An index of habitat suitability is simply a ratio determined by comparing a value of interest to some standard. In HEP, this index is determined by comparing existing habitat conditions for a species to optimal habitat conditions for the species. By definition, then, the range of an HSI must fall within the range of 0.0 to 1.0. On this scale, 0.0 represents no habitat suitability, and 1.0 represents optimum suitability.

A model is an abstraction of reality. The extent to which a given model mimics the "reality" being modeled depends on several factors, including the complexity of the situation, the understanding of the system being modeled (i.e., the available information base, and the effort expended in model development. A model is intended to be used as a tool to help increase the understanding of a specified system in order to make a more informed decision. There are at least six reasons for using documented models in applications of HEP:

(l) Models document the process used in an evaluation.
(2) Models may establish credibility of an evaluation.
(3) Models provide permanent records of the basis for decisions.
(4) Models function as an effective communications tool.
(5) Models synthesize habitat information.
(6) Models provide a framework from which to make improvements.

The advantages are not unique to HSI models; in fact, all models provide these advantages. Models that produce an index of habitat suitability (or whose outputs can be converted to such an index) are required in HEP. Existing models with different outputs (e.g., population measures) can be converted to an index of habitat suitability if the "optimum" population condition can be defined.

There are about 240 HSI models published as "blue books" by the U.S. Fish and Wildlife Service. Although the models are about evenly divided between aquatic and terrestrial species, the number that may apply to the Mississippi River project is significantly fewer. As both AHAG and WHAG model constructions are based on an HSI structure, I am confident that any model in either WHAG or AHAG could be put into the HEP format.

A major advantage that HEP/HSI has over WHAG and AHAG is the flexibility it has in the type of SI transformation it allows, and the type of aggregations of the SIs into a final HSI. The structure of the method demands sound biological decisions, which should result in defendable results. Further, I can develop a Spreadsheet of the evaluation species (SHEP) which will allow future habitat projections, under various scenarios to be quickly and easily compared. Additionally, the IREM (a GIS-HSI interface) is compatible with HSI format models. Although IREM does not demand HSI models, its sensitivity to special variables and predictive power would be under-utilized with the lowered sensitivity of both AHAG and WHAG.

Attributes of HEP:

Positive :
1. Both game and nongame species well represented.
2. New models and custom matrices may be created.
3. Some acceptance in the Midwest, and other areas.
4. Uses HSI models generally, but other models (regression, abundance, etc.) may be used also.
5. Compatible with SHEP and IREM.

Negative:
1. Some agency distrust of the method.
2. New models must be constructed for species not in HSI format.

Conclusions:

I suggest that HEP is the most appropriate tool for this project. I suggest that there will be some development time necessary if SHEP is to be incorporated into the process, but that the development time associated with SHEP will be less than the time needed to provide a broad base for decision making. Additional time will be needed to integrate HEP and IREM, but again the capability of the application to address complex future scenarios, with graphical output will, in my opinion, be highly worthwhile.

Appendix C

Final List of Evaluation Species

Including: Habitat Definitions and Modeling Criteria
Model Modifications, Descriptions, and Citations

DEFINITION OF HABITATS IDENTIFIED FOR USE IN THE UMR-IWWS NAVIGATION STUDY HEP

Backwater - An area of water beyond the banks of the main channel that is typically connected during normal or high flows.

Side Channel - Includes all departures from the main channel in which there is inflow and outflow during normal river stages.

Backwater Lake - A water body only connected to the main channel during flood stage. Depth at low water is generally > 2m at the deepest part of the basin.

Bottomland Forest - Floodplain forest regularly inundated with floodwater which results in a unique species composition. Depending on hydrology, species composition varies and may include mast producing trees.

Non-forested Wetland - A moist soil area periodically flooded for long periods, thus devoid of trees. Can be subject to drying. Characterized by annual grasses and can include emergent and submergent wetlands with water generally < 1m deep.

Main Channel - The portion of the river where commercial vessels operate and is defined by river regulating structures. Minimum depth is 9 feet and substrate varies from silt to coarse or rocky material.

Main Channel Border - The zone between the main channel and the river bank. Wing dikes would be found here and substrates are typically sand or silt.

Tailwater - The main channel, main channel border and area directly below the navigation dam. The boundary is one-half mile below the dam.

Cutbank - An eroded shoreline with vertical or nearly vertical face, possibly with overhanging vegetation or root wads.

Sandbar - A slightly-sloped area within the main or side channel with sand substrate. It can be along a shoreline or an island and either natural or created by dredge material placement.

Mudflat - A slightly-sloped area within the main or side channel with mud substrate. Along a shoreline or island.

References:

Rasmussen, J., ed. 1979. A compendium of fishery information on the Upper Mississippi River. UMRCC.

Cowardin, L.M., et. al. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service.

Wilcox, D.B. 1993. An aquatic habitat classification system for the Upper Mississippi River System. U.S. Fish and Wildlife Service, Environmental Management Technical Center, Onalaska, Wis. Publ. EMTC 93-T003.

Final List of Evaluation Species

Recommendations and considerations taken into account during the final selection process are included.

BOTTOMLAND HARDWOOD FOREST

pileated woodpecker	**prothonotary warbler**	**wild turkey**
hairy woodpecker	**wood duck**	**Western chorus frog**
gray squirrel		

Considerations:

Hairy woodpecker. The Missouri Department of Conservation (MDOC) suggested removing this species from the species list. The HAT decided to retain this species to pick up medium-sized trees and snags, those between the sizes identified in the Pileated woodpecker and Prothonotary warbler models.

Gray squirrel. The MDOC suggested adding this species to the species list. The addition of this species will provide more complete coverage of mast tree diversity, which is an important aspect of bottomland hardwood forests. The HAT decided to add this species to the list.

Eastern gray treefrog. The MDOC suggested adding this species to the species list. The Illinois Department of Natural Resources (ILDNR) stated that the chorus frog would be an appropriate species to model for bottomland hardwood forest. The HAT believes a potential gray treefrog model may focus on smaller trees (covered by the prothonotary warbler model), shrubs (covered by the wild turkey model) and permanence of water. The intent for adding a herp. to the species list is to pick up ephemeral pool habitat. Therefore, we decided that *Western chorus frog* is a more appropriate addition to the list because its water requirements are more seasonal than those of gray treefrog.

Great-crested flycatcher. The MDOC suggested adding this species to the species list. The HAT believes a potential great-crested flycatcher model may focus on tree canopy cover and the presence of snags. The flycatcher's canopy cover preference should be covered by the prothonotary warbler model and its cavity needs covered by the hairy woodpecker model. Therefore, we decided not to add this species to the list.

Great blue heron. The MDOC suggested removing this species from the bottomland hardwood forest species list. The HAT decided to model it if a rookery is present. This will be accomplished by listing a rookery habitat type with great blue heron as the evaluation species.

Red-shouldered hawk. The HAT believes that the variables which may be included in a potential red-shouldered hawk model will be covered by other species on the list. Nest trees will be covered by the pileated woodpecker model. Canopy cover preference is expected to be covered by the prothonotary warbler model. The wild turkey model covers components which would be characteristic of foraging areas, as well as the wood duck model covering wetland interspersion. The prothonotary warbler model covers presence of water. Therefore, we decided to remove this species from the list.

ROOKERY

great blue heron

Considerations:

Great blue heron. The MDOC suggested removing this species from the bottomland hardwood forest list. The HAT decided to account for its particular habitat type by modeling great blue heron if a rookery is present.

MAIN CHANNEL / MAIN CHANNEL BORDER

lake sturgeon	**paddlefish**	**walleye**
channel catfish	**sauger**	**emerald shiner**

Considerations:

Skipjack herring. The U.S. Fish & Wildlife Service (USFWS) suggested removing this species from the species list in anticipation of its migration requirements being addressed by other species on the list. The ILDNR and USFWS are skeptical that a model can be developed because of the paucity of information on the species. Another biologist expressed the same concern at the Quincy meeting. The HAT also believes that the lack of information will make the development of a reliable model very difficult. In contrast to the opinion expressed by the ILDNR, the HAT is hopeful that its migration requirements will be addressed to some extent by the other two migratory species on the list. For these reasons, the HAT decided to remove skipjack herring from the list.

NATIVE MUSSELS

Considerations:

Existing information on mussel beds and occurrences will form the basis of the site-specific impact evaluations for native mussels. At this point, evaluations will be qualitative and will not involve surveys or HEP modeling.

SANDBAR

Considerations:

Because of the homogeneous and dynamic nature of sandbar habitat, the HAT decided to calculate the area of sandbar habitat lost or gained, rather than using a species model to make this determination. By definition, sandbar habitat will be limited to the sandy area, and the fringe vegetation will be picked up in the evaluations of other habitats types.

NON-FORESTED WETLAND

mallard **sora** **Western chorus frog**
muskrat

Considerations:

Sora. The MDOC suggested adding this species to the species list. The HAT believes that modeling sora will pick up sedge and grass-like emergent vegetation. We decided to add this species to the list.

Muskrat. The MDOC suggested adding this species to the non-forested wetland list. Modeling this species will pick up a variety of variables for the permanent wetlands in this category, such as presence of bulrushes and cattails, permanence of water and other vegetation and water characteristics. The HAT decided to add this species to the list.

Least bittern. The MDOC suggested adding this species to the species list. The HAT believes a potential least bittern model would contain habitat requirements very similar to those in a potential sora model. Therefore, we decided not to add this species to the list.

Great blue heron. The MDOC suggested adding this species to the species list for non-forested wetland. Great blue heron is listed for rookery habitat and will be modeled when appropriate. When it is modeled, non-forested wetlands within three kilometers of the rookery will be picked up as forage areas. The HAT decided not to add this species to the non-forested wetland list.

Bullfrog. The MDOC suggested modeling this species under certain circumstances, instead of Western chorus frog. The HAT decided to use Western chorus frog in all instances.

CUTBANK

flathead catfish

Considerations:

No changes were made to this category.

MUDFLAT

Considerations:

Because of the homogeneous nature of mudflat habitat, the HAT decided to calculate the area of mudflat habitat lost or gained, rather than using a species model to make this determination. By definition, mudflat habitat will be limited to the muddy area, and the fringe vegetation will be picked up in evaluations of other habitats.

BACKWATER / BACKWATER LAKE

paddlefish **largemouth bass** **black crappie**
lesser scaup **sora** **bullfrog**
red-eared slider **muskrat**

Considerations:

Great blue heron. The MDOC suggested adding this species to the species list. Great blue heron is listed for rookery habitat and will be modeled when appropriate. When it is modeled, backwaters and backwater lakes within three kilometers of the rookery will be picked up as forage areas. The HAT decided not to add this species to the list for backwater/ backwater lakes.

Sora. The MDOC suggested adding this species to the species list. The HAT believes that modeling sora will pick up sedge and grass-like emergent vegetation. We decided to add this species to the list.

Red-eared slider. The MDOC suggested adding this species to the species list. The USFWS suggested adding this species to the list and modifying its model to pick up woody debris and basking sites. The HAT decided to add this species to the list.

Eastern gray treefrog. The MDOC suggested adding this species to the species list for fishless areas. The HAT believes that the variables in a potential gray treefrog model will be covered by the models of other species, particularly by the bullfrog and muskrat models in non-forested areas and by the Western chorus frog, prothonotary warbler and wild turkey models in forested areas.

Marsh wren. The MDOC suggested removing this species from the species list. The HAT believes that its requirements will be covered by the sora and muskrat models. Therefore, we decided to remove it from the list.

Bluegill. There were originally three Centrarchids on the species list, and after closer scrutinization of the model variables for the three species the HAT decided to remove bluegill from the list. Over half its model variables were the same as those in the largemouth bass and/or black crappie models. The only discrepancies were in some of the temperature and velocity variables. The variation of the bluegill's variables were not deemed significant enough to warrant its retention on the species list.

Largemouth bass. Because of the removal of bluegill from the species list, it will be necessary to modify the largemouth bass model to include overwintering variables.

SIDE CHANNEL

channel catfish	**smallmouth buffalo**	**emerald shiner**
river otter	**beaver**	

Considerations:

Bullhead minnow. The USFWS advocated modeling emerald shiner, rather than bullhead minnow, as a representative minnow. Some biologists at the Quincy meeting stated that the emerald shiner inhabits side channels and would be a suitable minnow species for that habitat type. Therefore, the HAT decided to model emerald shiner.

False map turtle. The HAT believes that a potential map turtle model may focus on aquatic vegetation and water velocity. These requirements should be covered by the fish species in this category. We decided not to add this species to the list.

HSI MODELS

PILEATED WOODPECKER

Source of Model: Schroeder, R. L. 1982. Habitat suitability index models: Pileated woodpecker. U.S. Dept. Int. Fish Wildl. Serv. FWS/OBS-82/ 10.39. 15 pp.

Habitat Type: Bottomland Hardwood Forest

WILD TURKEY

Source of Model: Schroeder, R. L. 1985 Habitat suitability index models: Eastern wild turkey. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.106). 33 pp.

Habitat Type: Bottomland Hardwood Forest

HAIRY WOODPECKER

Source of Model: Sousa, P. J. 1987. Habitat suitability index models: Hairy woodpecker. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.146). 19 pp.

Habitat Type: Bottomland Hardwood Forest

WOOD DUCK

Source of Model: Sousa, P. J. and A. H. Farmer. 1983. Habitat suitability index models: Wood duck. U.S. Dept. Int., Fish Wildl. Serv. FWS/OBS-82/10.43. 27 pp.

Habitat Type: Bottomland Hardwood Forest

Modifications:

- **V1**: Based on information in the Illinois Department of Natural Resources' (ILDNR) publication of Wood Duck Investigations by Aaron Yetter, Stephen Havera and Christopher Hine (1995, Final Report W-118-R-1-2-3), Havera and Yetter (Illinois Natural History Survey; ILNHS) recommended changing the value for $P1_T$ from 0.18 to 0.303. This change was incorporated and 0.303 became the multiplier for V1.
- **V2**: Havera and Yetter stated that a value of 0.52 was rather high for $P2_T$, but agreed that as an optimum this value is suitable.
- **V3**: Havera and Yetter advocated a minimum value of 3, rather than 5, to receive a SI of 1.0. This change was adopted.
- **V5**: Havera and Yetter stated that the wood duck model is not applicable as a winter model. Therefore, this variable was eliminated from the model, and comments from other reviewers were not applicable.
- **V7**: Havera and Yetter questioned the minimum value of 20% for a SI of 1.0. They suggested adopting a value from 25-35% and it was decided to use 30%.

MALLARD

Source of Model: Allen, A. W. 1986. Habitat Suitability Index Models: Mallard (winter habitat, Lower Mississippi Valley). U.S. Fish Wildl. Serv. Biol. Rep. 82(10.132). 37 pp.

Habitat Type: Bottomland Hardwood Forest

Modifications:

- Dave Harper (ILDNR) recommended dropping mallard from the species list. In light of comments from other biologists on the desirability of using mallard as an evaluation species as well as specific recommendations on model modification, it was decided to retain the species for evaluation. However, the season of applicability was changed to 15 October - 31 December and 1 February - 1 April to coincide with comments made by Dale Humburg (Missouri Department of Conservation; MDOC), Harper, Havera and Yetter regarding the fact that mallards migrate through the study area but do not winter there. This change specifically affects **V3**, **V7** and **V11**.
- **V1** & **V3**: Havera and Yetter stated that mallards do not feed on rice or soybeans in the region and recommended removing those crops from the model. This recommendation was adopted.
- **V2**: Havera and Yetter recommended adjusting the suitability index of fall-tilled corn to a value of 0.35. During a phone conversation, Humburg altered his initial recommendation and suggested reconfiguring the histogram into five categories: flooded standing, flooded harvested, dry harvested, dry standing and tilled. However, we feel the flooding issue is adequately addressed in V3. To incorporate all comments from these individuals it was decided to have four categories in the histogram and SI's were assigned as follows: standing or harvested other (1.0), tilled corn (0.35), standing corn (0.2) and tilled other (0.15).
- **V3**: Havera and Yetter suggested eliminating this variable for corn fields because inundation of the crop is not necessary for feeding. Because the curve reaches an index of 1.0 with as little as six days of flooding it was decided to leave this variable as is.

- **Table 1**: Humburg suggested reevaluating the table's values. Havera and Yetter recommended changing the nonforested wetland percentage to ≥40. This recommendation was adopted and will result in several changes to Table 1 (p. 24 in the model) as well as the calculations outlined in Step 5 on page 27.

Cover Type	Recommended Minimum % Composition of Cover Type	Habitat Composition Index
cropland	≥ 10	0.12
palustrine forested wetlands	≥ 40	0.44
nonforested palustrine, lacustrine and riverine wetlands	≥ 40	0.44
Total	90	1.00

- In relation to tillage practices and available waste grain, Humburg cited Fredrick's monograph on snow geese in western Iowa. He also cited Petrie's M.S. Thesis from the University of Missouri regarding food availability in flooded agricultural fields.

PROTHONOTARY WARBLER

Source of Model: Stauffer, D. 1995. Unpublished Draft. Prothonotary warbler Habitat Suitability Index Model.

Habitat Type: Bottomland Hardwood Forest

Assumptions: Water surrounding nesting trees is helpful in limiting nest depredation.

Aggregation Formula: HSI = V6 * [min. of $((V1*V2*V3)^{1/3})$ or (V4 + (0.8*V5))]

LESSER SCAUP

Source of Model: Modified from a Wildlife Habitat Appraisal Guide Migrating diving duck model developed by U.S. Army Corps of Engineers (USACE).

Habitat Type: Backwater/Backwater Lake

Assumptions: Because no variables reach an SI value of zero, all wetlands are assumed to have at least some value.

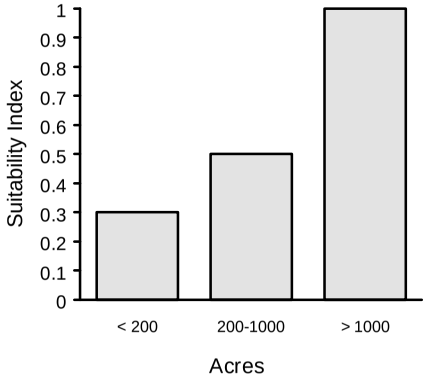
Aggregation Formula: HSI = (V1+V2+V3+V4+V5+V6+V7) / 7

Modifications:

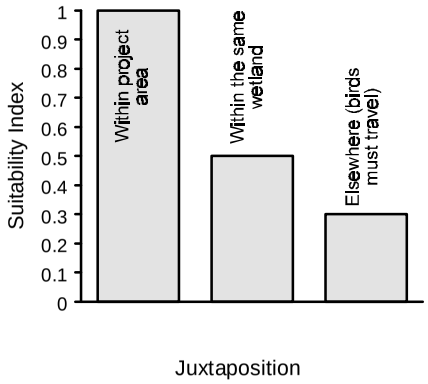
- **V3**: Steve Havera and Aaron Yetter (ILNHS) suggested that scaup feed primarily on invertebrates which makes this variable less important when determining habitat suitability. It was decided to deal with this in the variable aggregation, rather than redefining the variable.
- **V4**: Havera and Yetter stated that scaup feed in areas which are in excess of six feet in depth, and they recommended lowering the suitability index of the optimal category. After consultation with Havera it was decided to increase the depth to fifteen feet. It was decided to retain a suitability index of 1 for the optimal category because it is reasonable that there is indeed an optimal value which will be reached by increasing the amount of foraging habitat above a certain level (in this case, above 70%).
- **V4** and **V5**: Dale Humburg (MDOC) suggested emphasizing both migration periods for these variables. Thus, the variable definitions were changed to address the periods of 15 October to 31 December and 1 February to 1 April.
- **V5**: Humburg suggested changing the variable definition from disturbance to the percentage of the area which is inviolate refuge. Because many areas which are relatively undisturbed are not officially designated as refuges, it was decided not to change the variable.
- **V5**: Based on the literature and a conversation with Havera, we decided to define disturbance factors as boating activity (hunting, fishing, recreational), proximity to human habitation and other human shore activities, and tow traffic. There is some indication that these factors may have differential degrees of severity and seasonal variation which would be difficult to quantify. We also considered the proximity of the disturbance factor. We assumed equal effect among the factors and based our SI values upon proximity rather than rate. Therefore, any disturbance occurring within 400 meters will result in an SI of 0.4, and those disturbances at a distance of ≥ 400 meters will yield an SI of 1.0.
- **V4** and **V7**: Humburg stated that there is an apparent conflict between the dates used for these variables. However, we feel there is no conflict because the variables are independent of each other.
- Humburg recommended considering the model to only be applicable during migration periods. He asked that the non-numeric values for variables be defined, which we subsequently accomplished.
- **Abundance of aquatic invertebrates used as a food source**: We decided to drop this variable because of 1) the inability to define/measure it based on current data, and 2) the inherent variability of invertebrate populations.
- **Percentage of submergent vegetation desirable as a food source** and **Percent cover of emergent vegetation**: Based on information in Havera's in-press publication, *Waterfowl of Illinois: Status and Management*, pointing out that scaup feed primarily on invertebrates, Havera and Yetter suggested dropping these variables from the model. This recommendation was adopted.
- **Is the wetland/pool within a flyway corridor?**: We decided to drop this variable because the project areas will all be within the Mississippi flyway and that will not change. Also, any comparisons will be made to other areas within the flyway.

Lesser Scaup Model Variables

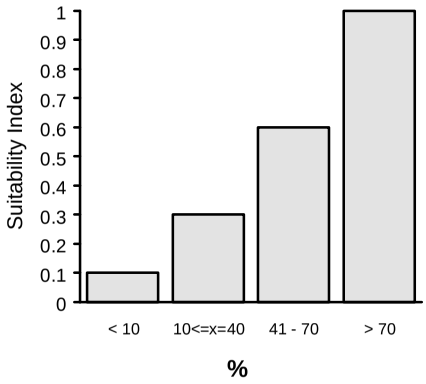
V1: Size of wetland or pool.



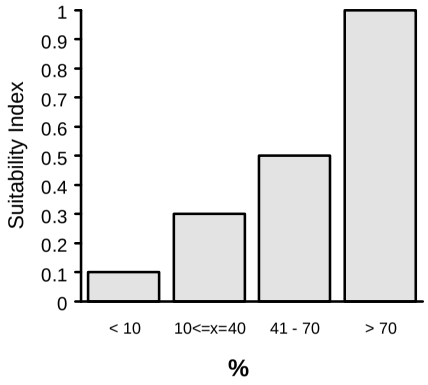
V2: Juxtaposition of critical habitat types (feeding, loafing/rafting, severe weather shelter).



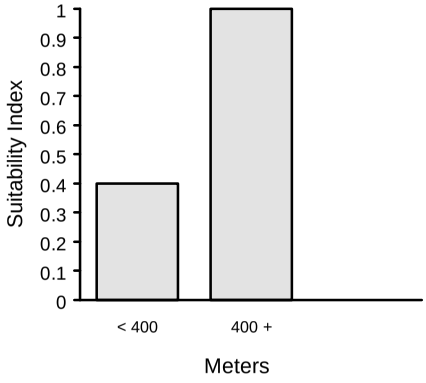
V3: Percentage of area covered with submergent vegetation.



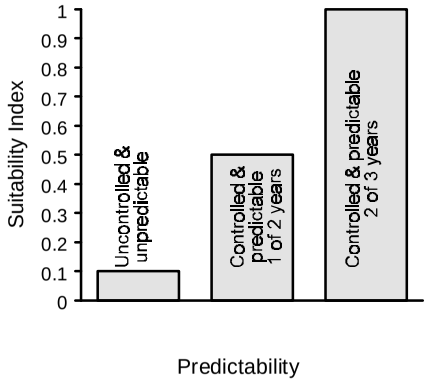
V4: Percentage of area with water depth of 18 in. - 15 ft. from 15 Oct. to 31 Dec and 1 Feb. to 1 Apr.



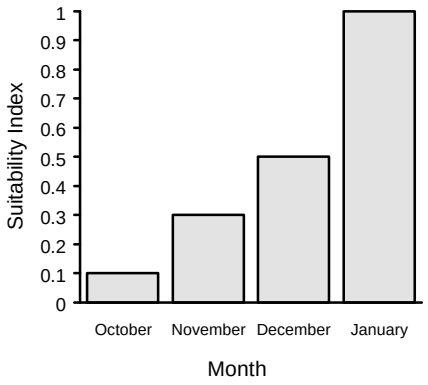
V5: Distance to disturbance during fall migration season (15 Oct. to 31 Dec.).



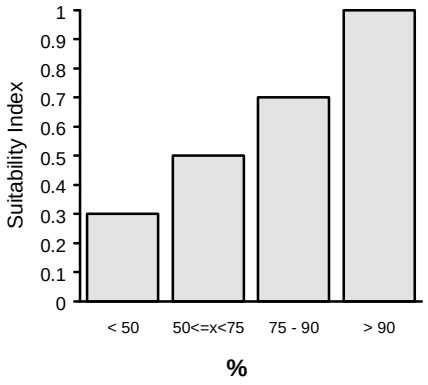
V6: Water level fluctuation predictability.



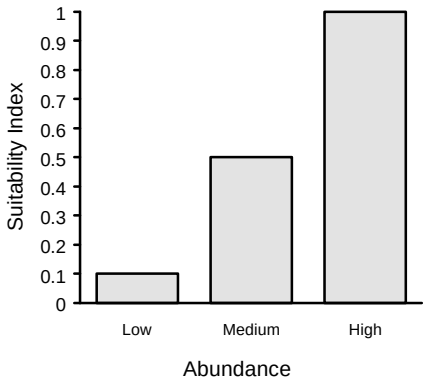
V7: Month in which ice-over first reduces available habitat by 50%.



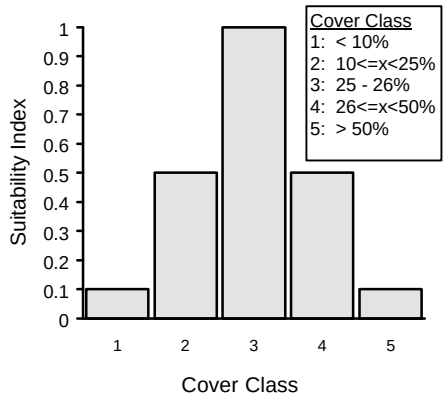
OMIT: Percentage of submergent vegetation desirable as a food source.



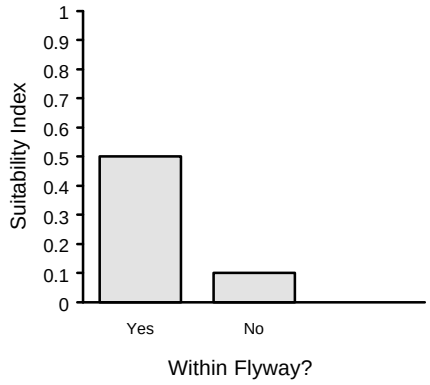
OMIT: Abundance of aquatic invertebrates used as a food source.



OMIT: Percent cover of emergent vegetation.



OMIT: Is the wetland/pool within a flyway corridor?



SORA

Source of Model: U.S. Army Corps of Engineers, Rock Island District, and U.S. Geological Survey, B.R.D.. 1996. Habitat Suitability Index Model: Sora rail. Unpublished Model.

Habitat Type: Backwater/Backwater Lake, Non-Forested Wetland

Assumptions:
- The major components of the model are identifiable in the habitat.
- Robust emergent vegetation with high interspersion is acceptable nesting habitat.
- Water depth from 5-20 cm must be maintained during the nesting season.
- Anthropogenic increases in water levels of greater than 3 cm result in nest failure.
- The amount of acceptable terrestrial cover has proportional importance.
- Suitable nesting habitat will be enhanced by optimal terrestrial cover around the wetland.
- Food availability (seed production) is proportional to plant community diversity.

Aggregation Formula: HSI = min. of [((((V1*V2)$^{1/2}$)*V4)*V3) + (V5*V6*V7*V8)] or 1

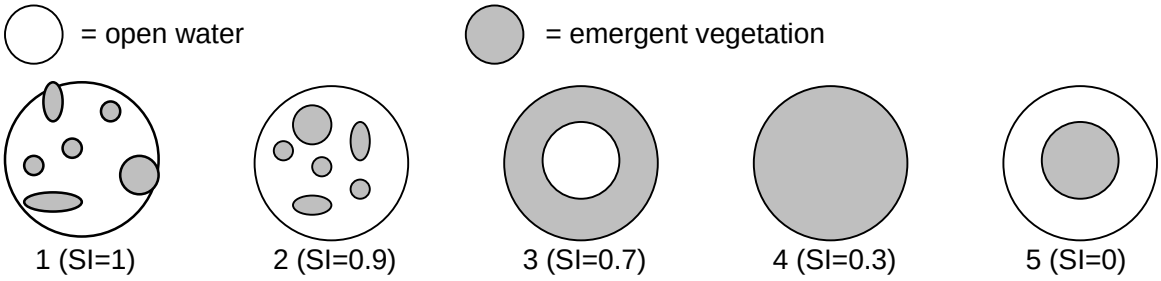
Modifications:
- **V2**: MDOC mentioned that an interspersion configuration may exist which is of greater value than #1 in the model. After further consultation, they suggested that an SI of 1 be given to an interspersion configuration where some patches of emergent vegetation are contiguous with the vegetation outside the perimeter of the open water area. We decided to adopt this recommendation and give an SI of 0.9 to the current configuration #1. The configurations are depicted below.
- **V3**: MDOC stated that water level increases may not be a critical issue as long as some of the habitat contains water in the 5-20 cm range. The possibility of nest destruction is what prompted the development of V3 and we feel that this is a legitimate concern. We decided to leave this variable as is.
- **V4**: MDOC suggested changing the water depth range to 0-20 cm because soras utilize areas with less than 5 cm of water, and saturated soil areas, for feeding. Though such areas are sometimes utilized, after further consultation the reviewer stated that utilization of areas in the 5-20 cm range is much more common. We decided not to alter the depth range for this variable.
- MDOC expressed a concern over the lack of consideration given to the seed production potential of the vegetation present. We feel that because the highest SI value for V1 is given to the most diverse plant community it is likely that seed production will be adequately addressed. This was added to the model's assumptions.

Sora Model Variables

V1: Quality of emergent vegetation (A=robust; B=moderate; C=weak-stemmed).

Menu Choice	Suitability Index
1 (A+B+C)	1.0
2 (A+C)	0.7
3 (B+C)	0.5
4 (A+B)	0.3
5 (A only)	0.2
6 (B only)	0.2
7 (C only)	0

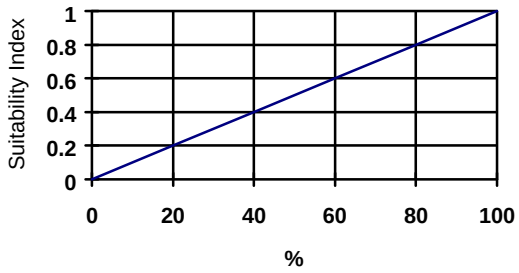
V2: Interspersion configuration of emergent vegetation.



V3: Is there an anthropogenic water level increase of ≥ 3 cm during April-June?

Menu Choice	Suitability Index
1 (yes)	0
2 (no)	1

5-20 cm water depth during April-June.



V4: Percent of emergent vegetation with

V5: Percent of wetland edge comprised of forest (multiply by 0).

V6: Percent of wetland edge comprised of crops or shrubs (multiply by 0.25).

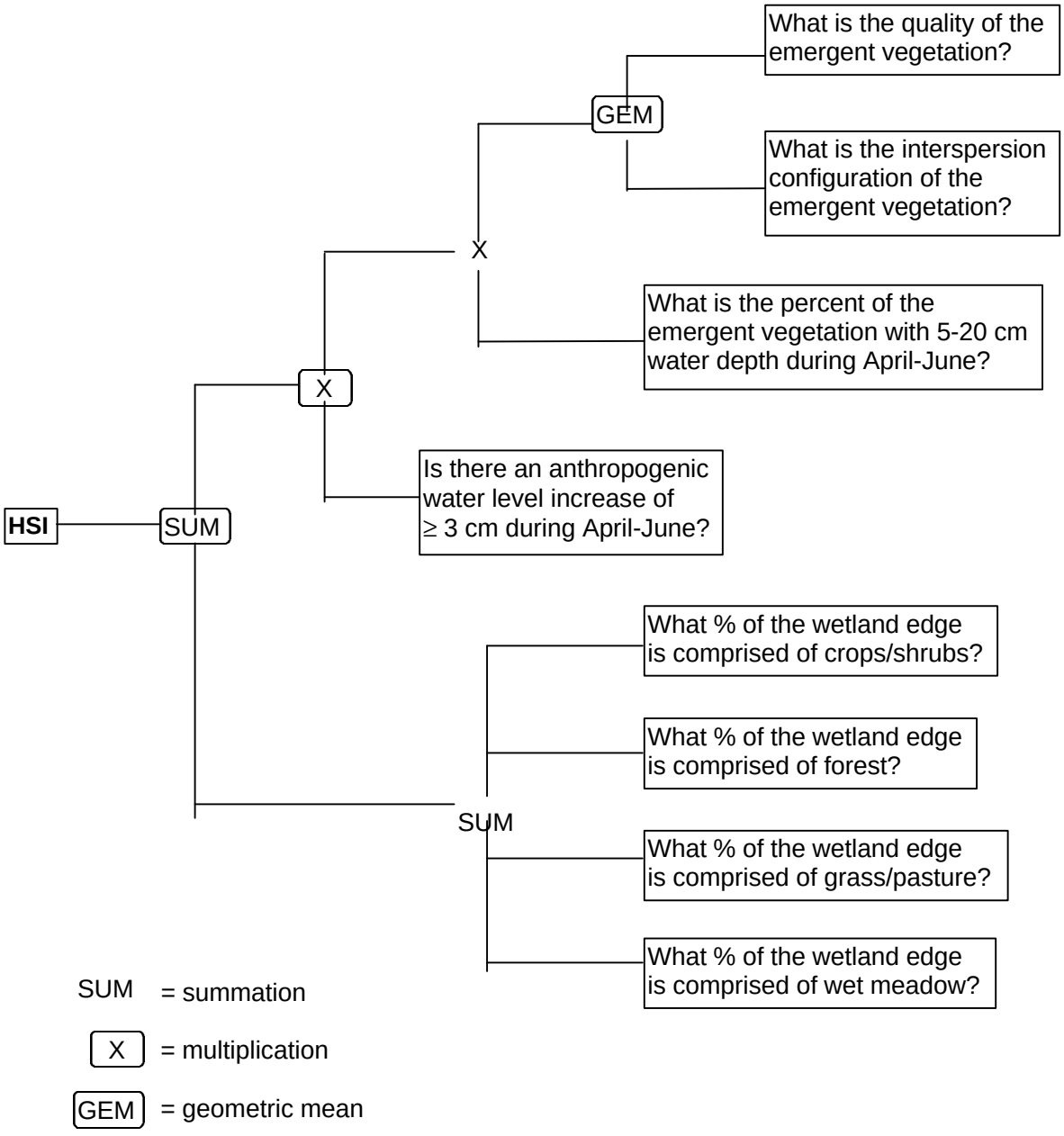
V7: Percent of wetland edge comprised of grass or pasture (multiply by 0.5).

V8: Percent of wetland edge comprised of wet meadow (multiply by 1.0).

Sora HSI Determination

The HSI is determined by asking the following questions:

- What is the quality of the emergent vegetation?
- What is the interspersion of the emergent vegetation?
- Is there an Anthropogenic water level increase during April-June?
- What percent of the emergent vegetation is in water 5-20 cm deep during April-June?
- What cover types surround the wetland?



GRAY SQUIRREL

Source of Model: Allen, A. W. 1987. Habitat suitability index models: Gray squirrel, revised. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.135). 16 pp. [First printed as: FWS/OBS-82/10.19, July 1982.]

Habitat Type: Bottomland Hardwood Forest

MUSKRAT

Source of Model: Allen, A. W., and R. D. Hoffman. 1984. Habitat suitability index models: Muskrat. U.S. Fish Wildl. Serv. FWS/OBS-82/10.46. 27 pp.

Habitat Type: Non-Forested Wetland, Backwater/Backwater Lakes

Modifications:

- Dave Hamilton (MDOC) suggested adding a variable for denning substrate. Consultation with other State agency biologists revealed that bank denning is uncommon and that water level fluctuations in the Mississippi system tend to relegate muskrats to backwater areas where they prefer to use lodges. Therefore, it was decided that a denning substrate variable is unnecessary.
- Hamilton suggested that the effects on den sites should be assessed if project alternatives will affect water depth and fluctuations. Water regulation changes are not a part of the project and water levels are not expected to be influenced.
- **V8**: Hamilton asserted that muskrats tend to eat whatever vegetation is available, but he also forwarded information from a MDOC model which identified several specific plants which are important food sources. The blue book model listed three species as being of greatest importance and it was decided to use the variable as defined in the blue book. Although the MDOC model has a submergent vegetation variable, the authors of the blue book model did not feel that submergent vegetation warranted such treatment and we decided to follow the blue book pattern.

RIVER OTTER

Source of Model: U.S. Fish and Wildlife Service. 1984. Draft habitat suitability index model: River otter (*Lutra canadensis*). U.S. FWS, Division of Ecological Services, Sacramento, California.

Habitat Type: Side Channel

BEAVER

Source of Model: Allen, A. W. 1983. Habitat suitability index models: Beaver. U.S. Fish Wildl. Serv. FWS/OBS-82/10.30 Revised. 20 pp.

Habitat Type: Side Channel

Modifications:

- Personnel from the Rock Island Field Office (RIFO) of the FWS mentioned the blue book's guidelines for determining the area to be evaluated. This will be taken into account when collecting the field data.

PADDLEFISH

Source of Model: Hubert, W. A., S. H. Anderson, P. D. Southall, and J. H. Crance. 1984. Habitat suitability index models and instream flow suitability curves: Paddlefish. U.S. Fish Wildl. Serv. FWS/OBS-82 10.80. 32 pp.

Habitat Type: Main Channel/Main Channel Border, Backwater/Backwater Lakes
Modifications:

- **V2**: Based on the results of Southall and Hubert (1984), Chuck Surprenant (FWS) recommended that spring access be defined as the condition of the dam gates being fully opened, and that the period under consideration be any two week period from 11 April to 25 May. Both recommendations were adopted. He further suggested that the better option would be if the fully opened condition existed at all dams within the study reach. However, based on information from Corps of Engineers Operations personnel, it is unlikely that such conditions would exist other than during a massive flood. Therefore, it was decided to consider fully opened conditions at each dam individually.
- **V8**: FWS, Fishery Resources Office, Onalaska recommended changing the minimum average channel depth from 1 m to 3 m. This recommendation was adopted.
- **V10**: FWS, Fishery Resources Office, Onalaska recommended changing channel depth from 1.5 m to ≥ 3 m. This recommendation was adopted.

CHANNEL CATFISH

Source of Model: McMahon, T. E., and J. W. Terrell. 1982. Habitat suitability index models: Channel catfish. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.2. 29 pp.

Habitat Type: Main Channel/Main Channel Border, Side Channel

Modifications:

- Richard Sparks and Marvin Hubbell (ILNHS) pointed out that certain information on the seasonal habitat preferences of channel catfish in the Illinois River can be found in the ILNHS report, *Barge Effects on Channel Catfish*. However, they offered no specific suggestions as to model modifications. One portion of their suggested readings which directly relates to the model is the information on velocity preferences. The model contains a variable for summertime velocity (V18) and gives a maximum SI value to velocities in the range of 0-0.41 ft/sec. The report indicates that average velocities in which fish were found was 0.39-0.43 ft/sec, with a range of 0-1.02 ft/sec. Therefore, the suitability curve in the model and the results in the report correlate adequately.
- Additional comments regarding habitat selectivity closely match the habitat types for which the species is being evaluated.
- Sparks and Hubbell expressed concern that some habitat may receive a poor rating if a selected species is on the margin of its natural range at the site under consideration. However, only the habitat characteristics are considered in the model, not the species' range or even its presence.

BLACK CRAPPIE

Source of Model: Edwards, E. A., D. A. Krieger, M. Bacteller, and O. E. Maughan. 1982. Habitat suitability index models: Black crappie. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.6. 25 pp.

Habitat Type: Backwater/Backwater lake

SMALLMOUTH BUFFALO

Source of Model: Edwards, E. A., and K. Twomey. 1982. Habitat suitability index models: Smallmouth buffalo. U.S. Dept. Int. Fish Wildl. Serv. FWS/OBS-82/10.13. 28 pp.

Habitat Type: Side Channel

LAKE STURGEON

Source of Model: Tarandus Associates Limited. 1996. Development of a Habitat Suitability Index Model for Lake Sturgeon (Acipenser fulvescens): DRAFT Final Report. Prepared for Ontario Hydro: Northern Development Department, Canada.

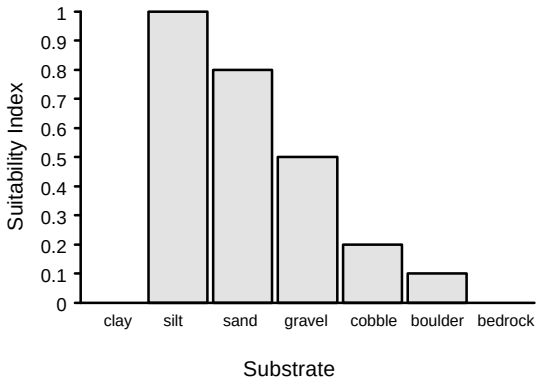
Habitat Type: Main Channel/Main Channel Border

Modifications:

- **V1**: MDOC recommended changing some of the SI values. The following SI changes were made.

Substrate	SI
sand	0.8
gravel	0.5
cobble	0.2
boulder	0.1

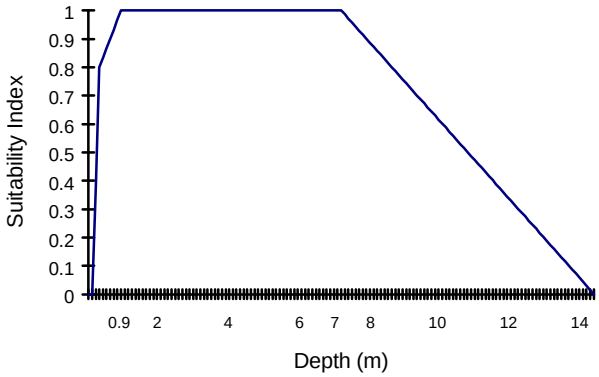
V1: Adult foraging substrate type.



- **V3**: MDOC recommended changing several of the SI values. After further consultation with the reviewer, the following changes were adopted.

Meters	SI
0.1	0
0.3	0.8
0.9	1.0
2.0	1.0

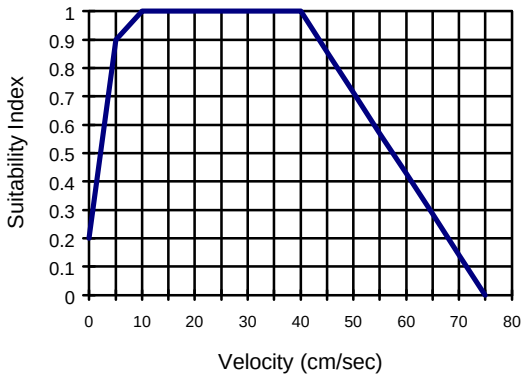
V3: Juvenile foraging depth.



X	Y
0.1	0
0.3	0.8
0.9	1
7	1
14	0

- **V4**: MDOC suggested that an SI value of 0.2 be given to a velocity of zero. This recommendation was adopted.

V4: Juvenile foraging water velocity.



EMERALD SHINER

Source of Model: Mathias, D., Hardy, T.B., Killgore, K.J., and Jordan, J.W. (1996). "Aquatic Habitat Appraisal Guide; User's Manual," Instruction Report EL-96-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. (Emerald Shiner)

Habitat Type: Main Channel/Main Channel Border, Side Channel

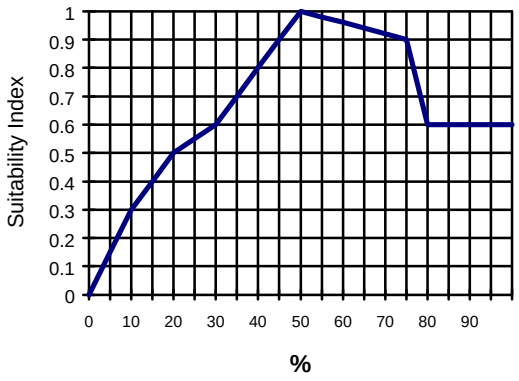
Assumptions:
- The model was developed for the Upper Mississippi River System.
- The abundance and distribution of species respond in a predictable and measurable fashion to changes in habitat quality.
-Habitat variables represent physical and water quality characteristics of the study area.

Modifications:

- **V1**: MDOC questioned the meaning of this variable, but after further consultation agreed that the variable is acceptable.
- **V4**: MDOC questioned whether there were data which demonstrated the importance of riprap. ILDNR stated that their data showed that emerald shiners were more abundant over riprapped areas than areas which had no riprap.
- **V7**: MDOC questioned the lack of clarity in the definitions of the variable and its categories. We determined that this variable should be considered during May-July because it will have its greatest effect on spawning activities. Therefore, we used the SI values for the spawning model. A conversation with Jack Kilgore, one of the developers of the model, revealed that rapid could be defined as occurring in a week or less and that slow would take more than a week.
- **V8**: MDOC suggested that the SI histogram should be reconfigured to indicate the fish's preference for lower velocities. A subsequent phone conversation led to the following changes to the SI values.

Velocity (cm/sec)	SI
0 - 30	1.0
30 - 50	0.8
50 - 75	0.45
75 - 100	0.15
> 100	0

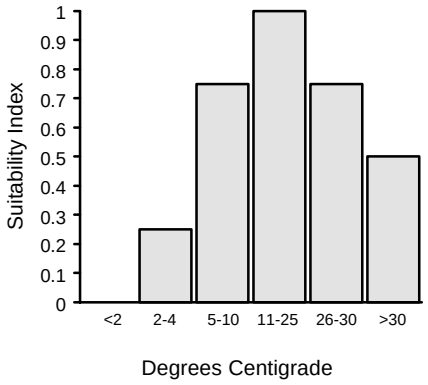
- **V9**: MDOC questioned the relevance of thalweg depth for emerald shiner. Further consultation with the reviewer resulted in a recommendation to drop this variable and add a variable for shallow water habitat. We decided to adopt this recommendation. This variable is now the *percentage of area £ 5 feet deep* and the SI curve is depicted below.



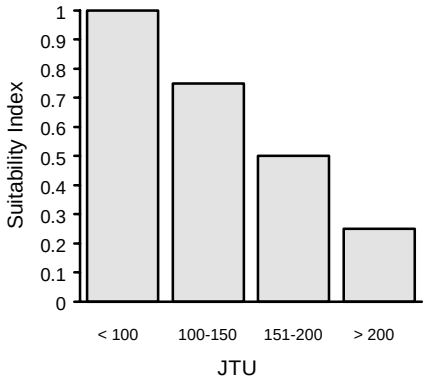
- **V10**: Our depiction of the SI values had an incorrect number in it, which prompted MDOC's comment. After explanation of the problem, they agreed that the SI's are acceptable.
- MDOC suggested that percent slope of bank and percent island/shoal/sand bar habitat should be considered because of the species' preference for shallow areas. We believe the revised V9 will address their concerns.
- MDOC suggested that depth at capture should be considered. The subject of depth preference was further discussed with the reviewer, which resulted in the revision of V9.

Emerald Shiner Model Variables

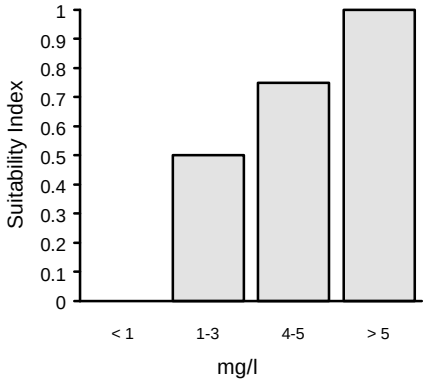
V1: Mean water temperature.



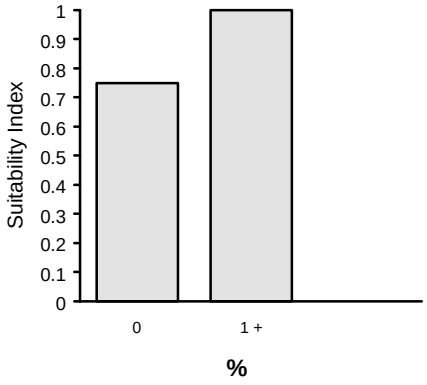
V2: Mean turbidity.



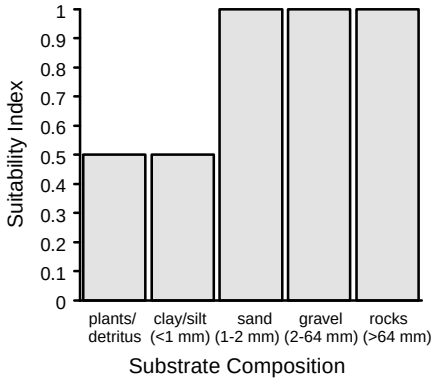
V3: Minimum daily dissolved oxygen.



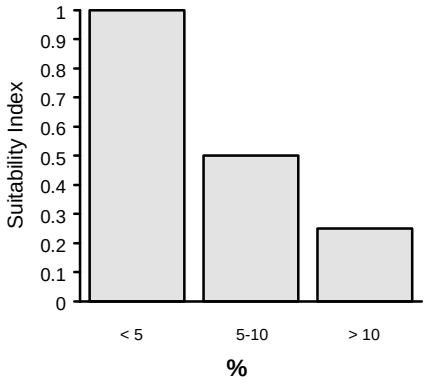
V4: Percent of shoreline riprapped.



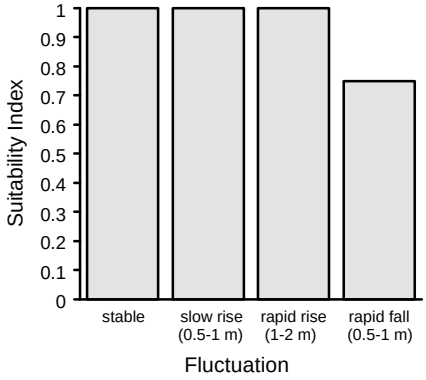
V5: Dominant substrate.



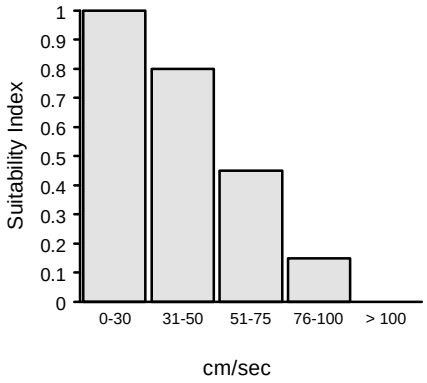
V6: Percent cover (logs, inundated timber, brush, undercut banks).



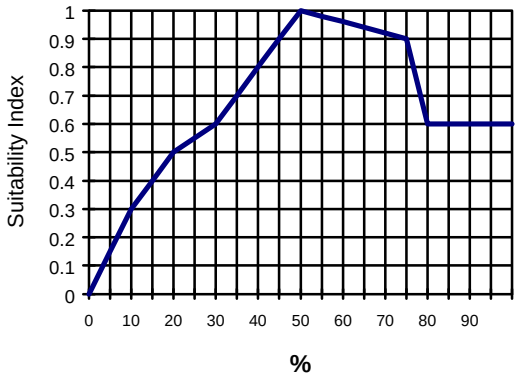
V7: Water level fluctuation (rapid = one week or less; slow = > one week).



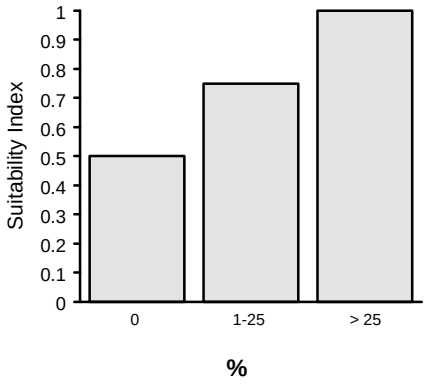
V8: Mean water velocity.



V9: Percentage of area ≤ 5 feet deep.



V10: Percent of backwater area suitable as overwintering habitat during Nov-Feb (no current, water temp. at least 1°C warmer than main channel, dissolved oxygen ≥ 3 mg/l, water depth ≥ 1.5 m, periodically contiguous with main channel).



SAUGER

Source of Model: Mathias, D., Hardy, T.B., Killgore, K.J., and Jordan, J.W. (1996). "Aquatic habitat appraisal guide; User's manual," Instruction Report EL-96-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS. (Sauger)

Habitat Type: Main Channel/Main Channel Border

Assumptions: The model is only applicable to large rivers.

Aggregation Formula:
(V1+V2+V3+V4+V5+V6+V7+V8+V9+V10) / 9

Modifications:

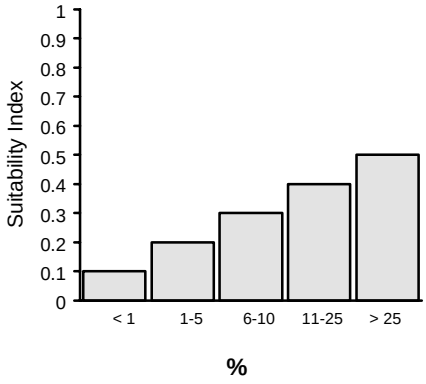
- **V2**: MDOC questioned the applicability of this variable. Because this variable has a maximum SI value of 0.5, the model developers determined that it was less important than most of the other variables but not completely without importance. We decided to retain this variable.
- **V4**: MDOC advocated increasing the SI value of the 25-50% category. We decided to increase the SI of the category to 0.7.
- **V5**: MDOC suggested decreasing the SI value of the > 50% category. To retain the maximum SI value of 1.0, we decided to assign that value to the 25-50% category. We reduced the SI value of the > 50% category to 0.5.
- **V8**: MDOC recommended giving an SI value of 1.0 to the 10-20-inch category and reducing the SI for the > 30 category. We gave an SI of 1.0 to the 10-20 and 20-30 categories, and changed the > 30 SI to 0.8.
- **V9**: MDOC questioned why the greater distances to gravel received higher scores. Based on the life history of the species and its requirement for spawning gravel, we agree that the numbers were somehow reversed when the model was put together. The correct values are listed below.

Distance (mi)	SI
< 0.5	1.0
0.5 - 1.0	0.7
1 - 2	0.4
> 2	0.1

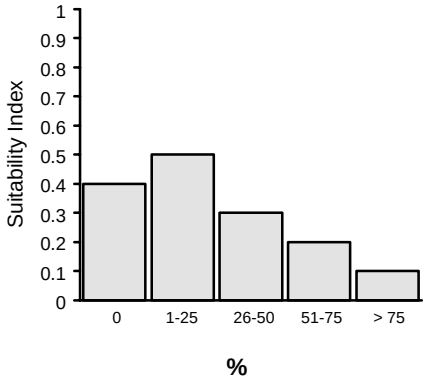
- **V10**: MDOC stated that this variable may artificially lower the HSI because of the absence of aquatic vegetation in the lower pools. We believe this variable was developed to address cover for young fish and it is an applicable variable.

Sauger Model Variables

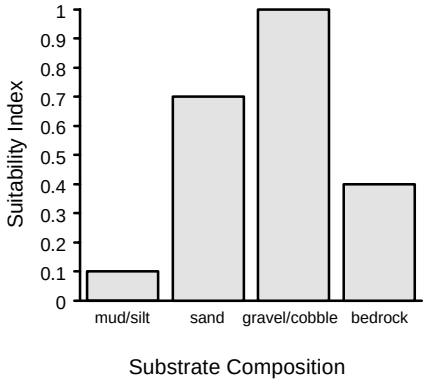
V1: % of 2 mile diameter circle which is water > 8 feet deep.



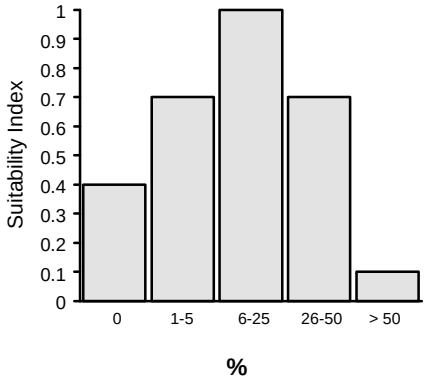
V2: % emergent, submergent, floating vegetation.



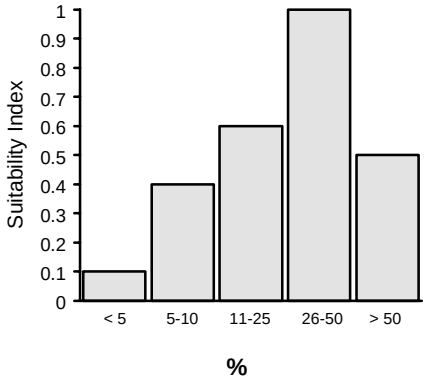
V3: Dominant substrate.



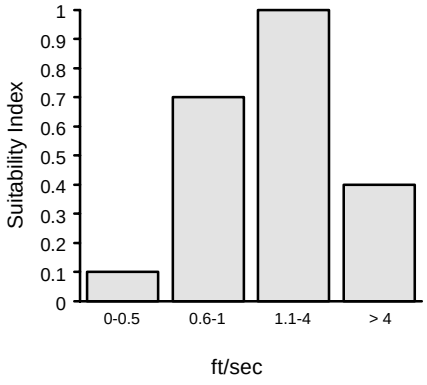
V4: % of submerged bank covered by riprap.



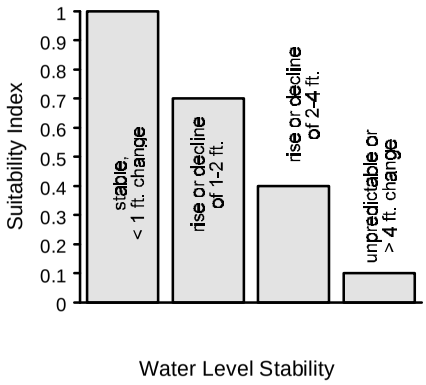
V5: % of channel < 8 feet deep.



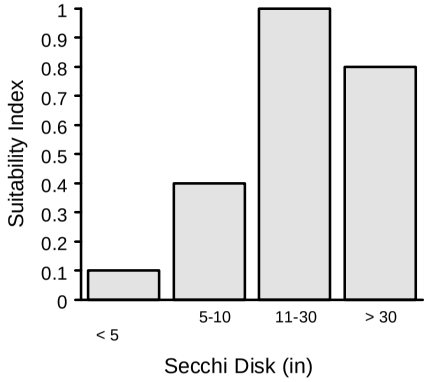
V6: Mean velocity at normal flows May through September.



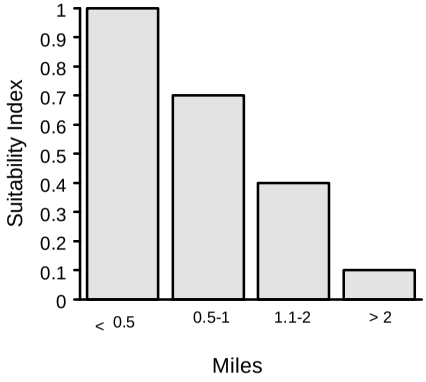
V7: Water level stability May through June.



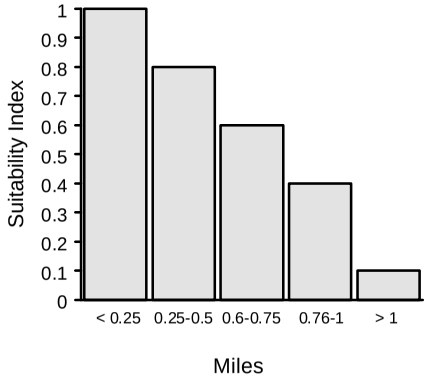
V8: Mean non-flood turbidity.



V9: Distance to gravel substrate or gravel shoreline.



V10: Distance to emergent vegetation in water 1-4 feet deep.



FLATHEAD CATFISH

Source of Model: Lee, L. A., and J. W. Terrell. 1987. Habitat and suitability index models: Flathead catfish. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.152). 39 pp.

Habitat Type: Main Channel Border

Assumptions: The assumptions listed on page 14 of the blue book were accepted in order to apply the simplified version of the model.

Model Variables:
V1: m^2 of object cover
V2: m of undercut bank
V3: m^2 of deep pools without object cover

Aggregation Formula: HSI = min. of $\frac{[(V1/38) + (V2/12.6) + (V3/10{,}000)]}{\text{ha of aquatic habitat}}$ x 0.17 ha/fish or 1

LARGEMOUTH BASS

Source of Model: Tuber, R. J., G Gebhart, and O. E. Maughan. 1982. Habitat suitability index models: Largemouth bass. U.S. Fish Wildl. Serv. FWS/OBS-82/10.16. 32 pp.

Habitat Type: Backwater/Backwater Lake

Aggregation Formula: The model's riverine aggregation formulas are depicted on page 16 of the blue book, and V23 will be added to the cover component. This will result in the following formula.

$$C_C = \left\lceil V1 \times \frac{(V3 + V4)}{2} \times \frac{(V16 + V18)}{2} \times V23 \right\rceil^{1/4}$$

Modifications:

- **V23**: MDOC advocated adding a variable to the overwintering model for the distance between summer and winter habitat. John Pitlo (IADNR) also stated that such distances should be given consideration. We felt the SI for this variable would be artificially high if it was added to the overwintering model because much of the river can be considered summer habitat and would therefore be in close proximity to the area under evaluation. Therefore, we added this variable to the riverine blue book model. Acceptable winter habitat is defined as areas which are greater than five feet deep at normal pool elevation, have a minimum winter dissolved oxygen content of at least 3 mg/l, have a minimum winter water temperature of not less than 1° C, have a winter current velocity of less than 3 cm/sec and are contiguous with the main channel during winter. This definition is based upon publications by Sheehan et al.[1] and Gent et al.[2], as well as the overwintering variables we submitted to other agencies for their review. Additionally, Pitlo stated that winter habitat should be on the same side of the river as the summer habitat which it complements. This prompted us to modify the SI's recommended by MDOC. The variable is defined as the *distance (mi) to nearest acceptable winter habitat* (V23) and will be added to the model as a riverine variable.

The adopted SI's are in the table below.

Distance (mi)	Suitability Index	
	Same Side	Other Side
< 3	1.0	0.5
3 - 4	0.8	0.4
4 < x ≤ 5	0.5	0.2
5 < x ≤ 6	0.4	0.1
> 6	0.2	0

[1] Sheehan, R.J., W.M. Lewis, and L.R. Bodensteiner. Publ. date unk. Winter habitat requirements and overwintering of riverine fishes. Project F-79-R. Fisheries Research Lab., Southern Ill. Univ., Carbondale.

[2] Gent, R., J. Pitlo, Jr., and T. Boland. 1995. Largemouth bass response to habitat and water quality rehabilitation in a backwater of the Upper Mississippi River. N. Amer. J. Fish. Manage. 15:784-793.

LARGEMOUTH BASS (overwintering)

Source of Model: adapted from: Modification of the Habitat Suitability Index Model for the Bluegill (Lepomis macrochirus) for Winter Conditions for Upper Mississippi River Backwater Habitats by Gary Palesh and Dennis Anderson (1990, U.S. Army Corps of Engineers).

Habitat Type: Backwater/Backwater lake

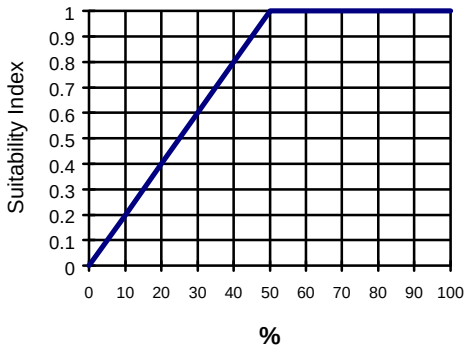
Assumptions: The bluegill model was utilized because largemouth bass are expected to react to habitat conditions in a manner similar to bluegill.

Modifications:

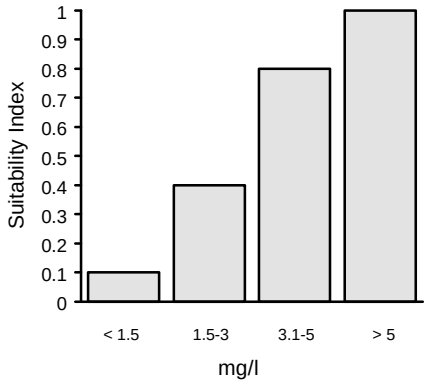
- **V1**: John Pitlo (IADNR) suggested changing the minimum depth to five feet to account for ice thickness. This recommendation was adopted.
- **V1**: MDOC recommended repositioning the SI curve so that 0% will receive an SI value of zero. This recommendation was adopted.
- **V2**: MDOC suggested giving the 3-5 mg/l category an SI value of 0.8. This recommendation was adopted.
- **V3**: MDOC recommended giving an SI value of 1 to the 2-3° range and lowering the SI value of 4° to 0.7. These recommendations were adopted.
- **V4**: MDOC suggested increasing the SI value for 0.5 cm/sec to 1.0. This recommendation was adopted.

Largemouth Bass Overwintering Variables

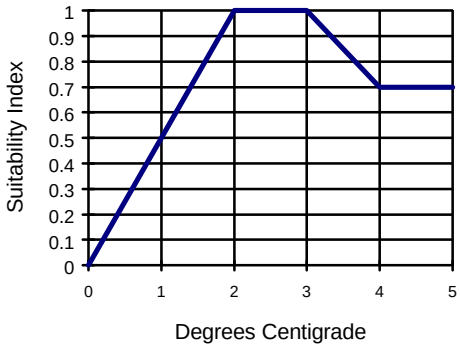
V1: Percent of backwater > 5 feet deep at normal pool elevation.



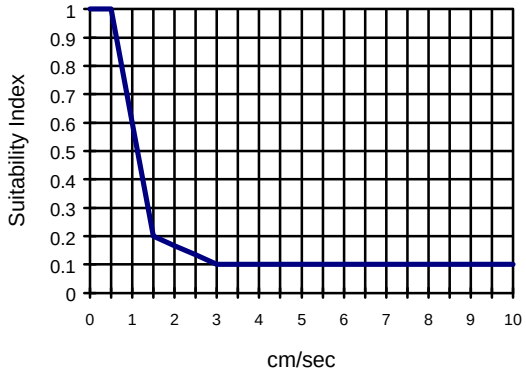
V2: Minimum winter dissolved oxygen.



V3: Winter water temperature.



V4: Current velocity.



Largemouth Bass HSI Determination

The information below is taken from *Modification of the Habitat Suitability Index Model for the Bluegill (Lepomis macrochirus) for Winter Conditions for Upper Mississippi River Backwater Habitats* by Gary Palesh and Dennis Anderson (1990, U.S. Army Corps of Engineers).

The summer HSI would be calculated using the methods described in the existing U.S. Fish and Wildlife Service habitat suitability index model. The winter HSI would be calculated as follows.

Winter HSI Determination
Winter Cover: $C_{W\text{-}C} = V1$

Winter Water Quality: $C_{W\text{-}WQ} = \frac{(2V2 + V3)}{3}$

If the SI for V2 or V3 is ≤ 0.4, then $C_{W\text{-}WQ}$ equals the lower of the two variables.

Winter Other: $C_{W\text{-}OT} = V4$

Winter HSI = $(C_{W\text{-}C} \times C_{W\text{-}WQ}^2 \times C_{W\text{-}OT})^{1/4}$
If $C_{W\text{-}WQ}$ is ≤ 0.4, then the winter HSI = $C_{W\text{-}WQ}$.

Overall HSI Determination
Two methods are suggested for determination of an overall HSI value for a particular Upper Mississippi River backwater habitat.

Scenario 1: The backwater habitat being evaluated is a relatively isolated area that must serve as both the summer and winter habitat for the resident largemouth bass population. The lowest quality habitat (summer or winter) will likely be the limiting factor on the largemouth population.

Overall HSI = the lower of the summer HSI or winter HSI

Scenario 2: The backwater habitat being evaluated is well connected to other suitable habitat for largemouth bass such that it does not have to provide both summer and winter habitat for survival of a particular largemouth population.

Overall HSI = (summer HSI x winter HSI)$^{1/2}$

Modifications:

- HSI Determination: RIFO recommended either using a weighting factor of 4 for the overwintering component, or considering winter habitat as the limiting factor in the HSI determination. Bill Bertrand (ILDNR) suggested assigning a weighting factor of 4. Pitlo stated that the proper weighting factor could go as high as 30. We agree that winter habitat is more scarce than summer habitat, and we feel that the weighting factor of 4 proposed by FWS and ILDNR adequately accounts for this disparity in availability. The aggregation formula is as follows:

  $HSI_O = (HSI_S \times HSI_W^4)^{1/5}$ where HSI_O = overall HSI, HSI_S = blue book HSI, HSI_W = overwintering HSI

WALLEYE

Source of Model: McMahon, T. E., J. W. Terrell, and P. C. Nelson. 1984. Habitat Suitability Information: Walleye. U.S. Fish Wildl. Serv. FWS/OBS-82/10.56. 43 pp.

Habitat Type: Main Channel/Main Channel Border

Modifications:

- Ken Brummett (MDOC) made several comments regarding the validity of the model. A subsequent phone conversation revealed that his primary concern was that the suitability index curves in the model agree with results from John Pitlo's 1992 paper on walleye. These evaluations will be made. For dissolved oxygen and

pH, we will assess the availability of existing data. Specific efforts will be made to assess availability and applicability of existing prey abundance data, and if such data is unavailable a collection effort will be considered. He suggested adding overwintering variables to the model, which the HAT has accomplished.

WALLEYE (overwintering)

Source of Model: See Below.

Habitat Type: Main channel/main channel border

Assumptions: Overwintering variables and SI curves are based on the literature cited.

Aggregation Formulas:

C_W = min. of V1, V2 or V3, where C_W is the HSI of the overwintering component

overall HSI = min. of C_W, C_F, C_C, C_{WQ} or C_R, where:

C_F is the food component HSI from the blue book
C_C is the cover component HSI from the blue book
C_{WQ} is the water quality component HSI from the blue book
C_R is the reproduction component HSI from the blue book

Modifications:

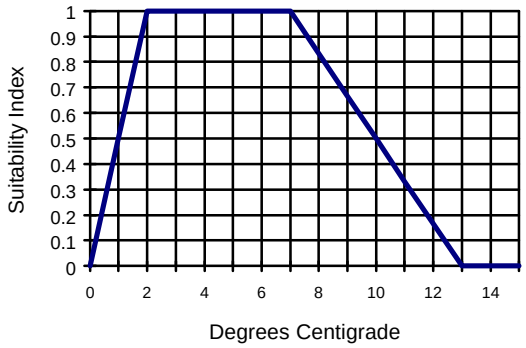
- **V3**: MDOC advocated giving an SI of 1.0 to velocities up to 0.2 m/sec. This correlates with velocity data supplied by ILDNR, so the recommendation was adopted.

Walleye Overwintering Variables

The following variables were developed in response to concerns that the present walleye HEP model did not adequately assess overwintering habitat for walleye in the Mississippi River. Three variables (water temperature, depth and velocity) represent the most important parameters impacting overwintering success. The existing HEP model bases the Habitat Suitability Index (HSI) on the lowest value of four habitat requisites: food, cover, water quality and reproduction. We recommend that a fifth requisite, overwintering, be added and that the HSI value be based on the lowest of all five requisites. To determine the value of the overwintering requisite, we suggest taking the lowest Suitability Index (SI) value of the following three variables. This methodology is consistent with the existing HEP model.

V1: Mean winter water temperature.

X	Y
0.0	0
1.7 (35°F)	1
7.2 (45°F)	1
12.8 (55°F)	0

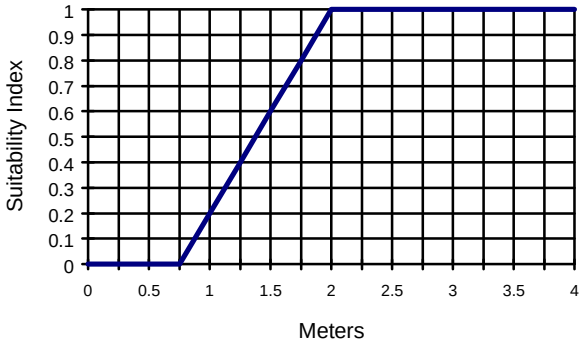


The SI curve for variable one came from the sauger curves developed from the Delphi method (Crance 1986). Biologically, these temperatures are also applicable to walleye. On the lower end, temperatures below freezing

(0°C) would not support walleye. On the upper end, Hokanson (1977) reported that proper maturation of gonads in female walleye required minimum winter water temperatures lower than 10°C. Miller (1967) found that walleyes failed to reproduce in a reservoir with minimum water temperatures between 10° and 25°C. Overwintering temperatures between 1.7° and 7.2°C should provide for optimal gonad development.

V2: Minimum winter water depth.

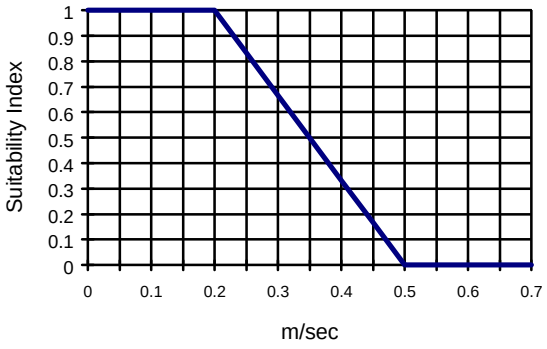
X	Y
0.0	0
0.75	0
2.0	1
> 2.0	1



Paragamian (1989) found that most walleye limited their movement during the winter and that fish appeared to select deep pool habitat during this time. Depths in these wintering pools ranged from 1.5 to 3 m (maximum depth of pools in the river was 3.7 m). He found that even in autumn fish were never found in water less than 0.6 m deep. Pitlo (1992) noted that walleye appeared to overwinter in areas with moderate depth, though no specific depths were given. We found no indication in the literature that depths like those seen in the Mississippi River (> 5 m) would adversely impact walleye overwintering success. Based on the information in Paragamian (1989) and Pitlo (1992), we estimated that depths less than 0.75 m would have no overwintering value to walleye and that depths greater than 2 m would be most suitable as overwintering habitat.

V3: Winter water velocity.

X	Y
0.0	1
0.2	1
0.5	0
> 0.5	0



We were not able to locate specific information on the overwintering water velocities required by walleye. Paragamian (1989) found that walleye selected deep pools with negligible current in the winter, but no specific velocities were given. Pitlo (1992) noted that walleye appeared to overwinter in areas with adequate flow, though no specifics were given. The draft Aquatic Habitat Appraisal Guide developed for the Corps of Engineers (1994) gave the following velocities and corresponding SI values for walleye:

m/sec	SI
< 0.1	1
0.1-0.25	0.75
0.25-0.5	0.5
> 0.5	0.25

The above values were not associated with a particular season. A review of the average main channel current velocities in Pool 26 during winter showed that velocities generally ranged between 0.15 and 0.5 m/sec. Based on information in Pitlo (1984), approximately 80% of all winter observations were in habitats (wingdam, main channel border, slough/side channel) where velocities would be expected to be lower than those found in the main channel. We have constructed an SI curve for Variable 3 which incorporates all of this information.

References

Crance, J.H. 1986. Sauger habitat suitability index curves developed by the Delphi method. U.S. Fish Wildl. Serv., Fort Collins. 34 pp.

Hokanson, K.E.F. 1977. Temperature requirements of some Percids and adaptations to the seasonal temperature cycle. J. Fish. Res. Board Can. 34(10):1524-1550.
McMahon, T.E., J.W. Terrell, and P.C. Nelson. 1984. Habitat suitability information: Walleye. U.S. Fish Wildl. Serv. FWS/OBS-82/10.56. 43 pp.

Miller, L.W. 1967. The introduction, growth, diet, and depth distribution of walleye, Stizostedion vitreum, in El Capitan Reservoir, San Diego County. Calif. Res. Agency, Dep. Fish Game, Inland Fish. Br., Admin. Rep. 67-10. 13 pp.

Paragamian, V.L. 1989. Seasonal habitat use by walleye in a warmwater river system, as determined by radiotelemetry. North Amer. J. Fish. Manag. 9:392-401.

Pitlo, J., Jr. 1984. Wing and closing dam investigations. Iowa Conservation Commission, Federal Aid in Fish Restoration, Completion Report F-96-R, Des Moines.

Pitlo, J., Jr. 1992. Walleye and sauger in the upper Mississippi River: early life history. Upper Mississippi River Conservation Committee, Rock Island, Ill. 39 pp.

U.S. Army Corps of Engineers. 1994. Aquatic habitat appraisal guide. Waterways Experiment Station, Vicksburg, Miss. Draft report. 60 pp.

BULLFROG

Source of Model: Graves, B. M., and S. H. Anderson. 1987. Habitat and Suitability Index Models: Bullfrog. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.138). 22 pp.

Habitat Type: Backwater/Backwater Lake

Modifications:

- Tom Johnson (MDOC) recommended several changes to the text of the model. Those changes were noted but they do not affect the model's applicability.

RED-EARED SLIDER

Source of Model: Morreale, S. J., and J. W. Gibbons. 1986. Habitat suitability index models: Slider turtle. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.125). 14 pp.

Habitat Type: Backwater/Backwater Lake

Modifications: RIFO recommended re-evaluating the applicability of the model to locks and dams 11-14 if it is to be used in those areas. This recommendation was adopted.

WESTERN CHORUS FROG

Source of Model: U.S. Army Corps of Engineers, Rock Island District, and U.S. Geological Survey, B.R.D.. 1996. Habitat Suitability Index Model: Chorus frog. Unpublished Model.

Habitat Type: Bottomland Hardwood Forest, Non-Forested Wetland

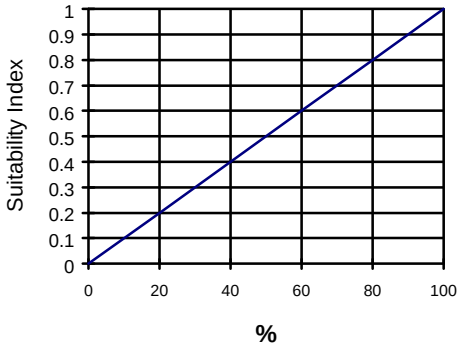
Assumptions:
- The major components of the model are identifiable in the habitat.
- All barriers to travel are impermeable to chorus frogs.
- All subjective distance factors are quantifiable.
- The amount of acceptable terrestrial cover has proportional importance.
- Suitable vegetative cover (for reproduction) consists of > 60 stems/m^2 of ≤ 1 cm diameter.
- Acceptable terrestrial cover consists of trees, brush, downed logs, stones and other debris.
- Most breeding activity takes place in water depths at the shallow end of the variable range.
- Because of its ability to breed in such ephemeral locations as rain pools and roadside ditches, it is not necessary to identify a minimum habitat area for this species.

Aggregation Formula: $HSI = [((V2*V3)^{1/2})*V1] * [(V4*V5)^{1/2}]$

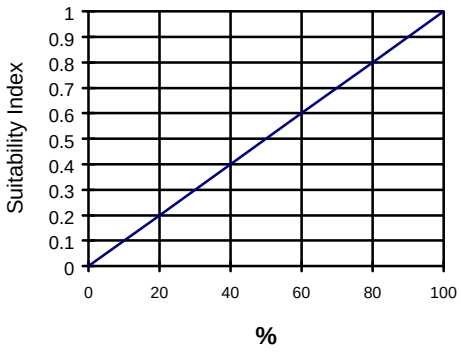
Modifications:
- RIFO requested that a minimum habitat area be established. At the workshop, *ideal* conditions were described as being a 5 acre pond plus 10 acres of undisturbed forest, but we do not believe there was any discussion of a minimum habitat area. Also, it was stated that the frogs are able to breed in such ephemeral locations as rain pools and roadside ditches. Therefore, we do not believe it is necessary to identify a minimum habitat area and this will be added to the model's assumptions.
- RIFO requested clarification of the assumption that predation by game fish is not an area of significant concern. MDOC stated that the only types of ponds which should be considered as suitable breeding sites are those which are small and fishless. The chorus frog model will be applied to bottomland hardwood forests and non-forested wetlands. Ponded areas within these cover types are assumed to be devoid of fish, except under temporary extraordinary circumstances, because they are typically not connected to the river. Therefore, we believe that predation does not warrant further consideration.
- **V4**: MDOC expressed the belief that grasses are important as terrestrial cover. A species expert involved in the modeling workshop stated that grass cover does not provide adequate moisture for survival of the frogs, so we decided to leave the definition of V4 and assumption 6 as they are. MDOC also stated that downed logs, rocks and other debris are seldom used for cover. However, the workshop species experts stated that such cover is utilized. Therefore, those cover types will remain in the model.
- **Assumption 7**: MDOC recommended changing this assumption to read that *most <u>breeding</u> activity takes place in water depths at the shallow end of the variable range*. This recommendation was adopted.

Chorus Frog Model Variables

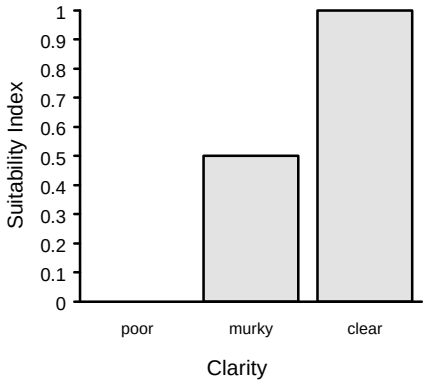
V1: Percent of pond with suitable water depth (10-45 cm).



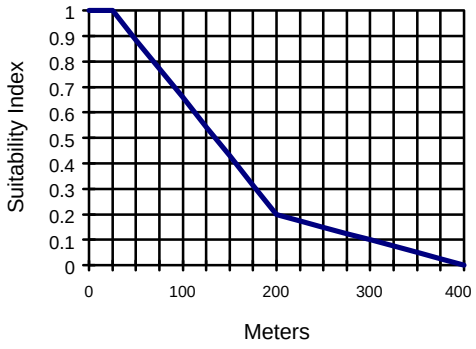
V2: Percent of suitable depth area with suitable vegetative cover (> 60 stems of ≤ 1 cm diameter per m^2).



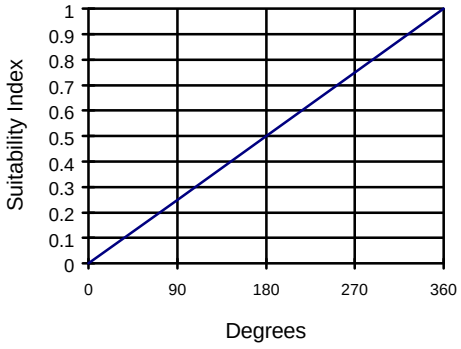
V3: Water clarity.



V4: Distance to acceptable terrestrial cover (trees, brush, downed logs, etc.).



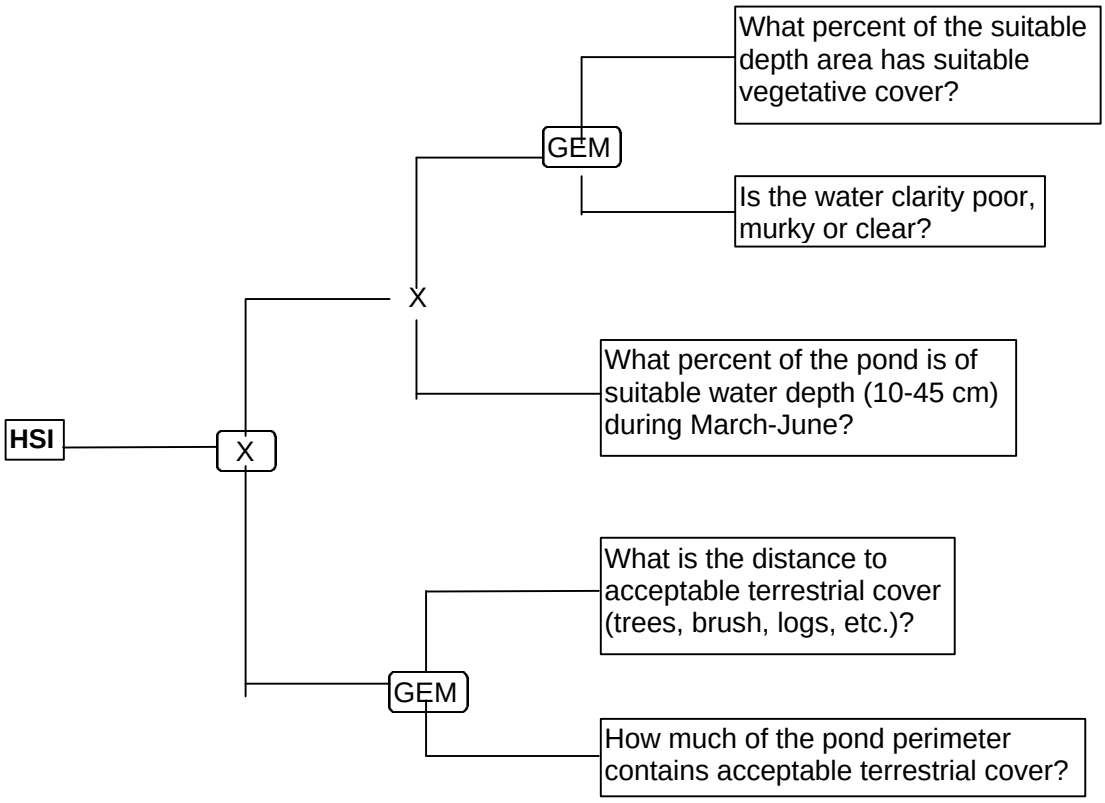
V5: Pond perimeter with acceptable terrestrial cover.



Chorus Frog HSI Determination

The HSI is determined by asking the following questions:

- Is there suitable depth and vegetative cover?
- Does the pond have clear water?
- How far is it to acceptable terrestrial cover?
- How much of the pond perimeter contains acceptable terrestrial cover?



X = multiplication

GEM = geometric mean

Appendix D

HEP Results

Appendix D Preface

In this appendix values were rounded for illustrative purposes. Values were not rounded during calculation. Occasionally this results in appearance that similar HSI values have different AAHU values, (see L/D 20, Location 2, MCB, 4D, Emerald Shiner as an example). In actuality, the HSI values were not exactly the same.

Habitat Abbreviations:

MCB - Main Channel Border
MC - Main Channel
BHF - Bottomland Hardwood Forest
SC - Side Channel
NFW - Non-Forested Wetland

Calculation Abbreviations and Definitions:

HSI - Habitat Suitability Index - A measure of the quality of a species habitat. Values range from 0 to 1. One value is calculated for each target year of the study.

TY - Target Year. Pre-selected years during which changes in the project are expected to take place. For this study, years 0, 1, 2, 5, 10, 25, and 50 were selected.

AAHUs - Average Annual Habitat Units. Calculated annual value of the habitat to a species over the life of the project (50 years).

Lock and Dam 20

Location: 2
Habitat Type: MCB
Site: 1U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	78.01	78.01	78.01	78.01	78.01	78.01	78.01
with project	78.01	78.01	93.06	93.06	93.06	93.06	93.06

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.58	45.70		
	with	0.59	0.59	0.56	0.56	0.56	0.56	0.56		51.72	6.02
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	62.41		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		74.09	11.68
Channel Catfish	w/o	0.45	0.45	0.45	0.45	0.45	0.45	0.45	35.04		
	with	0.45	0.45	0.44	0.44	0.44	0.44	0.44		40.69	5.65
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	65.30		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		77.52	12.22
Paddlefish (adult)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.32	25.36		
	with	0.33	0.33	0.33	0.33	0.33	0.33	0.32		30.11	4.75
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	45.94		
	with	0.59	0.59	0.49	0.49	0.49	0.49	0.49		45.51	-0.43
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	20.43		
	with	0.27	0.27	0.31	0.31	0.31	0.30	0.29		27.86	7.43
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	68.83		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		81.71	12.88
Walleye (reproduction)	w/o	0.16	0.16	0.16	0.16	0.16	0.16	0.16	12.17		
	with	0.16	0.16	0.16	0.16	0.16	0.16	0.16		14.45	2.28
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.76	59.32		
	with	0.76	0.76	0.76	0.76	0.76	0.76	0.76		70.18	10.86
								Net Sum AAHU's =			73.34

Location: 2
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.61	6.61	6.61	6.61	6.61	6.61	6.61
with project	6.61	6.61	6.61	6.61	6.61	6.61	6.61

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.43	0.43	0.43	0.43	0.43	0.43	0.43	2.84		
	with	0.43	0.43	0.46	0.46	0.46	0.45	0.45		3.00	0.16
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	5.29		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		5.29	0.00
Channel Catfish	w/o	0.46	0.46	0.46	0.46	0.46	0.46	0.46	3.03		
	with	0.46	0.46	0.47	0.47	0.47	0.47	0.47		3.11	0.08
Paddlefish (spawning)	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	4.49		
	with	0.68	0.68	0.68	0.68	0.68	0.68	0.68		4.49	0.00
Paddlefish (adult)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	2.26		
	with	0.34	0.34	0.36	0.36	0.36	0.36	0.36		2.36	0.10
Sauger	w/o	0.69	0.69	0.69	0.69	0.69	0.69	0.69	4.55		
	with	0.69	0.69	0.69	0.69	0.69	0.69	0.69		4.55	0.00
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	1.73		
	with	0.27	0.27	0.27	0.27	0.27	0.26	0.25		1.73	0.00
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	5.83		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		5.83	0.00
Walleye (reproduction)	w/o	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.45		
	with	0.07	0.07	0.07	0.07	0.07	0.07	0.07		0.45	0.00
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.76	5.03		
	with	0.76	0.76	0.76	0.76	0.76	0.76	0.76		5.03	0.00
								Net Sum AAHU's =			0.34

Location: 2
Habitat Type: MCB
Site: 4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	13.91	13.91	13.91	13.91	13.91	13.91	13.91
with project	13.91	13.91	13.91	13.91	13.91	13.91	13.91

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.47	0.47	0.47	0.47	0.47	0.47	0.47	6.51		
	with	0.47	0.47	0.47	0.47	0.47	0.47	0.47		6.51	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	11.13		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		11.13	0.00
Channel Catfish	w/o	0.70	0.70	0.70	0.70	0.70	0.70	0.70	9.79		
	with	0.70	0.70	0.70	0.70	0.70	0.70	0.70		9.79	0.00
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	11.64		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		11.64	0.00
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	4.28		
	with	0.31	0.31	0.31	0.31	0.31	0.31	0.31		4.28	0.00
Sauger	w/o	0.69	0.69	0.69	0.69	0.69	0.69	0.69	9.58		
	with	0.69	0.69	0.69	0.69	0.69	0.69	0.69		9.58	0.00
Walleye (summer)	w/o	0.43	0.43	0.43	0.43	0.43	0.42	0.41	5.87		
	with	0.43	0.43	0.43	0.43	0.43	0.42	0.41		5.87	0.00
Walleye (winter)	w/o	0.67	0.67	0.67	0.67	0.67	0.67	0.63	9.16		
	with	0.67	0.67	0.67	0.67	0.67	0.67	0.63		9.16	0.00
Walleye (reproduction)	w/o	0.16	0.16	0.16	0.16	0.16	0.16	0.16	2.17		
	with	0.16	0.16	0.16	0.16	0.16	0.16	0.16		2.17	0.00
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	11.01		
	with	0.79	0.79	0.79	0.79	0.79	0.79	0.79		10.94	-0.07
								Net Sum AAHU's =			-0.07

Location: 2
Habitat Type: MCB
Site: 11D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.27	8.27	8.27	8.27	8.27	8.27	8.27
with project	8.27	8.27	8.27	8.27	8.27	8.27	8.27

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.54	0.54	0.54	0.54	0.54	0.54	0.54	4.45		
	with	0.54	0.54	0.54	0.54	0.54	0.54	0.54		4.46	0.01
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	6.62		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		6.62	0.00
Channel Catfish	w/o	0.54	0.54	0.54	0.54	0.54	0.53	0.53	4.42		
	with	0.54	0.52	0.39	0.40	0.40	0.40	0.39		3.32	-1.10
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	6.92		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		6.92	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	2.89		
	with	0.35	0.35	0.35	0.35	0.35	0.35	0.35		2.89	0.00
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	4.59		
	with	0.56	0.49	0.52	0.59	0.59	0.59	0.59		4.83	0.24
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	2.17		
	with	0.27	0.18	0.18	0.27	0.27	0.26	0.25		2.12	-0.05
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	7.30		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		7.30	0.00
Walleye (reproduction)	w/o	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.62		
	with	0.07	0.00	0.00	0.00	0.00	0.00	0.00		0.01	-0.61
Emerald Shiner	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.78	6.55		
	with	0.80	0.77	0.75	0.78	0.78	0.78	0.78		6.42	-0.13
								Net Sum AAHU's =			-1.64

Lock and Dam 20

Location: 2
Habitat Type: BHF
Site: 4U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	15.05	15.05	15.05	15.05	15.05	15.05	15.05
with project	15.05	15.05	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.00	0.20	0.48	2.99		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-2.99
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.20	0.30	2.36		
	with	0.00	0.00	0.00	0.00	0.00	0.20	0.30		0.00	-2.36
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.10	1.45		
	with	0.10	0.10	0.00	0.00	0.00	0.00	0.00		0.04	-1.41
Prothonotary Warbler	w/o	0.04	0.07	0.08	0.10	0.10	0.10	0.10	1.45		
	with	0.04	0.07	0.00	0.00	0.00	0.00	0.00		0.02	-1.43
Hairy Woodpecker	w/o	0.71	0.71	0.76	0.83	0.93	0.93	0.93	13.65		
	with	0.71	0.71	0.00	0.00	0.00	0.00	0.00		0.29	-13.36
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
								Net Sum AAHU's =			-21.55

Location: 2
Habitat Type: SC
Site: 8D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	16.16	16.16	16.16	16.16	16.16	16.16	16.16
with project	16.16	16.16	16.16	16.16	16.16	16.16	16.16

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Beaver	w/o	0.26	0.26	0.26	0.26	0.26	0.26	0.26	4.19		
	with	0.26	0.00	0.00	0.39	0.50	0.50	0.50		7.41	3.22
River Otter	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.86	0.86	13.90		
	with	0.86	0.86	0.86	0.86	0.86	0.86	0.86		13.90	0.00
Channel Catfish	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	7.87		
	with	0.49	0.49	0.49	0.49	0.49	0.49	0.49		7.87	0.00
Smallmouth Buffalo (repro)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	5.44		
	with	0.34	0.34	0.34	0.34	0.34	0.34	0.34		5.44	0.00
Smallmouth Buffalo (summer)	w/o	0.13	0.13	0.13	0.13	0.13	0.13	0.13	2.04		
	with	0.13	0.13	0.13	0.13	0.13	0.13	0.13		2.04	0.00
								Net Sum AAHU's =			3.22

Lock and Dam 20

Location: 3
Habitat Type: MCB
Site: 1U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	63.24	63.24	63.24	63.24	63.24	63.24	63.24
with project	63.24	63.24	70.25	70.25	70.25	70.25	70.25

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.58	37.05		
	with	0.59	0.59	0.56	0.56	0.56	0.56	0.56		39.12	2.07
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	50.59		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		56.03	5.44
Channel Catfish	w/o	0.45	0.45	0.45	0.45	0.45	0.45	0.45	28.41		
	with	0.45	0.45	0.44	0.44	0.44	0.44	0.44		30.77	2.36
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	52.94		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		58.63	5.69
Paddlefish (adult)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.32	20.56		
	with	0.33	0.33	0.33	0.33	0.33	0.33	0.32		22.77	2.21
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	37.24		
	with	0.59	0.59	0.49	0.49	0.49	0.49	0.49		34.43	-2.81
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	16.56		
	with	0.27	0.27	0.31	0.31	0.31	0.30	0.29		21.07	4.51
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	55.80		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		61.80	6.00
Walleye (reproduction)	w/o	0.16	0.16	0.16	0.16	0.16	0.16	0.16	9.87		
	with	0.16	0.16	0.16	0.16	0.16	0.16	0.16		10.93	1.06
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.76	48.09		
	with	0.76	0.76	0.76	0.76	0.76	0.76	0.76		53.07	4.98
								Net Sum AAHU's =			31.51

Location: 3
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	12.21	12.21	12.21	12.21	12.21	12.21	12.21
with project	12.21	12.21	12.21	12.21	12.21	12.21	12.21

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.43	0.43	0.43	0.43	0.43	0.43	0.43	5.24		
	with	0.43	0.43	0.48	0.48	0.48	0.48	0.48		5.86	0.62
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	9.77		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		9.77	0.00
Channel Catfish	w/o	0.46	0.46	0.46	0.46	0.46	0.46	0.46	5.59		
	with	0.46	0.46	0.52	0.52	0.52	0.52	0.52		6.31	0.72
Paddlefish (spawning)	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	8.29		
	with	0.68	0.68	0.63	0.63	0.63	0.64	0.65		7.82	-0.47
Paddlefish (adult)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	4.18		
	with	0.34	0.34	0.34	0.34	0.34	0.34	0.34		4.18	0.00
Sauger	w/o	0.69	0.69	0.69	0.69	0.69	0.69	0.69	8.41		
	with	0.69	0.69	0.69	0.69	0.69	0.69	0.69		8.41	0.00
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	3.20		
	with	0.27	0.27	0.27	0.27	0.27	0.26	0.25		3.20	0.00
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	10.77		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		10.77	0.00
Walleye (reproduction)	w/o	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.82		
	with	0.07	0.07	0.07	0.07	0.07	0.07	0.07		0.82	0.00
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.76	9.29		
	with	0.76	0.76	0.76	0.76	0.76	0.76	0.76		9.29	0.00
								Net Sum AAHU's =			0.87

Location: 3
Habitat Type: MCB
Site: 4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	13.91	13.91	13.91	13.91	13.91	13.91	13.91
with project	13.91	13.91	13.91	13.91	13.91	13.91	13.91

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.47	0.47	0.47	0.47	0.47	0.47	0.47	6.51		
	with	0.47	0.47	0.47	0.47	0.47	0.47	0.47		6.51	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	11.13		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		11.13	0.00
Channel Catfish	w/o	0.70	0.70	0.70	0.70	0.70	0.70	0.70	9.79		
	with	0.70	0.70	0.70	0.70	0.70	0.70	0.70		9.79	0.00
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	11.64		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		11.64	0.00
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	4.28		
	with	0.31	0.31	0.31	0.31	0.31	0.31	0.31		4.28	0.00
Sauger	w/o	0.69	0.69	0.69	0.69	0.69	0.69	0.69	9.58		
	with	0.69	0.69	0.69	0.69	0.69	0.69	0.69		9.58	0.00
Walleye (summer)	w/o	0.43	0.43	0.43	0.43	0.43	0.42	0.41	5.87		
	with	0.43	0.43	0.43	0.43	0.43	0.42	0.41		5.87	0.00
Walleye (winter)	w/o	0.67	0.67	0.67	0.67	0.67	0.67	0.63	9.16		
	with	0.67	0.67	0.67	0.67	0.67	0.67	0.63		9.16	0.00
Walleye (reproduction)	w/o	0.16	0.16	0.16	0.16	0.16	0.16	0.16	2.17		
	with	0.16	0.16	0.16	0.16	0.16	0.16	0.16		2.17	0.00
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	11.01		
	with	0.79	0.79	0.79	0.79	0.79	0.79	0.79		10.94	-0.07
								Net Sum AAHU's =			-0.07

Location: 3
Habitat Type: MCB
Site: 11D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	17.47	17.47	17.47	17.47	17.47	17.47	17.47
with project	17.47	17.47	17.47	17.47	17.47	17.47	17.47

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.54	0.54	0.54	0.54	0.54	0.54	0.54	9.40		
	with	0.54	0.54	0.00	0.00	0.00	0.47	0.47		5.65	-3.75
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	13.98		
	with	0.80	0.80	0.58	0.58	0.58	0.80	0.80		12.77	-1.21
Channel Catfish	w/o	0.54	0.54	0.54	0.54	0.54	0.53	0.53	9.33		
	with	0.54	0.52	0.67	0.68	0.68	0.69	0.65		11.72	2.39
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	14.62		
	with	0.83	0.83	0.00	0.00	0.00	0.00	0.00		0.43	-14.19
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	6.11		
	with	0.35	0.35	0.42	0.42	0.42	0.39	0.38		6.91	0.80
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	9.71		
	with	0.56	0.49	0.42	0.49	0.49	0.49	0.49		8.51	-1.20
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	4.58		
	with	0.27	0.18	0.20	0.20	0.20	0.20	0.20		3.50	-1.08
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	15.41		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		15.41	0.00
Walleye (reproduction)	w/o	0.07	0.07	0.07	0.07	0.07	0.07	0.07	1.31		
	with	0.07	0.00	0.00	0.00	0.00	0.00	0.00		0.01	-1.30
Emerald Shiner	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.78	13.83		
	with	0.80	0.77	0.82	0.85	0.85	0.80	0.80		14.17	0.34
								Net Sum AAHU's =			-19.20

Lock and Dam 20

Location: 3
Habitat Type: MCB
Site: 11D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.2	9.2	9.2	9.2	9.2	9.2	9.2
with project	9.2	9.2	9.2	9.2	9.2	9.2	9.2

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.54	0.54	0.54	0.54	0.54	0.54	0.54	4.95		
	with	0.54	0.54	0.54	0.54	0.54	0.54	0.54		4.96	0.01
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	7.36		
	with	0.80	0.80	0.80	0.80	0.80	0.79	0.77		7.24	-0.12
Channel Catfish	w/o	0.54	0.54	0.54	0.54	0.54	0.53	0.53	4.91		
	with	0.54	0.52	0.43	0.44	0.44	0.44	0.44		4.06	-0.85
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	7.70		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		7.70	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	3.22		
	with	0.35	0.35	0.35	0.35	0.35	0.35	0.35		3.22	0.00
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	5.11		
	with	0.56	0.49	0.56	0.62	0.62	0.62	0.62		5.67	0.56
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	2.41		
	with	0.27	0.18	0.18	0.27	0.27	0.26	0.25		2.36	-0.05
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	8.12		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		8.12	0.00
Walleye (reproduction)	w/o	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.69		
	with	0.07	0.07	0.00	0.00	0.00	0.00	0.00		0.02	-0.67
Emerald Shiner	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.78	7.28		
	with	0.80	0.77	0.72	0.74	0.74	0.74	0.74		6.82	-0.46
									Net Sum AAHU's =		-1.58

Location: 3
Habitat Type: BHF
Site: 4U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.01	7.01	7.01	7.01	7.01	7.01	7.01
with project	7.01	7.01	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.00	0.20	0.48	1.39		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.39
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.20	0.30	1.10		
	with	0.00	0.00	0.00	0.00	0.00	0.20	0.30		0.00	-1.10
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.68		
	with	0.10	0.10	0.00	0.00	0.00	0.00	0.00		0.02	-0.66
Prothonotary Warbler	w/o	0.04	0.07	0.08	0.10	0.10	0.10	0.10	0.68		
	with	0.04	0.07	0.00	0.00	0.00	0.00	0.00		0.01	-0.67
Hairy Woodpecker	w/o	0.71	0.71	0.76	0.83	0.93	0.93	0.93	6.36		
	with	0.71	0.71	0.00	0.00	0.00	0.00	0.00		0.13	-6.23
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-10.05

Location: 3
Habitat Type: SC
Site: 8D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	16.16	16.16	16.16	16.16	16.16	16.16	16.16
with project	16.16	16.16	16.16	16.16	16.16	16.16	16.16

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Beaver	w/o	0.26	0.26	0.26	0.26	0.26	0.26	0.26	4.19		
	with	0.26	0.00	0.00	0.39	0.50	0.50	0.50		7.41	3.22
River Otter	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.86	0.86	13.90		
	with	0.86	0.86	0.86	0.86	0.86	0.86	0.86		13.90	0.00
Channel Catfish	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	7.87		
	with	0.49	0.49	0.49	0.49	0.49	0.49	0.49		7.87	0.00
Smallmouth Buffalo (repro)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	5.44		
	with	0.34	0.34	0.34	0.34	0.34	0.34	0.34		5.44	0.00
Smallmouth Buffalo (summer)	w/o	0.13	0.13	0.13	0.13	0.13	0.13	0.13	2.04		
	with	0.13	0.13	0.13	0.13	0.13	0.13	0.13		2.04	0.00
									Net Sum AAHU's =		3.22

Lock and Dam 20

Location: 4
Habitat Type: MCB
Site: 1U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	36.6	36.6	36.6	36.6	36.6	36.6	36.6
with project	36.6	36.6	36.6	36.6	36.6	36.6	36.6

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.58	21.44		
	with	0.59	0.59	0.56	0.56	0.56	0.56	0.56		20.45	-0.99
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	29.28		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		29.28	0.00
Channel Catfish	w/o	0.45	0.45	0.45	0.45	0.45	0.45	0.45	16.44		
	with	0.45	0.45	0.44	0.44	0.44	0.44	0.44		16.08	-0.36
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	30.64		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		30.64	0.00
Paddlefish (adult)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.32	11.90		
	with	0.33	0.33	0.33	0.33	0.33	0.33	0.32		11.90	0.00
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	21.55		
	with	0.59	0.59	0.49	0.49	0.49	0.49	0.49		18.00	-3.55
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	9.59		
	with	0.27	0.27	0.31	0.31	0.31	0.30	0.29		11.01	1.42
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	32.29		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		32.29	0.00
Walleye (reproduction)	w/o	0.16	0.16	0.16	0.16	0.16	0.16	0.16	5.71		
	with	0.16	0.16	0.16	0.16	0.16	0.16	0.16		5.71	0.00
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.76	27.83		
	with	0.76	0.76	0.76	0.76	0.76	0.76	0.76		27.73	-0.10
								Net Sum AAHU's =			-3.58

Location: 4
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	17.81	17.81	17.81	17.81	17.81	17.81	17.81
with project	17.81	17.81	17.81	17.81	17.81	17.81	17.81

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.43	0.43	0.43	0.43	0.43	0.43	0.43	7.65		
	with	0.43	0.43	0.43	0.43	0.43	0.43	0.43		7.67	0.02
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	14.25		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		14.25	0.00
Channel Catfish	w/o	0.46	0.46	0.46	0.46	0.46	0.46	0.46	8.16		
	with	0.46	0.46	0.46	0.46	0.46	0.46	0.46		8.16	0.00
Paddlefish (spawning)	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	12.10		
	with	0.68	0.68	0.68	0.68	0.68	0.68	0.68		12.10	0.00
Paddlefish (adult)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	6.10		
	with	0.34	0.34	0.34	0.34	0.34	0.34	0.34		6.10	0.00
Sauger	w/o	0.69	0.69	0.69	0.69	0.69	0.69	0.69	12.27		
	with	0.69	0.69	0.69	0.69	0.69	0.69	0.69		12.27	0.00
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	4.66		
	with	0.27	0.27	0.27	0.27	0.27	0.26	0.25		4.66	0.00
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	15.71		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		15.71	0.00
Walleye (reproduction)	w/o	0.07	0.07	0.07	0.07	0.07	0.07	0.07	1.20		
	with	0.07	0.07	0.07	0.07	0.07	0.07	0.07		1.20	0.00
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.76	13.55		
	with	0.76	0.76	0.76	0.76	0.76	0.76	0.76		13.55	0.00
								Net Sum AAHU's =			0.02

Location: 4
Habitat Type: MCB
Site: 11D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	17.47	17.47	17.47	17.47	17.47	17.47	17.47
with project	17.47	17.47	17.47	17.47	17.47	17.47	17.47

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.54	0.54	0.54	0.54	0.54	0.54	0.54	9.40		
	with	0.54	0.54	0.00	0.00	0.00	0.47	0.47		5.65	-3.75
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	13.98		
	with	0.80	0.80	0.58	0.58	0.58	0.80	0.80		12.77	-1.21
Channel Catfish	w/o	0.54	0.54	0.54	0.54	0.54	0.53	0.53	9.33		
	with	0.54	0.52	0.67	0.68	0.68	0.69	0.65		11.72	2.39
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	14.62		
	with	0.83	0.83	0.00	0.00	0.00	0.00	0.00		0.43	-14.19
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	6.11		
	with	0.35	0.35	0.42	0.42	0.42	0.39	0.38		6.91	0.80
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	9.71		
	with	0.56	0.49	0.42	0.49	0.49	0.49	0.49		8.51	-1.20
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	4.58		
	with	0.27	0.18	0.20	0.20	0.20	0.20	0.20		3.50	-1.08
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	15.41		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		15.41	0.00
Walleye (reproduction)	w/o	0.07	0.07	0.07	0.07	0.07	0.07	0.07	1.31		
	with	0.07	0.00	0.00	0.00	0.00	0.00	0.00		0.01	-1.30
Emerald Shiner	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.78	13.83		
	with	0.80	0.77	0.82	0.85	0.85	0.80	0.80		14.17	0.34
								Net Sum AAHU's =			-19.20

Location: 4
Habitat Type: MCB
Site: 11D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.2	9.2	9.2	9.2	9.2	9.2	9.2
with project	9.2	9.2	9.2	9.2	9.2	9.2	9.2

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.54	0.54	0.54	0.54	0.54	0.54	0.54	4.95		
	with	0.54	0.54	0.54	0.54	0.54	0.54	0.54		4.96	0.01
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	7.36		
	with	0.80	0.80	0.80	0.80	0.80	0.79	0.77		7.24	-0.12
Channel Catfish	w/o	0.54	0.54	0.54	0.54	0.54	0.53	0.53	4.91		
	with	0.54	0.52	0.43	0.44	0.44	0.44	0.44		4.06	-0.85
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	7.70		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		7.70	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	3.22		
	with	0.35	0.35	0.35	0.35	0.35	0.35	0.35		3.22	0.00
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	5.11		
	with	0.56	0.49	0.56	0.62	0.62	0.62	0.62		5.67	0.56
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	2.41		
	with	0.27	0.18	0.18	0.27	0.27	0.26	0.25		2.36	-0.05
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	8.12		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		8.12	0.00
Walleye (reproduction)	w/o	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.69		
	with	0.07	0.07	0.00	0.00	0.00	0.00	0.00		0.02	-0.67
Emerald Shiner	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.78	7.28		
	with	0.80	0.77	0.72	0.74	0.74	0.74	0.74		6.82	-0.46
								Net Sum AAHU's =			-1.58

Lock and Dam 20

Location: 4
Habitat Type: SC
Site: 8D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	16.16	16.16	16.16	16.16	16.16	16.16	16.16
with project	16.16	16.16	16.16	16.16	16.16	16.16	16.16

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Beaver	w/o	0.26	0.26	0.26	0.26	0.26	0.26	0.26	4.19		
	with	0.26	0.00	0.00	0.39	0.50	0.50	0.50		7.41	3.22
River Otter	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.86	0.86	13.90		
	with	0.86	0.86	0.86	0.86	0.86	0.86	0.86		13.90	0.00
Channel Catfish	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	7.87		
	with	0.49	0.49	0.49	0.49	0.49	0.49	0.49		7.87	0.00
Smallmouth Buffalo (repro)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	5.44		
	with	0.34	0.34	0.34	0.34	0.34	0.34	0.34		5.44	0.00
Smallmouth Buffalo (summer)	w/o	0.13	0.13	0.13	0.13	0.13	0.13	0.13	2.04		
	with	0.13	0.13	0.13	0.13	0.13	0.13	0.13		2.04	0.00
								Net Sum AAHU's =			3.22

Lock and Dam 20

Location: Wicket Gate
Habitat Type: MCB
Site: 5D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	38.26	38.26	38.26	38.26	38.26	38.26	38.26
with project	38.26	38.26	51.84	51.84	51.84	51.84	51.84

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.47	0.47	0.47	0.47	0.47	0.46	0.46	17.75		
	with	0.47	0.47	0.47	0.47	0.47	0.46	0.46		23.87	6.12
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	30.61		
	with	0.80	0.80	0.66	0.66	0.66	0.61	0.58		32.11	1.50
Channel Catfish	w/o	0.60	0.60	0.60	0.60	0.60	0.60	0.60	22.92		
	with	0.60	0.60	0.60	0.60	0.60	0.60	0.60		30.95	8.03
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	32.03		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		43.06	11.03
Paddlefish (adult)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	12.92		
	with	0.34	0.34	0.32	0.32	0.32	0.32	0.32		16.68	3.76
Sauger	w/o	0.69	0.69	0.69	0.69	0.69	0.69	0.69	26.36		
	with	0.69	0.69	0.66	0.66	0.66	0.66	0.66		33.76	7.40
Walleye (summer)	w/o	0.39	0.39	0.39	0.39	0.39	0.38	0.37	14.61		
	with	0.39	0.39	0.43	0.43	0.43	0.42	0.41		21.65	7.04
Walleye (winter)	w/o	0.87	0.87	0.87	0.87	0.87	0.87	0.87	33.16		
	with	0.87	0.87	0.87	0.87	0.87	0.87	0.87		44.57	11.41
Walleye (reproduction)	w/o	0.16	0.16	0.16	0.16	0.16	0.16	0.16	5.97		
	with	0.16	0.16	0.16	0.16	0.16	0.16	0.16		8.02	2.05
Emerald Shiner	w/o	0.78	0.78	0.78	0.78	0.78	0.78	0.78	29.74		
	with	0.78	0.78	0.78	0.78	0.78	0.78	0.74		39.49	9.75
								Net Sum AAHU's =			68.09

Location: Wicket Gate
Habitat Type: BHF
Site: 1D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.93	6.93	6.93	6.93	6.93	6.93	6.93
with project	6.93	6.93	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.33	0.35	0.39	0.50	0.70	0.85	0.85	5.27		
	with	0.33	0.35	0.00	0.00	0.00	0.00	0.00		0.06	-5.21
Wild Turkey	w/o	0.68	0.68	0.68	0.62	0.55	0.48	0.39	3.45		
	with	0.68	0.68	0.00	0.00	0.00	0.00	0.00		0.13	-3.32
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.35		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-0.35
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.22	0.22	0.22	0.22	0.22	0.22	0.22	1.50		
	with	0.22	0.22	0.00	0.00	0.00	0.00	0.00		0.04	-1.46
Prothonotary Warbler	w/o	0.09	0.10	0.10	0.10	0.10	0.10	0.10	0.69		
	with	0.09	0.10	0.00	0.00	0.00	0.00	0.00		0.02	-0.67
Hairy Woodpecker	w/o	0.40	0.43	0.50	0.57	0.71	0.79	0.79	5.07		
	with	0.40	0.43	0.00	0.00	0.00	0.00	0.00		0.08	-4.99
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-16.00

Location: Wicket Gate
Habitat Type: SC
Site: 2D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.65	6.65	6.65	6.65	6.65	6.65	6.65
with project	6.65	6.65	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Beaver	w/o	0.50	0.50	0.50	0.50	0.50	0.50	0.50	3.33		
	with	0.50	0.50	0.00	0.00	0.00	0.00	0.00		0.09	-3.24
River Otter	w/o	0.22	0.22	0.22	0.22	0.22	0.22	0.22	1.46		
	with	0.22	0.22	0.00	0.00	0.00	0.00	0.00		0.04	-1.42
Emerald Shiner	w/o	0.83	0.83	0.83	0.83	0.83	0.83	0.83	5.49		
	with	0.83	0.83	0.00	0.00	0.00	0.00	0.00		0.15	-5.34
Channel Catfish	w/o	0.47	0.47	0.47	0.47	0.47	0.47	0.47	3.14		
	with	0.47	0.47	0.00	0.00	0.00	0.00	0.00		0.08	-3.06
Smallmouth Buffalo (repro)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Smallmouth Buffalo (summer)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
								Net Sum AAHU's =			-13.06

Lock and Dam 21

Location: 2
Habitat Type: MCB
Site: 2U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	25.94	25.94	25.94	25.94	25.94	25.94	25.94
with project	25.94	25.94	33.99	33.99	33.99	33.99	33.99

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.89	0.89	0.89	0.89	0.89	0.88	0.86	22.82		
	with	0.89	0.89	0.89	0.89	0.89	0.88	0.86		29.69	6.87
Channel Catfish	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.61	15.74		
	with	0.61	0.61	0.78	0.78	0.78	0.78	0.78		26.30	10.56
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	21.71		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		28.25	6.54
Paddlefish (adult)	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.40	10.58		
	with	0.41	0.41	0.39	0.39	0.39	0.39	0.38		13.07	2.49
Sauger	w/o	0.66	0.66	0.66	0.66	0.59	0.59	0.59	15.54		
	with	0.66	0.66	0.59	0.59	0.59	0.59	0.59		19.93	4.39
Walleye (summer)	w/o	0.31	0.31	0.31	0.31	0.33	0.36	0.41	9.40		
	with	0.31	0.31	0.43	0.43	0.43	0.42	0.41		14.14	4.74
Walleye (winter)	w/o	0.87	0.87	0.87	0.87	0.87	0.87	0.83	22.27		
	with	0.87	0.87	0.87	0.87	0.87	0.86	0.85		29.04	6.77
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08		
	with	0.00	0.00	0.01	0.01	0.01	0.01	0.01		0.44	0.36
Emerald Shiner	w/o	0.78	0.78	0.78	0.78	0.76	0.76	0.76	19.75		
	with	0.78	0.78	0.76	0.76	0.76	0.76	0.76		25.59	5.84
								Net Sum AAHU's =			48.56

Location: 2
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	5.71	5.71	5.71	5.71	5.71	5.71	5.71
with project	5.71	5.71	5.71	5.71	5.71	5.71	5.71

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	5.71		
	with	1.00	1.00	1.00	1.00	1.00	1.00	1.00		5.71	0.00
Channel Catfish	w/o	0.55	0.55	0.55	0.55	0.55	0.54	0.54	3.11		
	with	0.55	0.55	0.52	0.52	0.52	0.52	0.51		2.95	-0.16
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.83	0.83	4.72		
	with	0.83	0.83	0.83	0.83	0.83	0.83	0.83		4.72	0.00
Paddlefish (adult)	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.40	2.33		
	with	0.41	0.41	0.43	0.43	0.43	0.42	0.42		2.42	0.09
Sauger	w/o	0.50	0.50	0.50	0.50	0.50	0.50	0.50	2.86		
	with	0.50	0.50	0.53	0.53	0.53	0.53	0.53		3.04	0.18
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	1.50		
	with	0.27	0.27	0.27	0.27	0.27	0.26	0.25		1.50	0.00
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	5.04		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		5.04	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.01	0.00
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	4.49		
	with	0.79	0.79	0.79	0.79	0.79	0.79	0.79		4.49	0.00
								Net Sum AAHU's =			0.11

Location: 2
Habitat Type: MCB
Site: 4D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	12.5	12.5	12.5	12.5	12.5	12.5	12.5
with project	12.5	12.5	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	6.13		
	with	0.49	0.49	0.00	0.00	0.00	0.00	0.00		0.16	-5.97
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.79	9.97		
	with	0.80	0.80	0.00	0.00	0.00	0.00	0.00		0.27	-9.70
Channel Catfish	w/o	0.44	0.44	0.44	0.44	0.44	0.44	0.44	5.48		
	with	0.44	0.42	0.00	0.00	0.00	0.00	0.00		0.14	-5.34
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	10.46		
	with	0.83	0.83	0.00	0.00	0.00	0.00	0.00		0.28	-10.18
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	4.34		
	with	0.35	0.35	0.00	0.00	0.00	0.00	0.00		0.12	-4.22
Sauger	w/o	0.59	0.57	0.57	0.57	0.57	0.57	0.57	7.09		
	with	0.59	0.49	0.00	0.00	0.00	0.00	0.00		0.18	-6.91
Walleye (summer)	w/o	0.25	0.25	0.25	0.25	0.25	0.24	0.23	2.97		
	with	0.25	0.12	0.00	0.00	0.00	0.00	0.00		0.06	-2.91
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.32	0.30	4.00		
	with	0.33	0.33	0.00	0.00	0.00	0.00	0.00		0.11	-3.89
Walleye (reproduction)	w/o	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.31		
	with	0.02	0.02	0.00	0.00	0.00	0.00	0.00		0.01	-0.30
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	9.83		
	with	0.79	0.71	0.00	0.00	0.00	0.00	0.00		0.25	-9.58
								Net Sum AAHU's =			-59.00

Location: 2
Habitat Type: MCB
Site: 4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.11	7.11	7.11	7.11	7.11	7.11	7.11
with project	7.11	7.11	7.11	7.11	7.11	7.11	7.11

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	3.48		
	with	0.49	0.49	0.49	0.49	0.49	0.49	0.49		3.48	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.79	5.67		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.79		5.66	-0.01
Channel Catfish	w/o	0.44	0.44	0.44	0.44	0.44	0.44	0.44	3.12		
	with	0.44	0.44	0.41	0.41	0.41	0.41	0.41		2.90	-0.22
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	5.95		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		5.95	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	2.47		
	with	0.35	0.35	0.34	0.34	0.34	0.34	0.34		2.40	-0.07
Sauger	w/o	0.59	0.57	0.57	0.57	0.57	0.57	0.57	4.03		
	with	0.59	0.59	0.56	0.56	0.56	0.56	0.56		3.96	-0.07
Walleye (summer)	w/o	0.25	0.25	0.25	0.25	0.25	0.24	0.23	1.69		
	with	0.25	0.25	0.23	0.23	0.23	0.22	0.21		1.58	-0.11
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.32	0.30	2.27		
	with	0.33	0.33	0.33	0.33	0.33	0.33	0.30		2.31	0.04
Walleye (reproduction)	w/o	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.18		
	with	0.02	0.02	0.00	0.00	0.00	0.00	0.00		0.01	-0.17
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	5.59		
	with	0.79	0.79	0.76	0.76	0.76	0.76	0.76		5.42	-0.17
								Net Sum AAHU's =			-0.78

Lock and Dam 21

Location: 2
Habitat Type: BHF
Site: 1U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	12.6	12.6	12.6	12.6	12.6	12.6	12.6
with project	12.6	12.6	4.55	4.55	4.55	4.55	4.55

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.54	0.54	0.63	6.09		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-6.09
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.18	0.71		1.13	1.13
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.20	0.30	1.97		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.97
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.09	0.09	0.09	1.17		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.24	-0.93
Prothonotary Warbler	w/o	0.88	0.89	0.88	0.88	0.87	0.97	0.87	11.50		
	with	0.88	0.00	0.00	0.00	0.00	0.00	0.84		1.07	-10.43
Hairy Woodpecker	w/o	0.87	0.87	0.89	0.93	1.00	1.00	1.00	12.42		
	with	0.87	0.00	0.00	0.00	0.00	0.07	0.50		0.81	-11.61
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-29.90

Location: 2
Habitat Type: BHF
Site: 1D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	11.35	11.35	11.35	11.35	11.35	11.35	11.35
with project	11.35	11.35	11.35	11.35	11.35	11.35	11.35

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.59	0.70	0.74	0.74	7.62		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-7.62
Wild Turkey	w/o	0.94	0.95	0.95	0.87	0.79	0.71	0.50	7.96		
	with	0.94	0.00	0.00	0.00	0.00	0.18	0.71		2.93	-5.03
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.20	0.30	0.30	2.69		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-2.69
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.19		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-0.19
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.10	1.14		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.58	-0.56
Prothonotary Warbler	w/o	0.93	0.99	0.94	0.79	0.79	1.00	0.79	10.05		
	with	0.93	0.00	0.00	0.00	0.00	0.00	0.78		2.32	-7.73
Hairy Woodpecker	w/o	0.47	0.47	0.50	0.57	0.71	0.79	0.79	8.32		
	with	0.47	0.00	0.00	0.00	0.00	0.07	0.50		1.80	-6.52
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-30.34

Lock and Dam 21

Location: 3
Habitat Type: MCB
Site: 2U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	25.94	25.94	25.94	25.94	25.94	25.94	25.94
with project	25.94	25.94	33.99	33.99	33.99	33.99	33.99

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.89	0.89	0.89	0.89	0.89	0.88	0.86	22.82		
	with	0.89	0.89	0.89	0.89	0.89	0.88	0.86		29.69	6.87
Channel Catfish	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.61	15.74		
	with	0.61	0.61	0.78	0.78	0.78	0.78	0.78		26.30	10.56
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	21.71		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		28.25	6.54
Paddlefish (adult)	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.40	10.58		
	with	0.41	0.41	0.39	0.39	0.39	0.39	0.38		13.07	2.49
Sauger	w/o	0.66	0.66	0.66	0.66	0.59	0.59	0.59	15.54		
	with	0.66	0.66	0.59	0.59	0.59	0.59	0.59		19.93	4.39
Walleye (summer)	w/o	0.31	0.31	0.31	0.31	0.33	0.36	0.41	9.40		
	with	0.31	0.31	0.43	0.43	0.43	0.42	0.41		14.14	4.74
Walleye (winter)	w/o	0.87	0.87	0.87	0.87	0.87	0.87	0.83	22.27		
	with	0.87	0.87	0.87	0.87	0.87	0.86	0.85		29.04	6.77
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08		
	with	0.00	0.00	0.01	0.01	0.01	0.01	0.01		0.44	0.36
Emerald Shiner	w/o	0.78	0.78	0.78	0.78	0.76	0.76	0.76	19.75		
	with	0.78	0.78	0.76	0.76	0.76	0.76	0.76		25.59	5.84
								Net Sum AAHU's =			48.56

Location: 3
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.9	8.9	8.9	8.9	8.9	8.9	8.9
with project	8.9	8.9	8.9	8.9	8.9	8.9	8.9

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	8.90		
	with	1.00	1.00	1.00	1.00	1.00	1.00	1.00		8.90	0.00
Channel Catfish	w/o	0.55	0.55	0.55	0.55	0.55	0.54	0.54	4.84		
	with	0.55	0.55	0.51	0.51	0.51	0.50	0.50		4.50	-0.34
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.83	0.83	7.36		
	with	0.83	0.83	0.83	0.83	0.83	0.83	0.83		7.36	0.00
Paddlefish (adult)	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.40	3.63		
	with	0.41	0.41	0.41	0.41	0.41	0.41	0.40		3.63	0.00
Sauger	w/o	0.50	0.50	0.50	0.50	0.50	0.50	0.50	4.45		
	with	0.50	0.50	0.53	0.53	0.53	0.53	0.53		4.74	0.29
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	2.33		
	with	0.27	0.27	0.27	0.27	0.27	0.26	0.25		2.33	0.00
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	7.85		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		7.85	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.01	0.00
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	6.99		
	with	0.79	0.79	0.79	0.79	0.79	0.75	0.75		6.79	-0.20
								Net Sum AAHU's =			-0.25

Location: 3
Habitat Type: MCB
Site: 4D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	27.4	27.4	27.4	27.4	27.4	27.4	27.4
with project	27.4	27.4	27.4	27.4	27.4	27.4	27.4

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	13.43		
	with	0.49	0.49	0.00	0.00	0.00	0.42	0.42		7.92	-5.51
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.79	21.86		
	with	0.80	0.80	0.58	0.58	0.58	0.80	0.80		20.03	-1.83
Channel Catfish	w/o	0.44	0.44	0.44	0.44	0.44	0.44	0.44	12.02		
	with	0.44	0.42	0.66	0.65	0.65	0.67	0.63		17.70	5.68
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	22.94		
	with	0.83	0.83	0.00	0.00	0.00	0.00	0.00		0.68	-22.26
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	9.51		
	with	0.35	0.35	0.33	0.33	0.33	0.32	0.32		8.86	-0.65
Sauger	w/o	0.59	0.57	0.57	0.57	0.57	0.57	0.57	15.53		
	with	0.59	0.49	0.32	0.32	0.32	0.32	0.32		8.99	-6.54
Walleye (summer)	w/o	0.25	0.25	0.25	0.25	0.25	0.24	0.23	6.52		
	with	0.25	0.12	0.19	0.19	0.19	0.19	0.19		5.14	-1.38
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.32	0.30	8.76		
	with	0.33	0.33	0.88	0.88	0.88	0.88	0.88		23.72	14.96
Walleye (reproduction)	w/o	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.68		
	with	0.02	0.03	0.03	0.02	0.02	0.02	0.06		0.87	0.19
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	21.54		
	with	0.79	0.71	0.72	0.72	0.72	0.72	0.72		19.64	-1.90
								Net Sum AAHU's =			-19.24

Location: 3
Habitat Type: MCB
Site: 4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.53	7.53	7.53	7.53	7.53	7.53	7.53
with project	7.53	7.53	7.53	7.53	7.53	7.53	7.53

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	3.69		
	with	0.49	0.49	0.48	0.48	0.48	0.46	0.46		3.51	-0.18
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.79	6.01		
	with	0.80	0.80	0.52	0.52	0.52	0.44	0.31		3.34	-2.67
Channel Catfish	w/o	0.44	0.44	0.44	0.44	0.44	0.44	0.44	3.30		
	with	0.44	0.44	0.41	0.41	0.41	0.41	0.41		3.07	-0.23
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	6.30		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		6.30	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	2.61		
	with	0.35	0.35	0.31	0.31	0.31	0.31	0.31		2.36	-0.25
Sauger	w/o	0.59	0.57	0.57	0.57	0.57	0.57	0.57	4.27		
	with	0.59	0.52	0.56	0.56	0.56	0.56	0.56		4.18	-0.09
Walleye (summer)	w/o	0.25	0.25	0.25	0.25	0.25	0.24	0.23	1.79		
	with	0.25	0.12	0.23	0.23	0.23	0.22	0.21		1.66	-0.13
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.32	0.30	2.41		
	with	0.33	0.33	0.33	0.33	0.33	0.33	0.30		2.45	0.04
Walleye (reproduction)	w/o	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.19		
	with	0.02	0.02	0.00	0.00	0.00	0.00	0.00		0.01	-0.18
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	5.92		
	with	0.79	0.71	0.76	0.76	0.76	0.76	0.76		5.73	-0.19
								Net Sum AAHU's =			-3.88

Lock and Dam 21

Location: 3
Habitat Type: BHF
Site: 1D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	11.35	11.35	11.35	11.35	11.35	11.35	11.35
with project	11.35	11.35	11.35	11.35	11.35	11.35	11.35

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.59	0.70	0.74	0.74	7.62		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-7.62
Wild Turkey	w/o	0.94	0.95	0.95	0.87	0.79	0.71	0.50	7.96		
	with	0.94	0.00	0.00	0.00	0.00	0.18	0.71		2.93	-5.03
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.20	0.30	0.30	2.69		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-2.69
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.19		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-0.19
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.10	1.14		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.58	-0.56
Prothonotary Warbler	w/o	0.93	0.99	0.94	0.79	0.79	1.00	0.79	10.05		
	with	0.93	0.00	0.00	0.00	0.00	0.00	0.78		2.32	-7.73
Hairy Woodpecker	w/o	0.47	0.47	0.50	0.57	0.71	0.79	0.79	8.32		
	with	0.47	0.00	0.00	0.00	0.00	0.07	0.50		1.80	-6.52
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-30.34

Location: 3
Habitat Type: BHF
Site: 1U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	12.6	12.6	12.6	12.6	12.6	12.6	12.6
with project	12.6	12.6	4.55	4.55	4.55	4.55	4.55

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.54	0.54	0.63	6.09		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-6.09
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.18	0.71		1.13	1.13
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.20	0.30	1.97		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.97
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.09	0.09	0.09	1.17		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.24	-0.93
Prothonotary Warbler	w/o	0.88	0.89	0.88	0.88	0.87	0.97	0.87	11.50		
	with	0.88	0.00	0.00	0.00	0.00	0.00	0.84		1.07	-10.43
Hairy Woodpecker	w/o	0.87	0.87	0.89	0.93	1.00	1.00	1.00	12.42		
	with	0.87	0.00	0.00	0.00	0.00	0.07	0.50		0.81	-11.61
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-29.90

Lock and Dam 21

Location: 4
Habitat Type: MCB
Site: 2U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	25.94	25.94	25.94	25.94	25.94	25.94	25.94
with project	25.94	25.94	25.94	25.94	25.94	25.94	25.94

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.89	0.89	0.89	0.89	0.89	0.88	0.86	22.82		
	with	0.89	0.89	0.89	0.89	0.89	0.88	0.86		22.82	0.00
Channel Catfish	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.61	15.74		
	with	0.61	0.61	0.78	0.78	0.78	0.78	0.78		20.18	4.44
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	21.71		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		21.71	0.00
Paddlefish (adult)	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.40	10.58		
	with	0.41	0.41	0.39	0.39	0.39	0.39	0.38		10.05	-0.53
Sauger	w/o	0.66	0.66	0.66	0.66	0.59	0.59	0.59	15.54		
	with	0.66	0.66	0.59	0.59	0.59	0.59	0.59		15.33	-0.21
Walleye (summer)	w/o	0.31	0.31	0.31	0.31	0.33	0.36	0.41	9.40		
	with	0.31	0.31	0.43	0.43	0.43	0.42	0.41		10.85	1.45
Walleye (winter)	w/o	0.87	0.87	0.87	0.87	0.87	0.87	0.83	22.27		
	with	0.87	0.87	0.87	0.87	0.87	0.86	0.85		22.33	0.06
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08		
	with	0.00	0.00	0.01	0.01	0.01	0.01	0.01		0.34	0.26
Emerald Shiner	w/o	0.78	0.78	0.78	0.78	0.76	0.76	0.76	19.75		
	with	0.78	0.78	0.76	0.76	0.76	0.76	0.76		19.67	-0.08
								Net Sum AAHU's =			5.39

Location: 4
Habitat Type: MCB
Site: 4U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	3.56	3.56	3.56	3.56	3.56	3.56	3.56
with project	3.56	3.56	3.56	3.56	3.56	3.56	3.56

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.52	0.52	0.52	0.52	0.52	0.52	0.51	1.84		
	with	0.52	0.52	0.43	0.43	0.43	0.43	0.43		1.54	-0.30
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	2.85		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		2.85	0.00
Channel Catfish	w/o	0.66	0.66	0.66	0.66	0.66	0.66	0.66	2.35		
	with	0.66	0.66	0.39	0.39	0.39	0.39	0.39		1.42	-0.93
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	2.98		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		2.98	0.00
Paddlefish (adult)	w/o	0.39	0.39	0.39	0.39	0.39	0.39	0.38	1.38		
	with	0.39	0.39	0.39	0.39	0.39	0.39	0.38		1.38	0.00
Sauger	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.76	2.69		
	with	0.76	0.76	0.86	0.86	0.86	0.86	0.86		3.04	0.35
Walleye (summer)	w/o	0.35	0.35	0.35	0.35	0.35	0.34	0.33	1.22		
	with	0.35	0.35	0.27	0.27	0.27	0.26	0.25		0.94	-0.28
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	3.14		
	with	0.88	0.88	0.03	0.03	0.03	0.00	0.00		0.13	-3.01
Walleye (reproduction)	w/o	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.26		
	with	0.07	0.07	0.00	0.00	0.00	0.00	0.00		0.01	-0.25
Emerald Shiner	w/o	0.84	0.84	0.84	0.84	0.84	0.82	0.82	2.95		
	with	0.84	0.84	0.85	0.85	0.85	0.85	0.81		2.98	0.03
								Net Sum AAHU's =			-4.39

Location: 4
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	14.08	14.08	14.08	14.08	14.08	14.08	14.08
with project	14.08	14.08	14.08	14.08	14.08	14.08	14.08

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	14.08		
	with	1.00	1.00	1.00	1.00	1.00	1.00	1.00		14.08	0.00
Channel Catfish	w/o	0.55	0.55	0.55	0.55	0.55	0.54	0.54	7.66		
	with	0.55	0.55	0.52	0.52	0.52	0.52	0.51		7.27	-0.39
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.83	0.83	11.65		
	with	0.83	0.83	0.83	0.83	0.83	0.83	0.83		11.65	0.00
Paddlefish (adult)	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.40	5.74		
	with	0.41	0.41	0.41	0.41	0.41	0.41	0.40		5.74	0.00
Sauger	w/o	0.50	0.50	0.50	0.50	0.50	0.50	0.50	7.04		
	with	0.50	0.50	0.53	0.53	0.53	0.53	0.53		7.50	0.46
Walleye (summer)	w/o	0.27	0.27	0.27	0.27	0.27	0.26	0.25	3.69		
	with	0.27	0.27	0.27	0.27	0.27	0.26	0.25		3.69	0.00
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	12.42		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		12.42	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.01	0.00
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	11.06		
	with	0.79	0.79	0.79	0.79	0.79	0.75	0.75		10.74	-0.32
								Net Sum AAHU's =			-0.25

Location: 4
Habitat Type: MCB
Site: 4D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	27.4	27.4	27.4	27.4	27.4	27.4	27.4
with project	27.4	27.4	27.4	27.4	27.4	27.4	27.4

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	13.43		
	with	0.49	0.49	0.00	0.00	0.00	0.49	0.49		9.19	-4.24
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.79	21.86		
	with	0.80	0.80	0.58	0.58	0.50	0.50	0.50		14.23	-7.63
Channel Catfish	w/o	0.44	0.44	0.44	0.44	0.44	0.44	0.44	12.02		
	with	0.44	0.42	0.51	0.52	0.52	0.52	0.52		14.19	2.17
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	22.94		
	with	0.83	0.83	0.00	0.00	0.00	0.00	0.00		0.68	-22.26
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	9.51		
	with	0.35	0.35	0.33	0.33	0.33	0.33	0.32		8.94	-0.57
Sauger	w/o	0.59	0.57	0.57	0.57	0.57	0.57	0.57	15.53		
	with	0.59	0.49	0.39	0.49	0.46	0.46	0.46		12.54	-2.99
Walleye (summer)	w/o	0.25	0.25	0.25	0.25	0.25	0.24	0.23	6.52		
	with	0.25	0.12	0.12	0.19	0.19	0.19	0.19		5.16	-1.36
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.32	0.30	8.76		
	with	0.33	0.33	1.00	1.00	1.00	1.00	1.00		26.85	18.09
Walleye (reproduction)	w/o	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.68		
	with	0.02	0.03	0.03	0.03	0.05	0.05	0.03		1.11	0.43
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	21.54		
	with	0.79	0.71	0.82	0.89	0.82	0.82	0.82		22.46	0.92
								Net Sum AAHU's =			-17.44

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Location: 4
Habitat Type: MCB
Site: 4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.53	7.53	7.53	7.53	7.53	7.53	7.53
with project	7.53	7.53	7.53	7.53	7.53	7.53	7.53

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	3.69		
	with	0.49	0.49	0.48	0.48	0.48	0.46	0.46		3.51	-0.18
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.79	6.01		
	with	0.80	0.80	0.52	0.52	0.52	0.44	0.31		3.34	-2.67
Channel Catfish	w/o	0.44	0.44	0.44	0.44	0.44	0.44	0.44	3.30		
	with	0.44	0.44	0.39	0.39	0.39	0.39	0.39		2.96	-0.34
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	6.30		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		6.30	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	2.61		
	with	0.35	0.35	0.33	0.33	0.33	0.33	0.32		2.46	-0.15
Sauger	w/o	0.59	0.57	0.57	0.57	0.57	0.57	0.57	4.27		
	with	0.59	0.52	0.56	0.56	0.56	0.56	0.56		4.18	-0.09
Walleye (summer)	w/o	0.25	0.25	0.25	0.25	0.25	0.24	0.23	1.79		
	with	0.25	0.12	0.23	0.23	0.23	0.22	0.21		1.66	-0.13
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.32	0.30	2.41		
	with	0.33	0.33	0.33	0.33	0.33	0.33	0.30		2.45	0.04
Walleye (reproduction)	w/o	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.19		
	with	0.02	0.02	0.00	0.00	0.00	0.00	0.00		0.01	-0.18
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	5.92		
	with	0.79	0.71	0.76	0.76	0.76	0.76	0.76		5.73	-0.19
								Net Sum AAHU's =			-3.89

Location: 4
Habitat Type: MCB
Site: 7D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	3.51	3.51	3.51	3.51	3.51	3.51	3.51
with project	3.51	3.51	3.51	3.51	3.51	3.51	3.51

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.54	0.54	0.54	0.54	0.54	0.55	0.55	1.92		
	with	0.54	0.54	0.33	0.33	0.33	0.32	0.31		1.16	-0.76
Lake Sturgeon (forage)	w/o	0.78	0.78	0.78	0.78	0.78	0.79	0.79	2.77		
	with	0.78	0.78	0.00	0.00	0.00	0.00	0.00		0.08	-2.69
Channel Catfish	w/o	0.69	0.69	0.69	0.69	0.69	0.69	0.69	2.42		
	with	0.69	0.69	0.39	0.39	0.39	0.39	0.39		1.40	-1.02
Paddlefish (spawning)	w/o	0.47	0.47	0.47	0.47	0.47	0.47	0.47	1.65		
	with	0.47	0.47	0.83	0.83	0.83	0.84	0.85		2.90	1.25
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	1.10		
	with	0.31	0.31	0.34	0.34	0.34	0.34	0.34		1.19	0.09
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	2.07		
	with	0.59	0.59	0.72	0.72	0.72	0.72	0.72		2.52	0.45
Walleye (summer)	w/o	0.31	0.31	0.31	0.31	0.31	0.30	0.29	1.06		
	with	0.31	0.31	0.29	0.29	0.29	0.28	0.27		0.98	-0.08
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	3.10		
	with	0.88	0.88	0.00	0.00	0.00	0.00	0.00		0.09	-3.01
Walleye (reproduction)	w/o	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.24		
	with	0.07	0.07	0.00	0.00	0.00	0.00	0.00		0.01	-0.23
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	2.78		
	with	0.79	0.79	0.76	0.76	0.76	0.76	0.76		2.66	-0.12
								Net Sum AAHU's =			-6.12

Location: 4
Habitat Type: MC
Site: 5D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	10.98	10.98	10.98	10.98	10.98	10.98	10.98
with project	10.98	10.98	10.98	10.98	10.98	10.98	10.98

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	6.47		
	with	0.59	0.59	0.56	0.56	0.56	0.55	0.55		6.10	-0.37
Lake Sturgeon (forage)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Channel Catfish	w/o	0.39	0.39	0.39	0.39	0.39	0.39	0.39	4.29		
	with	0.39	0.39	0.39	0.39	0.39	0.39	0.39		4.29	0.00
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.85	9.19		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.85		9.19	0.00
Paddlefish (adult)	w/o	0.30	0.30	0.30	0.30	0.30	0.30	0.30	3.26		
	with	0.30	0.30	0.31	0.31	0.31	0.31	0.31		3.40	0.14
Sauger	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	7.44		
	with	0.68	0.68	0.68	0.68	0.68	0.68	0.68		7.44	0.00
Walleye (summer)	w/o	0.23	0.23	0.23	0.23	0.23	0.22	0.21	2.44		
	with	0.23	0.23	0.23	0.23	0.23	0.22	0.21		2.44	0.00
Walleye (winter)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.73	8.28		
	with	0.76	0.76	0.76	0.76	0.76	0.76	0.73		8.28	0.00
								Net Sum AAHU's =			-0.23

Location: 4
Habitat Type: BHF
Site: 1D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	11.35	11.35	11.35	11.35	11.35	11.35	11.35
with project	11.35	11.35	11.35	11.35	11.35	11.35	11.35

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.59	0.70	0.74	0.74	7.62		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-7.62
Wild Turkey	w/o	0.94	0.95	0.95	0.87	0.79	0.71	0.50	7.96		
	with	0.94	0.00	0.00	0.00	0.00	0.18	0.71		2.93	-5.03
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.20	0.30	0.30	2.69		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-2.69
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.19		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-0.19
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.10	1.14		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.58	-0.56
Prothonotary Warbler	w/o	0.93	0.99	0.94	0.79	0.79	1.00	0.79	10.05		
	with	0.93	0.00	0.00	0.00	0.00	0.00	0.78		2.32	-7.73
Hairy Woodpecker	w/o	0.47	0.47	0.50	0.57	0.71	0.79	0.79	8.32		
	with	0.47	0.00	0.00	0.00	0.00	0.07	0.50		1.80	-6.52
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
								Net Sum AAHU's =			-30.34

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Location: 2
Habitat Type: MCB
Site: 2U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	4.37	4.37	4.37	4.37	4.37	4.37	4.37
with project	4.37	4.37	4.37	4.37	4.37	4.37	4.37

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.55	2.43		
	with	0.56	0.56	0.56	0.56	0.56	0.56	0.55		2.43	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	3.50		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		3.50	0.00
Channel Catfish	w/o	0.53	0.53	0.53	0.53	0.53	0.53	0.53	2.30		
	with	0.53	0.53	0.55	0.55	0.55	0.54	0.54		2.38	0.08
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	3.67		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.86		3.67	0.00
Paddlefish (adult)	w/o	0.38	0.38	0.38	0.38	0.38	0.38	0.38	1.66		
	with	0.38	0.38	0.38	0.38	0.38	0.38	0.38		1.66	0.00
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	2.43		
	with	0.56	0.56	0.52	0.52	0.52	0.52	0.56		2.32	-0.11
Walleye (summer)	w/o	0.31	0.31	0.31	0.31	0.31	0.30	0.29	1.32		
	with	0.31	0.31	0.31	0.31	0.31	0.30	0.29		1.32	0.00
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	3.86		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		3.86	0.00
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.14		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.14	0.00
Emerald Shiner	w/o	0.81	0.81	0.81	0.81	0.81	0.81	0.81	3.53		
	with	0.81	0.81	0.81	0.81	0.81	0.81	0.81		3.53	0.00
								Net Sum AAHU's =			-0.03

Location: 2
Habitat Type: MCB
Site: 3U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	73.39	73.39	73.39	73.39	73.39	73.39	73.39
with project	73.39	73.39	73.39	73.39	36.7	14.7	14.7

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.61	44.73		
	with	0.61	0.61	0.54	0.54	0.45	0.00	0.00		8.90	-35.83
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	58.71		
	with	0.80	0.80	0.80	0.80	0.80	0.98	0.98		24.27	-34.44
Channel Catfish	w/o	0.64	0.64	0.64	0.64	0.64	0.64	0.63	46.62		
	with	0.64	0.64	0.89	0.89	0.89	0.93	0.91		24.61	-22.01
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	61.64		
	with	0.83	0.83	0.72	0.72	0.72	0.74	0.75		20.62	-41.02
Paddlefish (adult)	w/o	0.38	0.38	0.38	0.38	0.38	0.38	0.38	27.96		
	with	0.38	0.38	0.44	0.44	0.44	0.42	0.42		12.00	-15.96
Sauger	w/o	0.66	0.66	0.66	0.66	0.66	0.66	0.66	48.11		
	with	0.66	0.66	0.46	0.47	0.63	0.60	0.60		15.97	-32.14
Walleye (summer)	w/o	0.39	0.39	0.39	0.39	0.39	0.38	0.37	28.03		
	with	0.39	0.28	0.10	0.10	0.10	0.10	0.10		3.26	-24.77
Walleye (winter)	w/o	0.77	0.77	0.77	0.77	0.77	0.77	0.73	55.65		
	with	0.77	0.77	0.88	0.88	0.59	0.59	0.59		19.22	-36.43
Walleye (reproduction)	w/o	0.05	0.05	0.05	0.05	0.05	0.05	0.05	3.45		
	with	0.05	0.05	0.05	0.05	0.03	0.03	0.03		1.04	-2.41
Emerald Shiner	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.86	64.27		
	with	0.88	0.88	0.93	0.93	0.91	0.89	0.89		25.24	-39.03
								Net Sum AAHU's =			-284.04

Location: 2
Habitat Type: MCB
Site: 1D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.48	6.48	6.48	6.48	6.48	6.48	6.48
with project	6.48	6.48	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	3.64		
	with	0.56	0.56	0.00	0.00	0.00	0.00	0.00		0.10	-3.54
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	5.18		
	with	0.80	0.80	0.00	0.00	0.00	0.00	0.00		0.14	-5.04
Channel Catfish	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.41	2.66		
	with	0.41	0.40	0.00	0.00	0.00	0.00	0.00		0.07	-2.59
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	5.44		
	with	0.83	0.83	0.00	0.00	0.00	0.00	0.00		0.14	-5.30
Paddlefish (adult)	w/o	0.32	0.32	0.32	0.32	0.32	0.32	0.32	2.05		
	with	0.32	0.32	0.00	0.00	0.00	0.00	0.00		0.05	-2.00
Sauger	w/o	0.62	0.62	0.62	0.62	0.62	0.62	0.62	4.03		
	with	0.62	0.52	0.00	0.00	0.00	0.00	0.00		0.10	-3.93
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.23	0.22	1.49		
	with	0.24	0.12	0.00	0.00	0.00	0.00	0.00		0.03	-1.46
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.30	2.11		
	with	0.33	0.33	0.00	0.00	0.00	0.00	0.00		0.06	-2.05
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.10		
	with	0.01	0.01	0.00	0.00	0.00	0.00	0.00		0.00	-0.10
Emerald Shiner	w/o	0.82	0.82	0.82	0.82	0.82	0.82	0.83	5.31		
	with	0.82	0.74	0.00	0.00	0.00	0.00	0.00		0.13	-5.18
								Net Sum AAHU's =			-31.19

Location: 2
Habitat Type: MCB
Site: 1D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.82	6.82	6.82	6.82	6.82	6.82	6.82
with project	6.82	6.82	6.82	6.82	6.82	6.82	6.82

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	3.83		
	with	0.56	0.56	0.56	0.56	0.56	0.56	0.56		3.83	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	5.46		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		5.46	0.00
Channel Catfish	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.41	2.80		
	with	0.41	0.41	0.41	0.41	0.41	0.41	0.41		2.80	0.00
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	5.73		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.86		5.73	0.00
Paddlefish (adult)	w/o	0.32	0.32	0.32	0.32	0.32	0.32	0.32	2.16		
	with	0.32	0.32	0.31	0.31	0.31	0.31	0.31		2.12	-0.04
Sauger	w/o	0.62	0.62	0.62	0.62	0.62	0.62	0.62	4.24		
	with	0.62	0.62	0.62	0.62	0.62	0.62	0.62		4.24	0.00
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.23	0.22	1.57		
	with	0.24	0.24	0.24	0.24	0.24	0.23	0.22		1.57	0.00
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.30	2.22		
	with	0.33	0.33	0.10	0.10	0.10	0.00	0.00		0.29	-1.93
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.10		
	with	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.10	0.00
Emerald Shiner	w/o	0.82	0.82	0.82	0.82	0.82	0.82	0.83	5.59		
	with	0.82	0.82	0.82	0.82	0.82	0.82	0.79		5.53	-0.06
								Net Sum AAHU's =			-2.03

Lock and Dam 22

Location: 2
Habitat Type: BHF
Site: 3D/4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.51	9.51	9.51	9.51	9.51	9.51	9.51
with project	9.51	9.51	9.51	9.51	9.51	9.51	9.51

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.39	0.39	0.39	0.44	0.52	0.66	0.58	5.46		
	with	0.39	0.00	0.00	0.00	0.00	0.00	0.00		0.04	-5.42
Wild Turkey	w/o	0.77	0.77	0.77	0.77	0.77	0.61	0.61	6.35		
	with	0.77	0.00	0.00	0.00	0.00	0.18	0.71		2.44	-3.91
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.67	1.59		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.59
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.95		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.49	-0.46
Prothonotary Warbler	w/o	0.10	0.10	0.08	0.06	0.06	0.09	0.06	0.70		
	with	0.10	0.00	0.00	0.00	0.00	0.00	0.08		0.20	-0.50
Hairy Woodpecker	w/o	0.42	0.42	0.42	0.50	0.64	0.64	0.64	5.86		
	with	0.42	0.00	0.00	0.00	0.00	0.07	0.50		1.50	-4.36
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-16.24

Location: 2
Habitat Type: BHF
Site: 4U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	12.39	12.39	12.39	12.39	12.39	12.39	12.39
with project	12.39	12.39	12.39	12.39	12.39	12.39	12.39

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.54	0.54	0.63	5.99		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-5.99
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.18	0.71		3.08	3.08
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.20	0.30	1.94		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.94
Wood Duck (brood rear.)	w/o	0.30	0.30	0.30	0.30	0.30	0.30	0.30	3.72		
	with	0.30	0.00	0.00	0.00	0.00	0.00	0.00		0.04	-3.68
Gray Squirrel	w/o	0.30	0.30	0.30	0.29	0.34	0.36	0.40	4.44		
	with	0.30	0.00	0.00	0.00	0.08	0.16	0.32		2.00	-2.44
Prothonotary Warbler	w/o	0.55	0.66	0.72	0.90	0.97	0.97	0.97	11.68		
	with	0.55	0.00	0.00	0.00	0.00	0.00	0.08		0.33	-11.35
Hairy Woodpecker	w/o	0.97	0.97	0.97	1.00	1.00	1.00	1.00	12.36		
	with	0.97	0.00	0.00	0.00	0.00	0.07	0.50		2.02	-10.34
Western Chorus Frog	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
									Net Sum AAHU's =		-32.66

Lock and Dam 22

Location: 3
Habitat Type: MCB
Site: 2U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.2	7.2	7.2	7.2	7.2	7.2	7.2
with project	7.2	7.2	7.2	7.2	7.2	7.2	7.2

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.55	4.00		
	with	0.56	0.56	0.56	0.56	0.56	0.56	0.55		4.00	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	5.76		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		5.76	0.00
Channel Catfish	w/o	0.53	0.53	0.53	0.53	0.53	0.53	0.53	3.79		
	with	0.53	0.53	0.51	0.51	0.51	0.51	0.51		3.65	-0.14
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	6.05		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.86		6.05	0.00
Paddlefish (adult)	w/o	0.38	0.38	0.38	0.38	0.38	0.38	0.38	2.74		
	with	0.38	0.38	0.35	0.35	0.35	0.35	0.35		2.50	-0.24
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	4.00		
	with	0.56	0.56	0.56	0.56	0.56	0.56	0.56		4.00	0.00
Walleye (summer)	w/o	0.31	0.31	0.31	0.31	0.31	0.30	0.29	2.17		
	with	0.31	0.31	0.31	0.31	0.31	0.30	0.29		2.17	0.00
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	6.35		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		6.35	0.00
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.23		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.23	0.00
Emerald Shiner	w/o	0.81	0.81	0.81	0.81	0.81	0.81	0.81	5.81		
	with	0.81	0.81	0.81	0.81	0.81	0.81	0.81		5.81	0.00
								Net Sum AAHU's =			-0.38

Location: 3
Habitat Type: MCB
Site: 3U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	73.39	73.39	73.39	73.39	73.39	73.39	73.39
with project	73.39	73.39	73.39	73.39	36.7	14.7	14.7

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.61	44.73		
	with	0.61	0.61	0.54	0.54	0.45	0.00	0.00		8.90	-35.83
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	58.71		
	with	0.80	0.80	0.80	0.80	0.80	0.98	0.98		24.27	-34.44
Channel Catfish	w/o	0.64	0.64	0.64	0.64	0.64	0.64	0.63	46.62		
	with	0.64	0.64	0.89	0.89	0.89	0.93	0.91		24.61	-22.01
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	61.64		
	with	0.83	0.83	0.72	0.72	0.72	0.74	0.75		20.62	-41.02
Paddlefish (adult)	w/o	0.38	0.38	0.38	0.38	0.38	0.38	0.38	27.96		
	with	0.38	0.38	0.44	0.44	0.44	0.42	0.42		12.00	-15.96
Sauger	w/o	0.66	0.66	0.66	0.66	0.66	0.66	0.66	48.11		
	with	0.66	0.66	0.46	0.47	0.63	0.60	0.60		15.97	-32.14
Walleye (summer)	w/o	0.39	0.39	0.39	0.39	0.39	0.38	0.37	28.03		
	with	0.39	0.28	0.10	0.10	0.10	0.10	0.10		3.26	-24.77
Walleye (winter)	w/o	0.77	0.77	0.77	0.77	0.77	0.77	0.73	55.65		
	with	0.77	0.77	0.88	0.88	0.59	0.59	0.59		19.22	-36.43
Walleye (reproduction)	w/o	0.05	0.05	0.05	0.05	0.05	0.05	0.05	3.45		
	with	0.05	0.05	0.05	0.05	0.03	0.03	0.03		1.04	-2.41
Emerald Shiner	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.86	64.27		
	with	0.88	0.88	0.93	0.93	0.91	0.89	0.89		25.24	-39.03
								Net Sum AAHU's =			-284.04

Location: 3
Habitat Type: MCB
Site: 1D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	11.53	11.53	11.53	11.53	11.53	11.53	11.53
with project	11.53	11.53	11.53	11.53	11.53	11.53	11.53

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	6.47		
	with	0.56	0.56	0.56	0.56	0.56	0.56	0.56		6.44	-0.03
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	9.22		
	with	0.80	0.80	0.64	0.64	0.64	0.57	0.50		6.71	-2.51
Channel Catfish	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.41	4.74		
	with	0.41	0.41	0.41	0.41	0.41	0.41	0.41		4.74	0.00
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	9.68		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.86		9.68	0.00
Paddlefish (adult)	w/o	0.32	0.32	0.32	0.32	0.32	0.32	0.32	3.65		
	with	0.32	0.32	0.31	0.31	0.31	0.31	0.31		3.59	-0.06
Sauger	w/o	0.62	0.62	0.62	0.62	0.62	0.62	0.62	7.17		
	with	0.62	0.62	0.62	0.62	0.62	0.62	0.64		7.24	0.07
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.23	0.22	2.65		
	with	0.24	0.24	0.24	0.24	0.24	0.23	0.22		2.65	0.00
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.30	3.75		
	with	0.33	0.33	0.10	0.10	0.10	0.00	0.00		0.48	-3.27
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.17		
	with	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.17	0.00
Emerald Shiner	w/o	0.82	0.82	0.82	0.82	0.82	0.82	0.83	9.46		
	with	0.82	0.82	0.78	0.78	0.78	0.78	0.79		9.07	-0.39
								Net Sum AAHU's =			-6.19

Location: 3
Habitat Type: MCB
Site: 1D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	23.1	23.1	23.1	23.1	23.1	23.1	23.1
with project	23.1	23.1	23.1	23.1	23.1	23.1	23.1

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	12.96		
	with	0.56	0.56	0.00	0.00	0.00	0.00	0.00		0.39	-12.57
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	18.48		
	with	0.80	0.80	0.58	0.58	0.58	1.00	1.00		19.89	1.41
Channel Catfish	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.41	9.49		
	with	0.41	0.40	0.62	0.60	0.60	0.62	0.59		13.85	4.36
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	19.40		
	with	0.83	0.83	0.00	0.00	0.00	0.00	0.00		0.58	-18.82
Paddlefish (adult)	w/o	0.32	0.32	0.32	0.32	0.32	0.32	0.32	7.31		
	with	0.32	0.32	0.37	0.37	0.37	0.34	0.33		8.04	0.73
Sauger	w/o	0.62	0.62	0.62	0.62	0.62	0.62	0.62	14.37		
	with	0.62	0.52	0.32	0.26	0.26	0.26	0.26		6.17	-8.20
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.23	0.22	5.31		
	with	0.24	0.12	0.11	0.11	0.11	0.11	0.11		2.63	-2.68
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.30	7.51		
	with	0.33	0.33	0.88	0.88	0.88	0.88	0.88		20.00	12.49
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.35		
	with	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.20	-0.15
Emerald Shiner	w/o	0.82	0.82	0.82	0.82	0.82	0.82	0.83	18.95		
	with	0.82	0.74	0.76	0.71	0.71	0.71	0.72		16.61	-2.34
								Net Sum AAHU's =			-25.77

Lock and Dam 22

Location: 3
Habitat Type: BHF
Site: 3D/4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.51	9.51	9.51	9.51	9.51	9.51	9.51
with project	9.51	9.51	9.51	9.51	9.51	9.51	9.51

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.39	0.39	0.39	0.44	0.52	0.66	0.58	5.46		
	with	0.39	0.00	0.00	0.00	0.00	0.00	0.00		0.04	-5.42
Wild Turkey	w/o	0.77	0.77	0.77	0.77	0.77	0.61	0.61	6.35		
	with	0.77	0.00	0.00	0.00	0.00	0.18	0.71		2.44	-3.91
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.67	1.59		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.59
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.95		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.49	-0.46
Prothonotary Warbler	w/o	0.10	0.10	0.08	0.06	0.06	0.09	0.06	0.70		
	with	0.10	0.00	0.00	0.00	0.00	0.00	0.08		0.20	-0.50
Hairy Woodpecker	w/o	0.42	0.42	0.42	0.50	0.64	0.64	0.64	5.86		
	with	0.42	0.00	0.00	0.00	0.00	0.07	0.50		1.50	-4.36
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-16.24

Location: 3
Habitat Type: BHF
Site: 4U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	12.39	12.39	12.39	12.39	12.39	12.39	12.39
with project	12.39	12.39	12.39	12.39	12.39	12.39	12.39

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.54	0.54	0.63	5.99		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-5.99
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.18	0.71		3.08	3.08
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.20	0.30	1.94		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.94
Wood Duck (brood rear.)	w/o	0.30	0.30	0.30	0.30	0.30	0.30	0.30	3.72		
	with	0.30	0.00	0.00	0.00	0.00	0.00	0.00		0.04	-3.68
Gray Squirrel	w/o	0.30	0.30	0.30	0.29	0.34	0.36	0.40	4.44		
	with	0.30	0.00	0.00	0.00	0.08	0.16	0.32		2.00	-2.44
Prothonotary Warbler	w/o	0.55	0.66	0.72	0.90	0.97	0.97	0.97	11.68		
	with	0.55	0.00	0.00	0.00	0.00	0.00	0.08		0.33	-11.35
Hairy Woodpecker	w/o	0.97	0.97	0.97	1.00	1.00	1.00	1.00	12.36		
	with	0.97	0.00	0.00	0.00	0.00	0.07	0.50		2.02	-10.34
Western Chorus Frog	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
									Net Sum AAHU's =		-32.66

Lock and Dam 22

Location: 4
Habitat Type: MCB
Site: 1U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	3.65	3.65	3.65	3.65	3.65	3.65	3.65
with project	3.65	3.65	3.65	3.65	3.65	3.65	3.65

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.55	0.55	0.55	0.55	0.55	0.55	0.55	2.00		
	with	0.55	0.55	0.28	0.28	0.28	0.27	0.26		1.02	-0.98
Lake Sturgeon (forage)	w/o	0.79	0.79	0.79	0.79	0.79	0.77	0.74	2.80		
	with	0.79	0.79	0.00	0.00	0.00	0.00	0.00		0.09	-2.71
Channel Catfish	w/o	0.71	0.71	0.71	0.71	0.71	0.71	0.71	2.60		
	with	0.71	0.71	0.39	0.39	0.39	0.39	0.39		1.46	-1.14
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	3.07		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.86		3.07	0.00
Paddlefish (adult)	w/o	0.37	0.37	0.37	0.37	0.37	0.37	0.37	1.33		
	with	0.37	0.37	0.37	0.37	0.37	0.37	0.37		1.33	0.00
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	2.03		
	with	0.56	0.56	0.66	0.66	0.66	0.66	0.66		2.38	0.35
Walleye (summer)	w/o	0.43	0.43	0.43	0.43	0.43	0.42	0.41	1.54		
	with	0.43	0.43	0.23	0.23	0.23	0.22	0.21		0.83	-0.71
Walleye (winter)	w/o	0.67	0.67	0.67	0.67	0.67	0.67	0.63	2.40		
	with	0.67	0.67	0.00	0.00	0.00	0.00	0.00		0.07	-2.33
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.05		
	with	0.01	0.01	0.00	0.00	0.00	0.00	0.00		0.00	-0.05
Emerald Shiner	w/o	0.82	0.82	0.82	0.82	0.82	0.82	0.82	3.00		
	with	0.82	0.82	0.79	0.79	0.79	0.79	0.79		2.88	-0.12
								Net Sum AAHU's =			-7.69

Location: 4
Habitat Type: MCB
Site: 2U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	13.3	13.3	13.3	13.3	13.3	13.3	13.3
with project	13.3	13.3	13.3	13.3	13.3	13.3	13.3

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.55	7.38		
	with	0.56	0.56	0.56	0.56	0.56	0.56	0.55		7.38	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	10.64		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		10.64	0.00
Channel Catfish	w/o	0.53	0.53	0.53	0.53	0.53	0.53	0.53	7.00		
	with	0.53	0.53	0.51	0.51	0.51	0.51	0.51		6.73	-0.27
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	11.17		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.86		11.17	0.00
Paddlefish (adult)	w/o	0.38	0.38	0.38	0.38	0.38	0.38	0.38	5.07		
	with	0.38	0.38	0.35	0.35	0.35	0.35	0.35		4.63	-0.44
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	7.39		
	with	0.56	0.56	0.56	0.56	0.56	0.56	0.56		7.39	0.00
Walleye (summer)	w/o	0.31	0.31	0.31	0.31	0.31	0.30	0.29	4.02		
	with	0.31	0.31	0.31	0.31	0.31	0.30	0.29		4.02	0.00
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	11.74		
	with	0.88	0.88	0.88	0.88	0.88	0.88	0.88		11.74	0.00
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.43		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.43	0.00
Emerald Shiner	w/o	0.81	0.81	0.81	0.81	0.81	0.81	0.81	10.73		
	with	0.81	0.81	0.81	0.81	0.81	0.81	0.81		10.73	0.00
								Net Sum AAHU's =			-0.71

Location: 4
Habitat Type: MCB
Site: 3U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	73.39	73.39	73.39	73.39	73.39	73.39	73.39
with project	73.39	73.39	73.39	73.39	36.7	14.7	14.7

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.61	44.73		
	with	0.61	0.61	0.54	0.54	0.45	0.00	0.00		8.90	-35.83
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	58.71		
	with	0.80	0.80	0.80	0.80	0.80	0.98	0.98		24.27	-34.44
Channel Catfish	w/o	0.64	0.64	0.64	0.64	0.64	0.64	0.63	46.62		
	with	0.64	0.64	0.89	0.89	0.89	0.93	0.91		24.61	-22.01
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	61.64		
	with	0.83	0.83	0.72	0.72	0.72	0.74	0.75		20.62	-41.02
Paddlefish (adult)	w/o	0.38	0.38	0.38	0.38	0.38	0.38	0.38	27.96		
	with	0.38	0.38	0.44	0.44	0.44	0.42	0.42		12.00	-15.96
Sauger	w/o	0.66	0.66	0.66	0.66	0.66	0.66	0.66	48.11		
	with	0.66	0.66	0.46	0.47	0.63	0.60	0.60		15.97	-32.14
Walleye (summer)	w/o	0.39	0.39	0.39	0.39	0.39	0.38	0.37	28.03		
	with	0.39	0.28	0.10	0.10	0.10	0.10	0.10		3.26	-24.77
Walleye (winter)	w/o	0.77	0.77	0.77	0.77	0.77	0.77	0.73	55.65		
	with	0.77	0.77	0.88	0.88	0.59	0.59	0.59		19.22	-36.43
Walleye (reproduction)	w/o	0.05	0.05	0.05	0.05	0.05	0.05	0.05	3.45		
	with	0.05	0.05	0.05	0.05	0.03	0.03	0.03		1.04	-2.41
Emerald Shiner	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.86	64.27		
	with	0.88	0.88	0.93	0.93	0.91	0.89	0.89		25.24	-39.03
								Net Sum AAHU's =			-284.04

Location: 4
Habitat Type: MCB
Site: 1D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	23.1	23.1	23.1	23.1	23.1	23.1	23.1
with project	23.1	23.1	23.1	23.1	23.1	23.1	23.1

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	12.96		
	with	0.56	0.56	0.00	0.00	0.00	0.00	0.00		0.39	-12.57
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	18.48		
	with	0.80	0.80	0.58	0.58	0.58	0.58	0.58		13.66	-4.82
Channel Catfish	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.41	9.49		
	with	0.41	0.40	0.50	0.51	0.51	0.51	0.51		11.64	2.15
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	19.40		
	with	0.83	0.83	0.00	0.00	0.00	0.00	0.00		0.58	-18.82
Paddlefish (adult)	w/o	0.32	0.32	0.32	0.32	0.32	0.32	0.32	7.31		
	with	0.32	0.32	0.37	0.37	0.37	0.37	0.37		8.51	1.20
Sauger	w/o	0.62	0.62	0.62	0.62	0.62	0.62	0.62	14.37		
	with	0.62	0.52	0.32	0.42	0.36	0.36	0.36		8.44	-5.93
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.23	0.22	5.31		
	with	0.24	0.12	0.11	0.18	0.18	0.18	0.18		4.01	-1.30
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.30	7.51		
	with	0.33	0.33	1.00	1.00	1.00	1.00	1.00		22.64	15.13
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.35		
	with	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.20	-0.15
Emerald Shiner	w/o	0.82	0.82	0.82	0.82	0.82	0.82	0.83	18.95		
	with	0.82	0.74	0.81	0.89	0.84	0.84	0.85		19.43	0.48
								Net Sum AAHU's =			-24.63

Lock and Dam 22

Location: 4
Habitat Type: MCB
Site: 1D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	11.53	11.53	11.53	11.53	11.53	11.53	11.53
with project	11.53	11.53	11.53	11.53	11.53	11.53	11.53

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	6.47		
	with	0.56	0.56	0.56	0.56	0.56	0.56	0.56		6.47	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	9.22		
	with	0.80	0.80	0.77	0.77	0.77	0.74	0.70		8.53	-0.69
Channel Catfish	w/o	0.41	0.41	0.41	0.41	0.41	0.41	0.41	4.74		
	with	0.41	0.41	0.41	0.41	0.41	0.41	0.41		4.74	0.00
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	9.68		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.86		9.68	0.00
Paddlefish (adult)	w/o	0.32	0.32	0.32	0.32	0.32	0.32	0.32	3.65		
	with	0.32	0.32	0.31	0.31	0.31	0.31	0.31		3.59	-0.06
Sauger	w/o	0.62	0.62	0.62	0.62	0.62	0.62	0.62	7.17		
	with	0.62	0.62	0.62	0.62	0.62	0.62	0.62		7.17	0.00
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.23	0.22	2.65		
	with	0.24	0.24	0.24	0.24	0.24	0.23	0.22		2.65	0.00
Walleye (winter)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.30	3.75		
	with	0.33	0.33	0.10	0.10	0.10	0.00	0.00		0.48	-3.27
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.17		
	with	0.01	0.01	0.00	0.00	0.00	0.00	0.00		0.01	-0.16
Emerald Shiner	w/o	0.82	0.82	0.82	0.82	0.82	0.82	0.83	9.46		
	with	0.82	0.82	0.78	0.78	0.78	0.78	0.79		9.07	-0.39
								Net Sum AAHU's =			-4.57

Location: 4
Habitat Type: MCB
Site: 2D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	4.86	4.86	4.86	4.86	4.86	4.86	4.86
with project	4.86	4.86	4.86	4.86	4.86	4.86	4.86

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.58	0.58	0.58	0.58	0.58	0.58	0.58	2.81		
	with	0.58	0.58	0.29	0.29	0.29	0.28	0.27		1.41	-1.40
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	3.89		
	with	0.80	0.80	0.00	0.00	0.00	0.00	0.00		0.12	-3.77
Channel Catfish	w/o	0.74	0.74	0.74	0.74	0.74	0.74	0.74	3.58		
	with	0.74	0.74	0.44	0.44	0.44	0.44	0.44		2.20	-1.38
Paddlefish (spawning)	w/o	0.69	0.69	0.69	0.69	0.69	0.71	0.72	3.43		
	with	0.69	0.69	0.83	0.83	0.83	0.84	0.86		4.06	0.63
Paddlefish (adult)	w/o	0.32	0.32	0.32	0.32	0.32	0.32	0.32	1.54		
	with	0.32	0.32	0.00	0.00	0.00	0.00	0.00		0.05	-1.49
Sauger	w/o	0.46	0.46	0.46	0.46	0.46	0.52	0.52	2.42		
	with	0.46	0.46	0.62	0.62	0.62	0.62	0.62		3.00	0.58
Walleye (summer)	w/o	0.35	0.35	0.35	0.35	0.35	0.34	0.33	1.66		
	with	0.35	0.35	0.23	0.23	0.23	0.22	0.21		1.10	-0.56
Walleye (winter)	w/o	0.88	0.88	0.88	0.88	0.88	0.88	0.88	4.29		
	with	0.88	0.88	0.00	0.00	0.00	0.00	0.00		0.13	-4.16
Walleye (reproduction)	w/o	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.76		
	with	0.16	0.16	0.00	0.00	0.00	0.00	0.00		0.02	-0.74
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.76	3.71		
	with	0.76	0.76	0.74	0.74	0.74	0.74	0.74		3.59	-0.12
								Net Sum AAHU's =			-12.41

Location: 4
Habitat Type: MC
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.4	8.4	8.4	8.4	8.4	8.4	8.4
with project	8.4	8.4	8.4	8.4	8.4	8.4	8.4

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	4.97		
	with	0.59	0.59	0.59	0.59	0.59	0.59	0.59		4.97	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	6.72		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.79		6.70	-0.02
Channel Catfish	w/o	0.39	0.39	0.39	0.39	0.39	0.39	0.39	3.29		
	with	0.39	0.39	0.39	0.39	0.39	0.39	0.39		3.29	0.00
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	7.06		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.86		7.06	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	2.91		
	with	0.35	0.35	0.35	0.35	0.35	0.35	0.35		2.91	0.00
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	4.95		
	with	0.59	0.59	0.59	0.59	0.59	0.59	0.59		4.95	0.00
Walleye (summer)	w/o	0.23	0.23	0.23	0.23	0.23	0.22	0.21	1.86		
	with	0.23	0.23	0.23	0.23	0.23	0.22	0.21		1.86	0.00
Walleye (winter)	w/o	0.87	0.87	0.87	0.87	0.87	0.85	0.83	7.13		
	with	0.87	0.87	0.83	0.83	0.83	0.81	0.79		6.86	-0.27
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.85	0.85	7.11		
	with	0.85	0.85	0.85	0.85	0.85	0.85	0.85		7.11	0.00
								Net Sum AAHU's =			-0.29

Location: 4
Habitat Type: MC
Site: 5D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.15	6.15	6.15	6.15	6.15	6.15	6.15
with project	6.15	6.15	6.15	6.15	6.15	6.15	6.15

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.44	0.44	0.44	0.44	0.44	0.43	0.43	2.68		
	with	0.44	0.44	0.44	0.44	0.44	0.43	0.42		2.67	-0.01
Lake Sturgeon (forage)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.38	0.38	0.38	0.14	0.00		1.09	1.09
Channel Catfish	w/o	0.39	0.39	0.39	0.39	0.39	0.39	0.39	2.41		
	with	0.39	0.39	0.39	0.39	0.39	0.39	0.39		2.41	0.00
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.84	0.86	5.17		
	with	0.83	0.83	0.83	0.83	0.83	0.84	0.86		5.17	0.00
Paddlefish (adult)	w/o	0.30	0.30	0.30	0.30	0.30	0.30	0.30	1.85		
	with	0.30	0.30	0.35	0.35	0.35	0.35	0.35		2.15	0.30
Sauger	w/o	0.62	0.62	0.62	0.62	0.62	0.62	0.62	3.83		
	with	0.62	0.62	0.62	0.62	0.62	0.62	0.62		3.83	0.00
Walleye (summer)	w/o	0.23	0.23	0.23	0.23	0.23	0.22	0.21	1.36		
	with	0.23	0.23	0.23	0.23	0.23	0.22	0.21		1.36	0.00
Walleye (winter)	w/o	0.03	0.03	0.03	0.03	0.03	0.00	0.00	0.07		
	with	0.03	0.03	0.03	0.03	0.03	0.00	0.00		0.07	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.73	0.73	4.54		
	with	0.76	0.76	0.76	0.76	0.76	0.73	0.73		4.54	0.00
								Net Sum AAHU's =			1.38

Lock and Dam 22

Location: 4
Habitat Type: BHF
Site: 4U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	12.39	12.39	12.39	12.39	12.39	12.39	12.39
with project	12.39	12.39	12.39	12.39	12.39	12.39	12.39

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.54	0.54	0.63	5.99		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-5.99
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.18	0.71		3.08	3.08
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.20	0.30	1.94		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.94
Wood Duck (brood rear.)	w/o	0.30	0.30	0.30	0.30	0.30	0.30	0.30	3.72		
	with	0.30	0.00	0.00	0.00	0.00	0.00	0.00		0.04	-3.68
Gray Squirrel	w/o	0.30	0.30	0.30	0.29	0.34	0.36	0.40	4.44		
	with	0.30	0.00	0.00	0.00	0.08	0.16	0.32		2.00	-2.44
Prothonotary Warbler	w/o	0.55	0.66	0.72	0.90	0.97	0.97	0.97	11.68		
	with	0.55	0.00	0.00	0.00	0.00	0.00	0.08		0.33	-11.35
Hairy Woodpecker	w/o	0.97	0.97	0.97	1.00	1.00	1.00	1.00	12.36		
	with	0.97	0.00	0.00	0.00	0.00	0.07	0.50		2.02	-10.34
Western Chorus Frog	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
								Net Sum AAHU's =			-32.66

Location: 4
Habitat Type: BHF
Site: 3D/4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.51	9.51	9.51	9.51	9.51	9.51	9.51
with project	9.51	9.51	9.51	9.51	9.51	9.51	9.51

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.39	0.39	0.39	0.44	0.52	0.66	0.58	5.46		
	with	0.39	0.00	0.00	0.00	0.00	0.00	0.00		0.04	-5.42
Wild Turkey	w/o	0.77	0.77	0.77	0.77	0.77	0.61	0.61	6.35		
	with	0.77	0.00	0.00	0.00	0.00	0.18	0.71		2.44	-3.91
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.67	1.59		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.59
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.95		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.49	-0.46
Prothonotary Warbler	w/o	0.10	0.10	0.08	0.06	0.06	0.09	0.06	0.70		
	with	0.10	0.00	0.00	0.00	0.00	0.00	0.08		0.20	-0.50
Hairy Woodpecker	w/o	0.42	0.42	0.42	0.50	0.64	0.64	0.64	5.86		
	with	0.42	0.00	0.00	0.00	0.00	0.07	0.50		1.50	-4.36
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
								Net Sum AAHU's =			-16.24

Lock and Dam 24

Location: 2
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	5.35	5.35	5.35	5.35	5.35	5.35	5.35
with project	5.35	5.35	5.35	5.35	5.35	5.35	5.35

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.50	2.70		
	with	0.51	0.51	0.51	0.51	0.51	0.51	0.50		2.70	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	4.28		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		4.28	0.00
Channel Catfish	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	2.97		
	with	0.56	0.56	0.56	0.56	0.56	0.56	0.56		2.97	0.00
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.36	0.36	0.36	0.36	0.36	0.36	0.36	1.92		
	with	0.36	0.36	0.38	0.38	0.38	0.37	0.37		2.00	0.08
Sauger	w/o	0.73	0.73	0.73	0.73	0.73	0.73	0.68	3.85		
	with	0.73	0.73	0.73	0.73	0.73	0.73	0.68		3.85	0.00
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	1.27		
	with	0.24	0.24	0.24	0.24	0.24	0.24	0.23		1.27	0.00
Walleye (winter)	w/o	0.87	0.87	0.87	0.87	0.87	0.86	0.85	4.59		
	with	0.87	0.87	0.87	0.87	0.87	0.86	0.85		4.59	0.00
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.15		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.15	0.00
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.87	0.88	4.63		
	with	0.85	0.85	0.85	0.85	0.85	0.87	0.88		4.63	0.00
									Net Sum AAHU's =		0.08

Location: 2
Habitat Type: MCB
Site: 2D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	14.67	14.67	14.67	14.67	14.67	14.67	14.67
with project	14.67	14.67	14.67	14.67	14.67	14.67	14.67

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.50	0.50	0.50	0.50	0.50	0.49	0.49	7.27		
	with	0.50	0.50	0.00	0.00	0.00	0.00	0.00		0.22	-7.05
Lake Sturgeon (forage)	w/o	0.74	0.74	0.74	0.74	0.74	0.71	0.68	10.44		
	with	0.74	0.74	0.58	0.58	0.58	0.58	0.58		8.65	-1.79
Channel Catfish	w/o	0.46	0.46	0.46	0.46	0.46	0.46	0.46	6.73		
	with	0.46	0.44	0.56	0.49	0.49	0.49	0.49		7.21	0.48
Paddlefish (spawning)	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.87	12.69		
	with	0.86	0.86	0.00	0.00	0.00	0.00	0.00		0.38	-12.31
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	5.12		
	with	0.35	0.35	0.34	0.34	0.34	0.34	0.34		5.01	-0.11
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	8.64		
	with	0.59	0.49	0.39	0.42	0.42	0.42	0.42		6.22	-2.42
Walleye (summer)	w/o	0.18	0.18	0.18	0.18	0.18	0.17	0.17	2.54		
	with	0.18	0.10	0.10	0.08	0.08	0.08	0.08		1.28	-1.26
Walleye (winter)	w/o	0.57	0.57	0.57	0.57	0.57	0.56	0.54	8.17		
	with	0.57	0.57	0.92	0.92	0.92	0.92	0.92		13.39	5.22
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.20		
	with	0.01	0.01	0.01	0.00	0.00	0.00	0.00		0.01	-0.19
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.85	0.85	12.43		
	with	0.85	0.77	0.83	0.85	0.85	0.85	0.85		12.46	0.03
									Net Sum AAHU's =		-19.40

Location: 2
Habitat Type: MCB
Site: 2D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.5	9.5	9.5	9.5	9.5	9.5	9.5
with project	9.5	9.5	9.5	9.5	9.5	9.5	9.5

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.50	0.50	0.50	0.50	0.50	0.49	0.49	4.71		
	with	0.50	0.50	0.48	0.48	0.48	0.48	0.48		4.56	-0.15
Lake Sturgeon (forage)	w/o	0.74	0.74	0.74	0.74	0.74	0.71	0.68	6.76		
	with	0.74	0.74	0.00	0.00	0.00	0.00	0.00		0.21	-6.55
Channel Catfish	w/o	0.46	0.46	0.46	0.46	0.46	0.46	0.46	4.36		
	with	0.46	0.46	0.45	0.45	0.45	0.45	0.44		4.23	-0.13
Paddlefish (spawning)	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.87	8.22		
	with	0.86	0.86	0.86	0.86	0.86	0.87	0.87		8.22	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	3.31		
	with	0.35	0.35	0.35	0.35	0.35	0.35	0.35		3.31	0.00
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	5.59		
	with	0.59	0.59	0.52	0.52	0.52	0.52	0.52		4.98	-0.61
Walleye (summer)	w/o	0.18	0.18	0.18	0.18	0.18	0.17	0.17	1.65		
	with	0.18	0.18	0.17	0.17	0.17	0.16	0.16		1.57	-0.08
Walleye (winter)	w/o	0.57	0.57	0.57	0.57	0.57	0.56	0.54	5.29		
	with	0.57	0.57	0.30	0.30	0.30	0.28	0.26		2.75	-2.54
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.13		
	with	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.12	-0.01
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.85	0.82	7.99		
	with	0.85	0.85	0.85	0.85	0.85	0.85	0.82		7.99	0.00
									Net Sum AAHU's =		-10.07

Location: 2
Habitat Type: BHF
Site: 1D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	5.84	5.84	5.84	5.84	5.84	5.84	5.84
with project	5.84	5.84	5.84	5.84	5.84	5.84	5.84

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.51	0.52	0.52	0.52	0.61	0.73	0.73	3.96		
	with	0.51	0.00	0.00	0.00	0.00	0.00	0.59		0.89	-3.07
Wild Turkey	w/o	0.22	0.22	0.22	0.22	0.00	0.00	0.00	0.20		
	with	0.22	0.00	0.00	0.00	0.00	0.00	0.00		0.01	-0.19
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.10	0.30	0.68		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.30		0.44	-0.24
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.08	0.55		
	with	0.10	0.00	0.00	0.00	0.14	0.55	0.48		2.15	1.60
Prothonotary Warbler	w/o	0.07	0.07	0.07	0.07	0.07	0.10	0.05	0.44		
	with	0.07	0.00	0.00	0.00	0.00	0.00	0.03		0.05	-0.39
Hairy Woodpecker	w/o	0.49	0.50	0.50	0.50	0.64	0.93	0.90	4.67		
	with	0.49	0.00	0.00	0.00	0.00	0.39	0.90		2.25	-2.42
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-4.71

Lock and Dam 24

Location: 3
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.85	9.85	9.85	9.85	9.85	9.85	9.85
with project	9.85	9.85	9.85	9.85	9.85	9.85	9.85

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.50	4.98		
	with	0.51	0.51	0.54	0.54	0.54	0.54	0.54		5.29	0.31
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	7.88		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		7.88	0.00
Channel Catfish	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	5.47		
	with	0.56	0.56	0.53	0.53	0.53	0.53	0.53		5.27	-0.20
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.36	0.36	0.36	0.36	0.36	0.36	0.36	3.54		
	with	0.36	0.36	0.36	0.36	0.36	0.36	0.36		3.54	0.00
Sauger	w/o	0.73	0.73	0.73	0.73	0.73	0.73	0.68	7.09		
	with	0.73	0.73	0.73	0.73	0.73	0.73	0.68		7.09	0.00
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	2.34		
	with	0.24	0.24	0.24	0.24	0.24	0.24	0.23		2.34	0.00
Walleye (winter)	w/o	0.87	0.87	0.87	0.87	0.87	0.86	0.85	8.45		
	with	0.87	0.87	0.87	0.87	0.87	0.86	0.85		8.45	0.00
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.27		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.27	0.00
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.87	0.88	8.53		
	with	0.85	0.85	0.85	0.85	0.85	0.87	0.88		8.53	0.00
									Net Sum AAHU's =		0.11

Location: 3
Habitat Type: MCB
Site: 2D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	33.62	33.62	33.62	33.62	33.62	33.62	33.62
with project	33.62	33.62	33.62	33.62	33.62	33.62	33.62

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.50	0.50	0.50	0.50	0.50	0.49	0.49	16.65		
	with	0.50	0.50	0.00	0.00	0.00	0.43	0.43		9.83	-6.82
Lake Sturgeon (forage)	w/o	0.74	0.74	0.74	0.74	0.74	0.71	0.68	23.93		
	with	0.74	0.74	0.58	0.58	0.58	0.80	0.80		24.52	0.59
Channel Catfish	w/o	0.46	0.46	0.46	0.46	0.46	0.46	0.46	15.41		
	with	0.46	0.44	0.50	0.49	0.49	0.49	0.49		16.52	1.11
Paddlefish (spawning)	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.87	29.09		
	with	0.86	0.86	0.00	0.00	0.00	0.00	0.00		0.87	-28.22
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	11.73		
	with	0.35	0.35	0.34	0.34	0.34	0.33	0.33		11.26	-0.47
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	19.80		
	with	0.59	0.49	0.39	0.39	0.39	0.39	0.39		13.21	-6.59
Walleye (summer)	w/o	0.18	0.18	0.18	0.18	0.18	0.17	0.17	5.83		
	with	0.18	0.10	0.10	0.10	0.10	0.10	0.10		3.45	-2.38
Walleye (winter)	w/o	0.57	0.57	0.57	0.57	0.57	0.56	0.54	18.72		
	with	0.57	0.57	0.92	0.92	0.92	0.92	0.92		30.69	11.97
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.45		
	with	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.45	0.00
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.85	0.85	28.48		
	with	0.85	0.77	0.83	0.83	0.83	0.83	0.83		27.77	-0.71
									Net Sum AAHU's =		-31.52

Location: 3
Habitat Type: MCB
Site: 2D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.56	8.56	8.56	8.56	8.56	8.56	8.56
with project	8.56	8.56	8.56	8.56	8.56	8.56	8.56

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.50	0.50	0.50	0.50	0.50	0.49	0.49	4.24		
	with	0.50	0.50	0.39	0.39	0.39	0.38	0.36		3.26	-0.98
Lake Sturgeon (forage)	w/o	0.74	0.74	0.74	0.74	0.74	0.71	0.68	6.09		
	with	0.74	0.74	0.00	0.00	0.00	0.00	0.00		0.19	-5.90
Channel Catfish	w/o	0.46	0.46	0.46	0.46	0.46	0.46	0.46	3.92		
	with	0.46	0.46	0.38	0.38	0.38	0.38	0.38		3.30	-0.62
Paddlefish (spawning)	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.87	7.41		
	with	0.86	0.86	0.86	0.86	0.86	0.87	0.87		7.41	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	2.99		
	with	0.35	0.35	0.34	0.34	0.34	0.33	0.33		2.87	-0.12
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	5.04		
	with	0.59	0.59	0.62	0.62	0.62	0.62	0.62		5.32	0.28
Walleye (summer)	w/o	0.18	0.18	0.18	0.18	0.18	0.17	0.17	1.48		
	with	0.18	0.18	0.16	0.16	0.16	0.16	0.15		1.35	-0.13
Walleye (winter)	w/o	0.57	0.57	0.57	0.57	0.57	0.56	0.54	4.77		
	with	0.57	0.57	0.00	0.00	0.00	0.00	0.00		0.15	-4.62
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.12		
	with	0.01	0.01	0.00	0.00	0.00	0.00	0.00		0.00	-0.12
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.85	0.82	7.20		
	with	0.85	0.85	0.79	0.79	0.79	0.79	0.77		6.74	-0.46
									Net Sum AAHU's =		-12.67

Location: 3
Habitat Type: BHF
Site: 1D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	5.84	5.84	5.84	5.84	5.84	5.84	5.84
with project	5.84	5.84	5.84	5.84	5.84	5.84	5.84

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.51	0.52	0.52	0.52	0.61	0.73	0.73	3.96		
	with	0.51	0.00	0.00	0.00	0.00	0.00	0.59		0.89	-3.07
Wild Turkey	w/o	0.22	0.22	0.22	0.22	0.00	0.00	0.00	0.20		
	with	0.22	0.00	0.00	0.00	0.00	0.00	0.00		0.01	-0.19
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.10	0.30	0.68		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.30		0.44	-0.24
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.08	0.55		
	with	0.10	0.00	0.00	0.00	0.14	0.55	0.48		2.15	1.60
Prothonotary Warbler	w/o	0.07	0.07	0.07	0.07	0.07	0.10	0.05	0.44		
	with	0.07	0.00	0.00	0.00	0.00	0.00	0.03		0.05	-0.39
Hairy Woodpecker	w/o	0.49	0.50	0.50	0.50	0.64	0.93	0.90	4.67		
	with	0.49	0.00	0.00	0.00	0.00	0.39	0.90		2.25	-2.42
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-4.71

Lock and Dam 24

Location: 4 w/ gate
Habitat Type: MCB
Site: 2U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	5.4	5.4	5.4	5.4	5.4	5.4	5.4
with project	5.4	5.4	5.4	5.4	5.4	5.4	5.4

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.69	0.69	0.69	0.69	0.69	0.69	0.69	3.74		
	with	0.69	0.69	0.41	0.41	0.41	0.41	0.41		2.27	-1.47
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	4.32		
	with	0.80	0.80	0.69	0.69	0.69	0.68	0.65		3.67	-0.65
Channel Catfish	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.61	3.28		
	with	0.61	0.61	0.41	0.41	0.41	0.41	0.41		2.26	-1.02
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	1.84		
	with	0.34	0.34	0.34	0.34	0.34	0.34	0.34		1.84	0.00
Sauger	w/o	0.61	0.61	0.61	0.61	0.61	0.68	0.62	3.46		
	with	0.61	0.61	0.71	0.71	0.71	0.71	0.66		3.75	0.29
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	1.28		
	with	0.24	0.24	0.18	0.18	0.18	0.17	0.17		0.95	-0.33
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	4.99		
	with	0.92	0.92	0.77	0.77	0.77	0.74	0.73		4.07	-0.92
Walleye (reproduction)	w/o	0.14	0.14	0.14	0.14	0.14	0.18	0.18	0.88		
	with	0.14	0.14	0.02	0.02	0.02	0.02	0.02		0.15	-0.73
Emerald Shiner	w/o	0.87	0.87	0.87	0.87	0.87	0.89	0.90	4.79		
	with	0.87	0.87	0.90	0.90	0.90	0.92	0.93		4.94	0.15
								Net Sum AAHU's =			-4.68

Location: 4 w/ gate
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	18.41	18.41	18.41	18.41	18.41	18.41	18.41
with project	18.41	18.41	18.41	18.41	18.41	18.41	18.41

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.50	9.31		
	with	0.51	0.51	0.46	0.46	0.46	0.45	0.45		8.41	-0.90
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	14.73		
	with	0.80	0.80	0.80	0.80	0.80	0.79	0.77		14.48	-0.25
Channel Catfish	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	10.23		
	with	0.56	0.56	0.53	0.53	0.53	0.53	0.53		9.85	-0.38
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.36	0.36	0.36	0.36	0.36	0.36	0.36	6.61		
	with	0.36	0.36	0.38	0.38	0.38	0.37	0.37		6.89	0.28
Sauger	w/o	0.73	0.73	0.73	0.73	0.73	0.73	0.68	13.24		
	with	0.73	0.73	0.73	0.73	0.73	0.73	0.68		13.24	0.00
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	4.37		
	with	0.24	0.24	0.24	0.24	0.24	0.24	0.23		4.37	0.00
Walleye (winter)	w/o	0.87	0.87	0.87	0.87	0.87	0.86	0.85	15.79		
	with	0.87	0.87	0.77	0.77	0.77	0.75	0.74		13.88	-1.91
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.51		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.51	0.00
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.87	0.88	15.95		
	with	0.85	0.85	0.85	0.85	0.85	0.87	0.88		15.95	0.00
								Net Sum AAHU's =			-3.16

Location: 4 w/ gate
Habitat Type: MCB
Site: 2D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	33.62	33.62	33.62	33.62	33.62	33.62	33.62
with project	33.62	33.62	33.62	33.62	33.62	33.62	33.62

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.50	0.50	0.50	0.50	0.50	0.49	0.49	16.65		
	with	0.50	0.50	0.48	0.48	0.48	0.47	0.46		15.91	-0.74
Lake Sturgeon (forage)	w/o	0.74	0.74	0.74	0.74	0.74	0.71	0.68	23.93		
	with	0.74	0.74	0.52	0.52	0.52	0.45	0.35		15.40	-8.53
Channel Catfish	w/o	0.46	0.46	0.46	0.46	0.46	0.46	0.46	15.41		
	with	0.46	0.44	0.51	0.53	0.53	0.53	0.53		17.85	2.44
Paddlefish (spawning)	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.87	29.09		
	with	0.86	0.86	0.86	0.86	0.86	0.87	0.87		29.09	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	11.73		
	with	0.35	0.35	0.36	0.36	0.36	0.36	0.36		12.12	0.39
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	19.80		
	with	0.59	0.49	0.49	0.59	0.59	0.59	0.59		19.60	-0.20
Walleye (summer)	w/o	0.18	0.18	0.18	0.18	0.18	0.17	0.17	5.83		
	with	0.18	0.10	0.17	0.24	0.24	0.24	0.23		7.76	1.93
Walleye (winter)	w/o	0.57	0.57	0.57	0.57	0.57	0.56	0.54	18.72		
	with	0.57	0.57	0.40	0.40	0.40	0.39	0.38		13.29	-5.43
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.45		
	with	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.45	0.00
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.85	0.82	28.27		
	with	0.85	0.77	0.72	0.80	0.80	0.80	0.77		26.48	-1.79
								Net Sum AAHU's =			-11.93

Location: 4 w/ gate
Habitat Type: MCB
Site: 2D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.56	8.56	8.56	8.56	8.56	8.56	8.56
with project	8.56	8.56	8.56	8.56	8.56	8.56	8.56

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.50	0.50	0.50	0.50	0.50	0.49	0.49	4.24		
	with	0.50	0.50	0.39	0.39	0.39	0.38	0.36		3.26	-0.98
Lake Sturgeon (forage)	w/o	0.74	0.74	0.74	0.74	0.74	0.71	0.68	6.09		
	with	0.74	0.74	0.00	0.00	0.00	0.00	0.00		0.19	-5.90
Channel Catfish	w/o	0.46	0.46	0.46	0.46	0.46	0.46	0.46	3.92		
	with	0.46	0.46	0.38	0.38	0.38	0.38	0.38		3.30	-0.62
Paddlefish (spawning)	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.87	7.41		
	with	0.86	0.86	0.86	0.86	0.86	0.87	0.87		7.41	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	2.99		
	with	0.35	0.35	0.35	0.35	0.35	0.35	0.35		2.99	0.00
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	5.04		
	with	0.59	0.59	0.62	0.62	0.62	0.62	0.62		5.32	0.28
Walleye (summer)	w/o	0.18	0.18	0.18	0.18	0.18	0.17	0.17	1.48		
	with	0.18	0.18	0.16	0.16	0.16	0.16	0.15		1.35	-0.13
Walleye (winter)	w/o	0.57	0.57	0.57	0.57	0.57	0.56	0.54	4.77		
	with	0.57	0.57	0.00	0.00	0.00	0.00	0.00		0.15	-4.62
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.12		
	with	0.01	0.01	0.00	0.00	0.00	0.00	0.00		0.00	-0.12
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.85	0.82	7.20		
	with	0.85	0.85	0.82	0.82	0.82	0.82	0.79		6.95	-0.25
								Net Sum AAHU's =			-12.36

Lock and Dam 24

Location: 4 w/ gate
Habitat Type: MCB
Site: 5D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.13	7.13	7.13	7.13	7.13	7.13	7.13
with project	7.13	7.13	7.13	7.13	7.13	7.13	7.13

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.35	0.35	0.35	0.34	0.33		2.35	2.35
Lake Sturgeon (forage)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.13		
	with	1.00	1.00	0.00	0.00	0.00	0.00	0.00		0.21	-6.92
Channel Catfish	w/o	0.74	0.74	0.74	0.74	0.74	0.74	0.74	5.27		
	with	0.74	0.74	0.57	0.57	0.57	0.57	0.57		4.09	-1.18
Paddlefish (spawning)	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.77	4.52		
	with	0.76	0.76	0.86	0.86	0.86	0.87	0.87		6.15	1.63
Paddlefish (adult)	w/o	0.34	0.34	0.34	0.34	0.34	0.33	0.33	2.39		
	with	0.34	0.34	0.35	0.35	0.35	0.34	0.34		2.45	0.06
Sauger	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	3.49		
	with	0.49	0.49	0.56	0.56	0.56	0.56	0.56		3.95	0.46
Walleye (summer)	w/o	0.28	0.28	0.28	0.28	0.28	0.28	0.27	1.98		
	with	0.28	0.28	0.28	0.28	0.28	0.28	0.27		1.98	0.00
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	6.58		
	with	0.92	0.92	0.00	0.00	0.00	0.00	0.00		0.20	-6.38
Walleye (reproduction)	w/o	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.98		
	with	0.14	0.14	0.07	0.07	0.07	0.07	0.07		0.53	-0.45
Emerald Shiner	w/o	0.78	0.78	0.78	0.78	0.78	0.78	0.75	5.50		
	with	0.78	0.78	0.74	0.74	0.74	0.74	0.72		5.25	-0.25
								Net Sum AAHU's =			-10.68

Location: 4 w/ gate
Habitat Type: BHF
Site: 1D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	5.84	5.84	5.84	5.84	5.84	5.84	5.84
with project	5.84	5.84	5.84	5.84	5.84	5.84	5.84

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.51	0.52	0.52	0.52	0.61	0.73	0.73	3.96		
	with	0.51	0.00	0.00	0.00	0.00	0.00	0.59		0.89	-3.07
Wild Turkey	w/o	0.22	0.22	0.22	0.22	0.00	0.00	0.00	0.20		
	with	0.22	0.00	0.00	0.00	0.00	0.00	0.00		0.01	-0.19
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.10	0.30	0.68		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.30		0.44	-0.24
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.08	0.55		
	with	0.10	0.00	0.00	0.00	0.14	0.55	0.48		2.15	1.60
Prothonotary Warbler	w/o	0.07	0.07	0.07	0.07	0.07	0.10	0.05	0.44		
	with	0.07	0.00	0.00	0.00	0.00	0.00	0.03		0.05	-0.39
Hairy Woodpecker	w/o	0.49	0.50	0.50	0.50	0.64	0.93	0.90	4.67		
	with	0.49	0.00	0.00	0.00	0.00	0.39	0.90		2.25	-2.42
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
								Net Sum AAHU's =			-4.71

Lock and Dam 24

Location: 4 w/o gate
Habitat Type: MCB
Site: 2U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	5.4	5.4	5.4	5.4	5.4	5.4	5.4
with project	5.4	5.4	5.4	5.4	5.4	5.4	5.4

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.69	0.69	0.69	0.69	0.69	0.69	0.69	3.74		
	with	0.69	0.69	0.41	0.41	0.41	0.41	0.41		2.27	-1.47
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	4.32		
	with	0.80	0.80	0.69	0.69	0.69	0.68	0.65		3.67	-0.65
Channel Catfish	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.61	3.28		
	with	0.61	0.61	0.41	0.41	0.41	0.41	0.41		2.26	-1.02
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	1.84		
	with	0.34	0.34	0.34	0.34	0.34	0.34	0.34		1.84	0.00
Sauger	w/o	0.61	0.61	0.61	0.61	0.61	0.68	0.62	3.46		
	with	0.61	0.61	0.71	0.71	0.71	0.71	0.66		3.75	0.29
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	1.28		
	with	0.24	0.24	0.18	0.18	0.18	0.17	0.17		0.95	-0.33
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	4.99		
	with	0.92	0.92	0.77	0.77	0.77	0.74	0.73		4.07	-0.92
Walleye (reproduction)	w/o	0.14	0.14	0.14	0.14	0.14	0.18	0.18	0.88		
	with	0.14	0.14	0.02	0.02	0.02	0.02	0.02		0.15	-0.73
Emerald Shiner	w/o	0.87	0.87	0.87	0.87	0.87	0.89	0.90	4.79		
	with	0.87	0.87	0.90	0.90	0.90	0.92	0.93		4.94	0.15
								Net Sum AAHU's =			-4.68

Location: 4 w/o gate
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	18.41	18.41	18.41	18.41	18.41	18.41	18.41
with project	18.41	18.41	18.41	18.41	18.41	18.41	18.41

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.50	9.31		
	with	0.51	0.51	0.54	0.54	0.54	0.53	0.53		9.83	0.52
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	14.73		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		14.73	0.00
Channel Catfish	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	10.24		
	with	0.56	0.56	0.56	0.56	0.56	0.56	0.56		10.26	0.02
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.36	0.36	0.36	0.36	0.36	0.36	0.36	6.61		
	with	0.36	0.36	0.36	0.36	0.36	0.36	0.36		6.61	0.00
Sauger	w/o	0.73	0.73	0.73	0.73	0.73	0.73	0.68	13.24		
	with	0.73	0.73	0.73	0.73	0.73	0.73	0.68		13.24	0.00
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	4.37		
	with	0.24	0.24	0.24	0.24	0.24	0.24	0.23		4.37	0.00
Walleye (winter)	w/o	0.87	0.87	0.87	0.87	0.87	0.86	0.85	15.79		
	with	0.87	0.87	0.92	0.92	0.92	0.92	0.92		16.97	1.18
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.51		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.51	0.00
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.87	0.88	15.95		
	with	0.85	0.73	0.73	0.73	0.73	0.75	0.76		13.67	-2.28
								Net Sum AAHU's =			-0.56

Location: 4 w/o gate
Habitat Type: MCB
Site: 2D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	33.62	33.62	33.62	33.62	33.62	33.62	33.62
with project	33.62	33.62	33.62	33.62	33.62	33.62	33.62

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.50	0.50	0.50	0.50	0.50	0.49	0.49	16.65		
	with	0.50	0.50	0.00	0.00	0.00	0.00	0.00		0.50	-16.15
Lake Sturgeon (forage)	w/o	0.74	0.74	0.74	0.74	0.74	0.71	0.68	23.93		
	with	0.74	0.74	0.58	0.58	0.58	0.58	0.58		19.81	-4.12
Channel Catfish	w/o	0.46	0.46	0.46	0.46	0.46	0.46	0.46	15.41		
	with	0.46	0.44	0.65	0.66	0.66	0.66	0.66		21.91	6.50
Paddlefish (spawning)	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.87	29.09		
	with	0.86	0.86	0.00	0.00	0.00	0.00	0.00		0.87	-28.22
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	11.73		
	with	0.35	0.35	0.34	0.34	0.34	0.34	0.33		11.40	-0.33
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	19.80		
	with	0.59	0.49	0.39	0.36	0.36	0.36	0.36		12.17	-7.63
Walleye (summer)	w/o	0.18	0.18	0.18	0.18	0.18	0.17	0.17	5.83		
	with	0.18	0.10	0.17	0.22	0.22	0.22	0.22		7.23	1.40
Walleye (winter)	w/o	0.57	0.57	0.57	0.57	0.57	0.56	0.54	18.72		
	with	0.57	0.57	0.92	0.92	0.92	0.92	0.92		30.69	11.97
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.45		
	with	0.01	0.01	0.08	0.07	0.07	0.07	0.07		2.31	1.86
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.85	0.82	28.27		
	with	0.85	0.77	0.78	0.80	0.80	0.80	0.80		26.92	-1.35
								Net Sum AAHU's =			-36.07

Location: 4 w/o gate
Habitat Type: MCB
Site: 2D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.56	8.56	8.56	8.56	8.56	8.56	8.56
with project	8.56	8.56	8.56	8.56	8.56	8.56	8.56

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.50	0.50	0.50	0.50	0.50	0.49	0.49	4.24		
	with	0.50	0.50	0.39	0.39	0.39	0.38	0.36		3.26	-0.98
Lake Sturgeon (forage)	w/o	0.74	0.74	0.74	0.74	0.74	0.71	0.68	6.09		
	with	0.74	0.74	0.00	0.00	0.00	0.00	0.00		0.19	-5.90
Channel Catfish	w/o	0.46	0.46	0.46	0.46	0.46	0.46	0.46	3.92		
	with	0.46	0.46	0.38	0.38	0.38	0.38	0.38		3.30	-0.62
Paddlefish (spawning)	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.87	7.41		
	with	0.86	0.86	0.86	0.86	0.86	0.87	0.87		7.41	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	2.99		
	with	0.35	0.35	0.35	0.35	0.35	0.35	0.35		2.99	0.00
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	5.04		
	with	0.59	0.59	0.62	0.62	0.62	0.62	0.62		5.32	0.28
Walleye (summer)	w/o	0.18	0.18	0.18	0.18	0.18	0.17	0.17	1.48		
	with	0.18	0.18	0.16	0.16	0.16	0.16	0.15		1.35	-0.13
Walleye (winter)	w/o	0.57	0.57	0.57	0.57	0.57	0.56	0.54	4.77		
	with	0.57	0.57	0.00	0.00	0.00	0.00	0.00		0.15	-4.62
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.12		
	with	0.01	0.01	0.00	0.00	0.00	0.00	0.00		0.00	-0.12
Emerald Shiner	w/o	0.85	0.85	0.85	0.85	0.85	0.85	0.82	7.20		
	with	0.85	0.85	0.82	0.82	0.82	0.82	0.79		6.95	-0.25
								Net Sum AAHU's =			-12.36

Lock and Dam 24

Location: 4 w/o gate
Habitat Type: MCB
Site: 5D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.13	7.13	7.13	7.13	7.13	7.13	7.13
with project	7.13	7.13	7.13	7.13	7.13	7.13	7.13

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.35	0.35	0.35	0.34	0.33		2.35	2.35
Lake Sturgeon (forage)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.13		
	with	1.00	1.00	0.00	0.00	0.00	0.00	0.00		0.21	-6.92
Channel Catfish	w/o	0.74	0.74	0.74	0.74	0.74	0.74	0.74	5.27		
	with	0.74	0.74	0.57	0.57	0.57	0.57	0.57		4.09	-1.18
Paddlefish (spawning)	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.77	4.52		
	with	0.76	0.76	0.86	0.86	0.86	0.87	0.87		6.15	1.63
Paddlefish (adult)	w/o	0.34	0.34	0.34	0.34	0.34	0.33	0.33	2.39		
	with	0.34	0.34	0.35	0.35	0.35	0.34	0.34		2.45	0.06
Sauger	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	3.49		
	with	0.49	0.49	0.56	0.56	0.56	0.56	0.56		3.95	0.46
Walleye (summer)	w/o	0.28	0.28	0.28	0.28	0.28	0.28	0.27	1.98		
	with	0.28	0.28	0.28	0.28	0.28	0.28	0.27		1.98	0.00
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	6.58		
	with	0.92	0.92	0.00	0.00	0.00	0.00	0.00		0.20	-6.38
Walleye (reproduction)	w/o	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.98		
	with	0.14	0.14	0.07	0.07	0.07	0.07	0.07		0.53	-0.45
Emerald Shiner	w/o	0.78	0.78	0.78	0.78	0.78	0.78	0.75	5.50		
	with	0.78	0.78	0.74	0.74	0.74	0.74	0.72		5.25	-0.25
								Net Sum AAHU's =			-10.68

Location: 4 w/o gate
Habitat Type: BHF
Site: 1D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	5.84	5.84	5.84	5.84	5.84	5.84	5.84
with project	5.84	5.84	5.84	5.84	5.84	5.84	5.84

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.51	0.52	0.52	0.52	0.61	0.73	0.73	3.96		
	with	0.51	0.00	0.00	0.00	0.00	0.00	0.59		0.89	-3.07
Wild Turkey	w/o	0.22	0.22	0.22	0.22	0.00	0.00	0.00	0.20		
	with	0.22	0.00	0.00	0.00	0.00	0.00	0.00		0.01	-0.19
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.10	0.30	0.68		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.30		0.44	-0.24
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.08	0.55		
	with	0.10	0.00	0.00	0.00	0.14	0.55	0.48		2.15	1.60
Prothonotary Warbler	w/o	0.07	0.07	0.07	0.07	0.07	0.10	0.05	0.44		
	with	0.07	0.00	0.00	0.00	0.00	0.00	0.03		0.05	-0.39
Hairy Woodpecker	w/o	0.49	0.50	0.50	0.50	0.64	0.93	0.90	4.67		
	with	0.49	0.00	0.00	0.00	0.00	0.39	0.90		2.25	-2.42
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
								Net Sum AAHU's =			-4.71

Lock and Dam 25

Location: 1
Habitat Type: MCB
Site: 3U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.13	7.13	7.13	7.13	7.13	7.13	7.13
with project	7.13	7.13	7.13	7.13	7.13	7.13	7.13

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.67	0.67	0.67	0.67	0.67	0.69	0.00	3.64		
	with	0.67	0.67	0.50	0.50	0.50	0.50	0.50		3.59	-0.05
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	1.00	6.06		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		5.70	-0.36
Channel Catfish	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	4.85		
	with	0.68	0.68	0.60	0.60	0.60	0.59	0.59		4.25	-0.60
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	2.40		
	with	0.34	0.34	0.33	0.33	0.33	0.33	0.33		2.36	-0.04
Sauger	w/o	0.70	0.66	0.66	0.66	0.66	0.66	0.53	4.46		
	with	0.70	0.70	0.69	0.69	0.69	0.69	0.63		4.82	0.36
Walleye (summer)	w/o	0.32	0.32	0.32	0.32	0.32	0.32	0.31	2.26		
	with	0.32	0.32	0.24	0.24	0.24	0.24	0.23		1.71	-0.55
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	6.58		
	with	0.92	0.92	0.92	0.92	0.92	0.92	0.92		6.58	0.00
Walleye (reproduction)	w/o	0.12	0.12	0.12	0.12	0.10	0.14	0.16	0.95		
	with	0.12	0.12	0.07	0.07	0.07	0.07	0.07		0.51	-0.44
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.83	6.08		
	with	0.86	0.86	0.88	0.88	0.88	0.89	0.90		6.34	0.26
								Net Sum AAHU's =			-1.42

Location: 1
Habitat Type: MCB
Site: 4U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	12.23	12.23	12.23	12.23	12.23	12.23	12.23
with project	12.23	12.23	12.23	12.23	12.23	12.23	12.23

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.50	0.50	0.50	0.50	0.50		5.97	5.97
Lake Sturgeon (forage)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	12.23		
	with	1.00	1.00	0.80	0.80	0.80	0.80	0.80		9.86	-2.37
Channel Catfish	w/o	0.83	0.83	0.83	0.83	0.83	0.65	0.63	8.64		
	with	0.83	0.83	0.60	0.60	0.60	0.59	0.59		7.35	-1.29
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	4.32		
	with	0.35	0.35	0.33	0.33	0.33	0.33	0.33		4.06	-0.26
Sauger	w/o	0.63	0.63	0.63	0.63	0.63	0.61	0.58	7.47		
	with	0.63	0.63	0.66	0.66	0.66	0.66	0.60		7.84	0.37
Walleye (summer)	w/o	0.36	0.36	0.36	0.36	0.36	0.24	0.23	3.43		
	with	0.36	0.36	0.24	0.24	0.24	0.24	0.23		2.96	-0.47
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	11.29		
	with	0.92	0.92	0.92	0.92	0.92	0.92	0.92		11.29	0.00
Walleye (reproduction)	w/o	0.05	0.05	0.05	0.05	0.08	0.14	0.14	1.40		
	with	0.05	0.05	0.14	0.14	0.14	0.14	0.14		1.71	0.31
Emerald Shiner	w/o	0.81	0.81	0.81	0.81	0.81	0.82	0.83	9.96		
	with	0.81	0.81	0.88	0.88	0.88	0.89	0.90		10.85	0.89
								Net Sum AAHU's =			3.15

Location: 1
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	0	0	0	0	0	0	0
with project	0	0	8.6	8.6	8.6	8.6	8.6

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.42	0.42	0.42	0.42	0.42		3.52	3.52
Lake Sturgeon (forage)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.80	0.80	0.80	0.80	0.80		6.67	6.67
Channel Catfish	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.41	0.41	0.41	0.41	0.41		3.41	3.41
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.36	0.36	0.36	0.36	0.36		3.04	3.04
Sauger	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.72	0.72	0.72	0.72	0.67		5.91	5.91
Walleye (summer)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.16	0.16	0.16	0.16	0.15		1.31	1.31
Walleye (winter)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.92	0.92	0.92	0.92	0.92		7.70	7.70
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.91	0.91	0.91	0.92	0.93		7.67	7.67
								Net Sum AAHU's =			39.23

Location: 1
Habitat Type: MCB
Site: 6D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.64	8.64	8.64	8.64	8.64	8.64	8.64
with project	8.64	8.64	17.47	17.47	17.47	17.47	17.47

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.50	0.50	0.50	0.50	0.50	0.49	0.49	4.28		
	with	0.50	0.50	0.50	0.50	0.50	0.49	0.49		8.52	4.24
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	6.91		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		13.76	6.85
Channel Catfish	w/o	0.66	0.66	0.66	0.66	0.66	0.65	0.65	5.66		
	with	0.66	0.66	0.56	0.56	0.56	0.56	0.55		9.67	4.01
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	7.88		
	with	0.91	0.91	0.91	0.91	0.91	0.91	0.91		15.69	7.81
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	2.67		
	with	0.31	0.31	0.29	0.29	0.29	0.29	0.29		5.04	2.37
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	4.80		
	with	0.56	0.56	0.56	0.56	0.56	0.56	0.56		9.56	4.76
Walleye (summer)	w/o	0.36	0.36	0.36	0.36	0.36	0.36	0.35	3.09		
	with	0.36	0.36	0.24	0.24	0.24	0.24	0.23		4.12	1.03
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	7.98		
	with	0.92	0.92	0.92	0.92	0.92	0.92	0.92		15.89	7.91
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.30		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.56	0.26
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.77	6.76		
	with	0.79	0.79	0.79	0.79	0.79	0.79	0.77		13.45	6.69
								Net Sum AAHU's =			45.93

Lock and Dam 25

Location: 1
Habitat Type: MCB
Site: 7D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.08	7.08	7.08	7.08	7.08	7.08	7.08
with project	7.08	7.08	7.08	7.08	7.08	7.08	7.08

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.51	0.51	0.51	0.51	0.50		3.48	3.48
Lake Sturgeon (forage)	w/o	0.98	0.98	0.98	0.98	0.98	0.97	0.96	6.86		
	with	0.98	0.98	0.80	0.80	0.80	0.80	0.80		5.70	-1.16
Channel Catfish	w/o	0.50	0.50	0.50	0.50	0.50	0.50	0.50	3.51		
	with	0.50	0.50	0.57	0.57	0.57	0.57	0.57		4.01	0.50
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	6.46		
	with	0.91	0.91	0.91	0.91	0.91	0.91	0.91		6.46	0.00
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	2.19		
	with	0.31	0.31	0.32	0.32	0.32	0.32	0.32		2.27	0.08
Sauger	w/o	0.64	0.64	0.64	0.64	0.64	0.64	0.64	4.56		
	with	0.64	0.64	0.61	0.61	0.61	0.61	0.61		4.33	-0.23
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	1.68		
	with	0.24	0.24	0.28	0.28	0.28	0.28	0.27		1.95	0.27
Walleye (winter)	w/o	0.90	0.90	0.90	0.90	0.90	0.89	0.88	6.32		
	with	0.90	0.90	0.90	0.90	0.90	0.89	0.88		6.32	0.00
Walleye (reproduction)	w/o	0.11	0.11	0.11	0.11	0.11	0.15	0.18	1.02		
	with	0.11	0.11	0.06	0.06	0.06	0.06	0.06		0.47	-0.55
Emerald Shiner	w/o	0.74	0.74	0.74	0.74	0.74	0.74	0.74	5.25		
	with	0.74	0.74	0.77	0.77	0.77	0.77	0.77		5.43	0.18
								Net Sum AAHU's =			2.57

Location: 1
Habitat Type: MCB
Site: 12D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	0	0	0	0	0	0	0
with project	0	0	6.9	6.9	6.9	6.9	6.9

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.34	0.34	0.34	0.50	0.50		3.01	3.01
Lake Sturgeon (forage)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.80	0.80	0.80	0.80	0.80		5.35	5.35
Channel Catfish	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.49	0.48	0.48	0.48	0.48		3.23	3.23
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.02	0.02
Paddlefish (adult)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.31	0.31	0.31	0.31	0.31		2.07	2.07
Sauger	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.48	0.48	0.48	0.48	0.48		3.20	3.20
Walleye (summer)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.13	0.13	0.13	0.13	0.13		0.84	0.84
Walleye (winter)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.92	0.92	0.92	0.92	0.92		6.18	6.18
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.12	0.12	0.12	0.12	0.12		0.80	0.80
Emerald Shiner	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.74	0.74	0.74	0.74	0.74		4.93	4.93
								Net Sum AAHU's =			29.63

Location: 1
Habitat Type: BHF
Site: 6U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.6	8.6	8.6	8.6	8.6	8.6	8.6
with project	8.6	8.6	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.50	0.50	0.50	3.66		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-3.66
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.20	0.20	0.40	0.51	2.96		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-2.96
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.80		
	with	0.10	0.00	0.00	0.00	0.00	0.00	0.00		0.01	-0.79
Prothonotary Warbler	w/o	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.19		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-0.19
Hairy Woodpecker	w/o	0.29	0.29	0.36	0.54	0.93	1.00	1.00	7.75		
	with	0.29	0.00	0.00	0.00	0.00	0.00	0.00		0.02	-7.73
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
								Net Sum AAHU's =			-15.33

Location: 1
Habitat Type: BHF
Site: 7U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.9	6.9	6.9	6.9	6.9	6.9	6.9
with project	6.9	6.9	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	4.05		
	with	0.59	0.00	0.00	0.00	0.00	0.00	0.00		0.04	-4.01
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.20	0.20	0.20	0.20	0.40	0.40	0.51	2.75		
	with	0.20	0.00	0.00	0.00	0.00	0.00	0.00		0.01	-2.74
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.64		
	with	0.10	0.00	0.00	0.00	0.00	0.00	0.00		0.01	-0.63
Prothonotary Warbler	w/o	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.17		
	with	0.02	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-0.17
Hairy Woodpecker	w/o	0.80	0.80	0.86	0.86	0.93	1.00	1.00	6.64		
	with	0.80	0.00	0.00	0.00	0.00	0.00	0.00		0.06	-6.58
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
								Net Sum AAHU's =			-14.13

Lock and Dam 25

Location: 1
Habitat Type: BHF
Site: 13D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.83	8.83	8.83	8.83	8.83	8.83	8.83
with project	8.83	8.83	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.53	0.53	0.53	0.53	0.53	0.53	0.53	4.69		
	with	0.53	0.53	0.00	0.00	0.00	0.00	0.00		0.13	-4.56
Wild Turkey	w/o	0.50	0.50	0.50	0.50	0.50	0.50	0.50	4.42		
	with	0.50	0.50	0.00	0.00	0.00	0.00	0.00		0.12	-4.30
Wood Duck (nesting)	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.10	4.24		
	with	0.61	0.61	0.00	0.00	0.00	0.00	0.00		0.14	-4.10
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.19	0.19	0.19	0.19	0.19	0.31	0.31	2.37		
	with	0.19	0.19	0.00	0.00	0.00	0.00	0.00		0.05	-2.32
Prothonotary Warbler	w/o	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.12		
	with	0.01	0.01	0.00	0.00	0.00	0.00	0.00		0.00	-0.12
Hairy Woodpecker	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	6.94		
	with	0.79	0.79	0.00	0.00	0.00	0.00	0.00		0.19	-6.75
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-22.15

Location: 1
Habitat Type: SC
Site: 16D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.8	7.8	7.8	7.8	7.8	7.8	7.8
with project	7.8	7.8	7.8	7.8	7.8	7.8	7.8

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj	AAHU's w/ proj.	Net AAHU's
Beaver	w/o	0.50	0.50	0.50	0.50	0.50	0.50	0.50	3.90		
	with	0.50	0.50	0.00	0.00	0.00	0.00	0.00		0.12	-3.78
River Otter	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.76	5.93		
	with	0.76	0.74	0.74	0.76	0.76	0.76	0.76		5.92	-0.01
Channel Catfish	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.25	2.44		
	with	0.33	0.33	0.33	0.33	0.33	0.33	0.25		2.44	0.00
Smallmouth Buffalo (repro)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Smallmouth Buffalo (summer)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
									Net Sum AAHU's =		-3.79

Lock and Dam 25

Location: 2
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	3.31	3.31	3.31	3.31	3.31	3.31	3.31
with project	3.31	3.31	3.31	3.31	3.31	3.31	3.31

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.42	0.42	0.42	0.42	0.42	0.42	0.42	1.40		
	with	0.42	0.42	0.42	0.42	0.42	0.42	0.42		1.40	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	2.65		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		2.65	0.00
Channel Catfish	w/o	0.57	0.57	0.57	0.57	0.57	0.57	0.56	1.88		
	with	0.57	0.57	0.57	0.57	0.57	0.56	0.56		1.86	-0.02
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	1.17		
	with	0.35	0.35	0.35	0.35	0.35	0.35	0.35		1.17	0.00
Sauger	w/o	0.77	0.77	0.77	0.77	0.77	0.77	0.71	2.49		
	with	0.77	0.77	0.77	0.77	0.77	0.77	0.71		2.49	0.00
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	0.79		
	with	0.24	0.24	0.24	0.24	0.24	0.24	0.23		0.79	0.00
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	3.06		
	with	0.92	0.92	0.92	0.92	0.92	0.92	0.92		3.06	0.00
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.09		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.09	0.00
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.88	2.88		
	with	0.86	0.86	0.86	0.86	0.86	0.87	0.88		2.88	0.00
								Net Sum AAHU's =			-0.02

Location: 2
Habitat Type: MCB
Site: 6D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.64	8.64	8.64	8.64	8.64	8.64	8.64
with project	8.64	8.64	8.64	8.64	8.64	8.64	8.64

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.50	0.50	0.50	0.50	0.50	0.49	0.49	4.28		
	with	0.50	0.50	0.43	0.43	0.43	0.43	0.43		3.74	-0.54
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	6.91		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		6.91	0.00
Channel Catfish	w/o	0.66	0.66	0.66	0.66	0.66	0.65	0.65	5.66		
	with	0.66	0.66	0.62	0.62	0.62	0.62	0.62		5.41	-0.25
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	7.88		
	with	0.91	0.91	0.91	0.91	0.91	0.91	0.91		7.88	0.00
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	2.67		
	with	0.31	0.31	0.29	0.29	0.29	0.29	0.29		2.53	-0.14
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	4.80		
	with	0.56	0.56	0.59	0.59	0.59	0.59	0.59		5.08	0.28
Walleye (summer)	w/o	0.36	0.36	0.36	0.36	0.36	0.36	0.35	3.09		
	with	0.36	0.36	0.36	0.36	0.36	0.36	0.35		3.09	0.00
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	7.98		
	with	0.92	0.92	0.70	0.70	0.70	0.69	0.68		6.05	-1.93
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.30		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.30	0.00
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.77	6.76		
	with	0.79	0.79	0.77	0.77	0.77	0.73	0.73		6.44	-0.32
								Net Sum AAHU's =			-2.90

Location: 2
Habitat Type: MCB
Site: 7D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.08	7.08	7.08	7.08	7.08	7.08	7.08
with project	7.08	7.08	2.12	2.12	2.12	2.12	2.12

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.98	0.98	0.98	0.98	0.98	0.97	0.96	6.86		
	with	0.98	0.98	0.92	0.92	0.90	0.86	0.87		2.01	-4.85
Channel Catfish	w/o	0.50	0.50	0.50	0.50	0.50	0.50	0.50	3.51		
	with	0.50	0.50	0.63	0.63	0.63	0.00	0.00		0.54	-2.97
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	6.46		
	with	0.91	0.91	0.00	0.00	0.00	0.00	0.00		0.18	-6.28
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	2.19		
	with	0.31	0.31	0.31	0.31	0.31	0.31	0.31		0.70	-1.49
Sauger	w/o	0.64	0.64	0.64	0.64	0.64	0.64	0.64	4.56		
	with	0.64	0.64	0.54	0.54	0.56	0.56	0.56		1.27	-3.29
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	1.68		
	with	0.24	0.24	0.25	0.25	0.20	0.05	0.05		0.27	-1.41
Walleye (winter)	w/o	0.90	0.90	0.90	0.90	0.90	0.89	0.88	6.32		
	with	0.90	0.90	0.92	0.52	0.00	0.00	0.00		0.36	-5.96
Walleye (reproduction)	w/o	0.11	0.11	0.11	0.11	0.11	0.15	0.18	1.02		
	with	0.11	0.11	0.06	0.18	0.18	0.18	0.18		0.38	-0.64
Emerald Shiner	w/o	0.74	0.74	0.74	0.74	0.74	0.74	0.74	5.25		
	with	0.74	0.74	0.81	0.79	0.76	0.76	0.76		1.73	-3.52
								Net Sum AAHU's =			-30.41

Location: 2
Habitat Type: MCB
Site: 12D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.59	7.59	7.59	7.59	7.59	7.59	7.59
with project	7.59	7.59	7.59	7.59	7.59	7.59	7.59

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.50	3.84		
	with	0.51	0.51	0.43	0.43	0.43	0.43	0.43		3.30	-0.54
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	6.07		
	with	0.80	0.80	0.77	0.77	0.77	0.75	0.72		5.68	-0.39
Channel Catfish	w/o	0.45	0.45	0.45	0.45	0.45	0.45	0.45	3.41		
	with	0.45	0.45	0.45	0.45	0.45	0.45	0.45		3.41	0.00
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	6.92		
	with	0.91	0.91	0.91	0.91	0.91	0.91	0.91		6.92	0.00
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	2.34		
	with	0.31	0.31	0.31	0.31	0.31	0.31	0.31		2.34	0.00
Sauger	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	5.14		
	with	0.68	0.68	0.61	0.61	0.61	0.61	0.61		4.65	-0.49
Walleye (summer)	w/o	0.20	0.20	0.20	0.20	0.20	0.20	0.19	1.50		
	with	0.20	0.20	0.20	0.20	0.20	0.20	0.19		1.50	0.00
Walleye (winter)	w/o	0.70	0.70	0.70	0.70	0.70	0.69	0.68	5.24		
	with	0.70	0.70	0.60	0.60	0.60	0.58	0.56		4.44	-0.80
Walleye (reproduction)	w/o	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.68		
	with	0.09	0.09	0.03	0.03	0.03	0.03	0.03		0.22	-0.46
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.76	0.76	5.84		
	with	0.79	0.79	0.76	0.76	0.76	0.76	0.76		5.75	-0.09
								Net Sum AAHU's =			-2.77

Lock and Dam 25

Location: 2
Habitat Type: BHF
Site: 6U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.6	8.6	8.6	8.6	8.6	8.6	8.6
with project	8.6	8.6	8.6	8.6	8.6	8.6	8.6

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.50	0.50	0.50	3.66		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.50		1.08	-2.58
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.20	0.20	0.40	0.51	2.96		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.30		0.65	-2.31
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.80		
	with	0.10	0.00	0.00	0.00	0.10	0.39	0.35		2.28	1.48
Prothonotary Warbler	w/o	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.19		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.03		0.06	-0.13
Hairy Woodpecker	w/o	0.29	0.29	0.36	0.54	0.93	1.00	1.00	7.75		
	with	0.29	0.00	0.00	0.00	0.00	0.76	1.00		4.78	-2.97
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-6.51

Location: 2
Habitat Type: BHF
Site: 7U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.9	6.9	6.9	6.9	6.9	6.9	6.9
with project	6.9	6.9	6.9	6.9	6.9	6.9	6.9

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	4.05		
	with	0.59	0.00	0.00	0.00	0.00	0.00	0.50		0.90	-3.15
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.20	0.20	0.20	0.20	0.40	0.40	0.51	2.75		
	with	0.20	0.00	0.00	0.00	0.00	0.00	0.30		0.54	-2.21
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.64		
	with	0.10	0.00	0.00	0.00	0.10	0.39	0.35		1.83	1.19
Prothonotary Warbler	w/o	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.17		
	with	0.02	0.00	0.00	0.00	0.00	0.00	0.03		0.05	-0.12
Hairy Woodpecker	w/o	0.80	0.80	0.86	0.86	0.93	1.00	1.00	6.64		
	with	0.80	0.00	0.00	0.00	0.00	0.76	1.00		3.87	-2.77
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-7.06

Location: 2
Habitat Type: BHF
Site: 13D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.83	8.83	8.83	8.83	8.83	8.83	8.83
with project	8.83	8.83	8.83	8.83	8.83	13.78	13.78

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.53	0.53	0.53	0.53	0.53	0.53	0.53	4.69		
	with	0.53	0.53	0.53	0.53	0.53	0.53	0.53		6.40	1.71
Wild Turkey	w/o	0.50	0.50	0.50	0.50	0.50	0.50	0.50	4.42		
	with	0.50	0.50	0.50	0.50	0.50	0.50	0.50		6.02	1.60
Wood Duck (nesting)	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.10	4.24		
	with	0.61	0.61	0.61	0.61	0.61	0.61	0.10		5.56	1.32
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.19	0.19	0.19	0.19	0.19	0.31	0.31	2.37		
	with	0.19	0.19	0.19	0.19	0.19	0.31	0.31		3.34	0.97
Prothonotary Warbler	w/o	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.12		
	with	0.01	0.01	0.01	0.01	0.01	0.02	0.02		0.17	0.05
Hairy Woodpecker	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.79	6.94		
	with	0.79	0.79	0.79	0.79	0.79	0.79	0.79		9.47	2.53
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		8.18

Lock and Dam 25

Location: 3
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.49	7.49	7.49	7.49	7.49	7.49	7.49
with project	7.49	7.49	7.49	7.49	7.49	7.49	7.49

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.42	0.42	0.42	0.42	0.42	0.42	0.42	3.16		
	with	0.42	0.42	0.43	0.43	0.43	0.43	0.43		3.21	0.05
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	5.99		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		5.99	0.00
Channel Catfish	w/o	0.57	0.57	0.57	0.57	0.57	0.57	0.56	4.26		
	with	0.57	0.57	0.61	0.61	0.61	0.61	0.61		4.54	0.28
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	2.65		
	with	0.35	0.35	0.35	0.35	0.35	0.35	0.35		2.65	0.00
Sauger	w/o	0.77	0.77	0.77	0.77	0.77	0.77	0.71	5.64		
	with	0.77	0.77	0.67	0.67	0.67	0.67	0.61		4.91	-0.73
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	1.78		
	with	0.24	0.24	0.24	0.24	0.24	0.24	0.23		1.78	0.00
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	6.92		
	with	0.92	0.92	0.92	0.92	0.92	0.92	0.92		6.92	0.00
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.21		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.21	0.00
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.88	6.51		
	with	0.86	0.86	0.88	0.88	0.88	0.89	0.90		6.66	0.15
									Net Sum AAHU's =		-0.25

Location: 3
Habitat Type: MCB
Site: 6D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.64	8.64	8.64	8.64	8.64	8.64	8.64
with project	8.64	8.64	8.64	8.64	8.64	8.64	8.64

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.50	0.50	0.50	0.50	0.50	0.49	0.49	4.28		
	with	0.50	0.50	0.47	0.47	0.47	0.47	0.47		4.07	-0.21
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	6.91		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		6.91	0.00
Channel Catfish	w/o	0.66	0.66	0.66	0.66	0.66	0.65	0.65	5.66		
	with	0.66	0.66	0.62	0.62	0.62	0.62	0.62		5.41	-0.25
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	7.88		
	with	0.91	0.91	0.91	0.91	0.91	0.91	0.91		7.88	0.00
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	2.67		
	with	0.31	0.31	0.29	0.29	0.29	0.29	0.29		2.53	-0.14
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	4.80		
	with	0.56	0.56	0.59	0.59	0.59	0.59	0.59		5.08	0.28
Walleye (summer)	w/o	0.36	0.36	0.36	0.36	0.36	0.36	0.35	3.09		
	with	0.36	0.36	0.36	0.36	0.36	0.36	0.35		3.09	0.00
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	7.98		
	with	0.92	0.92	0.70	0.70	0.70	0.69	0.68		6.05	-1.93
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.30		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.30	0.00
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.79	0.77	6.76		
	with	0.79	0.79	0.77	0.77	0.77	0.73	0.73		6.44	-0.32
									Net Sum AAHU's =		-2.57

Location: 3
Habitat Type: MCB
Site: 12D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	14.81	14.81	14.81	14.81	14.81	14.81	14.81
with project	14.81	14.81	14.81	14.81	14.81	14.81	14.81

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.50	7.49		
	with	0.51	0.51	0.34	0.34	0.34	0.50	0.50		6.68	-0.81
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	11.85		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		11.85	0.00
Channel Catfish	w/o	0.45	0.45	0.45	0.45	0.45	0.45	0.45	6.65		
	with	0.45	0.43	0.49	0.48	0.48	0.48	0.48		7.12	0.47
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	13.51		
	with	0.91	0.91	0.00	0.00	0.00	0.00	0.00		0.41	-13.10
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	4.57		
	with	0.31	0.31	0.31	0.31	0.31	0.31	0.31		4.57	0.00
Sauger	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	10.04		
	with	0.68	0.58	0.48	0.48	0.48	0.48	0.48		7.14	-2.90
Walleye (summer)	w/o	0.20	0.20	0.20	0.20	0.20	0.20	0.19	2.92		
	with	0.20	0.13	0.13	0.13	0.13	0.13	0.13		1.88	-1.04
Walleye (winter)	w/o	0.70	0.70	0.70	0.70	0.70	0.69	0.68	10.23		
	with	0.70	0.70	0.92	0.92	0.92	0.92	0.92		13.58	3.35
Walleye (reproduction)	w/o	0.09	0.09	0.09	0.09	0.09	0.09	0.09	1.33		
	with	0.09	0.09	0.12	0.12	0.12	0.12	0.12		1.76	0.43
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.76	0.76	11.39		
	with	0.79	0.72	0.74	0.74	0.74	0.74	0.74		10.92	-0.47
									Net Sum AAHU's =		-14.07

Location: 3
Habitat Type: MCB
Site: 12D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	15.22	15.22	15.22	15.22	15.22	15.22	15.22
with project	15.22	15.22	15.22	15.22	15.22	15.22	15.22

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.50	7.69		
	with	0.51	0.51	0.41	0.41	0.41	0.40	0.39		6.11	-1.58
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	12.18		
	with	0.80	0.80	0.00	0.00	0.00	0.00	0.00		0.37	-11.81
Channel Catfish	w/o	0.45	0.45	0.45	0.45	0.45	0.45	0.45	6.83		
	with	0.45	0.45	0.38	0.38	0.38	0.38	0.38		5.86	-0.97
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	13.88		
	with	0.91	0.91	0.91	0.91	0.91	0.91	0.91		13.88	0.00
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	4.70		
	with	0.31	0.31	0.29	0.29	0.29	0.29	0.29		4.46	-0.24
Sauger	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	10.32		
	with	0.68	0.68	0.64	0.64	0.64	0.64	0.64		9.82	-0.50
Walleye (summer)	w/o	0.20	0.20	0.20	0.20	0.20	0.20	0.19	3.00		
	with	0.20	0.20	0.16	0.16	0.16	0.16	0.15		2.41	-0.59
Walleye (winter)	w/o	0.70	0.70	0.70	0.70	0.70	0.69	0.68	10.52		
	with	0.70	0.70	0.20	0.20	0.20	0.18	0.16		2.98	-7.54
Walleye (reproduction)	w/o	0.09	0.09	0.09	0.09	0.09	0.09	0.09	1.37		
	with	0.09	0.09	0.00	0.00	0.00	0.00	0.00		0.04	-1.33
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.76	0.76	11.71		
	with	0.79	0.79	0.78	0.78	0.78	0.75	0.75		11.61	-0.10
									Net Sum AAHU's =		-24.66

Lock and Dam 25

Location: 3
Habitat Type: BHF
Site: 6U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.6	8.6	8.6	8.6	8.6	8.6	8.6
with project	8.6	8.6	8.6	8.6	8.6	8.6	8.6

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.50	0.50	0.50	3.66		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.50		1.08	-2.58
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.20	0.20	0.40	0.51	2.96		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.30		0.65	-2.31
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.80		
	with	0.10	0.00	0.00	0.00	0.10	0.39	0.35		2.28	1.48
Prothonotary Warbler	w/o	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.19		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.03		0.06	-0.13
Hairy Woodpecker	w/o	0.29	0.29	0.36	0.54	0.93	1.00	1.00	7.75		
	with	0.29	0.00	0.00	0.00	0.00	0.76	1.00		4.78	-2.97
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-6.51

Location: 3
Habitat Type: BHF
Site: 7U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.9	6.9	6.9	6.9	6.9	6.9	6.9
with project	6.9	6.9	6.9	6.9	6.9	6.9	6.9

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	4.05		
	with	0.59	0.00	0.00	0.00	0.00	0.00	0.50		0.90	-3.15
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.20	0.20	0.20	0.20	0.40	0.40	0.51	2.75		
	with	0.20	0.00	0.00	0.00	0.00	0.00	0.30		0.54	-2.21
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.64		
	with	0.10	0.00	0.00	0.00	0.10	0.39	0.35		1.83	1.19
Prothonotary Warbler	w/o	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.17		
	with	0.02	0.00	0.00	0.00	0.00	0.00	0.03		0.05	-0.12
Hairy Woodpecker	w/o	0.80	0.80	0.86	0.86	0.93	1.00	1.00	6.64		
	with	0.80	0.00	0.00	0.00	0.00	0.76	1.00		3.87	-2.77
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-7.06

Lock and Dam 25

Location: 4 w/ gate
Habitat Type: MCB
Site: 1U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	3.59	3.59	3.59	3.59	3.59	3.59	3.59
with project	3.59	3.59	3.59	3.59	3.59	3.59	3.59

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.57	0.57	0.57	0.57	0.57	0.57	0.57	2.04		
	with	0.57	0.57	0.43	0.43	0.43	0.43	0.42		1.54	-0.50
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	2.87		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		2.87	0.00
Channel Catfish	w/o	0.62	0.62	0.62	0.62	0.62	0.62	0.62	2.23		
	with	0.62	0.62	0.41	0.41	0.41	0.41	0.41		1.51	-0.72
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	1.21		
	with	0.34	0.34	0.34	0.34	0.34	0.34	0.34		1.21	0.00
Sauger	w/o	0.69	0.69	0.69	0.69	0.69	0.69	0.63	2.42		
	with	0.69	0.63	0.67	0.67	0.67	0.67	0.67		2.39	-0.03
Walleye (summer)	w/o	0.28	0.28	0.28	0.28	0.28	0.28	0.27	1.00		
	with	0.28	0.28	0.18	0.18	0.18	0.17	0.17		0.63	-0.37
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	3.32		
	with	0.92	0.92	0.90	0.90	0.90	0.88	0.87		3.18	-0.14
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03		
	with	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.04	0.01
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.88	3.10		
	with	0.86	0.86	0.91	0.91	0.91	0.92	0.93		3.30	0.20
								Net Sum AAHU's =			-1.55

Location: 4 w/ gate
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	15.26	15.26	15.26	15.26	15.26	15.26	15.26
with project	15.26	15.26	15.26	15.26	15.26	15.26	15.26

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.42	0.42	0.42	0.42	0.42	0.42	0.42	6.44		
	with	0.42	0.42	0.42	0.42	0.42	0.42	0.42		6.39	-0.05
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	12.21		
	with	0.80	0.80	0.79	0.79	0.79	0.78	0.77		11.89	-0.32
Channel Catfish	w/o	0.57	0.57	0.57	0.57	0.57	0.57	0.56	8.68		
	with	0.57	0.57	0.53	0.53	0.53	0.53	0.53		8.17	-0.51
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	5.39		
	with	0.35	0.35	0.37	0.37	0.37	0.37	0.36		5.62	0.23
Sauger	w/o	0.77	0.77	0.77	0.77	0.77	0.77	0.71	11.49		
	with	0.77	0.77	0.77	0.77	0.77	0.77	0.71		11.49	0.00
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	3.62		
	with	0.24	0.24	0.24	0.24	0.24	0.24	0.23		3.62	0.00
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	14.09		
	with	0.92	0.92	0.92	0.92	0.92	0.92	0.92		14.09	0.00
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.42		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.42	0.00
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.88	13.27		
	with	0.86	0.86	0.86	0.86	0.86	0.87	0.88		13.27	0.00
								Net Sum AAHU's =			-0.65

Location: 4 w/ gate
Habitat Type: MCB
Site: 4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.9	6.9	6.9	6.9	6.9	6.9	6.9
with project	6.9	6.9	9.65	9.65	9.65	9.65	9.65

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.40	0.40	0.40	0.40	0.39		3.70	3.70
Lake Sturgeon (forage)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6.90		
	with	1.00	1.00	0.65	0.65	0.65	0.63	0.61		6.15	-0.75
Channel Catfish	w/o	0.47	0.47	0.47	0.47	0.47	0.47	0.47	3.25		
	with	0.47	0.47	0.53	0.53	0.53	0.53	0.53		5.10	1.85
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	6.29		
	with	0.91	0.91	0.91	0.91	0.91	0.91	0.91		8.72	2.43
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	2.13		
	with	0.31	0.31	0.29	0.29	0.29	0.29	0.29		2.81	0.68
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.59	3.89		
	with	0.56	0.56	0.59	0.59	0.59	0.59	0.59		5.63	1.74
Walleye (summer)	w/o	0.20	0.20	0.20	0.20	0.20	0.20	0.19	1.36		
	with	0.20	0.20	0.24	0.24	0.24	0.24	0.23		2.26	0.90
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	6.37		
	with	0.92	0.92	0.77	0.77	0.77	0.75	0.74		7.25	0.88
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.08		
	with	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.13	0.05
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.74	5.22		
	with	0.76	0.76	0.79	0.79	0.79	0.79	0.76		7.49	2.27
								Net Sum AAHU's =			13.75

Location: 4 w/ gate
Habitat Type: MCB
Site: 12D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	14.81	14.81	14.81	14.81	14.81	14.81	14.81
with project	14.81	14.81	14.81	14.81	14.81	14.81	14.81

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.50	7.49		
	with	0.51	0.51	0.43	0.43	0.43	0.43	0.43		6.43	-1.06
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	11.85		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		11.85	0.00
Channel Catfish	w/o	0.45	0.45	0.45	0.45	0.45	0.45	0.45	6.65		
	with	0.45	0.43	0.48	0.50	0.50	0.50	0.50		7.30	0.65
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	13.51		
	with	0.91	0.91	0.91	0.91	0.91	0.91	0.91		13.51	0.00
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	4.57		
	with	0.31	0.31	0.32	0.32	0.32	0.32	0.32		4.76	0.19
Sauger	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	10.04		
	with	0.68	0.58	0.58	0.68	0.68	0.68	0.68		9.95	-0.09
Walleye (summer)	w/o	0.20	0.20	0.20	0.20	0.20	0.20	0.19	2.92		
	with	0.20	0.13	0.17	0.24	0.24	0.24	0.23		3.45	0.53
Walleye (winter)	w/o	0.70	0.70	0.70	0.70	0.70	0.69	0.68	10.23		
	with	0.70	0.70	0.50	0.50	0.50	0.48	0.47		7.25	-2.98
Walleye (reproduction)	w/o	0.09	0.09	0.09	0.09	0.09	0.09	0.09	1.33		
	with	0.09	0.09	0.09	0.09	0.09	0.09	0.09		1.30	-0.03
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.76	0.76	11.39		
	with	0.79	0.72	0.72	0.79	0.79	0.79	0.79		11.66	0.27
								Net Sum AAHU's =			-2.52

Lock and Dam 25

Location: 4 w/ gate
Habitat Type: MCB
Site: 12D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	15.22	15.22	15.22	15.22	15.22	15.22	15.22
with project	15.22	15.22	15.22	15.22	15.22	15.22	15.22

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.50	7.69		
	with	0.51	0.51	0.38	0.38	0.38	0.37	0.36		5.74	-1.95
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	12.18		
	with	0.80	0.80	0.00	0.00	0.00	0.00	0.00		0.37	-11.81
Channel Catfish	w/o	0.45	0.45	0.45	0.45	0.45	0.45	0.45	6.83		
	with	0.45	0.45	0.38	0.38	0.38	0.38	0.38		5.86	-0.97
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	13.88		
	with	0.91	0.91	0.91	0.91	0.91	0.91	0.91		13.88	0.00
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	4.70		
	with	0.31	0.31	0.31	0.31	0.31	0.31	0.31		4.70	0.00
Sauger	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	10.32		
	with	0.68	0.68	0.64	0.64	0.64	0.64	0.64		9.82	-0.50
Walleye (summer)	w/o	0.20	0.20	0.20	0.20	0.20	0.20	0.19	3.00		
	with	0.20	0.20	0.16	0.16	0.16	0.16	0.15		2.41	-0.59
Walleye (winter)	w/o	0.70	0.70	0.70	0.70	0.70	0.69	0.68	10.52		
	with	0.70	0.70	0.07	0.07	0.07	0.06	0.04		1.17	-9.35
Walleye (reproduction)	w/o	0.09	0.09	0.09	0.09	0.09	0.09	0.09	1.37		
	with	0.09	0.09	0.00	0.00	0.00	0.00	0.00		0.04	-1.33
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.76	0.76	11.71		
	with	0.79	0.79	0.75	0.75	0.75	0.75	0.75		11.46	-0.25
									Net Sum AAHU's =		-26.75

Location: 4 w/ gate
Habitat Type: BHF
Site: 6U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.6	8.6	8.6	8.6	8.6	8.6	8.6
with project	8.6	8.6	8.6	8.6	8.6	8.6	8.6

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.50	0.50	0.50	3.66		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.50		1.08	-2.58
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.20	0.20	0.40	0.51	2.96		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.30		0.65	-2.31
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.80		
	with	0.10	0.00	0.00	0.00	0.10	0.39	0.35		2.28	1.48
Prothonotary Warbler	w/o	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.19		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.03		0.06	-0.13
Hairy Woodpecker	w/o	0.29	0.29	0.36	0.54	0.93	1.00	1.00	7.75		
	with	0.29	0.00	0.00	0.00	0.00	0.76	1.00		4.78	-2.97
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-6.51

Location: 4 w/ gate
Habitat Type: BHF
Site: 7U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.9	6.9	6.9	6.9	6.9	6.9	6.9
with project	6.9	6.9	6.9	6.9	6.9	6.9	6.9

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	4.05		
	with	0.59	0.00	0.00	0.00	0.00	0.00	0.50		0.90	-3.15
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.20	0.20	0.20	0.20	0.40	0.40	0.51	2.75		
	with	0.20	0.00	0.00	0.00	0.00	0.00	0.30		0.54	-2.21
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.64		
	with	0.10	0.00	0.00	0.00	0.10	0.39	0.35		1.83	1.19
Prothonotary Warbler	w/o	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.17		
	with	0.02	0.00	0.00	0.00	0.00	0.00	0.03		0.05	-0.12
Hairy Woodpecker	w/o	0.80	0.80	0.86	0.86	0.93	1.00	1.00	6.64		
	with	0.80	0.00	0.00	0.00	0.00	0.76	1.00		3.87	-2.77
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-7.06

Location: 4 w/ gate
Habitat Type: BHF
Site: 14D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	2.2	2.2	2.2	2.2	2.2	2.2	2.2
with project	2.2	2.2	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.05	0.05	0.06	0.07	0.09	0.10	0.10	0.20		
	with	0.05	0.05	0.00	0.00	0.00	0.00	0.00		0.00	-0.20
Prothonotary Warbler	w/o	0.05	0.05	0.05	0.05	0.08	0.08	0.08	0.17		
	with	0.05	0.05	0.00	0.00	0.00	0.00	0.00		0.00	-0.17
Hairy Woodpecker	w/o	0.04	0.05	0.06	0.13	0.24	0.34	0.34	0.62		
	with	0.04	0.04	0.00	0.00	0.00	0.00	0.00		0.00	-0.62
Western Chorus Frog	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
									Net Sum AAHU's =		-0.99

Lock and Dam 25

Location: 4 w/ gate
Habitat Type: NFW
Site: 15D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	0.65	0.65	0.65	0.65	0.65	0.65	0.65
with project	0.65	0.65	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Mallard	w/o	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.04		
	with	0.06	0.06	0.00	0.00	0.00	0.00	0.00		0.00	-0.04
Western Chorus Frog	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Sora Rail	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Muskrat	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
								Net Sum AAHU's =			-0.04

Lock and Dam 25

Location: 4 w/o gate
Habitat Type: MCB
Site: 1U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	3.59	3.59	3.59	3.59	3.59	3.59	3.59
with project	3.59	3.59	3.59	3.59	3.59	3.59	3.59

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.57	0.57	0.57	0.57	0.57	0.57	0.57	2.04		
	with	0.57	0.57	0.43	0.43	0.43	0.43	0.42		1.54	-0.50
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	2.87		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		2.87	0.00
Channel Catfish	w/o	0.62	0.62	0.62	0.62	0.62	0.62	0.62	2.23		
	with	0.62	0.62	0.41	0.41	0.41	0.41	0.41		1.51	-0.72
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.34	0.34	0.34	0.34	0.34	0.34	0.34	1.21		
	with	0.34	0.34	0.34	0.34	0.34	0.34	0.34		1.21	0.00
Sauger	w/o	0.69	0.69	0.69	0.69	0.69	0.69	0.63	2.42		
	with	0.69	0.63	0.67	0.67	0.67	0.67	0.67		2.39	-0.03
Walleye (summer)	w/o	0.28	0.28	0.28	0.28	0.28	0.28	0.27	1.00		
	with	0.28	0.28	0.18	0.18	0.18	0.17	0.17		0.63	-0.37
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	3.32		
	with	0.92	0.92	0.90	0.90	0.90	0.88	0.87		3.18	-0.14
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03		
	with	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.04	0.01
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.88	3.10		
	with	0.86	0.86	0.91	0.91	0.91	0.92	0.93		3.30	0.20
								Net Sum AAHU's =			-1.55

Location: 4 w/o gate
Habitat Type: MCB
Site: 5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	15.26	15.26	15.26	15.26	15.26	15.26	15.26
with project	15.26	15.26	15.26	15.26	15.26	15.26	15.26

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.42	0.42	0.42	0.42	0.42	0.42	0.42	6.44		
	with	0.42	0.42	0.42	0.42	0.42	0.42	0.42		6.47	0.03
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	12.21		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		12.21	0.00
Channel Catfish	w/o	0.57	0.57	0.57	0.57	0.57	0.57	0.56	8.68		
	with	0.57	0.57	0.57	0.57	0.57	0.57	0.57		8.68	0.00
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.35	0.35	0.35	0.35	0.35	0.35	0.35	5.39		
	with	0.35	0.35	0.35	0.35	0.35	0.35	0.35		5.39	0.00
Sauger	w/o	0.77	0.77	0.77	0.77	0.77	0.77	0.71	11.49		
	with	0.77	0.77	0.77	0.77	0.77	0.77	0.71		11.49	0.00
Walleye (summer)	w/o	0.24	0.24	0.24	0.24	0.24	0.24	0.23	3.62		
	with	0.24	0.24	0.24	0.24	0.24	0.24	0.23		3.62	0.00
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	14.09		
	with	0.92	0.92	0.92	0.92	0.92	0.92	0.92		14.09	0.00
Walleye (reproduction)	w/o	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.42		
	with	0.03	0.03	0.03	0.03	0.03	0.03	0.03		0.42	0.00
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.87	0.88	13.27		
	with	0.86	0.86	0.86	0.86	0.86	0.87	0.88		13.27	0.00
								Net Sum AAHU's =			0.03

Location: 4 w/o gate
Habitat Type: MCB
Site: 4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.9	6.9	6.9	6.9	6.9	6.9	6.9
with project	6.9	6.9	9.65	9.65	9.65	9.65	9.65

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.40	0.40	0.40	0.40	0.39		3.70	3.70
Lake Sturgeon (forage)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	6.90		
	with	1.00	1.00	0.65	0.65	0.65	0.63	0.61		6.15	-0.75
Channel Catfish	w/o	0.47	0.47	0.47	0.47	0.47	0.47	0.47	3.25		
	with	0.47	0.47	0.53	0.53	0.53	0.53	0.53		5.10	1.85
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	6.29		
	with	0.91	0.91	0.91	0.91	0.91	0.91	0.91		8.72	2.43
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	2.13		
	with	0.31	0.31	0.29	0.29	0.29	0.29	0.29		2.81	0.68
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.59	3.89		
	with	0.56	0.56	0.59	0.59	0.59	0.59	0.59		5.63	1.74
Walleye (summer)	w/o	0.20	0.20	0.20	0.20	0.20	0.20	0.19	1.36		
	with	0.20	0.20	0.24	0.24	0.24	0.24	0.23		2.26	0.90
Walleye (winter)	w/o	0.92	0.92	0.92	0.92	0.92	0.92	0.92	6.37		
	with	0.92	0.92	0.77	0.77	0.77	0.75	0.74		7.25	0.88
Walleye (reproduction)	w/o	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.08		
	with	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.13	0.05
Emerald Shiner	w/o	0.76	0.76	0.76	0.76	0.76	0.76	0.74	5.22		
	with	0.76	0.76	0.79	0.79	0.79	0.79	0.76		7.49	2.27
								Net Sum AAHU's =			13.75

Location: 4 w/o gate
Habitat Type: MCB
Site: 12D(A)

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	14.81	14.81	14.81	14.81	14.81	14.81	14.81
with project	14.81	14.81	14.81	14.81	14.81	14.81	14.81

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.50	7.49		
	with	0.51	0.51	0.34	0.00	0.00	0.00	0.00		0.43	-7.06
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	11.85		
	with	0.80	0.80	0.80	0.97	0.97	0.97	0.97		14.17	2.32
Channel Catfish	w/o	0.45	0.45	0.45	0.45	0.45	0.45	0.45	6.65		
	with	0.45	0.43	0.60	0.61	0.61	0.61	0.61		8.96	2.31
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	13.51		
	with	0.91	0.91	0.00	0.00	0.00	0.00	0.00		0.41	-13.10
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	4.57		
	with	0.31	0.31	0.31	0.31	0.31	0.31	0.31		4.64	0.07
Sauger	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	10.04		
	with	0.68	0.58	0.48	0.44	0.44	0.44	0.44		6.68	-3.36
Walleye (summer)	w/o	0.20	0.20	0.20	0.20	0.20	0.20	0.19	2.92		
	with	0.20	0.13	0.17	0.22	0.22	0.22	0.22		3.20	0.28
Walleye (winter)	w/o	0.70	0.70	0.70	0.70	0.70	0.69	0.68	10.23		
	with	0.70	0.70	0.92	0.92	0.92	0.92	0.92		13.58	3.35
Walleye (reproduction)	w/o	0.09	0.09	0.09	0.09	0.09	0.09	0.09	1.33		
	with	0.09	0.09	0.09	0.04	0.04	0.06	0.08		0.92	-0.41
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.76	0.76	11.39		
	with	0.79	0.72	0.79	0.81	0.81	0.81	0.81		11.98	0.59
								Net Sum AAHU's =			-15.01

Lock and Dam 25

Location: 4 w/o gate
Habitat Type: MCB
Site: 12D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	15.22	15.22	15.22	15.22	15.22	15.22	15.22
with project	15.22	15.22	15.22	15.22	15.22	15.22	15.22

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.50	7.69		
	with	0.51	0.51	0.38	0.38	0.38	0.37	0.36		5.74	-1.95
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	12.18		
	with	0.80	0.80	0.00	0.00	0.00	0.00	0.00		0.37	-11.81
Channel Catfish	w/o	0.45	0.45	0.45	0.45	0.45	0.45	0.45	6.83		
	with	0.45	0.45	0.38	0.38	0.38	0.38	0.38		5.86	-0.97
Paddlefish (spawning)	w/o	0.91	0.91	0.91	0.91	0.91	0.91	0.91	13.88		
	with	0.91	0.91	0.91	0.91	0.91	0.91	0.91		13.88	0.00
Paddlefish (adult)	w/o	0.31	0.31	0.31	0.31	0.31	0.31	0.31	4.70		
	with	0.31	0.31	0.31	0.31	0.31	0.31	0.31		4.70	0.00
Sauger	w/o	0.68	0.68	0.68	0.68	0.68	0.68	0.68	10.32		
	with	0.68	0.68	0.64	0.64	0.64	0.64	0.64		9.82	-0.50
Walleye (summer)	w/o	0.20	0.20	0.20	0.20	0.20	0.20	0.19	3.00		
	with	0.20	0.20	0.16	0.16	0.16	0.16	0.15		2.41	-0.59
Walleye (winter)	w/o	0.70	0.70	0.70	0.70	0.70	0.69	0.68	10.52		
	with	0.70	0.70	0.07	0.07	0.07	0.06	0.04		1.17	-9.35
Walleye (reproduction)	w/o	0.09	0.09	0.09	0.09	0.09	0.09	0.09	1.37		
	with	0.09	0.09	0.00	0.00	0.00	0.00	0.00		0.04	-1.33
Emerald Shiner	w/o	0.79	0.79	0.79	0.79	0.79	0.76	0.76	11.71		
	with	0.79	0.79	0.75	0.75	0.75	0.75	0.75		11.46	-0.25
								Net Sum AAHU's =			-26.75

Location: 4 w/o gate
Habitat Type: BHF
Site: 6U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.6	8.6	8.6	8.6	8.6	8.6	8.6
with project	8.6	8.6	8.6	8.6	8.6	8.6	8.6

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.50	0.50	0.50	3.66		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.50		1.08	-2.58
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.20	0.20	0.40	0.51	2.96		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.30		0.65	-2.31
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.80		
	with	0.10	0.00	0.00	0.00	0.10	0.39	0.35		2.28	1.48
Prothonotary Warbler	w/o	0.00	0.00	0.00	0.00	0.03	0.03	0.03	0.19		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.03		0.06	-0.13
Hairy Woodpecker	w/o	0.29	0.29	0.36	0.54	0.93	1.00	1.00	7.75		
	with	0.29	0.00	0.00	0.00	0.00	0.76	1.00		4.78	-2.97
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
								Net Sum AAHU's =			-6.51

Location: 4 w/o gate
Habitat Type: BHF
Site: 7U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	6.9	6.9	6.9	6.9	6.9	6.9	6.9
with project	6.9	6.9	6.9	6.9	6.9	6.9	6.9

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	4.05		
	with	0.59	0.00	0.00	0.00	0.00	0.00	0.50		0.90	-3.15
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.20	0.20	0.20	0.20	0.40	0.40	0.51	2.75		
	with	0.20	0.00	0.00	0.00	0.00	0.00	0.30		0.54	-2.21
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.64		
	with	0.10	0.00	0.00	0.00	0.10	0.39	0.35		1.83	1.19
Prothonotary Warbler	w/o	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.17		
	with	0.02	0.00	0.00	0.00	0.00	0.00	0.03		0.05	-0.12
Hairy Woodpecker	w/o	0.80	0.80	0.86	0.86	0.93	1.00	1.00	6.64		
	with	0.80	0.00	0.00	0.00	0.00	0.76	1.00		3.87	-2.77
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
								Net Sum AAHU's =			-7.06

Location: 4 w/o gate
Habitat Type: BHF
Site: 14D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	2.2	2.2	2.2	2.2	2.2	2.2	2.2
with project	2.2	2.2	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.05	0.05	0.06	0.07	0.09	0.10	0.10	0.20		
	with	0.05	0.05	0.00	0.00	0.00	0.00	0.00		0.00	-0.20
Prothonotary Warbler	w/o	0.05	0.05	0.05	0.05	0.08	0.08	0.08	0.17		
	with	0.05	0.05	0.00	0.00	0.00	0.00	0.00		0.00	-0.17
Hairy Woodpecker	w/o	0.04	0.05	0.06	0.13	0.24	0.34	0.34	0.62		
	with	0.04	0.04	0.00	0.00	0.00	0.00	0.00		0.00	-0.62
Western Chorus Frog	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
								Net Sum AAHU's =			-0.99

Lock and Dam 25

Location: 4 w/o gate
Habitat Type: NFW
Site: 15D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	0.65	0.65	0.65	0.65	0.65	0.65	0.65
with project	0.65	0.65	0	0	0	0	0

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Mallard	w/o	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.04		
	with	0.06	0.06	0.00	0.00	0.00	0.00	0.00		0.00	-0.04
Western Chorus Frog	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Sora Rail	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Muskrat	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
								Net Sum AAHU's =			-0.04

LaGrange Lock and Dam

Location: 1
Habitat Type: MCB
Site: 2U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	1.19	1.19	1.19	1.19	1.19	1.19	1.19
with project	1.19	1.19	1.19	1.19	1.19	1.19	1.19

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.86	0.86	0.86	0.86	0.86	0.85	0.83	1.01		
	with	0.86	0.86	0.86	0.86	0.86	0.85	0.83		1.01	0.00
Channel Catfish	w/o	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.57		
	with	0.48	0.48	0.48	0.48	0.48	0.48	0.48		0.57	0.00
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.83	0.83	0.98		
	with	0.83	0.83	0.83	0.83	0.83	0.83	0.83		0.98	0.00
Paddlefish (adult)	w/o	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.27		
	with	0.23	0.23	0.23	0.23	0.23	0.23	0.23		0.27	0.00
Sauger	w/o	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.56		
	with	0.47	0.43	0.43	0.47	0.47	0.47	0.47		0.55	-0.01
Walleye (summer)	w/o	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.19		
	with	0.16	0.12	0.12	0.16	0.16	0.16	0.15		0.19	0.00
Walleye (winter)	w/o	0.63	0.63	0.63	0.63	0.63	0.63	0.60	0.74		
	with	0.63	0.63	0.63	0.63	0.63	0.63	0.60		0.74	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.88		
	with	0.74	0.69	0.69	0.74	0.74	0.74	0.74		0.88	0.00
									Net Sum AAHU's =		-0.01

Location: 1
Habitat Type: MCB
Site: 3U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.54	9.54	9.54	9.54	9.54	9.54	9.54
with project	9.54	33.17	33.17	33.17	33.17	33.17	33.17

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.84	0.84	0.84	0.84	0.84	0.82	0.80	7.80		
	with	0.84	0.84	0.84	0.84	0.84	0.82	0.80		26.94	19.14
Channel Catfish	w/o	0.43	0.43	0.43	0.43	0.43	0.43	0.43	4.12		
	with	0.43	0.40	0.42	0.42	0.42	0.42	0.42		13.74	9.62
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.83	0.83	7.89		
	with	0.83	0.83	0.83	0.83	0.83	0.83	0.83		27.24	19.35
Paddlefish (adult)	w/o	0.23	0.23	0.23	0.23	0.23	0.23	0.23	2.17		
	with	0.23	0.23	0.23	0.23	0.23	0.23	0.23		7.50	5.33
Sauger	w/o	0.42	0.42	0.42	0.42	0.42	0.42	0.42	4.03		
	with	0.42	0.39	0.36	0.39	0.39	0.39	0.39		12.77	8.74
Walleye (summer)	w/o	0.16	0.16	0.16	0.16	0.16	0.16	0.15	1.52		
	with	0.16	0.12	0.12	0.16	0.16	0.16	0.15		5.17	3.65
Walleye (winter)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.57	0.57	0.57	0.57	0.53		17.96	17.96
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.72	0.72	0.72	0.72	0.72	0.68	0.68	6.64		
	with	0.72	0.67	0.69	0.74	0.74	0.71	0.71		23.62	16.98
									Net Sum AAHU's =		100.77

Location: 1
Habitat Type: MCB
Site: 9U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.11	9.11	9.11	9.11	9.11	9.11	9.11
with project	9.11	9.11	9.11	9.11	9.11	9.11	9.11

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.75	0.75	0.75	0.75	0.75	0.73	0.70	6.65		
	with	0.75	0.75	1.00	1.00	1.00	1.00	1.00		9.04	2.39
Channel Catfish	w/o	0.70	0.70	0.70	0.70	0.70	0.70	0.70	6.34		
	with	0.70	0.70	0.78	0.78	0.78	0.77	0.77		7.04	0.70
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.83	0.83	7.53		
	with	0.83	0.83	0.83	0.83	0.83	0.83	0.83		7.53	0.00
Paddlefish (adult)	w/o	0.23	0.23	0.23	0.23	0.23	0.23	0.23	2.07		
	with	0.23	0.23	0.27	0.27	0.27	0.27	0.27		2.42	0.35
Sauger	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	4.45		
	with	0.49	0.49	0.42	0.42	0.42	0.42	0.42		3.86	-0.59
Walleye (summer)	w/o	0.19	0.19	0.19	0.19	0.19	0.19	0.19	1.75		
	with	0.19	0.19	0.19	0.19	0.19	0.19	0.19		1.75	0.00
Walleye (winter)	w/o	0.53	0.53	0.53	0.53	0.53	0.53	0.50	4.78		
	with	0.53	0.53	0.53	0.53	0.53	0.53	0.50		4.78	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.61	5.54		
	with	0.61	0.61	0.69	0.69	0.69	0.69	0.69		6.25	0.71
									Net Sum AAHU's =		3.56

Location: 1
Habitat Type: MCB
Site: 2D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	0	0	0	0	0	0	0
with project	0	9.4	9.4	9.4	9.4	9.4	9.4

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.64	0.64	0.64	0.64	0.60	0.54		5.54	5.54
Channel Catfish	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.42	0.42	0.42	0.42	0.42	0.42		3.89	3.89
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.99	0.99	0.99	0.99	0.99	0.99		9.24	9.24
Paddlefish (adult)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.23	0.23	0.23	0.23	0.23	0.23		2.10	2.10
Sauger	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.52	0.52	0.56	0.56	0.56	0.56		5.15	5.15
Walleye (summer)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.11	0.11	0.16	0.16	0.15	0.14		1.39	1.39
Walleye (winter)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.66	0.66	0.71	0.71	0.71	0.71		6.57	6.57
									Net Sum AAHU's =		33.88

LaGrange Lock and Dam

Location: 1
Habitat Type: MCB
Site: 3D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	0	0	0	0	0	0	0
with project	0	8.77	8.77	8.77	8.77	8.77	8.77

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.64	0.64	0.64	0.64	0.60	0.54		5.17	5.17
Channel Catfish	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.42	0.42	0.42	0.42	0.42	0.42		3.62	3.62
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.99	0.99	0.99	0.99	0.99	0.99		8.62	8.62
Paddlefish (adult)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.23	0.23	0.23	0.23	0.23	0.23		1.96	1.96
Sauger	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.52	0.52	0.56	0.56	0.56	0.56		4.81	4.81
Walleye (summer)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.11	0.11	0.16	0.16	0.15	0.14		1.29	1.29
Walleye (winter)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.66	0.66	0.71	0.71	0.71	0.71		6.13	6.13
									Net Sum AAHU's =		31.60

Location: 1
Habitat Type: BHF
Site: 6U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.72	7.72	7.72	7.72	7.72	7.72	7.72
with project	7.72	5.01	5.01	5.01	5.01	5.01	5.01

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wild Turkey	w/o	0.43	0.45	0.50	0.63	0.71	0.71	0.71	5.28		
	with	0.43	0.00	0.00	0.00	0.00	0.18	0.71		1.28	-4.00
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.10	0.20	0.30	1.36		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.36
Wood Duck (brood rear.)	w/o	0.40	0.40	0.40	0.40	0.40	0.40	0.40	3.09		
	with	0.40	0.40	0.40	0.40	0.40	0.40	0.40		2.01	-1.08
Gray Squirrel	w/o	0.07	0.07	0.07	0.09	0.10	0.10	0.10	0.75		
	with	0.07	0.00	0.00	0.00	0.02	0.05	0.10		0.26	-0.49
Prothonotary Warbler	w/o	0.07	0.08	0.08	0.09	0.07	0.07	0.07	0.56		
	with	0.07	0.00	0.00	0.00	0.00	0.00	0.08		0.10	-0.46
Hairy Woodpecker	w/o	0.17	0.19	0.21	0.29	0.36	0.57	0.74	4.03		
	with	0.17	0.00	0.00	0.00	0.00	0.14	0.50		0.92	-3.11
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	
									Net Sum AAHU's =		-10.50

Location: 1
Habitat Type: BHF
Site: 7U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	25.9	25.9	25.9	25.9	25.9	25.9	25.9
with project	25.9	6.51	6.51	6.51	6.51	6.51	6.51

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wild Turkey	w/o	0.44	0.48	0.53	0.65	0.57	0.57	0.57	14.80		
	with	0.44	0.00	0.00	0.00	0.00	0.18	0.71		1.71	-13.09
Wood Duck (nesting)	w/o	0.10	0.10	0.10	0.10	0.42	0.73	1.00	16.64		
	with	0.10	0.00	0.00	0.00	0.00	0.00	0.00		0.02	-16.62
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.07	0.07	0.08	0.09	0.10	0.10	0.10	2.52		
	with	0.07	0.00	0.00	0.00	0.02	0.05	0.10		0.34	-2.18
Prothonotary Warbler	w/o	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.06		
	with	0.01	0.00	0.00	0.00	0.00	0.00	0.08		0.13	0.07
Hairy Woodpecker	w/o	0.14	0.20	0.23	0.30	0.35	0.56	0.72	13.25		
	with	0.14	0.00	0.00	0.00	0.00	0.14	0.50		1.21	-12.04
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-43.86

Location: 1
Habitat Type: BHF
Site: 8U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.61	8.61	8.61	8.61	8.61	8.61	8.61
with project	8.61	7.08	7.08	7.08	7.08	7.08	7.08

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.00	0.18	0.20	1.03		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.03
Wild Turkey	w/o	0.62	0.64	0.65	0.50	0.27	0.27	0.27	2.74		
	with	0.62	0.00	0.00	0.00	0.00	0.18	0.71		1.81	-0.93
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.10	0.20	0.30	1.52		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.52
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.86		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.36	-0.50
Prothonotary Warbler	w/o	0.00	0.10	0.16	0.11	0.01	0.01	0.01	0.20		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.78		1.38	1.18
Hairy Woodpecker	w/o	0.18	0.26	0.36	0.38	0.40	0.68	0.84	5.29		
	with	0.18	0.00	0.00	0.00	0.00	0.14	0.50		1.30	-3.99
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
									Net Sum AAHU's =		-6.79

LaGrange Lock and Dam

Location: 1
Habitat Type: NFW
Site: 4U/5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	15.8	15.8	15.8	15.8	15.8	15.8	15.8
with project	15.8	9.5	9.5	9.5	9.5	9.5	9.5

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Mallard	w/o	0.30	0.30	0.30	0.30	0.30	0.30	0.30	4.77		
	with	0.30	0.00	0.00	0.30	0.30	0.30	0.30		2.71	-2.06
Western Chorus Frog	w/o	0.25	0.25	0.25	0.25	0.25	0.25	0.25	3.89		
	with	0.25	0.22	0.22	0.22	0.22	0.22	0.22		2.10	-1.79
Sora Rail	w/o	0.70	0.70	0.70	0.70	0.70	0.70	0.70	11.06		
	with	0.70	0.70	0.70	0.70	0.70	0.70	0.70		6.69	-4.37
Muskrat	w/o	0.70	0.70	0.70	0.70	0.70	0.70	0.70	3.43		
	with	0.22	0.22	0.22	0.22	0.22	0.22	0.22		2.08	-1.35
								Net Sum	AAHU's =		-9.57

LaGrange Lock and Dam

Location: 2
Habitat Type: MCB
Site: 2U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	4.22	4.22	4.22	4.22	4.22	4.22	4.22
with project	4.22	4.22	4.22	4.22	4.22	4.22	4.22

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.86	0.86	0.86	0.86	0.86	0.85	0.83	3.58		
	with	0.86	0.86	0.86	0.86	0.86	0.85	0.83		3.58	0.00
Channel Catfish	w/o	0.48	0.48	0.48	0.48	0.48	0.48	0.48	2.03		
	with	0.48	0.48	0.48	0.48	0.48	0.48	0.48		2.02	-0.01
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.83	0.83	3.49		
	with	0.83	0.83	0.83	0.83	0.83	0.83	0.83		3.49	0.00
Paddlefish (adult)	w/o	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.96		
	with	0.23	0.23	0.23	0.23	0.23	0.23	0.23		0.96	0.00
Sauger	w/o	0.47	0.47	0.47	0.47	0.47	0.47	0.47	1.97		
	with	0.47	0.43	0.43	0.47	0.47	0.47	0.47		1.96	-0.01
Walleye (summer)	w/o	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.67		
	with	0.16	0.12	0.12	0.16	0.16	0.16	0.15		0.66	-0.01
Walleye (winter)	w/o	0.63	0.63	0.63	0.63	0.63	0.63	0.60	2.64		
	with	0.63	0.63	0.63	0.63	0.63	0.63	0.60		2.64	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.74	0.74	0.74	0.74	0.74	0.74	0.74	3.14		
	with	0.74	0.69	0.69	0.74	0.74	0.74	0.74		3.12	-0.02
									Net Sum AAHU's =		-0.05

Location: 2
Habitat Type: MCB
Site: 3U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.54	9.54	9.54	9.54	9.54	9.54	9.54
with project	9.54	14.71	14.71	14.71	14.71	14.71	14.71

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.84	0.84	0.84	0.84	0.84	0.82	0.80	7.80		
	with	0.84	0.84	0.84	0.84	0.84	0.82	0.80		11.99	4.19
Channel Catfish	w/o	0.43	0.43	0.43	0.43	0.43	0.43	0.43	4.12		
	with	0.43	0.40	0.42	0.42	0.42	0.42	0.42		6.12	2.00
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.83	0.83	7.89		
	with	0.83	0.83	0.83	0.83	0.83	0.83	0.83		12.12	4.23
Paddlefish (adult)	w/o	0.23	0.23	0.23	0.23	0.23	0.23	0.23	2.17		
	with	0.23	0.23	0.23	0.23	0.23	0.23	0.23		3.34	1.17
Sauger	w/o	0.42	0.42	0.42	0.42	0.42	0.42	0.42	4.03		
	with	0.42	0.39	0.36	0.39	0.39	0.39	0.39		5.68	1.65
Walleye (summer)	w/o	0.16	0.16	0.16	0.16	0.16	0.16	0.15	1.52		
	with	0.16	0.12	0.12	0.16	0.16	0.16	0.15		2.30	0.78
Walleye (winter)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.57	0.57	0.57	0.57	0.53		7.96	7.96
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.72	0.72	0.72	0.72	0.72	0.68	0.68	6.64		
	with	0.72	0.67	0.69	0.74	0.74	0.71	0.71		10.51	3.87
									Net Sum AAHU's =		25.85

Location: 2
Habitat Type: MCB
Site: 9U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.11	9.11	9.11	9.11	9.11	9.11	9.11
with project	9.11	9.11	9.11	9.11	9.11	9.11	9.11

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.75	0.75	0.75	0.75	0.75	0.73	0.70	6.65		
	with	0.75	0.75	1.00	1.00	1.00	1.00	1.00		9.04	2.39
Channel Catfish	w/o	0.70	0.70	0.70	0.70	0.70	0.70	0.70	6.34		
	with	0.70	0.70	0.78	0.78	0.78	0.77	0.77		7.04	0.70
Paddlefish (spawning)	w/o	0.83	0.83	0.83	0.83	0.83	0.83	0.83	7.53		
	with	0.83	0.83	0.83	0.83	0.83	0.83	0.83		7.53	0.00
Paddlefish (adult)	w/o	0.23	0.23	0.23	0.23	0.23	0.23	0.23	2.07		
	with	0.23	0.23	0.27	0.27	0.27	0.27	0.27		2.42	0.35
Sauger	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	4.45		
	with	0.49	0.49	0.42	0.42	0.42	0.42	0.42		3.86	-0.59
Walleye (summer)	w/o	0.19	0.19	0.19	0.19	0.19	0.19	0.19	1.75		
	with	0.19	0.19	0.19	0.19	0.19	0.19	0.19		1.75	0.00
Walleye (winter)	w/o	0.53	0.53	0.53	0.53	0.53	0.53	0.50	4.78		
	with	0.53	0.53	0.53	0.53	0.53	0.53	0.50		4.78	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.61	0.61	0.61	0.61	0.61	0.61	0.61	5.54		
	with	0.61	0.61	0.69	0.69	0.69	0.69	0.69		6.25	0.71
									Net Sum AAHU's =		3.56

Location: 2
Habitat Type: MCB
Site: 2D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.45	8.45	8.45	8.45	8.45	8.45	8.45
with project	8.45	8.45	8.45	8.45	8.45	8.45	8.45

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.64	0.64	0.64	0.64	0.64	0.60	0.54	5.03		
	with	0.64	0.64	0.64	0.64	0.64	0.60	0.54		5.03	0.00
Channel Catfish	w/o	0.42	0.42	0.42	0.42	0.42	0.42	0.42	3.53		
	with	0.42	0.47	0.47	0.47	0.47	0.47	0.47		4.00	0.47
Paddlefish (spawning)	w/o	0.99	0.99	0.99	0.99	0.99	0.99	0.99	8.39		
	with	0.99	0.00	0.00	0.00	0.00	0.00	0.00		0.08	-8.31
Paddlefish (adult)	w/o	0.23	0.23	0.23	0.23	0.23	0.23	0.23	1.91		
	with	0.23	0.23	0.21	0.21	0.21	0.21	0.20		1.74	-0.17
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	4.69		
	with	0.56	0.42	0.42	0.46	0.46	0.46	0.46		3.84	-0.85
Walleye (summer)	w/o	0.16	0.16	0.16	0.16	0.16	0.15	0.14	1.28		
	with	0.16	0.11	0.11	0.16	0.16	0.15	0.14		1.26	-0.02
Walleye (winter)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	1.00	1.00	1.00	1.00	1.00	1.00		8.37	8.37
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.71	0.71	0.71	0.71	0.71	0.71	0.71	5.99		
	with	0.71	0.71	0.71	0.76	0.76	0.76	0.76		6.42	0.43
									Net Sum AAHU's =		-0.08

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LaGrange Lock and Dam

Location: 2
Habitat Type: BHF
Site: 6U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	7.72	7.72	7.72	7.72	7.72	7.72	7.72
with project	7.72	6.67	6.67	6.67	6.67	6.67	6.67

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wild Turkey	w/o	0.43	0.45	0.50	0.63	0.71	0.71	0.71	5.28		
	with	0.43	0.00	0.00	0.00	0.00	0.18	0.71		1.69	-3.59
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.10	0.20	0.30	1.36		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.36
Wood Duck (brood rear.)	w/o	0.40	0.40	0.40	0.40	0.40	0.40	0.40	3.09		
	with	0.40	0.40	0.40	0.40	0.40	0.40	0.40		2.67	-0.42
Gray Squirrel	w/o	0.07	0.07	0.07	0.09	0.10	0.10	0.10	0.75		
	with	0.07	0.00	0.00	0.00	0.02	0.05	0.10		0.34	-0.41
Prothonotary Warbler	w/o	0.07	0.08	0.08	0.09	0.07	0.07	0.07	0.56		
	with	0.07	0.00	0.00	0.00	0.00	0.00	0.08		0.14	-0.42
Hairy Woodpecker	w/o	0.17	0.19	0.21	0.29	0.36	0.57	0.74	4.03		
	with	0.17	0.00	0.00	0.00	0.00	0.14	0.50		1.23	-2.80
Western Chorus Frog	w/o	NA	NA	NA	NA	NA	NA	NA	NA		
	with	NA	NA	NA	NA	NA	NA	NA		NA	NA
									Net Sum AAHU's =		-9.00

Location: 2
Habitat Type: BHF
Site: 7U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	25.9	25.9	25.9	25.9	25.9	25.9	25.9
with project	25.9	22.22	22.22	22.22	22.22	22.22	22.22

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Wild Turkey	w/o	0.44	0.48	0.53	0.65	0.57	0.57	0.57	14.80		
	with	0.44	0.00	0.00	0.00	0.00	0.18	0.71		5.64	-9.16
Wood Duck (nesting)	w/o	0.10	0.10	0.10	0.10	0.42	0.73	1.00	16.64		
	with	0.10	0.00	0.00	0.00	0.00	0.00	0.00		0.03	-16.61
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.07	0.07	0.08	0.09	0.10	0.10	0.10	2.52		
	with	0.07	0.00	0.00	0.00	0.02	0.05	0.10		1.13	-1.39
Prothonotary Warbler	w/o	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.06		
	with	0.01	0.00	0.00	0.00	0.00	0.00	0.08		0.44	0.38
Hairy Woodpecker	w/o	0.14	0.20	0.23	0.30	0.35	0.56	0.72	13.25		
	with	0.14	0.00	0.00	0.00	0.00	0.14	0.50		4.08	-9.17
Western Chorus Frog	w/o	NA	NA	NA	NA	NA	NA	NA	NA		
	with	NA	NA	NA	NA	NA	NA	NA		NA	NA
									Net Sum AAHU's =		-35.95

Location: 2
Habitat Type: BHF
Site: 8U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.61	8.61	8.61	8.61	8.61	8.61	8.61
with project	8.61	8.17	8.17	8.17	8.17	8.17	8.17

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.00	0.00	0.18	0.20	1.03		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.03
Wild Turkey	w/o	0.62	0.64	0.65	0.50	0.27	0.27	0.27	2.74		
	with	0.62	0.00	0.00	0.00	0.00	0.18	0.71		2.09	-0.65
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.10	0.20	0.30	1.52		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.52
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.86		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.42	-0.44
Prothonotary Warbler	w/o	0.00	0.10	0.16	0.11	0.01	0.01	0.01	0.20		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.78		1.60	1.40
Hairy Woodpecker	w/o	0.18	0.26	0.36	0.38	0.40	0.68	0.84	5.29		
	with	0.18	0.00	0.00	0.00	0.00	0.14	0.50		1.50	-3.79
Western Chorus Frog	w/o	NA	NA	NA	NA	NA	NA	NA	NA		
	with	NA	NA	NA	NA	NA	NA	NA		NA	NA
									Net Sum AAHU's =		-6.03

Location: 2
Habitat Type: NFW
Site: 4U/5U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	15.8	15.8	15.8	15.8	15.8	15.8	15.8
with project	15.8	9.5	9.5	9.5	9.5	9.5	9.5

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Mallard	w/o	0.30	0.30	0.30	0.30	0.30	0.30	0.30	4.77		
	with	0.30	0.00	0.00	0.00	0.30	0.30	0.30		2.71	-2.06
Western Chorus Frog	w/o	0.25	0.25	0.25	0.25	0.25	0.25	0.25	3.89		
	with	0.25	0.22	0.22	0.22	0.22	0.22	0.22		2.10	-1.79
Sora Rail	w/o	0.70	0.70	0.70	0.70	0.70	0.70	0.70	11.06		
	with	0.70	0.70	0.70	0.70	0.70	0.70	0.70		6.69	-4.37
Muskrat	w/o	0.70	0.70	0.70	0.70	0.70	0.70	0.70	3.43		
	with	0.22	0.22	0.22	0.22	0.22	0.22	0.22		2.08	-1.35
									Net Sum AAHU's =		-9.57

Peoria Lock and Dam

Location: 1
Habitat Type: MCB
Site: 1U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	5.9	5.9	5.9	5.9	5.9	5.9	5.9
with project	5.9	5.9	5.9	5.9	5.9	5.9	5.9

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.75	0.75	0.75	0.75	0.75	0.74	0.74	4.38		
	with	0.75	0.75	0.75	0.75	0.75	0.74	0.74		4.38	0.00
Lake Sturgeon (forage)	w/o	0.50	0.50	0.50	0.50	0.50	0.50	0.50	2.95		
	with	0.50	0.50	0.50	0.50	0.50	0.50	0.50		2.95	0.00
Channel Catfish	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	3.48		
	with	0.59	0.59	0.59	0.59	0.59	0.59	0.59		3.48	0.00
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.33	1.92		
	with	0.33	0.33	0.33	0.33	0.33	0.33	0.33		1.92	0.00
Sauger	w/o	0.63	0.63	0.63	0.63	0.63	0.63	0.63	3.74		
	with	0.63	0.60	0.60	0.60	0.60	0.63	0.63		3.67	-0.07
Walleye (summer)	w/o	0.15	0.15	0.15	0.15	0.15	0.14	0.14	0.86		
	with	0.15	0.10	0.10	0.10	0.10	0.14	0.14		0.76	-0.10
Walleye (winter)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	5.90		
	with	1.00	1.00	1.00	1.00	1.00	1.00	1.00		5.90	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.86	0.86	5.09		
	with	0.86	0.84	0.84	0.84	0.84	0.86	0.86		5.04	-0.05
								Net Sum AAHU's =			-0.22

Location: 1
Habitat Type: MCB
Site: 3U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.8	8.8	8.8	8.8	8.8	8.8	8.8
with project	8.8	8.8	8.8	8.8	8.8	8.8	8.8

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.99	0.99	0.99	0.99	0.99	0.99	0.99	8.69		
	with	0.99	0.99	0.99	0.99	0.99	0.99	0.99		8.69	0.00
Channel Catfish	w/o	0.48	0.48	0.48	0.48	0.48	0.48	0.48	4.18		
	with	0.48	0.47	0.47	0.48	0.48	0.48	0.48		4.18	0.00
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.33	2.87		
	with	0.33	0.33	0.33	0.33	0.33	0.33	0.33		2.87	0.00
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	4.89		
	with	0.56	0.52	0.52	0.56	0.56	0.56	0.56		4.87	-0.02
Walleye (summer)	w/o	0.15	0.15	0.15	0.15	0.15	0.14	0.14	1.28		
	with	0.15	0.10	0.10	0.15	0.15	0.14	0.14		1.25	-0.03
Walleye (winter)	w/o	1.00	0.33	1.00	1.00	1.00	1.00	1.00	8.68		
	with	1.00	0.33	1.00	1.00	1.00	1.00	1.00		8.68	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.81	0.81	0.81	0.81	0.81	0.81	0.81	7.16		
	with	0.81	0.79	0.79	0.81	0.81	0.81	0.81		7.15	-0.01
								Net Sum AAHU's =			-0.06

Location: 1
Habitat Type: MCB
Site: 2D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	1.35	1.35	1.35	1.35	1.35	1.35	1.35
with project	1.35	1.35	1.35	1.35	1.35	1.35	1.35

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.58	0.79		
	with	0.59	0.59	0.59	0.59	0.59	0.59	0.58		0.79	0.00
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	1.08		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		1.08	0.00
Channel Catfish	w/o	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.72		
	with	0.54	0.53	0.53	0.54	0.54	0.54	0.54		0.72	0.00
Paddlefish (spawning)	w/o	0.62	0.62	0.62	0.62	0.62	0.63	0.63	0.85		
	with	0.62	0.62	0.62	0.62	0.62	0.63	0.63		0.85	0.00
Paddlefish (adult)	w/o	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.29		
	with	0.22	0.22	0.22	0.22	0.22	0.22	0.22		0.29	0.00
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	0.80		
	with	0.59	0.56	0.56	0.59	0.59	0.59	0.59		0.79	-0.01
Walleye (summer)	w/o	0.15	0.15	0.15	0.15	0.15	0.14	0.14	0.19		
	with	0.15	0.10	0.10	0.15	0.15	0.14	0.14		0.19	0.00
Walleye (winter)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.35		
	with	1.00	1.00	1.00	1.00	1.00	1.00	1.00		1.35	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.84	0.84	0.84	0.84	0.84	0.84	0.84	1.13		
	with	0.84	0.81	0.81	0.84	0.84	0.84	0.84		1.13	0.00
								Net Sum AAHU's =			-0.01

Location: 1
Habitat Type: MCB
Site: 3D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.55	8.55	8.55	8.55	8.55	8.55	8.55
with project	8.55	8.55	8.55	8.55	8.55	8.55	8.55

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.51	0.51	0.51	0.51	0.51	0.51	0.51	4.33		
	with	0.51	0.51	0.46	0.46	0.46	0.46	0.45		3.92	-0.41
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	6.84		
	with	0.80	0.80	0.80	0.80	0.80	0.80	0.80		6.84	0.00
Channel Catfish	w/o	0.48	0.48	0.48	0.48	0.48	0.48	0.48	4.11		
	with	0.48	0.48	0.48	0.48	0.48	0.48	0.48		4.11	0.00
Paddlefish (spawning)	w/o	0.49	0.49	0.49	0.49	0.49	0.52	0.53	4.37		
	with	0.49	0.49	0.49	0.49	0.49	0.52	0.53		4.37	0.00
Paddlefish (adult)	w/o	0.22	0.22	0.22	0.22	0.22	0.22	0.22	1.86		
	with	0.22	0.22	0.22	0.22	0.22	0.22	0.22		1.87	0.01
Sauger	w/o	0.49	0.49	0.49	0.49	0.49	0.49	0.49	4.18		
	with	0.49	0.49	0.56	0.56	0.56	0.56	0.56		4.73	0.55
Walleye (summer)	w/o	0.15	0.15	0.15	0.15	0.15	0.14	0.14	1.23		
	with	0.15	0.14	0.14	0.15	0.15	0.14	0.14		1.22	-0.01
Walleye (winter)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	8.55		
	with	1.00	1.00	1.00	1.00	1.00	1.00	1.00		8.55	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.84	0.84	0.84	0.84	0.84	0.84	0.84	7.17		
	with	0.84	0.84	0.86	0.86	0.86	0.86	0.86		7.38	0.21
								Net Sum AAHU's =			0.35

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Peoria Lock and Dam

Location: 1
Habitat Type: BHF
Site: 4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	3.85	3.85	3.85	3.85	3.85	3.85	3.85
with project	3.85	3.85	3.85	3.85	3.85	3.85	3.85

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.12	0.20	0.43	0.48	0.48	1.61		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.61
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.18	0.71		0.96	0.96
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.10	0.20	0.30	0.68		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-0.68
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.36		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.20	-0.16
Prothonotary Warbler	w/o	0.21	0.21	0.21	0.21	0.26	0.26	0.26	0.98		
	with	0.21	0.00	0.00	0.00	0.00	0.00	0.78		0.76	-0.22
Hairy Woodpecker	w/o	0.89	0.89	0.89	0.97	0.97	0.97	0.97	3.72		
	with	0.89	0.00	0.00	0.00	0.00	0.14	0.50		0.74	-2.98
Western Chorus Frog	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
								Net Sum AAHU's =			-4.69

Location: 1
Habitat Type: BHF
Site: 5D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.68	8.68	8.68	8.68	8.68	8.68	8.68
with project	8.68	8.68	8.68	8.68	8.68	8.68	8.68

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.34	0.52	0.52	0.52	4.06		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-4.06
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.18	0.71		2.16	2.16
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.10	0.20	0.30	1.53		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.53
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.80		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.44	-0.36
Prothonotary Warbler	w/o	0.00	0.00	0.00	0.05	0.10	0.11	0.11	0.82		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.78		1.70	0.88
Hairy Woodpecker	w/o	0.69	0.69	0.69	1.00	1.00	1.00	1.00	8.49		
	with	0.69	0.00	0.00	0.00	0.00	0.14	0.50		1.64	-6.85
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
								Net Sum AAHU's =			-9.76

Peoria Lock and Dam

Location: 2
Habitat Type: MCB
Site: 1U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	9.48	9.48	9.48	9.48	9.48	9.48	9.48
with project	9.48	9.48	9.48	9.48	9.48	9.48	9.48

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.75	0.75	0.75	0.75	0.75	0.74	0.74	7.04		
	with	0.75	0.75	0.75	0.75	0.75	0.74	0.74		7.04	0.00
Lake Sturgeon (forage)	w/o	0.50	0.50	0.50	0.50	0.50	0.50	0.50	4.74		
	with	0.50	0.50	0.50	0.50	0.50	0.50	0.50		4.74	0.00
Channel Catfish	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	5.59		
	with	0.59	0.59	0.59	0.59	0.59	0.59	0.59		5.59	0.00
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.33	3.09		
	with	0.33	0.33	0.33	0.33	0.33	0.33	0.33		3.09	0.00
Sauger	w/o	0.63	0.63	0.63	0.63	0.63	0.63	0.63	6.00		
	with	0.63	0.60	0.60	0.60	0.60	0.63	0.63		5.90	-0.10
Walleye (summer)	w/o	0.15	0.15	0.15	0.15	0.15	0.14	0.14	1.37		
	with	0.15	0.10	0.10	0.10	0.10	0.14	0.14		1.21	-0.16
Walleye (winter)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	9.48		
	with	1.00	1.00	1.00	1.00	1.00	1.00	1.00		9.48	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.86	0.86	0.86	0.86	0.86	0.86	0.86	8.19		
	with	0.86	0.84	0.84	0.84	0.84	0.86	0.86		8.11	-0.08
									Net Sum AAHU's =		-0.34

Location: 2
Habitat Type: MCB
Site: 3U

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.8	8.8	8.8	8.8	8.8	8.8	8.8
with project	8.8	8.8	8.8	8.8	8.8	8.8	8.8

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Lake Sturgeon (forage)	w/o	0.99	0.99	0.99	0.99	0.99	0.99	0.99	8.69		
	with	0.99	0.99	0.99	0.99	0.99	0.99	0.99		8.69	0.00
Channel Catfish	w/o	0.48	0.48	0.48	0.48	0.48	0.48	0.48	4.18		
	with	0.48	0.47	0.47	0.48	0.48	0.48	0.48		4.18	0.00
Paddlefish (spawning)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Paddlefish (adult)	w/o	0.33	0.33	0.33	0.33	0.33	0.33	0.33	2.87		
	with	0.33	0.33	0.33	0.33	0.33	0.33	0.33		2.87	0.00
Sauger	w/o	0.56	0.56	0.56	0.56	0.56	0.56	0.56	4.89		
	with	0.56	0.52	0.52	0.56	0.56	0.56	0.56		4.87	-0.02
Walleye (summer)	w/o	0.15	0.15	0.15	0.15	0.15	0.14	0.14	1.28		
	with	0.15	0.10	0.10	0.15	0.15	0.14	0.14		1.25	-0.03
Walleye (winter)	w/o	1.00	0.33	1.00	1.00	1.00	1.00	1.00	8.68		
	with	1.00	0.33	1.00	1.00	1.00	1.00	1.00		8.68	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.81	0.81	0.81	0.81	0.81	0.81	0.81	7.16		
	with	0.81	0.79	0.79	0.81	0.81	0.81	0.81		7.15	-0.01
									Net Sum AAHU's =		-0.06

Location: 2
Habitat Type: MCB
Site: 2D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.85	8.85	8.85	8.85	8.85	8.85	8.85
with project	8.85	8.85	8.85	8.85	8.85	8.85	8.85

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Lake Sturgeon (reproduction)	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.58	5.18		
	with	0.59	0.00	0.00	0.00	0.00	0.00	0.00		0.05	-5.13
Lake Sturgeon (forage)	w/o	0.80	0.80	0.80	0.80	0.80	0.80	0.80	7.08		
	with	0.80	0.58	0.58	0.58	0.58	0.58	0.58		5.19	-1.89
Channel Catfish	w/o	0.54	0.54	0.54	0.54	0.54	0.54	0.54	4.74		
	with	0.54	0.53	0.53	0.54	0.54	0.54	0.54		4.77	0.03
Paddlefish (spawning)	w/o	0.62	0.62	0.62	0.62	0.62	0.63	0.63	5.55		
	with	0.62	0.00	0.00	0.00	0.00	0.00	0.00		0.05	-5.50
Paddlefish (adult)	w/o	0.22	0.22	0.22	0.22	0.22	0.22	0.22	1.92		
	with	0.22	0.22	0.20	0.20	0.20	0.20	0.20		1.78	-0.14
Sauger	w/o	0.59	0.59	0.59	0.59	0.59	0.59	0.59	5.21		
	with	0.59	0.56	0.56	0.59	0.59	0.59	0.59		5.19	-0.02
Walleye (summer)	w/o	0.15	0.15	0.15	0.15	0.15	0.14	0.14	1.27		
	with	0.15	0.10	0.10	0.15	0.15	0.14	0.14		1.25	-0.02
Walleye (winter)	w/o	1.00	1.00	1.00	1.00	1.00	1.00	1.00	8.85		
	with	1.00	1.00	1.00	1.00	1.00	1.00	1.00		8.85	0.00
Walleye (reproduction)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Emerald Shiner	w/o	0.84	0.84	0.84	0.84	0.84	0.84	0.84	7.42		
	with	0.84	0.81	0.81	0.84	0.84	0.84	0.84		7.41	-0.01
									Net Sum AAHU's =		-12.68

Location: 2
Habitat Type: BHF
Site: 4D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	3.85	3.85	3.85	3.85	3.85	3.85	3.85
with project	3.85	3.85	3.85	3.85	3.85	3.85	3.85

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.12	0.20	0.43	0.48	0.48	1.61		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.61
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.18	0.71		0.96	0.96
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.10	0.20	0.30	0.68		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-0.68
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.36		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.20	-0.16
Prothonotary Warbler	w/o	0.21	0.21	0.21	0.21	0.26	0.26	0.26	0.98		
	with	0.21	0.00	0.00	0.00	0.00	0.00	0.78		0.76	-0.22
Hairy Woodpecker	w/o	0.89	0.89	0.89	0.97	0.97	0.97	0.97	3.72		
	with	0.89	0.00	0.00	0.00	0.00	0.14	0.50		0.74	-2.98
Western Chorus Frog	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
									Net Sum AAHU's =		-4.69

Peoria Lock and Dam

Location: 2
Habitat Type: BHF
Site: 5D

acreage	TY0	TY1	TY2	TY5	TY10	TY25	TY50
w/o project	8.68	8.68	8.68	8.68	8.68	8.68	8.68
with project	8.68	8.68	8.68	8.68	8.68	8.68	8.68

Species	Project condition	HSI Value TY0	TY1	TY2	TY5	TY10	TY25	TY50	AAHU's w/o proj.	AAHU's w/ proj.	Net AAHU's
Pileated Woodpecker	w/o	0.00	0.00	0.00	0.34	0.52	0.52	0.52	4.06		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-4.06
Wild Turkey	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.18	0.71		2.16	2.16
Wood Duck (nesting)	w/o	0.00	0.00	0.00	0.00	0.10	0.20	0.30	1.53		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	-1.53
Wood Duck (brood rear.)	w/o	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Gray Squirrel	w/o	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.80		
	with	0.10	0.00	0.00	0.00	0.02	0.05	0.10		0.44	-0.36
Prothonotary Warbler	w/o	0.00	0.00	0.00	0.05	0.10	0.11	0.11	0.82		
	with	0.00	0.00	0.00	0.00	0.00	0.00	0.78		1.70	0.88
Hairy Woodpecker	w/o	0.69	0.69	0.69	1.00	1.00	1.00	1.00	8.49		
	with	0.69	0.00	0.00	0.00	0.00	0.14	0.50		1.64	-6.85
Western Chorus Frog	w/o	HNA	HNA	HNA	HNA	HNA	HNA	HNA	HNA		
	with	HNA	HNA	HNA	HNA	HNA	HNA	HNA		HNA	HNA
								Net Sum AAHU's =			-9.76

Appendix E

Overview of Numerical Modeling Effort for Assessment of Site-Specific Tailwater Impacts

Overview of Numerical Modeling Effort for Assessment of Site-Specific Tailwater Impacts

I. General

As part of the ongoing engineering effort in support of the Upper Mississippi River and Illinois Waterway System Navigation Study, two-dimensional numerical models were built to investigate the hydraulic impacts of new lock construction at 16 lock and dam sites on the Upper Mississippi River and Illinois Waterway. The concerns for hydraulic impacts included approach and exit conditions as well as changes in flow conditions both during and after construction.

The numerical modeling effort was designed to complement the navigation modeling effort conducted at the Waterways Experiment Station (WES) in assessment of large-scale improvement measures. While physical models are best suited for studying navigation conditions, they have a high cost and do not have the flexibility of numerical models for making quick changes in bank alignment and bathymetry. Therefore, the physical modeling effort was confined to two sites that exhibited generically representative characteristics and were used to aid in the creation and verification of the numerical models.

The purpose of this document is to provide an overview of the numerical modeling procedures and assumptions and to provide examples of the type of output the model is capable of providing. A complete description of the numerical modeling effort is contained in an interim report entitled "Hydraulic Impacts of New Lock Construction," dated July 1996.

II. Terminology

As the terminology being used to describe the various lock locations, types, sites, and alternatives can be confusing, the following definitions are provided for clarity:

Lock *Location* – Refers to where a new lock would be located in the dam structure. A plan view of the lock locations is shown in Figure 1.

- Location 1 – Landward and adjacent to the existing lock structure
- Location 2 – Extension of the existing lock
- Location 3 – Auxiliary miter gate bay or lock chamber
- Location 4 – Gated portion of the dam
- Location 5 – Non-overflow or overflow section of the dam
- Location 6 – Landward of the lock and dam structure, located on the opposite bank from the exiting lock

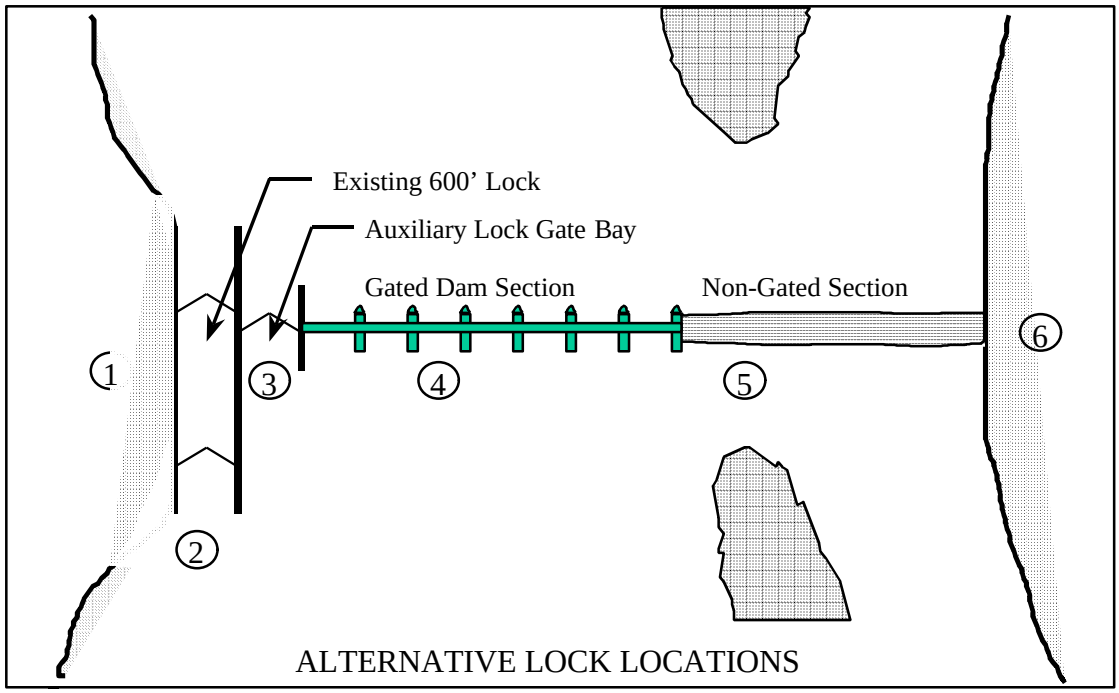


Figure 1 - Alternative New Lock Locations at a Typical Existing Lock and Dam Site.

Lock *Type* – Refers to the three conceptual lock designs being considered. Since from a river hydraulics standpoint the lock types are nearly identical, no attempt to differentiate between types was made in the modeling effort.

- Type A – Lock designed to current design standards and utilizing traditional construction techniques (i.e., a large, de-watered cofferdam).
- Type B – A lower cost lock using construction techniques proven in marine construction that previously have not commonly been used in lock construction.
- Type C – The lowest first cost design that is operationally safe with predictable performance. A "no frills" design utilizing innovative construction techniques.

Lock *Site* – Refers to a specific lock & dam (e.g., Lock & Dam 15, Lock & Dam 22, Peoria Lock & Dam, etc.)

Lock *Alternative* – Refers to a combination of lock site, location, and type.

Not all combinations of lock site, location and type are still under consideration. During the initial screening process, all Location 5, Location 6, and Type A locks were eliminated.

III. Scope of Modeling Effort

Numerical models were developed for Locks & Dams 20, 21, 22, 24, and 25 to assess navigation conditions for each large-scale improvement alternative under consideration. Unless prohibited by conditions at a specific site, lock Locations 1-4 were investigated for a variety of flows ranging from a 50% duration flow to the flow at which the lock goes out of operation. At each lock and dam site, the advantages and disadvantages for each of the lock locations were identified, and recommendations of channel improvements made. Results from the numerical and physical modeling were then used to assess plan alternatives for the remaining 11 unmodeled sites based on similarities with the modeled sites. All new locks modeled consisted of a 110-foot by 1,200-foot chamber, a 1,200-foot upstream guardwall, and a 1,200-foot downstream guidewall. Any refinements in the guardwall and guidewall lengths and configurations would be addressed during site-specific feasibility studies. Although 600-foot-long chambers were not separately modeled, the model results for the 1,200-foot locks would largely be applicable.

For the purpose of the modeling effort, it was assumed that any loss in gated capacity due to construction of a Location 4 lock would be replaced by adding new gates on a one for one basis in the overflow section of the dam (if possible).

IV. Overview of Numerical Modeling System

The TABS-2 numerical modeling system was selected to assess flow conditions at the lock and dam sites for the various lock alternatives under consideration. The TABS-2 modeling system consists of several different component programs. A brief description of the key components, and their role in the overall modeling effort, follows.

A. FastTABS

FastTABS is used as both the pre- and post-processor for the computational element of the TABS-2 modeling system. It is used to aid in the creation of the finite element mesh, the specification of model boundary conditions and flow parameters, and for the graphical presentation of model output.

B. RMA-2 (River Management Associates, Inc.)

RMA-2 is the computational element of the TABS-2 system used in this effort. RMA-2 is a two-dimensional, depth-averaged, free surface, finite element program for solving hydrodynamic problems. Through the use of conservation of mass and momentum, RMA-2 computes water surface elevations and flow velocities at nodal points in a finite element mesh representing a body of water such as a river, harbor, or estuary. Both steady-state and transient (unsteady) solutions can be performed. The output from RMA-2 is written into both a binary and an ASCII solution file. The binary solution file can be read into FastTABS for graphical display of results or the ASCII output can be reduced to a series of XYZ data points for import into a GIS database or other application.

V. Modeling Process

The following is a brief discussion of the procedures used in the creation, verification and application of the numerical models. A more detailed description of the modeling process is contained in the aforementioned interim report entitled “Hydraulic Impacts of New Lock Construction.”

A. Numerical Model Creation

Model creation consists of the construction of a numerical, finite element mesh and the specification of model parameters and boundary conditions.

1. Mesh Creation

At each lock and dam site, finite element meshes were constructed which described the bathymetry (bottom surface geometry) and adjacent topography of the sections of river being modeled. The original goal of the modeling effort was to reproduce two miles of the river both upstream and

downstream of the dam; however, the actual extent of the models was based on available bathymetric information, program constraints, and the presence of side channels. Two models were constructed for each lock and dam, one for the headwater and one for the tailwater. This is necessary as the flow through the dam structure could not be accurately represented within the numerical mesh and therefore was modeled as a known boundary condition. Hydrographic survey data in the form of XYZ coordinates were input into FastTABS as the basis for construction of the finite element mesh. The hydrographic surveys were augmented with detailed scour surveys, conducted in the vicinity of the dam, and digitized points taken from topographic maps.

Figure 2 shows a portion of the head and tailwater finite element meshes constructed for Lock & Dam 20, merged together for display purposes.

2. Boundary Conditions and Model Parameters

Once the mesh was constructed, boundary conditions were assigned to the mesh for each flow modeled. Boundary conditions were entered as an incoming (upstream) flow rate and a downstream water surface elevation. Also specified were roughness (Manning's n) and turbulent exchange parameters for each element in the geometric mesh.

B. Model Verification

The next step in the modeling process was the verification of model results in order to ensure that the model accurately reproduced conditions observed in the prototype. Through the model verification process, model parameters were adjusted to reproduce observed prototype velocities and water surface profiles. Verification of model results was accomplished through a combination of field measurements of velocity and depth, and measurements taken in the physical models of Lock & Dams 22 and 25, constructed at WES. Field measurements were used to verify the existing (or base condition) models at each site. Physical model results were used to verify the future (with project) conditions at Locks & Dams 22 and 25.

C. Application of Numerical Models

After verification of the existing condition models, adjustments were made to the finite element meshes to represent each proposed large-scale navigation improvement alternative (new lock construction at Locations 1-4). Each model was run for a variety of flow conditions representing average to maximum navigable discharges. The focus of this initial modeling effort was on higher discharges as this represents the worst conditions for navigation.

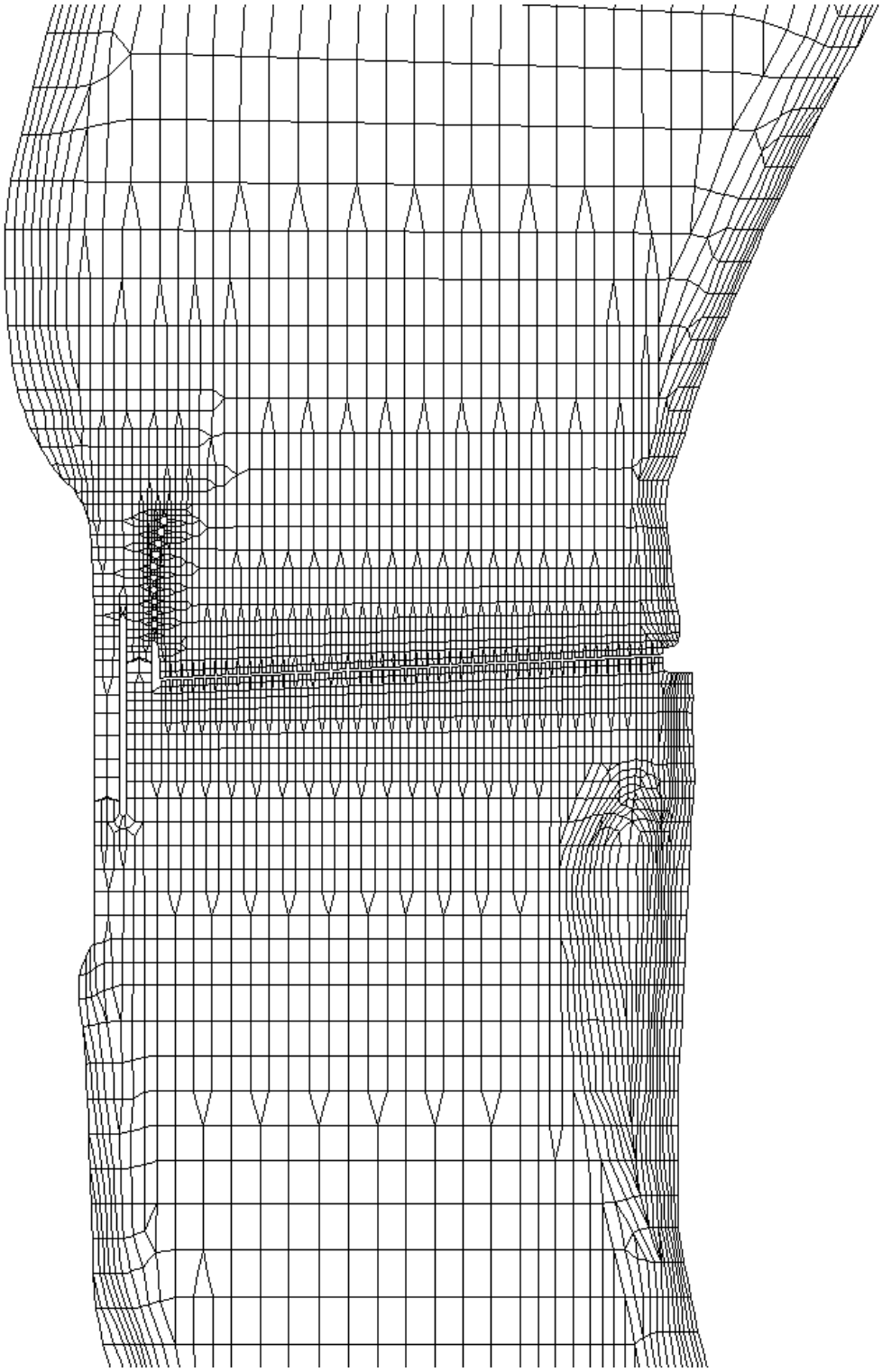


Figure 2 - Portions of the Head and Tailwater Finite Element Meshes for Lock and Dam 20, Base Conditions.

VI. Model Limitations and Assumptions

There are a number of limitations and assumptions inherent to the use of numerical models. These limitations and assumptions are not unique to this modeling effort, but rather are present in just about every application of this type of model. It is, however, important to understand these limitations and assumptions when interpreting and applying model results. The limitations and assumptions, described below, are divided into those associated with the model itself and those associated with the modeling process.

A. Numerical Model Assumptions and Limitations

As stated earlier, RMA-2 is a two-dimensional model; therefore, areas where three-dimensional flow conditions exist (such as flow through the submerged ports of the guardwall or in the immediate vicinity of the dam gates) can not be accurately represented in the model. However, if the model is capable of reproducing observed velocities and depths in these areas, it can be assumed that the three-dimensional flow conditions can be adequately represented two-dimensionally. It was on this premise that verification of the model was conducted. As with most hydraulic models, RMA-2 invokes the hydrostatic assumption, that is, the model assumes that vertical accelerations are negligible and that velocity vectors point in generally the same direction over the entire depth of the water column at any instant in time.

Second, RMA-2 is a fixed bed model. Therefore, it does not compute scour or deposition of sediments, nor does it account for any change in substrate composition or bedforms that may result from changes in the flow distribution associated with a given alternative.

As mentioned previously, the dam gates can not be accurately represented within the numerical mesh and must be modeled as a boundary condition. In the headwater model, the dam was specified as a constant water surface boundary. This resulted in a relatively uniform distribution of flow across the dam gates. At higher flows, and when the dam is out of operation, this uniform distribution of flow is appropriate. However, at low flows the majority of the flow is typically passed through the dam gates immediately adjacent to the auxiliary gate bay, not uniformly across the dam. This can be corrected for by limiting the number of gates that flow is allowed to pass through in the model at lower flows. This was not critical in the navigation modeling as the focus of the effort was on higher flows, when navigation conditions are at their worst, but would be important when modeling lower flows such as those representing overwintering conditions.

B. Assumptions and Limitations Associated with the Modeling Process

Data collection for the modeling effort extended over several seasons with bathymetric information collected first (to facilitate model creation) and prototype measurements of velocity and depth (used in the verification process) taken last. This made comparison of model and prototype velocities difficult as bathymetric changes were noted between the two surveys.

The minimum sounding increment of the hydrographic and scour surveys was 50 feet, with variable transect spacing. This makes detection of small-scale flow features impossible. While further data collection and refinement of the numerical grid sounds attractive, it would not necessarily produce a more accurate solution due to the other assumptions and limitations of the model.

Comparison of velocity measurements taken in the WES physical models to those computed in the numerical model was difficult due to the different methods of velocity measurement used in the two models. In the physical models, the velocity in the top 9 feet of the water column was measured, whereas the numerical models computed a depth-averaged velocity. This can result in large discrepancies in the tailwater region where the presence of deep scour holes results in model velocities significantly lower than those measured in the physical model.

VII. Description of Model Output

Output from the model consists of two-dimensional velocity components and water depths at each node of the finite element mesh. Contours and velocity vectors plots can be generated directly using FastTABS. Example bathymetric and velocity vector plots are shown in Figures 3 and 4. Direct comparison of alternatives is not possible in FastTABS unless the numbering and location of all nodes within the models remains the same. This is not the case between models of differing lock location, since the finite element mesh was adjusted to accommodate the new lock structure, guidewalls and guardwalls, and any channel improvements included in the model. Therefore, comparison of velocities between alternatives was accomplished through the use of GIS, described below.

VIII. Integration of Model Results with GIS Database

ArcInfo was utilized for the plotting of velocity contours and comparison of alternatives. Model input was imported into ArcInfo as XYZ coordinates with the other information (velocity, depth, etc.) input as attributes to the points. Using these points, a TIN (triangulated irregular network) was created for each alternative and velocity contours developed. In order to map the increase/decrease in velocity associated with a given alternative, the TINs had to first be converted to a lattice-grid (a 10-meter spacing was used) then subtracted from one another.

Contour diagrams, using depth-averaged data at two representative flows, 50,000 CFS and 120,000 CFS, were created for the base condition and for new lock Location 4. As described earlier, this location entails replacement of lost flow with a new gate, and thus has the most potential to induce changes in velocity magnitude or direction. Though

Figure 3 - Example Contour Plot Showing Existing Tailwater Bathymetry at Lock and Dam 20.

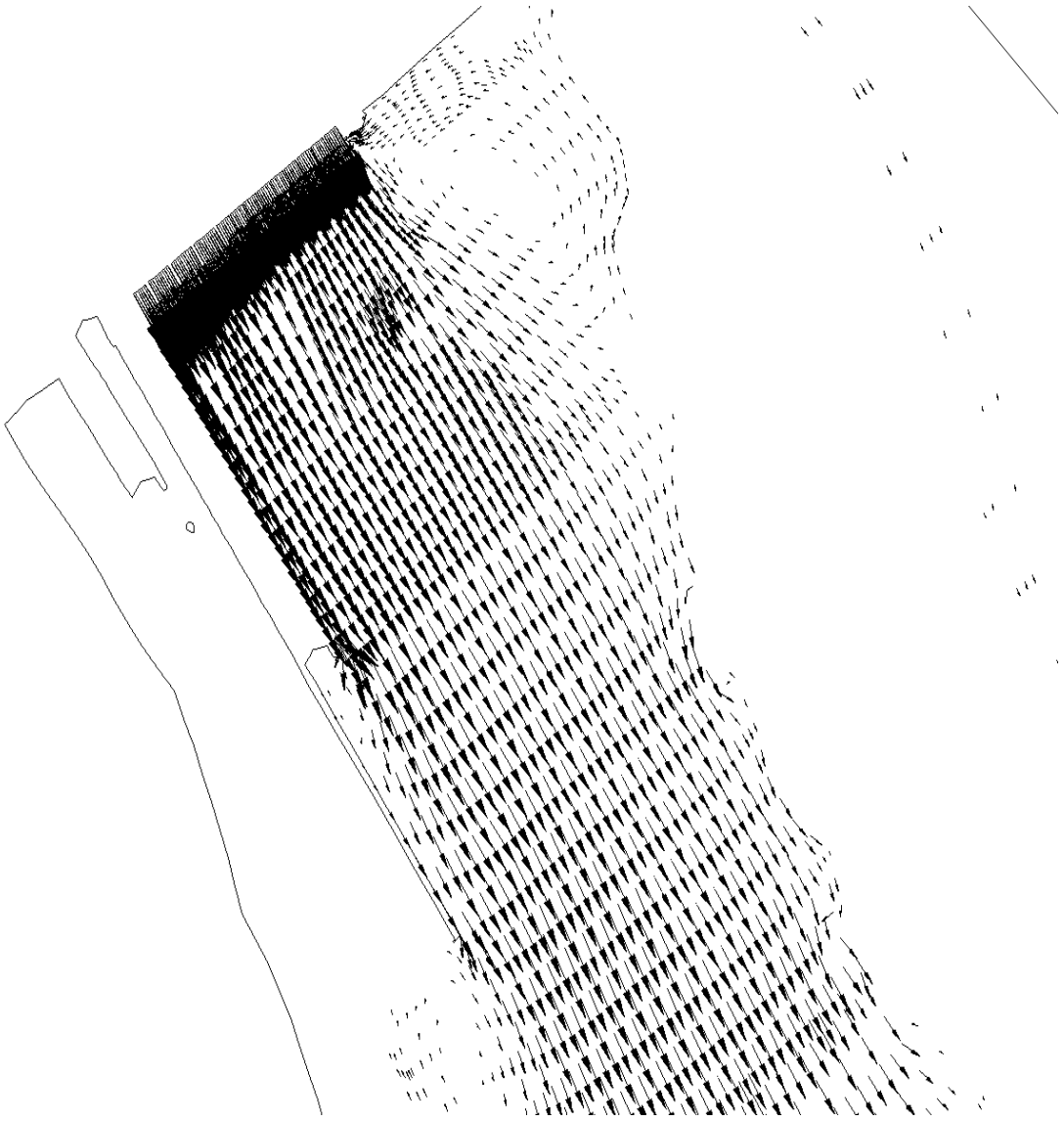


Figure 4 - Example Velocity Vector Plot Showing Flow Through a Location 4 Ported Guardwall at Lock and Dam 22.

changes (in the area of the dam) with other lock locations are not foreseen at this time, similar diagrams could be created if deemed necessary. These diagrams are intended to portray the areal extent and magnitudinal change in velocity in areas approximately 2 miles upstream and downstream of the dam, with the primary focus being downstream.

IX. Conversion from Depth-Averaged Velocity to Vertical Profile

At the November 13, 1996, NECC meeting, resource agency representatives inquired whether the depth-averaged velocities could be converted to a velocity one or two feet off the channel bottom. One way this could be done is through the use of a standard turbulent velocity profile. Knowing the depth, channel geometry, bed roughness (or representative grain size) and the computed depth-averaged velocity at each node, the velocity at any depth can be estimated using one of a number of turbulent velocity profiles that have been proposed. An example of such a profile, proposed by Vanoni (1967), is as follows:

$$v = V + \frac{1}{K}\sqrt{gdS}\left(1 + \ln\frac{y}{d}\right)$$

Where:
y = depth at which to compute velocity
v = velocity at depth y
V = depth-averaged velocity
d = channel depth
g = acceleration due to gravity
S = channel slope
K = Von Karmon constant ≈ 0.4

This type of approach would work in a fairly uniform portion of the channel, but would not be appropriate immediately upstream or downstream of the dam, near structures (e.g., ported guardwalls, dikes, etc.), or in areas downstream of the dam where significant scour holes have developed.

Glossary

Boundary Conditions: Water levels, flows, concentrations, stage/discharge relationships, etc., which are specified at the boundaries of the area being modeled. Unspecified boundaries are considered "no-flow" boundaries by the model.

Finite Element: A method of solving the basic governing equations of a numerical model. The spatial domain is divided into geometric elements in which the solution of the governing equations is approximated by a continuous function. This method lends itself well to the river environment because of its diversity in computational mesh (element size, shape, and orientation), flexibility of boundary conditions, and continuity of the solution over the area.

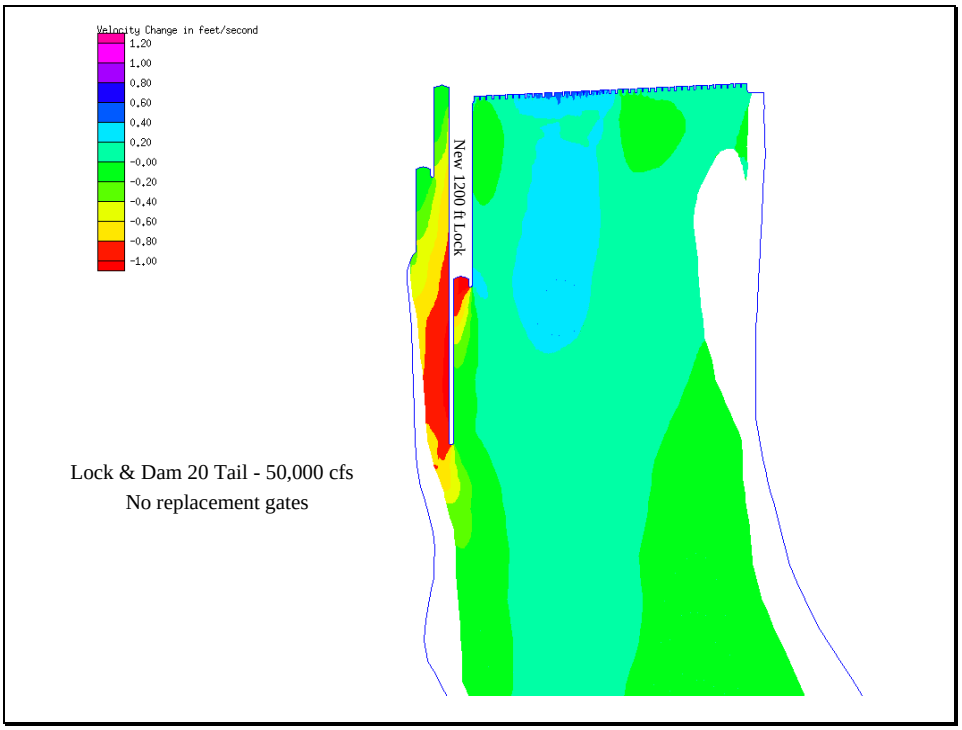
Manning's n: A channel roughness parameter attributed to R. Manning (1889), which is widely used in hydraulic calculations involving free-surface (open channel) flow.

Roughness: In a river or stream bed, the material on the side slopes or the bottom that inhibits the flow.

Steady-State: A simulation in which the boundary conditions are static. The variables being investigated (flow, depth, velocity) do not change with time.

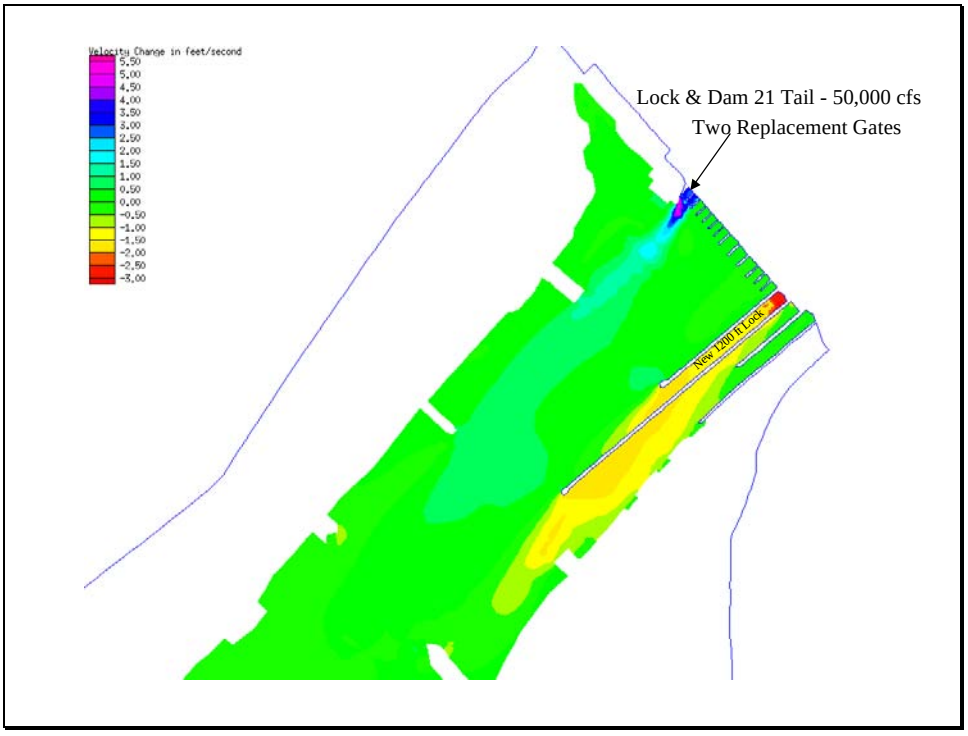
Transient: Opposite of steady-state. Boundary conditions and variables being investigated change with time. Used when modeling a specific event (e.g., the flood of 1993) or hypothetical hydrograph.

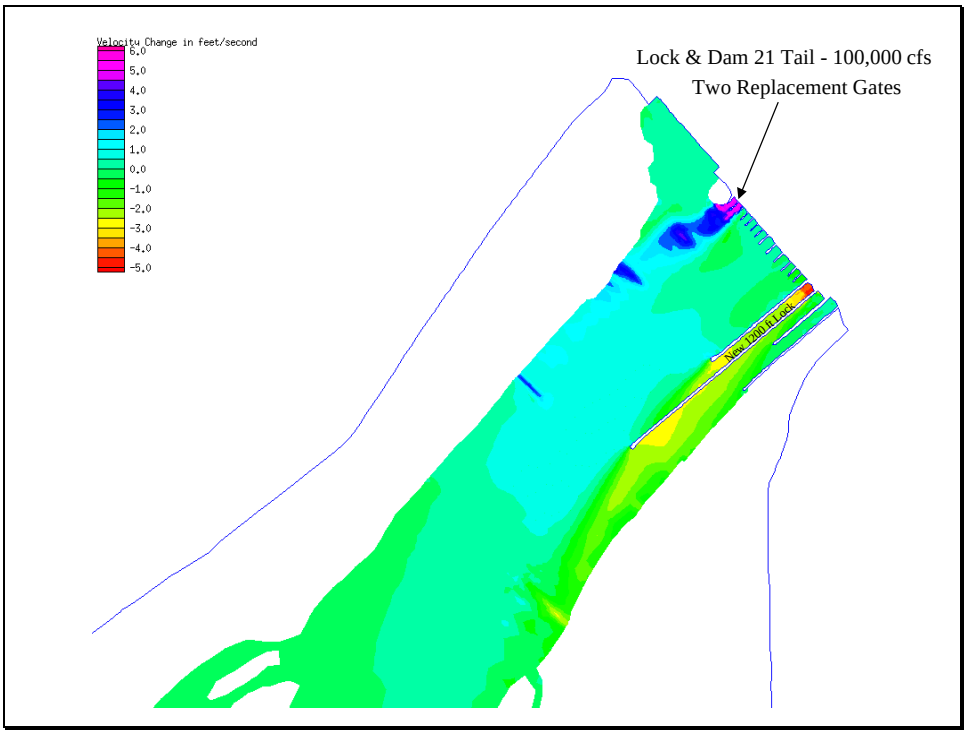
Example TABS Outputs at Each Lock Modeled

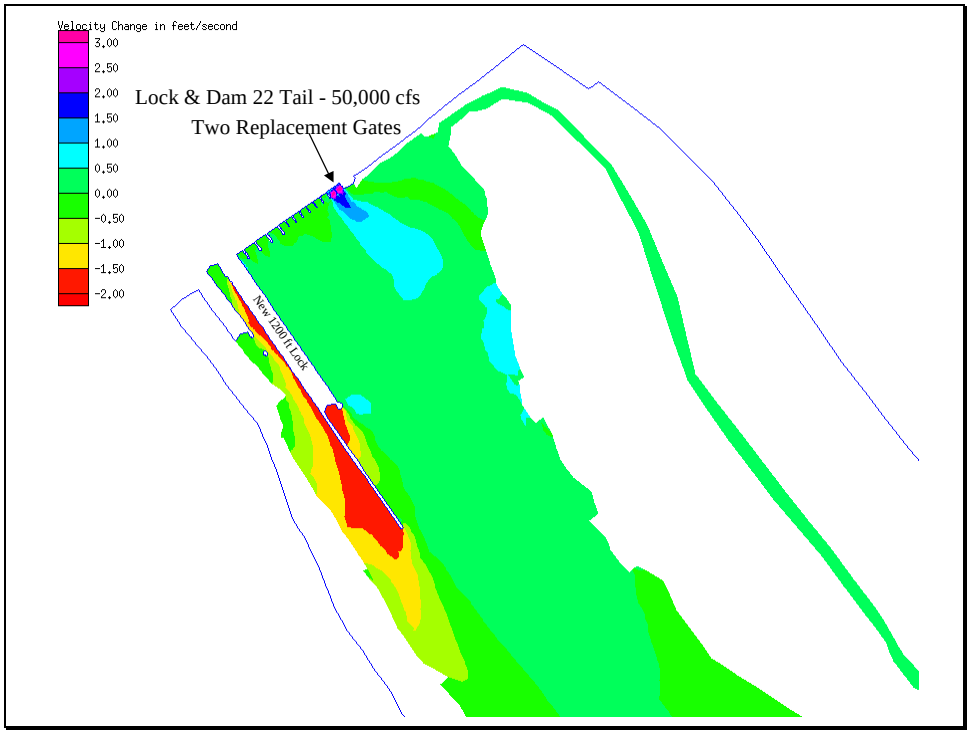


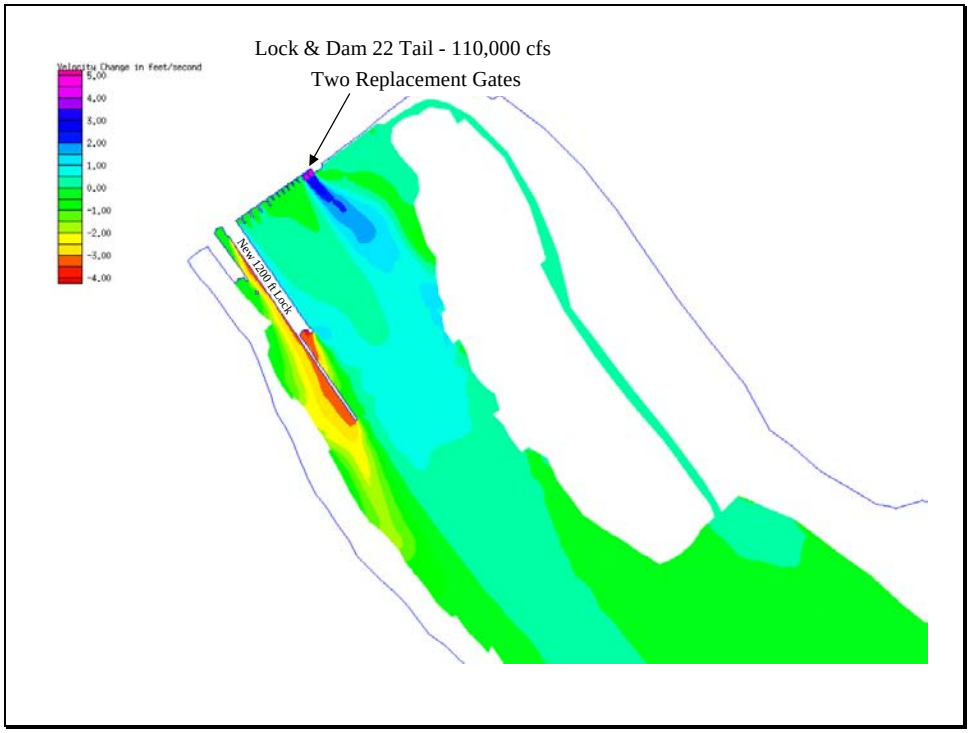
Lock & Dam 20 Tail - 50,000 cfs
No replacement gates

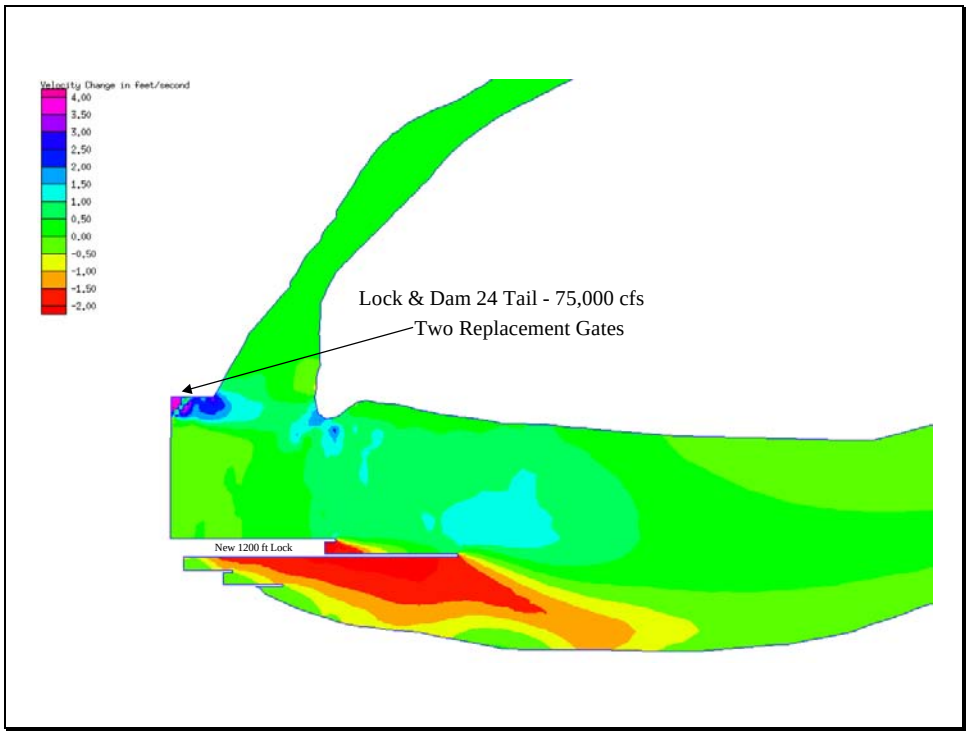
Lock & Dam 20 Tail - 95,000 cfs
No Replacement Gates

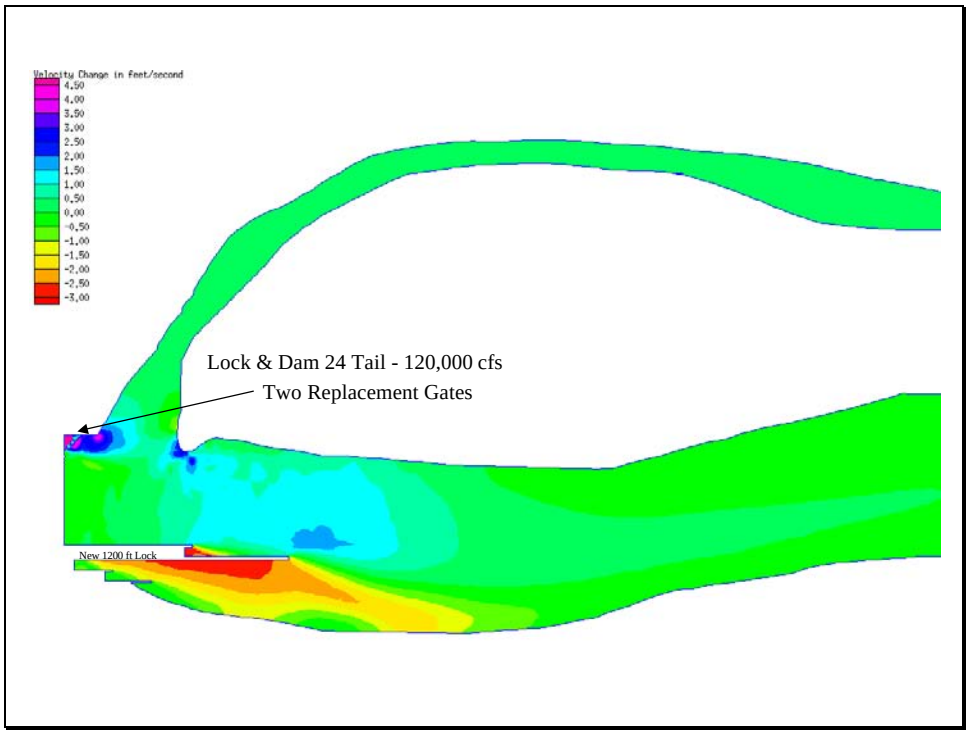

Velocity Change in feet/second
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
Lock & Dam 21 Tail - 50,000 cfs
Two Replacement Gates
New 1200 ft Lock

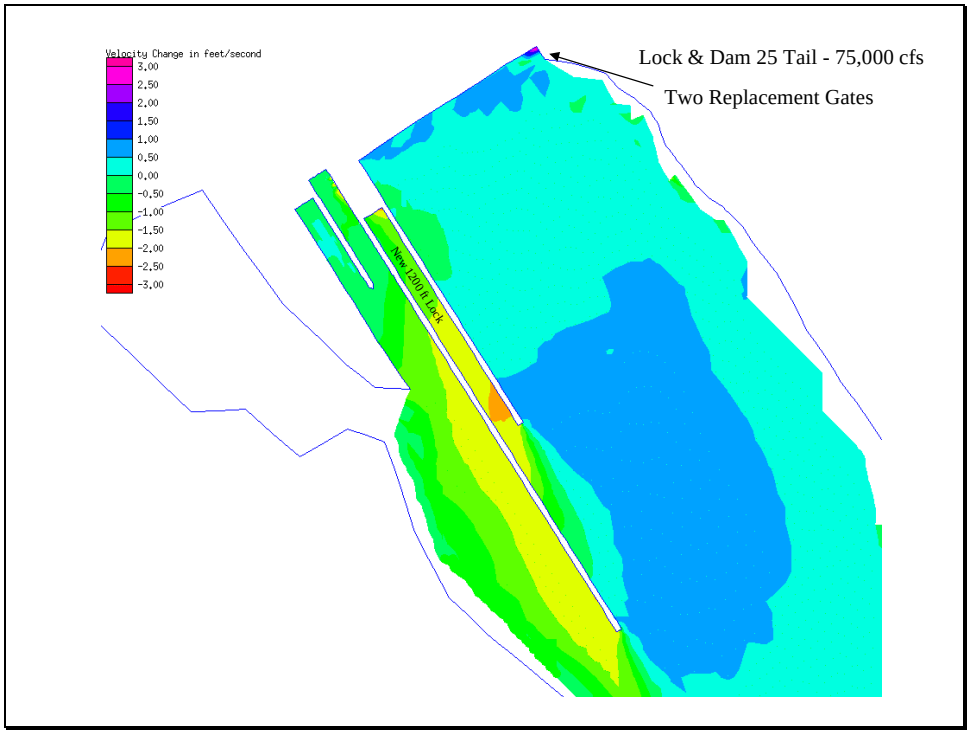

Velocity Change in feet/second
6.0
5.0
4.0
3.0
2.0
1.0
0.0
-1.0
-2.0
-3.0
-4.0
-5.0
Lock & Dam 21 Tail - 100,000 cfs
Two Replacement Gates
New 1200 ft Lock

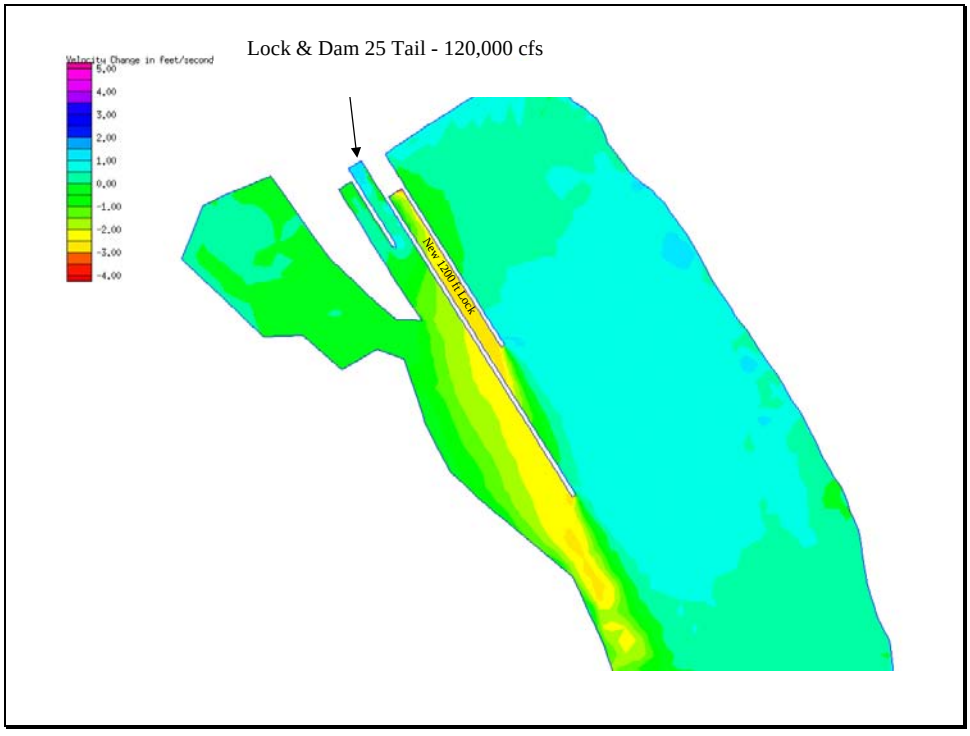

Velocity Change in feet/second
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
Lock & Dam 22 Tail - 50,000 cfs
Two Replacement Gates
New 1200 ft Lock


Lock & Dam 22 Tail - 110,000 cfs
Two Replacement Gates
Velocity Change in feet/second
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
New 1200 ft Lock


Velocity Change in Feet/second
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
Lock & Dam 24 Tail - 75,000 cfs
Two Replacement Gates
New 1200 ft Lock

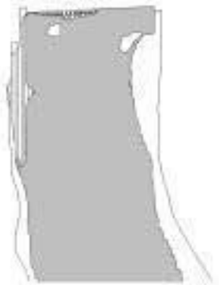

Velocity Change in Feet/second
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
Lock & Dam 24 Tail - 120,000 cfs
Two Replacement Gates
New 1200 ft Lock


Velocity Change in feet/second
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
-1.50
-2.00
-2.50
-3.00
New 1200 ft Lock
Lock & Dam 25 Tail - 75,000 cfs
Two Replacement Gates

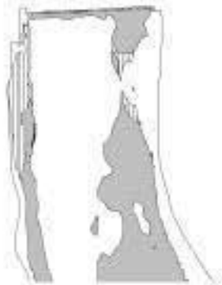

Lock & Dam 25 Tail - 120,000 cfs
Velocity Change in feet/second
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
New 1200 ft Lock

Appendix F

Tailwater Assessment Results

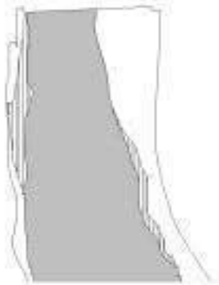


Lake Sturgeon
Foraging
50,000 CFS

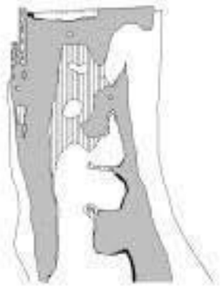


Lake Sturgeon
Spawning
95,000 CFS

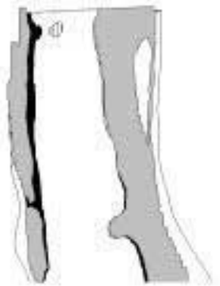
Channel Catfish
Year-Round
50,000 CFS



Paddlefish
Spawning
95,000 CFS

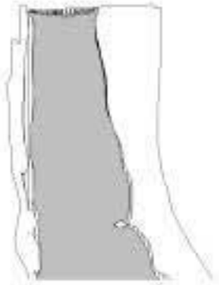


Paddlefish
Adult
50,000 CFS



Emerald Shiner
High Spring Flow
95,000 CFS

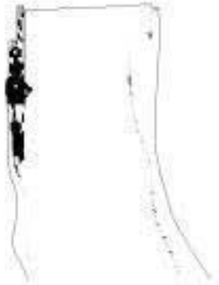
Lock & Dam 20



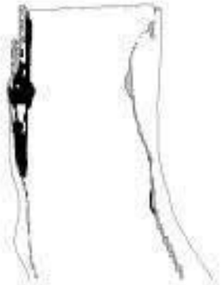
Sauger/Walleye
Spawning
95,000 CFS

Sauger/Walleye
Wintering
50,000 CFS

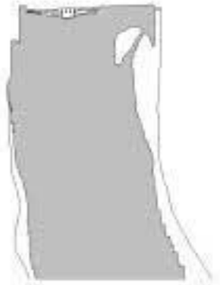
Largemouth Bass
Spawning
95,000 CFS



Largemouth Bass
Fry
50,000 CFS



Largemouth Bass
Adult/Juvenile
50,000 CFS



Emerald Shiner
Low Flow
50,000 CFS

Tailwater Fisheries Habitat Analysis

This assessment was completed to address potential fisheries effects with construction of a 1200-foot lock and guidewall at location 4. Potential aquatic habitat in the tailwater was determined using output from calibrated depth and velocity models (TABS). Velocity and bathymetric data were imported into Arc Info and queried to identify and quantify potential habitat and to determine changes in habitat with the project.

These figures merely show habitat changes resulting modeled depth and/or velocity. Other variables such as substrate, turbidity, disturbance, and temperature were not modeled but play a large role in determining available habitat. These figures can be used as a tool to examine general habitat changes but do not necessarily represent real losses nor gains in habitat.

Discussion of this assessment is included within the body of the report and description of TABS modeling are included in Appendix E.

Gain in Habitat With Project

Loss in Habitat With Project

No Change in Habitat With Project

2000 0 2000 4000 Feet

500 0 500 1000 Metres

U.S. ARMY ENGINEER DISTRICTS
CORPS OF ENGINEERS

ROCK ISLAND, ILLINOIS
ST. LOUIS, MISSOURI
ST. PAUL, MINNESOTA

US Army Corps of Engineers
Rock Island District
St. Louis District
St. Paul District

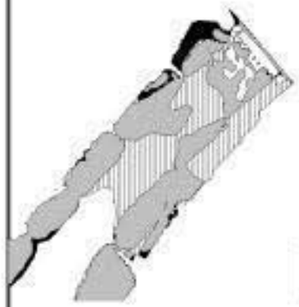
UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

SITE SPECIFIC HABITAT ASSESSMENT LOCK AND DAM NO. 20

Scale: AS SHOWN

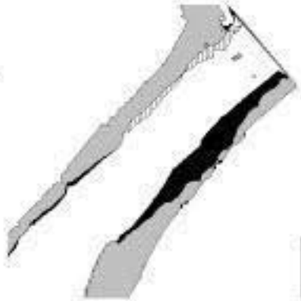
Date: 30 APRIL 1998

APPENDIX F

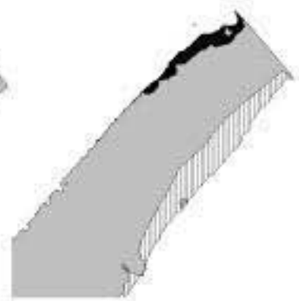


Lake Sturgeon
Foraging
50,000 CFS

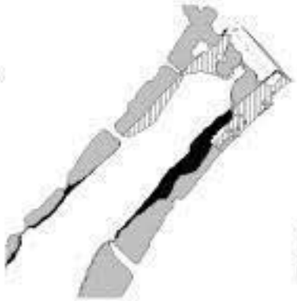
Lake Sturgeon
Spawning
100,000 CFS



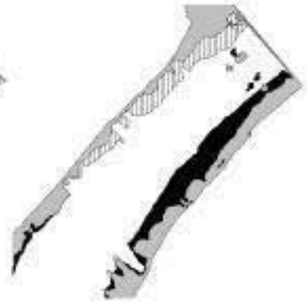
Channel Catfish
Year-Round
50,000 CFS



Paddlefish
Spawning
100,000 CFS

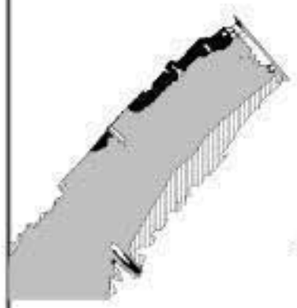


Paddlefish
Adult
50,000 CFS

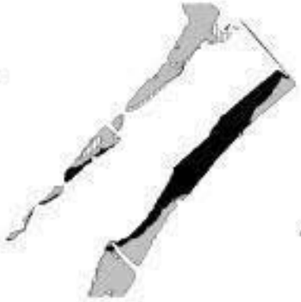


Emerald Shiner
High Spring Flow
100,000 CFS

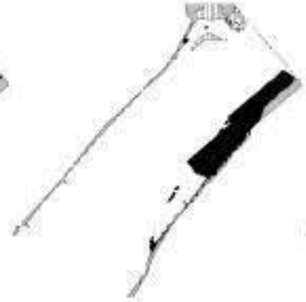
Lock & Dam 21



Sauger/Walleye
Spawning
100,000 CFS

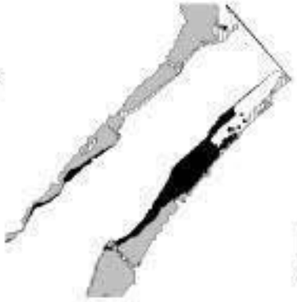


Sauger/Walleye
Wintering
50,000 CFS

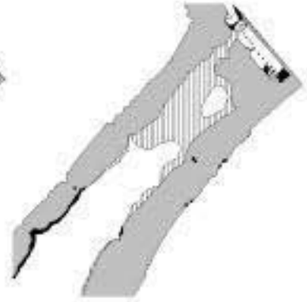


Largemouth Bass
Spawning
100,000 CFS

Largemouth Bass
Fry
50,000 CFS



Largemouth Bass
Adult/Juvenile
50,000 CFS



Emerald Shiner
Low Flow
50,000 CFS

Tailwater Fisheries Habitat Analysis

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Gain in Habitat With Project

Loss in Habitat With Project

No Change in Habitat With Project

2000 0 2000 4000 Feet

500 0 500 1000 Metres

U.S. ARMY ENGINEER DISTRICTS
CORPS OF ENGINEERS

ROCK ISLAND, ILLINOIS
ST. LOUIS, MISSOURI
ST. PAUL, MINNESOTA

US Army Corps of Engineers
Rock Island District
St. Louis District
St. Paul District

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

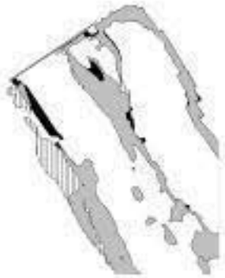
SITE SPECIFIC HABITAT ASSESSMENT LOCK AND DAM NO. 21

Scale: AS SHOWN

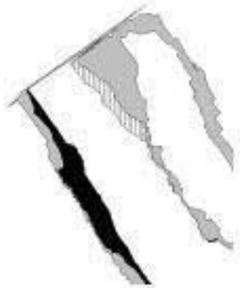
Date: 30 APRIL 1998

APPENDIX F

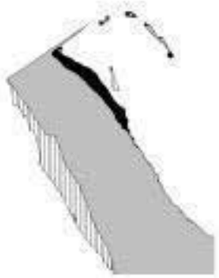
Lake Sturgeon
Foraging
50,000 CFS



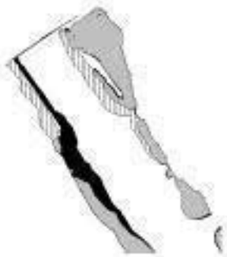
Lake Sturgeon
Spawning
120,000 CFS



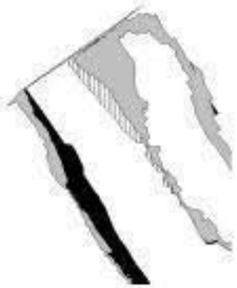
Channel Catfish
Year-Round
50,000 CFS



Paddlefish
Spawning
120,000 CFS



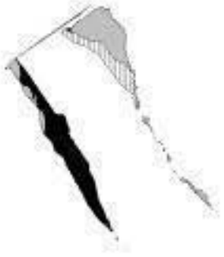
Paddlefish
Adult
50,000 CFS



Emerald Shiner
High Spring Flow
120,000 CFS

Lock & Dam 22

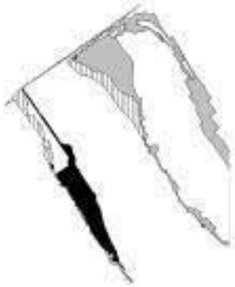
Sauger/Walleye
Spawning
120,000 CFS



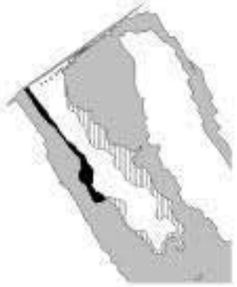
Sauger/Walleye
Wintering
50,000 CFS

Largemouth Bass
Spawning
120,000 CFS

Largemouth Bass
Fry
50,000 CFS



Largemouth Bass
Adult/Juvenile
50,000 CFS



Emerald Shiner
Low Flow
50,000 CFS

Tailwater Fisheries Habitat Analysis

This assessment was completed to address potential fisheries effects with construction of a 1200-foot lock and guidewall at location 4. Potential aquatic habitat in the tailwater was determined using output from calibrated depth and velocity models (TABS). Velocity and bathymetric data were imported into Arc Info and queried to identify and quantify potential habitat and to determine changes in habitat with the project.

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Gain in Habitat With Project

Loss in Habitat With Project

No Change in Habitat With Project

2000 0 2000 4000 Feet

500 0 500 1000 Metres

U.S. ARMY ENGINEER DISTRICTS
CORPS OF ENGINEERS

ROCK ISLAND, ILLINOIS
ST. LOUIS, MISSOURI
ST. PAUL, MINNESOTA

US Army Corps of Engineers
Rock Island District
St. Louis District
St. Paul District

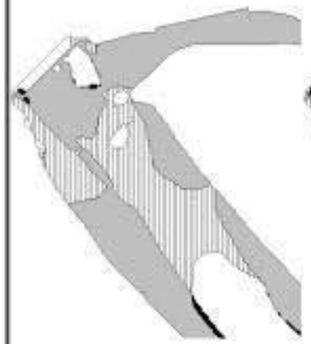
UPPER MISSISSIPPI RIVER &
ILLINOIS WATERWAY
SYSTEM NAVIGATION STUDY

SITE SPECIFIC
HABITAT ASSESSMENT
LOCK AND DAM NO. 22

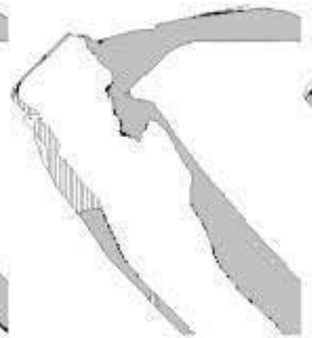
Scale: AS SHOWN

Date: 30 APRIL 1998

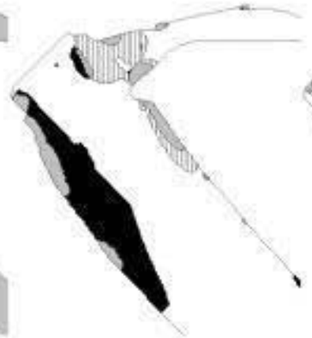
APPENDIX F



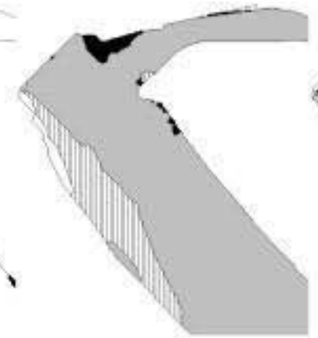
Lake Sturgeon
Foraging
65,000 CFS



Lake Sturgeon
Spawning
120,000 CFS



Channel Catfish
Year-Round
65,000 CFS

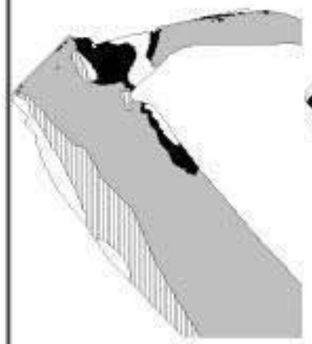


Paddlefish
Spawning
120,000 CFS

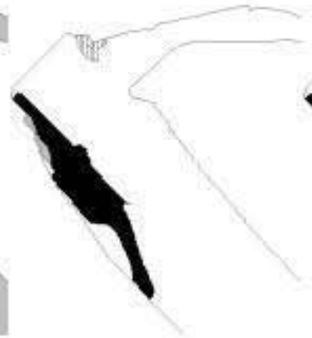
Paddlefish
Adult
65,000 CFS

Emerald Shiner
High Spring Flow
120,000 CFS

Lock & Dam 24

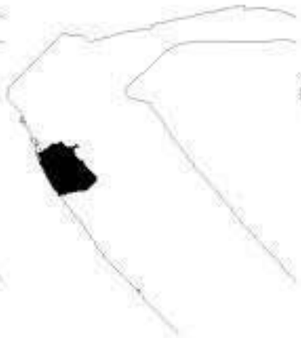


Sauger/Walleye
Spawning
120,000 CFS

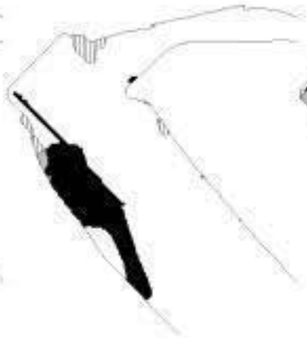


Sauger/Walleye
Wintering
65,000 CFS

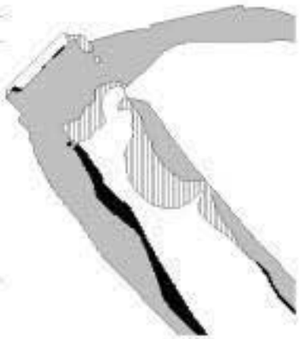
Largemouth Bass
Spawning
120,000 CFS



Largemouth Bass
Fry
65,000 CFS



Largemouth Bass
Adult/Juvenile
65,000 CFS



Emerald Shiner
Low Flow
65,000 CFS

Tailwater Fisheries Habitat Analysis

This assessment was completed to address potential fisheries effects with construction of a 1200-foot lock and guidewall at location 4. Potential aquatic habitat in the tailwater was determined using output from calibrated depth and velocity models (TABS). Velocity and bathymetric data were imported into Arc Info and queried to identify and quantify potential habitat and to determine changes in habitat with the project.

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Discussion of this assessment is included within the body of the report and description of TABS modeling are included in Appendix E.

Gain in Habitat With Project

Loss in Habitat With Project

No Change in Habitat With Project

2000 0 2000 4000 Feet

500 0 500 1000 Metres

U.S. ARMY ENGINEER DISTRICTS
CORPS OF ENGINEERS

ROCK ISLAND, ILLINOIS
ST. LOUIS, MISSOURI
ST. PAUL, MINNESOTA

US Army Corps of Engineers
Rock Island District
St. Louis District
St. Paul District

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

SITE SPECIFIC HABITAT ASSESSMENT LOCK AND DAM NO. 24

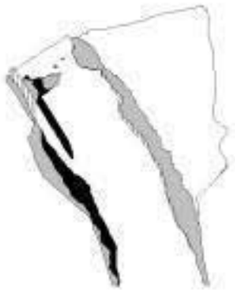
Scale: AS SHOWN

Date: 30 APRIL 1998

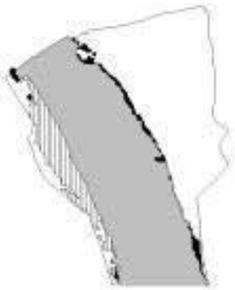
APPENDIX F

Lake Sturgeon
Foraging
65,000 CFS

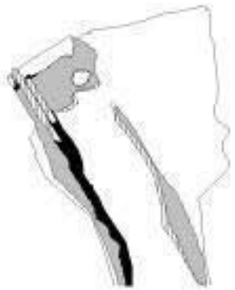
Lake Sturgeon
Spawning
120,000 CFS



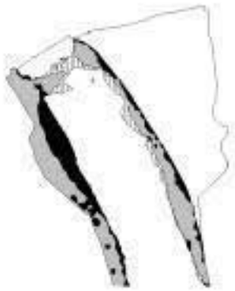
Channel Catfish
Year-Round
65,000 CFS



Paddlefish
Spawning
120,000 CFS



Paddlefish
Adult
65,000 CFS



Emerald Shiner
High Spring Flow
120,000 CFS

Lock & Dam 25

Sauger/Walleye
Spawning
120,000 CFS

Sauger/Walleye
Wintering
65,000 CFS

Largemouth Bass
Spawning
120,000 CFS

Largemouth Bass
Fry
65,000 CFS

Largemouth Bass
Adult/Juvenile
65,000 CFS

Emerald Shiner
Low Flow
65,000 CFS

Tailwater Fisheries Habitat Analysis

This assessment was completed to address potential fisheries effects with construction of a 1200-foot lock and guidewall at location 4. Potential aquatic habitat in the tailwater was determined using output from calibrated depth and velocity models (TABS). Velocity and bathymetric data were imported into Arc Info and queried to identify and quantify potential habitat and to determine changes in habitat with the project.

These figures merely show habitat changes resulting modeled depth and/or velocity. Other variables such as substrate, turbidity, disturbance, and temperature were not modeled but play a large role in determining available habitat. These figures can be used as a tool to examine general habitat changes but do not necessarily represent real losses nor gains in habitat.

Discussion of this assessment is included within the body of the report and description of TABS modeling are included in Appendix E.

Gain in Habitat With Project

Loss in Habitat With Project

No Change in Habitat With Project

2000 0 2000 4000 Feet

500 0 500 1000 Metres

U.S. ARMY ENGINEER DISTRICTS
CORPS OF ENGINEERS

ROCK ISLAND, ILLINOIS
ST. LOUIS, MISSOURI
ST. PAUL, MINNESOTA

US Army Corps of Engineers
Rock Island District
St. Louis District
St. Paul District

UPPER MISSISSIPPI RIVER & ILLINOIS WATERWAY SYSTEM NAVIGATION STUDY

SITE SPECIFIC HABITAT ASSESSMENT LOCK AND DAM NO. 25

Scale: AS SHOWN

Date: 30 APRIL 1998

APPENDIX F

Appendix G

Threatened and Endangered Species

Federally Listed Species that May Be Encountered within the Impact Area of Locks and Dams 11-19 and Upper Sites on the Illinois River

Lock and Dam 11
Bald eagle (*Haliaeetus leucocephalus*) (wintering, breeding)
Higgins' eye pearly mussel (*Lampsilis higginsi*)
Iowa Pleistocene snail (*Discus macclintocki*)
Northern monkshood (*Aconitum novaboracense*)

Lock and Dam 12
Bald eagle (wintering, breeding)
Higgins' eye pearly mussel (potential impacts to secondary habitat)
Iowa Pleistocene snail

Lock and Dam 13
Bald eagle (wintering, breeding)
Higgins' eye pearly mussel
Iowa Pleistocene snail
Northern monkshood
Eastern prairie fringed orchid (*Platanthera leucophaea*)

Lock and Dam 14
Indiana bat (*Myotis sodalis*)
Peregrine falcon (*Falco peregrinus*)
Higgins' eye pearly mussel (potential impacts to secondary habitat)
Bald eagle (wintering)

Lock and Dam 15
Indiana bat
Peregrine falcon
Higgins' eye pearly mussel
Bald eagle (wintering)

Lock and Dam 16
Indiana bat
Peregrine falcon
Higgins' eye pearly mussel
Bald eagle (wintering, breeding)

Lock and Dam 17
Indiana bat
Higgins' eye pearly mussel
Bald eagle (wintering)

Lock and Dam 18
Indiana bat
Higgins' eye pearly mussel
Bald eagle (wintering)

Lock and Dam 19
Indiana bat
Higgins' eye pearly mussel
Bald eagle (wintering, breeding)
Fat pocketbook pearly mussel (*Potamilus capax*)

Lockport, Brandon Road Lock and Dam
Bald eagle (wintering)
Leafy prairie clover (*Dalea foliosa*)
Lakeside daisy (*Hymenoxis herbacea*)
Hines emerald dragonfly (*Somatochlora hineana*)

Dresden Island, Marsailles, Starved Rock Locks and Dams
Bald eagle (wintering)
Eastern prairie fringed orchid

Species that may occur in the vicinity of Locks and Dams 20-25, Peoria, and La Grange are discussed within the body of the report.

State Listed Species that May Be Encountered within the Impact Area of Locks and Dams 11-25 and Upper Sites on the Illinois River

Lists of endangered, threatened and special concern species were compiled from the Missouri, Illinois, Iowa, Minnesota and Wisconsin Offices of Natural Heritage using their databases. An initial screening of those species was based upon presence or absence of the species' habitat in the floodplain and therefore within the study area. The following list includes species that have been recorded within the immediate vicinity (2 miles) of Locks and Dams 11-25 on the Upper Mississippi River and from Brandon Road to La Grange Locks and Dams on the Illinois River.

Without further inventories it is impossible to know of the presence of State-listed species within a potential zone of impact. However, there may be the potential to affect State-listed species by construction. As site-specific plans are developed, review by State natural resource agencies should identify the potential for adverse impacts to State-listed species. If potential impacts are identified, appropriate measures to avoid and minimize these impacts will be included in the planning process. This listing is included for consideration in further planning at each lock and dam site and should be verified at that time. Discussion of potential impacts will be included in separate documents.

Lock and Dam 11	**Iowa**	**Wisconsin**
Paddlefish *(Polydon spathula)*	NONE	THR
Goldeye *(Hiodon alosoides)*	NONE	END
Blue Sucker *(Cycleptus elongatus)*	NONE	THR
Black Buffalo *(Ictiobus niger)*	NONE	THR
Giant Carrion Beetle *(Nicrophorus americanus)*	NONE	END
Ebonyshell *(Fusconaia ebena)*	NONE	END
Wartyback *(Quadrula nodulata)*	NONE	THR
American Fever-few *(Parthenium integrifolium)*	NONE	THR
Roundfruit (St. John's Wort) *(Hypercum sphaerocarpum)*	NONE	THR
Bobcat *(Lynx rufus)*	END	NONE

Lock and Dam 12	**Iowa**	**Illinois**
Lake Sturgeon *(Acipenser fluvescens)*	THR	END
Hairy Umbrella Wort *(Mirabilis hirsuta)*	NONE	END
Red Shouldered Hawk *(Buteo lineatus)*	END	END
Great Egret *(Casmerodius albus)*	NONE	THR
River Otter *(Lutra Canadensis)*	THR	END
Rough Buttonweed *(Dioda teres)*	END	NONE
Cooper's Hawk *(Accipiter cooperii)*	END	END

Lock and Dam 13	**Iowa**	**Illinois**
Sandhill Crane *(Grus canadensis)*	NONE	END
River Otter *(Lutra canadensis)*	THR	END
Western Hognose Snake *(Hertodon nasicus)*	END	THR
Lake Sturgeon *(Acipenser fluvescens)*	THR	END
Kitten Tails *(Besseya bullii)*	THR	THR

Lock and Dam 14	**Iowa**	**Illinois**
Lake Sturgeon *(Acipenser fluvescens)*	THR	END

Lock and Dam 15	**Iowa**	**Illinois**
None	NONE	NONR

Lock and Dam 16	**Iowa**	**Illinois**
Spectaclecase *(Cumberlandia monodonta)*	END	END
Lake Sturgeon *(Acipenser fluvescens)*	THR	END
Blacknose Shiner *(Notropis heterolepis)*	THR	END

Lock and Dam 17	**Iowa**	**Illinois**
Great Egret *(Casmerodius albus)*	NONE	THR
Ebonyshell *(Fusconaia ebena)*	NONE	THR
Yellow Crowned Night Heron *(Nyctanassa violacea)*	NONE	THR
Red-Shouldered Hawk *(Buteo lineatus)*	END	END

Lock and Dam 18	**Iowa**	**Illinois**
Great Egret *(Casmerodius albus)*	NONE	THR

Lock and Dam 19	**Iowa**	**Illinois**
River Otter *(Lutra canadensis)*	THR	END
Sheepnose Mussel *(Plethobasus cyphus)*	NONE	END
Great Egret *(Casmerodius albus)*	NONE	THR
Common Barn Owl *(Tyto alba)*	END	END

Lock and Dam 20	**Missouri**	**Illinois**
River Otter *(Lutra canadensis)*	NONE	END
Plains Violet *(Viola varium)*	NONE	END
Pallid Shiner *(Notropis amnis)*	EXT	END

Lock and Dam 21	**Missouri**	**Illinois**
Mooneye *(Hiodon tergisus)*	RARE	NONE
Elusive Clubtail *(Stylurus notatus)*	SU	NONE

Lock and Dam 22	**Missouri**	**Illinois**
Fat Pocketbook *(Potamilus capax)*	END	END
Rock-Pocketbook *(Arcidens confragosus)*	RARE	NONE
Elusive Clubtail *(Stylurus notatus)*	SU	NONE
Wild Sarsparilla *(Aralia nudicaulis)*	RARE	NONE

Lock and Dam 24	**Missouri**	**Illinois**
River Otter *(Lutra canadensis)*	NONE	END
Great Egret *(Casmerodius albus)*	RARE	THR
Lake Sturgeon *(Acipenser fluvescens)*	END	END
Long-Tailed Weasel *(Mustela frenata)*	RARE	NONE

Lock and Dam 25	**Missouri**	**Illinois**
Spectaclecase *(Cumberlandia monodonta)*	NONE	END
Salt Meadow Grass *(Leptochloa panicoides)*	NONE	END

Peoria Lock and Dam	**Illinois**
Double-Crested Cormorant *(Phalacrocorax auritus)*	THR

La Grange Lock and Dam	**Illinois**
Great Egret (*Casmerodius albus)*	THR

Marseilles Lock and Dam	**Illinois**
None	

Starved Rock Lock and Dam	**Illinois**
Double-Crested Cormorant *(Phalacrocorax auritus)*	THR
Arbor Vitae *(Thuja occidentalis)*	THR
Red-Shouldered Hawk *(Buteo lineatus)*	END
Brown Creeper (*Certhia americana)*	THR
Forked Aster *(Aster furcatus)*	THR
Golden Corydalis *(Corydalis aurea)*	END
Hemlock Panic Grass *(Dicanthelium columbianum)*	END
Fibrous Root Sedge *(Carex communis)*	END
Veery *(Catharus fuscescens)*	THR

END – Endangered.
THR – Threatened.
SC – Special Concern.
RARE – Missouri's equivalence of Threatened.
SU – Status Undetermined (may be Rare or Endangered but not enough information is available to determine status).
EXT – Extirpated (species still occurs somewhere in its natural range but no longer within that state).
NONE – Not listed for that state.