# UPPER MISSISSIPPI RIVER RESTORATION
# FEASIBILITY REPORT
# WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

## GILEAD SLOUGH
## HABITAT REHABILITATION AND ENHANCEMENT PROJECT

**POOL 25, UPPER MISSISSIPPI RIVER MILES 253-248**
**CALHOUN COUNTY, IL**

Appendix B: Habitat Evaluation and Quantification

US Army Corps of Engineers®
St. Louis District

January **2026**
Draft Version

Upper Mississippi River Restoration
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## 1. Introduction

This appendix provides the documentation of the habitat evaluation and quantification process that was conducted to evaluate the benefits of various alternatives for the Gilead Slough HREP. The evaluation was conducted by a multi-agency team with active participants that included biologists and foresters from the St. Louis District U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, and the Illinois Department of Natural Resources; names and disciplines are included in Table B-1 below.

*Table B-1. Team that Participated in the Habitat Benefits Analysis for the Gilead Slough HREP.*

| Team Member | Specialty | Affiliation |
|---|---|---|
| Justin Garrett | Biologist | USACE |
| Evan Hill | Biologist | USACE |
| Matt Mangan | Fish and Wildlife Biologist | USFWS |
| Charlie Deutsch | Refuge Manager | USFWS |
| Kirsten Schmidt | Wildlife Biologist | USFWS |
| Cody Alger | IDNR Area Manager | IDNR |
| Ben Funk | Wildlife Biologist | IDNR |
| Butch Atwood | Fisheries Biologist | IDNR |
| Matthew Ganden | Forester | USACE |
| Tyler Goble | Wildlife Biologist | USACE |
| Ryan Swearingin | Wildlife Biologist | USACE |

## 2. Habitat Benefit Evaluation Methodology

The purpose of the habitat benefits evaluation is to evaluate and quantify, to the extent possible, environmental benefits of alternative plans for the aquatic habitat improvements within the study area.

Habitat benefits were quantified through the use of the Engineering Circular 1105-2-412, *Assuring Quality of Planning Models*, habitat suitability index (HSI) (blue book) models for the white bass (Hamilton & Nelson, 1984), the smallmouth buffalo (Edwards & Twomey, 1982), the dabbling duck migration model (Devendorf, 2013), and the yellow warbler (Schroeder, 1982).

Habitat Suitability Index (HSI) spreadsheet calculators for these models were reviewed by the Ecosystem Restoration Planning Center of Expertise and were recommended for regional use (Memorandum for CECW-MVD; 15 September 2016; Enclosure 1). Consistent with guidance from the USACE Ecosystem Restoration Planning Center of Expertise, the Agency Technical Review (ATR) Team for the Gilead Slough HREP assessed the models used for this study. This process evaluated the technical quality and appropriateness of the models utilized.

**The White Bass HSI Model** is an approved (bluebook) model, which is approved for regional and nationwide use by the USACE Ecosystem Restoration Planning Center of Expertise.

This model is applicable throughout the native and introduced range of white bass in the 48 contiguous United States and is applicable to riverine and lacustrine habitats. The standard of comparison for each variable is the optimum value of the variable that occurs anywhere within this region.

The white bass model employs the following seven variables to quantify habitat quality:

1. Stream Order
2. Percent surface area with a surface current velocity ~ 0.4 m/sec
3. Maximum water level change from the onset of white bass spawning to the hatching of fry.
4. Day-degrees above 16° C in upper 2m from onset of spawning to fall when water temperatures decrease to 16° C.
5. Average weekly water temperature during spawning and incubation.
6. Substrate index of habitat between 0.5 and 5.0m deep (lacustrine) or 0.5 and 3.0 m deep (riverine).
7. Forage fish composition.
8. Bank length: average depth ratio of largest suitable spawning site.
9. Percent of habitat that is suitable for spawning.

**The Smallmouth Buffalo HSI Model** is an approved (bluebook) model, which is approved for regional and nationwide use by the USACE Ecosystem Restoration Planning Center of Expertise.

The model is applicable throughout the native and introduced range of the smallmouth buffalo in North America. The standard of comparison for each individual variable suitability index is the optimum value of the variable that occurs anywhere within this region.

The smallmouth buffalo model employs the following 12 variables to quantify habitat quality in riverine systems:

1. Average stream width in meters during summer flow.
2. Percent pools and off channel areas (e.g., ponds and marshes) during spring and summer (adult, embryo, juvenile, and fry).
3. Maximum monthly average turbidity during average summer flow or summer stratification.
4. pH levels during the year.
5. Average water temperatures where the species occurs during July-August (adult).
6. Average maximum water temperatures during spring and summer (embryo).
7. Average water temperatures during June-July (fry and juvenile).
8. Average minimum dissolved oxygen levels during the summer (adult, fry, and juvenile).
9. Minimum dissolved oxygen levels during spawning (embryo).
10. Average current velocity of the river during average summer flow (adult).
11. Average pool velocity (embryo, fry, and juvenile).
12. Percent vegetative cover (aquatic and inundated terrestrial) in pools and off-channel areas or along the shoreline during spring and summer (fry and juvenile).

**The Yellow Warbler HSI Model** is an approved (bluebook) model, which is approved for regional and nationwide use by the USACE Ecosystem Restoration Planning Center of Expertise.

**The Dabbling Duck Migration Model** is a certified model that was developed by the USACE and has been reviewed and approved for regional or nationwide application by the USACE Ecosystem Restoration Planning Center of Expertise.

### 2.1 Quantity Component

Traditionally, the USACE has used the quantity and quality of habitat jointly, in the form of habitat units, to measure the benefits provided by ecosystem restoration projects. The quantity portion is often measured as area (acres of habitat, landform, etc.) or number of species; and in some systems, it is measured as length (i.e., feet of stream bank). The area associated with a given proposed feature must have a clear definition for use as guidance in estimating the area component of the ecosystem output model and must be applied consistently to all actions evaluated. Quantities of each measure may vary depending on the alternative. Habitat was evaluated in the location in which each measure would be placed. Table B-4 at the end of this report provides the acres proposed for use for each alternative, and the applicable acreage for each model. In Section 3.3, the delineated acreage applied per habitat model is described and illustrated.

### 2.2 Quality Component

The qualitative component of the analysis is rated on a 0.0 to 1.0 scale, with higher values indicating better habitat for that species. The HSI for a particular habitat type is determined by selecting values that reflect present and future study area conditions from a series of abiotic and biotic metrics. Each value corresponds to a suitability index for each species. Future values are determined using management plans, historical conditions, and best professional judgment.

The quantitative component is the number of acres of the habitat being evaluated. From the calculated qualitative and quantitative values, the standard unit of measure, the habitat unit (HU) is calculated using the formula (HSI × Acres = HUs). Habitat units are calculated for specific target years to forecast changes in habitat values over the life of the project with- and without-project conditions. When HSI scores are not available for each year of analysis, a formula that requires only target year HSI and area estimates is used (USFWS, 1980). This formula is:

$$\int_0^T HU\,dt = (T_2 - T_1) = \left[\left(\frac{A_1H_1 + A_2H_2}{3}\right) + \left(\frac{A_2H_1 + A_1H_2}{6}\right)\right]$$

Where:

$\int_0^T HU\,dt$ = *Cumulative HUs*
$T_1$ = first target year of time interval
$T_2$ = last target year of time interval
$A_1$ = area of available habitat at beginning of time interval
$A_2$ = area of available habitat at end of time interval
$H_1$ = habitat suitability index at the beginning of time interval

$H_2$ = habitat suitability index at the end of time interval
*3 and 6*= constants derived from integration of HSI × Area for the interval between any two target years.

This formula was developed to precisely calculate cumulative HUs when either HSI, or area, or both change over a time interval, which is common when dealing with the unpredictable fluctuations found in nature. Habitat Unit gains and/or losses are annualized by summing the cumulative HUs calculated using the above equation across all target years in the period of analysis and dividing the total (cumulative HUs) by the number of years in the life of the project (i.e., 50 years). This calculation results in the Average Annual Habitat Units (AAHUs) (USFWS, 2016). The calculation of the HUs and AAHUs were completed in a Microsoft Excel spreadsheet for each model containing the formula above.

The benefits of the proposed project measures (net AAHUs) are then determined by calculating the difference in AAHUs between the with-project benefits and the without-project benefits. The effects of various habitat improvement feature combinations (alternatives) can then be evaluated by comparing the net AAHUs and their associated costs for each alternative considered.

For the purpose of planning, design, and impact analysis, the period of analysis was established as 50 years. To facilitate comparison, target years were established at 0 (existing conditions), 1, 5, 25, and 50 years for both future with and without project features. Target years are used to analyze HUs and characterize habitat changes over the estimated period of analysis. Target years of 1 and 5 capture short-term changes following construction completion. While target years 25 and 50 capture ecological changes that would occur over a longer period of time. The period of analysis was determined to be 50 years based on the prediction that some project features (e.g., development of key ecological processes needed to restore ecosystem structure and function) would need a longer period of time to reach maximum benefits; and the accrual of benefits were predicted to level off after 50 years. HSIs and cumulative HUs for each evaluation species were calculated at each of these target years.

Corps guidance requires that the team evaluate a suite of features that can be combined in various ways to form project alternatives. The approach used to assess the benefits at the Gilead Slough HREP study area looked at benefits of project features and their combinations as alternatives and comparatively evaluated each alternative separately. This process is called the iterations process. To determine the habitat units created by each feature, the habitat affected by the feature would be evaluated using the applicable HSI spreadsheets.

This appendix contains HSI summary tables and other data derived from the spreadsheet files not included in this appendix. These spreadsheets are available upon request. Please contact, Justin Garrett, 314-331-8047, or by email at Justin.M.Garrett@usace.army.mil if you would like to request an electronic copy of these files.

### 3. Assumptions

In preparation of using the HSI models, the evaluation team conducted a site visit, reviewed aerial photography, topographic maps, and used the results from physical and numerical hydraulic modeling as well as fisheries and mussel surveys, reports, and collection data provided by previous USACE, MDC, and IDNR survey efforts. During the evaluation,

assumptions were developed regarding existing conditions and projected with-project conditions relative to habitat changes over time and management practices.

For the aquatic areas, lotic habitat improvements will be quantified based on areas that would benefit from substrate and flow enhancement measures. Lotic habitat measures that were quantified using the white bass HSI model consist of: placement of GSR, scour structures, barbs, hard points, stone placement for containment associated with the island creation, and substrate diversity. (See Section 4.1 of the main report for more details regarding measures). These measures are anticipated to create flow diversity and substrate heterogeneity across the study area. It is anticipated that these substrate enhancements should also provide areas of transitional substrates and extend areas of potential benefit as flows move sediment and other bed material around the newly placed structure. Table B-2 below also illustrates the alternatives and their associated management measures included with each.

Lentic habitat improvements will be quantified based on backwater slough habitat that would benefit from bathymetric enhancements and reduced sedimentation. Lentic habitat measures that were quantified using the smallmouth buffalo HSI model consist of the excavation of deepwater pockets for overwintering thermal refugia, and additional benefits being garnered from the future reduction in sedimentation rates with the addition of the shoreline protection measure that is designed to preclude more sediment from the river during small flood events, prolonging the life and uplift for the excavated deep-water pockets (See Section 4.1 of the main report for more details regarding measures). These measures are anticipated to create thermal refuge to lacustrine/lentic aquatic life in the backwaters found in the northern end of Gilead Slough.

The yellow warbler HSI model was used to quantify benefits from the island creation measure. Once the dredged material is placed within a rock containment berm, the island will be left to establish with early successional forest species (See Section 4.1 of the main report for more details regarding measures) by the surrounding, existing native seed source (maple, ash, elm, sycamore, cottonwood). This early successional forest is vital to the life histories (nesting, feeding, etc.) of many floodplain-associated bird species in the study area, such as the yellow warbler.

The moist soil areas and emergent backwaters found in the lower end of the Gilead Slough side channel were quantified using the Dabbling Duck Migration Model. Excavation, contouring, and shaping of those areas (See Section 4.1 of the main report for more details regarding measures) will be designed to target backwater bed elevations that are conducive to emergent and moist soil vegetation in response to the ongoing operations of Environmental Pool Management drawdowns, of which the vegetative response would provide a vitally important food source to migrating waterfowl.

### 3.1 Side Channel Habitat

The Corps approved (per EC 1105-2-412) white bass HSI model (Hamilton & Nelson, 1984) was used to assess the side channel habitat benefits resulting in the proposed project measures. The project measures for side channel habitat were developed to increase flow and bathymetric diversity, to enhance instream structural diversity, and to facilitate effective sediment transport. The white bass (*Morone chrysops*), in the family Moronidae, has been successfully stocked throughout the United States. The white bass inhabits the deeper pools of

streams and the open waters of lakes and reservoirs. It tends to avoid waters that are continuously turbid and is most often found over a firm sandy or rocky bottom (MDC, 2023). White bass prefer to spawn over a firm substrate in water 0.5 to 6 m deep, most commonly at depths of 0.6 to 2 m (Hamilton and Nelson, 1984).

The following assumptions were made when applying the *White Bass HSI Model*. For more detailed descriptions of the assumptions made for each model parameter for a given alternative, the excel spreadsheet is available upon request.

**Baseline Condition:**

Currently, there are approximately 150 acres of lotic aquatic habitat within the study area, dominated by main channel border, secondary channels, and braided tertiary channels within a mosaic of multiple riverine islands. The study area side channels are currently characterized by shallow depths and shifting sands that are closing off and disconnecting access for aquatic organisms. Additionally, multiple upland drainages are actively depositing gravel sized substrates into the side channel complex, and there are two connections to the main channel in the study area. Heavy riverine borne sediments moving though the system is further threatening the positive connection of backwaters to side channels and the main channel.

**Future Without Project Condition:**

Without the project measures, it is anticipated that the side channel habitat within the study area will continue to degrade, primarily through increasingly shallower depths due to riverine sedimentation which will eventually cause areas to convert to more terrestrial habitat and further sever the connection of remaining aquatic habitats. As a result, these areas are also expected to experience higher water temperature and poorer water quality, with low dissolved oxygen levels making it unsuitable for most aquatic life. The shallower depths will also limit access for aquatic species to overwintering habitat as well as adequate foraging, spawning and rearing backwater habitats. The shifting sand substrates found throughout the side channel areas do not currently offer suitable habitat for freshwater mussels to colonize new areas, and recent mussel surveys reveal low densities of mussels throughout the study area, a condition that is anticipated to continue degradation into the future without a project intervention.

**Future With Project Condition:**

With the proposed project measures of the Recommended Plan implemented, velocities and connectivity are anticipated to be enhanced and restore access to backwaters for overwintering, foraging, spawning, and rearing for aquatic species. Measures of placed substrate, such as GSR, hard points, barbs, bank protection, will provide the much needed, stable substrate areas for a multitude of aquatic organisms.

**General Assumptions**

It was assumed that target years of 0 (existing condition), 1, 5, 25, and 50 (future without and future with project conditions) are sufficient to analyze HUs and characterize habitat changes over the estimated period of analysis. The period of analysis was determined to be 50 years based on the prediction that some project features (e.g., development of key ecological processes needed to restore ecosystem structure and function) would need a longer period of time to reach maximum benefits; and the accrual of benefits were predicted to level off after 50 years.

### 3.2 Riverine Backwater Habitat

The Corps approved (EC 1105-2-412) smallmouth buffalo HSI model (Edwards & Twomey, 1982) was used to assess aquatic habitat benefits from the backwater excavation measures. The smallmouth buffalo (*Ictiobus bubalus*), in the family Catostomidae, is an important commercial fish in the Mississippi River drainage basin. This species occurs in deep, flowing water, as well as sloughs, oxbow lakes and other backwaters for resting, spawning, and rearing. They feed on organisms in the substrate of large rivers and backwater lakes. This species was selected because it requires backwaters and off-channel areas to complete important life history stages.

The following assumptions in applying the *Smallmouth Buffalo HSI Model* were made. For more detailed descriptions of the assumptions made for each model parameter for a given alternative, the excel spreadsheet is available upon request.

#### Baseline Condition

Proxy sites were identified within Pool 26, a study reach for the Upper Mississippi River Restoration Long Term Resource Monitoring (LTRM) program. Three proxy sites were chosen based on size, connectedness, and then averaged together to act as a stand-in, since LTRM data is unavailable within Pool 25. From the three proxy sites that were chosen, detailed water quality data that were collected by the LTRM element from 1993 to present was identified for use. These data are randomly stratified and collected throughout the year; therefore, it was assumed that data collected was representative of the entirety of backwater areas for the project. The average depth range of the backwaters is less than 5 feet. These shallow depths lead to relatively poor overall conditions for smallmouth buffalo due to increased summer water temperatures, low dissolved oxygen levels, and decreasing availability/connectivity from sedimentation of the backwaters and their mouths, precluding access depending on pool levels.

#### Future Without Project Condition

The backwater in the north end of Gilead Slough is a large shallow lake in Pool 25 of the Mississippi River. There are some isolated pockets one to two feet in depth that exist at these conditions. During Flat or Full Pool conditions, this area would have an average water depth of 3.5 - 5 ft. and losing more depth each year. Heavy riverine sedimentation is degrading the backwater and the access to it as well. Without a project, sedimentation would cause this area to continue to become shallower, eventually converting acreage into terrestrial habitat. Along with shallower depths, this increase in sedimentation is assumed to also result in increased turbidity, increased temperatures, reduced dissolved oxygen as vegetative cover increases and the shift towards terrestrial habitat gradually takes over.

#### Future With Project Condition

The proposed measures for backwater habitat improvement include excavation of deep-water pockets and access channels to create bathymetric diversity, and deeper seasonal habitat that would lend itself to overwintering refugia for aquatic species; and emergent wetland enhancement that would excavate excessive sediments to elevations more conducive to herbaceous backwater wetlands that work in congruence with Environmental Pool Management. Excavation would result in an overall increase in backwater habitat function such as increased water depths, cooler summer water temperatures, increased capacity for dissolved oxygen, improved water clarity and lower turbidity.

### General Assumptions

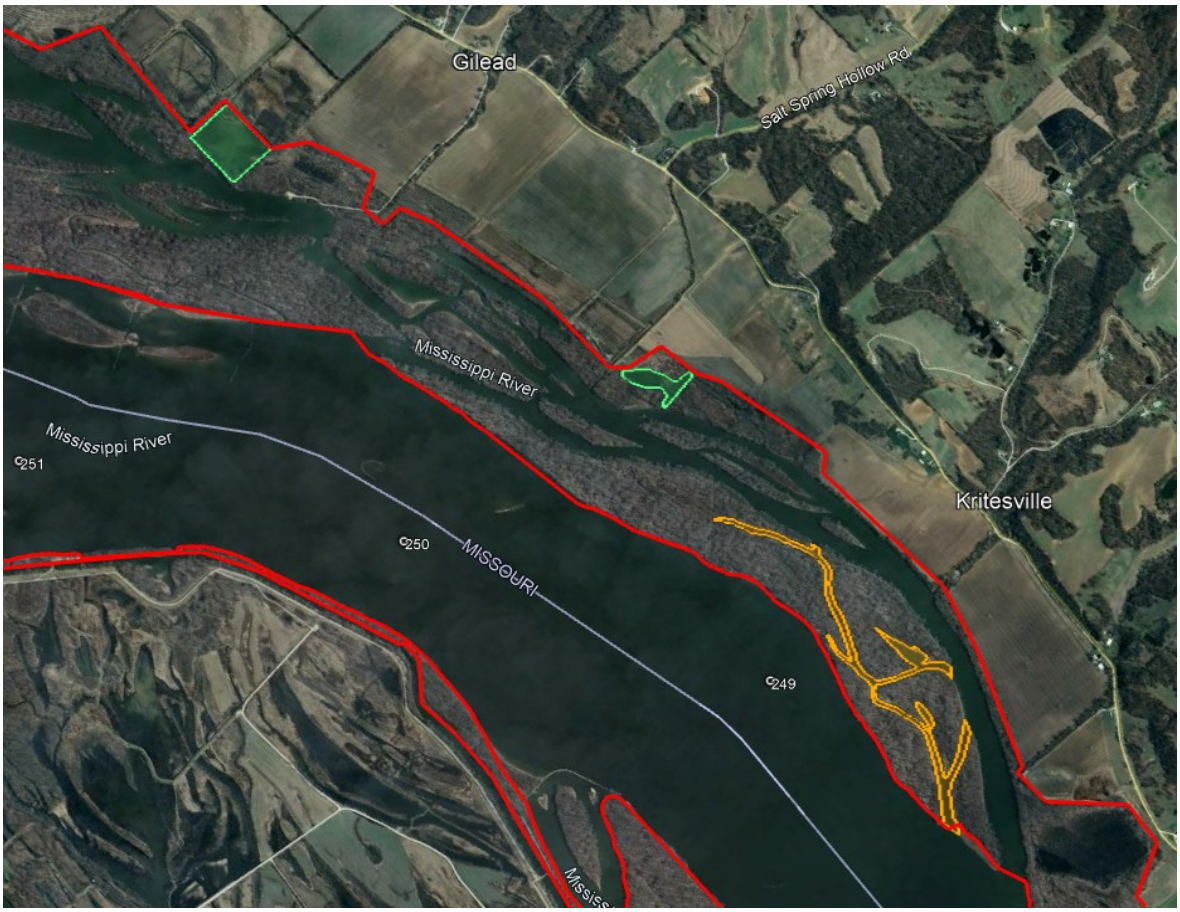
It was assumed that target years of 0 (existing condition), 1, 5, 25, and 50 (future without and future with project conditions) are sufficient to analyze HUs and characterize habitat changes over the estimated period of analysis. The period of analysis was determined to be 50 years based on the prediction that some project features (e.g., development of key ecological processes needed to restore ecosystem structure and function) would need a longer period of time to reach maximum benefits; and the accrual of benefits were predicted to level off after 50 years.

## 3.3 Model Acreage Delineation

### 3.3.1 Dabbling Duck Migration Model

Acreage identified in green polygon refers to acreage incorporated into the MSU measures, and the orange polygon refers to acreage incorporated into the backwater dredging areas that will be excavated to elevations that are conducive to EPM drawdowns. The red polygons indicated USACE GP lands boundaries. These areas of habitat benefit were captured using the Dabbling Duck Migration Model, see Figure B-1.

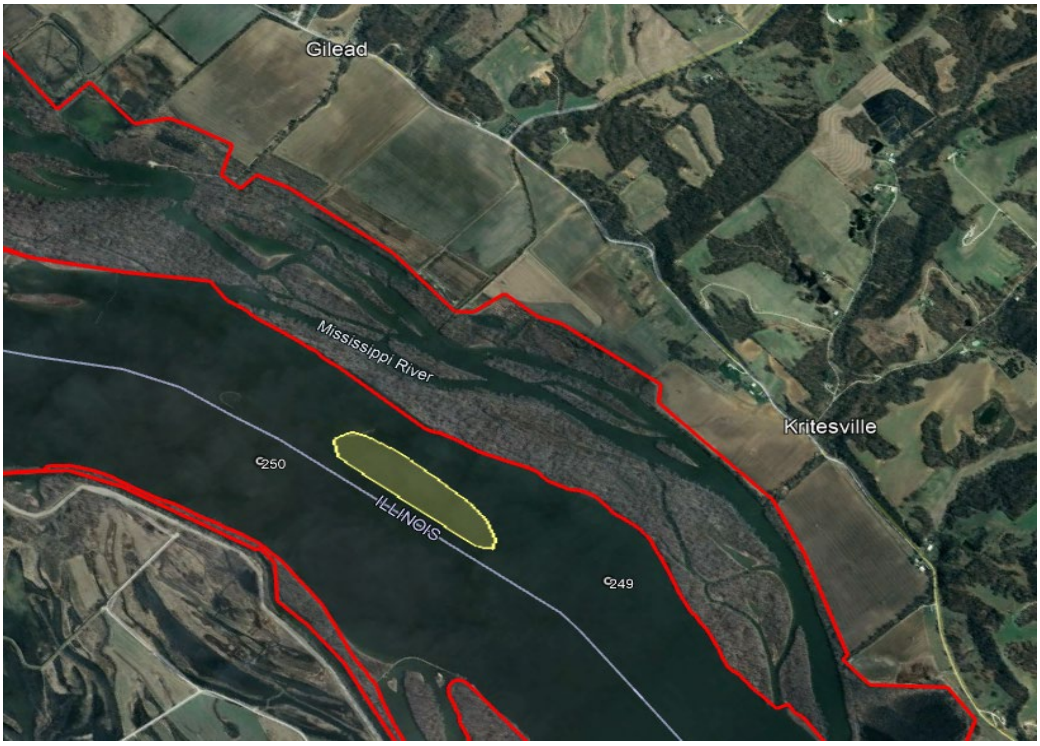
*Figure B-1: Acreage delineation of Dabbling Duck Migration Model (green and orange polygons).*



### 3.3.2 Yellow Warbler HSI Model

Acreage identified in yellow polygon refers to acreage incorporated into the island creation measure. The red polygons indicated USACE GP lands boundaries. These areas of habitat benefit were captured using the Yellow Warbler HSI Model, see Figure B-2.

*Figure B-2: Acreage delineation of Yellow Warbler HSI model (yellow polygon).*




### 3.3.3 Smallmouth Buffalo HSI Model

Acreage identified in orange polygon refers to acreage incorporated into the backwater habitat measures. The red polygons indicated USACE GP lands boundaries, and island acreage that was excluded from the acreage calculations for this model. These areas of habitat benefit were captured using the Smallmouth Buffalo HSI Model, see Figure B-3.

With drastically differing measures included in the Maximum Alternative, a change in model acreage delineation among the alternatives was deemed necessary. For the Maximum Alternative (Figure B-4), the green polygon displays the extent of acreage included with the white bass model, whereas the remaining acreage of lacustrine habitat quantified in the Maximum Alternative is displayed in the orange polygon.

In coordination with USACE ECO-PCX, delineations and assumptions were divided among lotic and lentic type habitats for the Maximum Alternative, which provided a new river connection in the upper portion of Gilead Slough, effectively converting much of the lacustrine backwater habitat into lotic, side channel habitat. Differences among the alternatives is displayed in Figures B-3 (FWOP, Minimum, and Intermediate Alternatives) and B-4 (Maximum Alternative).

*Figure B-3: Acreage delineation of Smallmouth Buffalo HSI model under the FWOP, Minimum, and Intermediate Alternatives (orange polygon).*

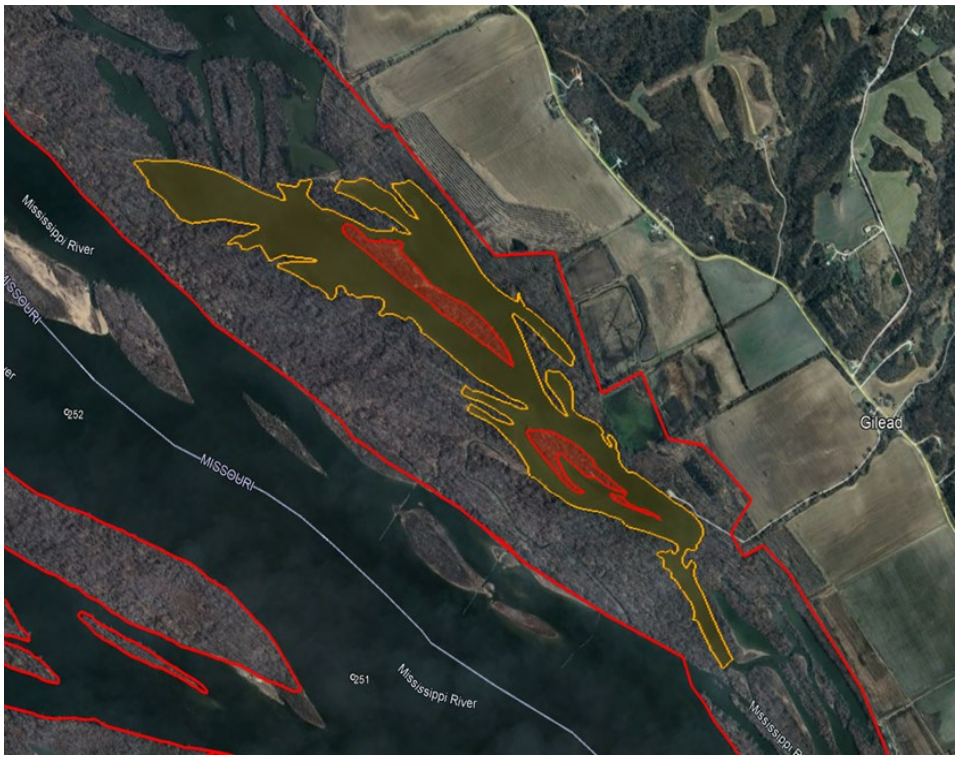
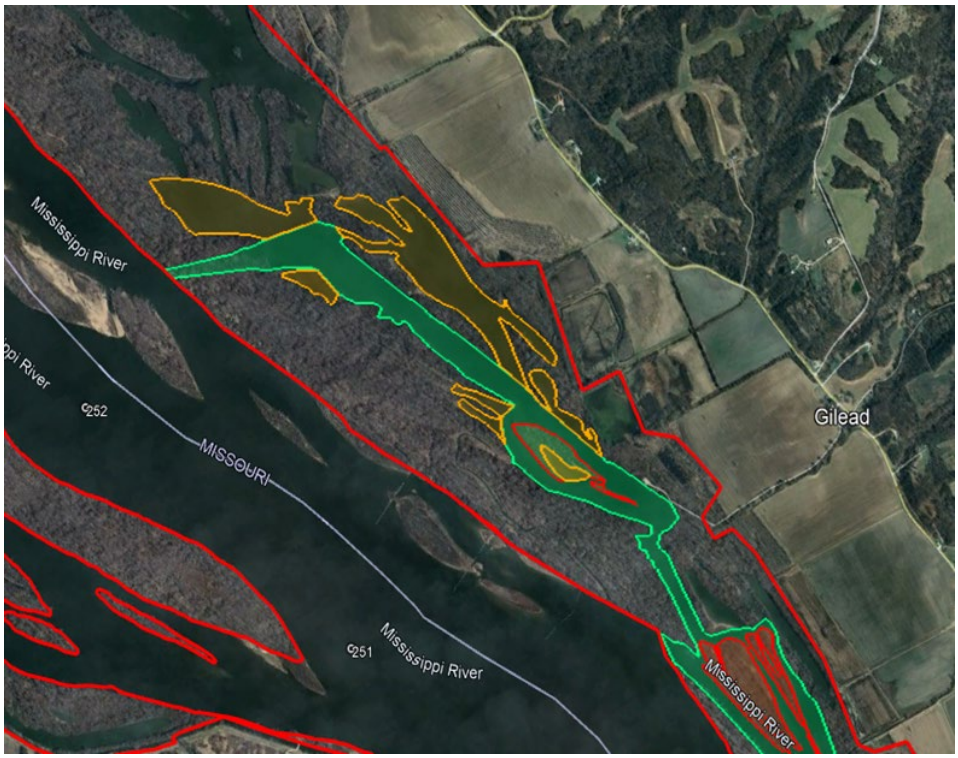



*Figure B-4: Acreage delineation of Smallmouth Buffalo model under the Max Alt. (orange polygon).*



### 3.3.4 White Bass HSI Model

Acreage identified in green polygon refers to acreage incorporated into the island creation measure. The red polygons indicated USACE GP lands boundaries, and island acreage that was excluded from the acreage calculations for this model. These areas of habitat benefit were captured using the White Bass HSI Model, see Figure B-5.

With drastically differing measures included in the Maximum Alternative, a change in model acreage delineation among the alternatives was deemed necessary. For the Maximum Alternative (Figure B-6), the green polygon displays the extent of acreage included with the white bass model, whereas the red polygons indicated USACE GP lands boundaries, and island acreage that was excluded from the acreage calculations for this model.

In coordination with USACE ECO-PCX, delineations and assumptions were divided among lotic and lentic type habitats for the Maximum Alternative, which provided a new river connection in the upper portion of Gilead Slough, effectively converting much of the lacustrine backwater habitat into lotic, side channel habitat. Differences among the alternatives is displayed in Figures B-5 (FWOP, Minimum, and Intermediate Alternatives) and B-6 (Maximum Alternative).

*Figure B-5: Acreage delineation of White Bass HSI model under the FWOP, Minimum, and Intermediate Alternatives (green polygon).*

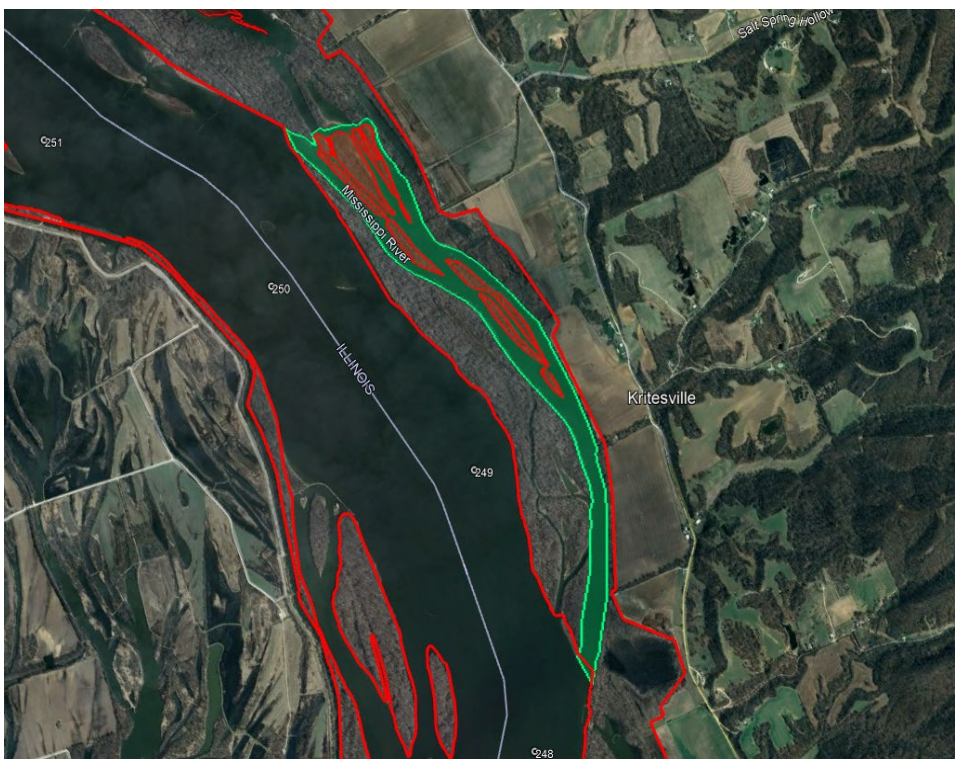
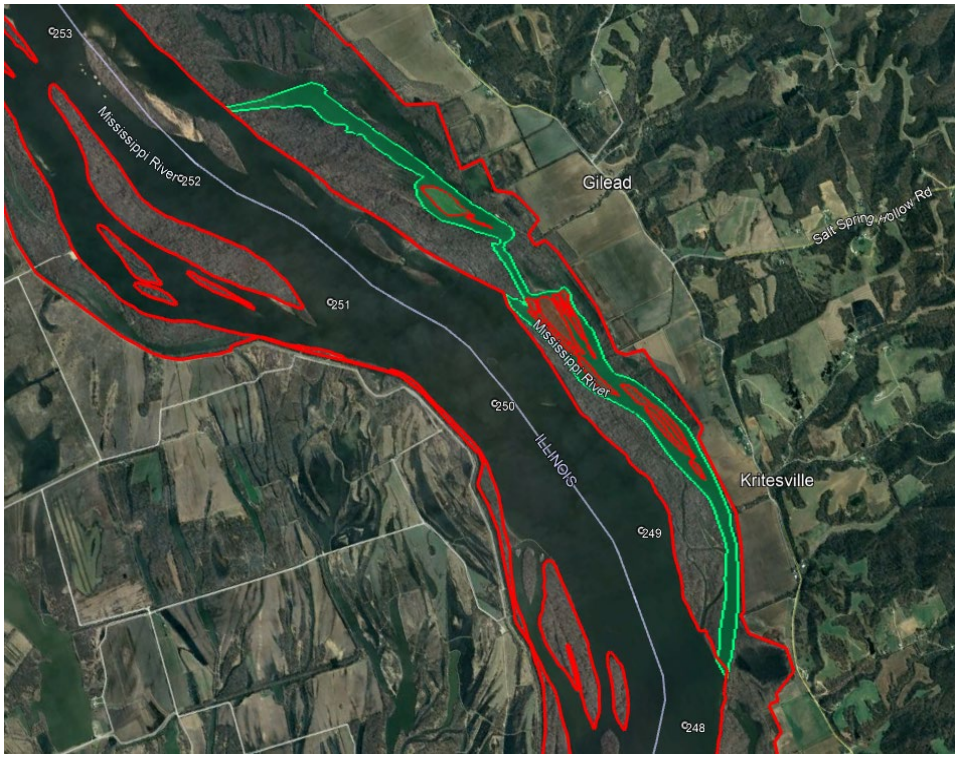


*Figure B-6: Acreage delineation of White Bass HSI model under the Max Alternative (green polygon).*




## 4. Results

Section 4 of the main report, *Plan Formulation*, describes each potential Project measure in detail. The Project planning team screened out several measures and alternatives before this habitat quantification process began. Section 4.1, Table 4 in the main report displays the proposed measures, screening criteria, and which measures were retained for inclusion in the project alternatives. The results of the habitat benefit evaluations respective to habitat model that was used to evaluate each alternative by habitat type is provided below in 4.1, Table B-3.

### 4.1 Total Habitat Benefits

Table B-3 lists the calculated net average annual habitat benefits by habitat model for the final array of alternatives. Table B-4 illustrates the acreage considered for habitat benefits, by alternative and model applied.

*Table B-3: Results of the habitat benefit evaluations for each habitat model used to evaluate alternatives by habitat type.*

| Alternative | Dabbling Duck Migration Model Net AAHU | Yellow Warbler HSI Model Net AAHU | Smallmouth Buffalo HSI Model Net AAHU | White Bass HSI Model Net AAHU | Total Net AAHU |
|---|---|---|---|---|---|
| **No Action** | 0 | 0 | 0 | 0 | 0 |
| **Minimum** | 2 | 18 | 108 | 21 | 149 |
| **Intermediate** | 13 | 20 | 123 | 41 | 197 |
| **Maximum** | 17 | 22 | 17 | 120 | 175 |

*Table B-4: Acreage considered for habitat benefits, by alternative and model utilized.*

| Alternative | Model | Acres per Habitat Type |
|---|---|---|
| **FWOP - No Action** | Dabbling Duck | 17.8 |
| | Yellow Warbler | 0 |
| | Smallmouth Buffalo | 183.3 |
| | White Bass | 142.8 |
| | **Alternative Total** | **344** |
| **Minimum Alternative** | Dabbling Duck | 17.8 |
| | Yellow Warbler | 25 |
| | Smallmouth Buffalo | 183.3 |
| | White Bass | 142.8 |
| | **Alternative Total** | **369** |
| **Intermediate Alternative** | Dabbling Duck | 35.5 |
| | Yellow Warbler | 28 |
| | Smallmouth Buffalo | 183.3 |
| | White Bass | 149.78 |
| | **Alternative Total** | **397** |
| **Maximum Alternative** | Dabbling Duck | 35.5 |
| | Yellow Warbler | 30 |
| | Smallmouth Buffalo | 91.5 |
| | White Bass | 244.6 |
| | **Alternative Total** | **402** |

## 5. References

Devendorf, Randall D. (2013). A Dabbling Duck Migration Model for the Upper Mississippi River. U.S. Army Corps of Engineers, St. Paul District, St. Paul.

Edwards, E., & Twomey, K. (1982). Habitat Suitability Index Models: Smallmouth Buffalo. US Department of Interior, Fish and Wildlife Services.

Hamilton, K., & Nelson, P. (1984). Habitat Suitability Index Models and Instream Flow Suitability Index Curves: White Bass. US Department of Interior, Fish and Wildlife Services.

Schroeder, R. (1982). Habitat Suitability Index Models: Yellow Warbler. US Department of Interior, Fish and Wildlife Services.

USFWS (US Fish and Wildlife Services). (2016, July 15). Habitat Evaluation Procedures (HEP) ESM 102. Retrieved from http://www.fws.gov/polociy/ESM102.pdf: http://www.fws.gov/polociy/ESM102.pdf

**Enclosure 1**

**DEPARTMENT OF THE ARMY**
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REPLY TO
ATTENTION OF:

CEMVD-PD-L 15 September 2016

MEMORANDUM FOR CECW-MVD (Redican)

SUBJECT: Recommendation for Regional Use Approval of 11 Spreadsheet Calculators for Application of Regionally Approved Habitat Suitability Index Models

1. References:
   a. Engineer Circular 1105-2-412: Assuring Quality of Planning Models, dated 31 March 2011.
   b. Final Planning Model Quality Assurance Review Comment Response Record for 11 Habitat Suitability Index Model Calculators, USACE (Encl 1).
   c. Ecosystem Restoration Model Library, Habitat Suitability Index Models

2. The National Ecosystem Restoration Planning Center of Expertise (ECO-PCX) evaluated spreadsheet calculators for the black capped chickadee, bullfrog, creek chub, fox squirrel, gray squirrel, least tern, smallmouth bass, smallmouth buffalo, striped bass, white bass, and wood duck habitat suitability index models following reference 1.a. Based on the review results (Encl 1), the ECO-PCX recommends Regional Use Approval of all spreadsheet calculators for use in the geographic area defined for each model. Please log in this recommendation with the Office of Water Project Review for the Model Certification Team to consider.

3. The black capped chickadee, bullfrog, creek chub, fox squirrel, gray squirrel, least tern, smallmouth bass, smallmouth buffalo, striped bass, white bass, and wood duck habitat suitability index models are approved for regional use per EC 1105-2-412 (Reference 1.c.). However, software was lacking which would allow planners to apply the models in a computational correct fashion for individual projects. Consequently, MVP, MVR, and MVS collaborated to develop a library of Microsoft Excel spreadsheet calculators. Each spreadsheet calculator is an independent spreadsheet built using the same variables, habitat suitability index curves, aggregation equations, and habitat cover types as displayed in the approved model documentation. Furthermore, all spreadsheet calculators employed a similar development scheme to include consistent use of formatting, input requirements, and output display. Each calculator includes user documentation or a link to a user's guide, and employs best spreadsheet practices.

4. The ECO-PCX and biologists from MVP, MVR, and MVS reviewed each spreadsheet calculator independently to assess the degree to which the spreadsheets meet the system quality and usability criteria in accordance with EC 1105-2-412. The spreadsheet development team and the spreadsheet reviewers included individuals with expertise in habitat benefit evaluations, Habitat Evaluation Procedures, plan formulation policies, and software/spreadsheet programming and auditing. Review results are found in the Final Planning Model Quality Assurance Review Comment Response Record for 11 Habitat Suitability Index Model Calculators, USACE (Encl 1).

Review of the spreadsheet calculators resulted in 72 total comments. All comments were related to the system quality and usability of the model, all were of low to medium significance, and all evaluations resulted in concurrence with the comments. The ECO-PCX reviewed the comments, evaluations, and revisions made to the model. All were made to the satisfaction of the ECO-PCX and are in alignment with the requirements of assuring the quality of planning models. The following summarizes the overall review and modifications made to the spreadsheets to improve system quality and usability.