Missouri River
Master Water Control Manual
Review and Update

Final
Environmental Impact Statement
Volume V: Appendices B and C

- Appendix B, Summary of Clean Water Act Issues (Correction)
- Appendix C, Final Biological Assessment

U.S. Army Corps
of Engineers
Northwestern Division

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Appendix C
Final Biological Assessment

US ARMY CORPS OF ENGINEERS
NORTHWESTERN DIVISION
MISSOURI RIVER BASIN
WATER MANAGEMENT DIVISION

FINAL BIOLOGICAL ASSESSMENT ON THE OPERATION OF THE MISSOURI RIVER MAINSTEM RESERVOIR SYSTEM, THE OPERATION AND MAINTENANCE OF THE BANK STABILIZATION AND NAVIGATION PROJECT, AND THE OPERATION OF KANSAS RIVER RESERVOIR SYSTEM

November 2003

FINAL BIOLOGICAL ASSESSMENT ON THE OPERATION OF THE MISSOURI RIVER MAINSTEM RESERVOIR SYSTEM, OPERATION AND MAINTENANCE OF THE MISSOURI RIVER BANK STABILIZATION AND NAVIGATION PROJECT, AND OPERATION OF THE KANSAS RIVER RESERVOIR SYSTEM

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Acronyms

AF	acre-feet
AOP	Annual Operating Plan
BA	Biological Assessment
BiOp	Biological Opinion
BSNP	Bank Stabilization and Navigation Project

cfs	cubic feet per second
Corps	U.S. Army Corps of Engineers
CRP	Construction Reference Plane
CWCP	current Water Control Plan
DRM	Daily Routing Model
EA/FONSI	Environmental Assessment/Finding of No Significant Impact
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ESH	emergent sandbar habitat
FTC	Fish Technology Center
ft-msl	feet mean sea level
GPS	Geographic Positioning System
kcfs	thousand cubic feet per second
KDWP	Kansas Department of Wildlife and Parks
MAF	million acre-feet
Master Manual	Missouri River Master Water Control Manual
MDC	Missouri Department of Conservation
mm	millimeters
MRRIC	Missouri River Recovery Implementation Committee
msl	mean sea level
MTFWP	Montana Fish, Wildlife and Parks
NEPA	National Environmental Policy Act
NFH	National Fish Hatchery
NGPC	Nebraska Game and Parks Commission
NRC	National Research Council (National Academy of Sciences)

O&M	Operation and Maintenance
PA	Proposed Action
PIT	Passive Integrated Transponder
PVA	Population Viability Analysis
RM&E	Research, Monitoring, and Evaluation
RPA	Reasonable and Prudent Alternative
RPMAs	Recovery Priority Management Areas
SFH	State Fish Hatchery
SWH	shallow water habitat
System	Missouri River Mainstem Reservoir System
TESDMS	Threatened & Endangered Species Data Management System
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
WAPA	Western Area Power Administration
WRDA86	Water Resources Development Act of 1986
WRDA99	Water Resources Development Act of 1999
YOY	young of year

FINAL BIOLOGICAL ASSESSMENT ON THE OPERATION OF THE MISSOURI RIVER MAINSTEM RESERVOIR SYSTEM, OPERATION AND MAINTENANCE OF THE MISSOURI RIVER BANK STABILIZATION AND NAVIGATION PROJECT, AND OPERATION OF THE KANSAS RIVER RESERVOIR SYSTEM

I. INTRODUCTION

A. Federal Action Subject to ESA Section 7 Consultation. In accordance with the Endangered Species Act (ESA), the U.S. Army Corps of Engineers (Corps) must insure, in consultation with the U.S. Fish and Wildlife Service (USFWS), that any action carried out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat. The federal action subject to ESA consultation is the Corps' operation of the Missouri River Mainstem Reservoir System, operation of the Kansas River projects, and the operation and maintenance of the Bank Stabilization and Navigation Project (BSNP) (hereinafter referred to as the Missouri Basin Projects). Congress authorized the Corps to operate the Missouri River Mainstem Reservoir System for flood control, navigation, hydropower, irrigation, water supply, water quality, recreation, and fish and wildlife; the BSNP for navigation and bank stabilization purposes; and the Kansas River projects for flood control, water quality, recreation, fish and wildlife, navigation, irrigation, and water supply purposes.

The Corps entered into formal consultation with the USFWS pursuant to the ESA on the operation of the Missouri Basin Projects culminating in the USFWS Missouri River Biological Opinion issued November 2000 (2000 BiOp). The 2000 BiOp concluded the Corps' proposed action jeopardized the continued existence of the listed pallid sturgeon, piping plover, and the interior least tern, and recommended a Reasonable and Prudent Alternative (RPA). Subsequently, the Corps and the USFWS have continued coordination and entered into both informal and formal consultation over the Corps' operation of the mainstem system and other actions addressed by the 2000 BiOp.

In accordance with the ESA regulations, the Corps is reinitiating consultation based on new information concerning effects of the action on the species not previously considered, and the designation of piping plover critical habitat. Further, the Corps has concluded that certain components of the USFWS RPA contained in the 2000 BiOp do not comport with the regulatory criteria for an RPA. The regulations provide for the USFWS to identify alternative actions that can be implemented in a manner consistent with the intended purpose of the action, that can be implemented consistent with the scope of the agency's legal authority, that is economically and technologically feasible, and the USFWS believes would avoid the likelihood of jeopardizing the continued existence of listed species or result in the destruction or adverse modification of critical habitat. The Corps is therefore proposing alternative actions to avoid jeopardizing the species.

In its operation of the Missouri Basin Projects, the Corps will continue implementing a majority of the actions recommended in the 2000 BiOp. Additionally, the Corps has concluded in this

Biological Assessment (BA), that the proposed action avoids the likelihood of jeopardizing the continued existence of the listed species. This BA will consider the effects of the Corps proposed action, which includes revised mainstem system operations, the acceleration of shallow water habitat creation, implementation of a robust research, monitoring and evaluation program, flow tests, and expanded support for pallid sturgeon propagation efforts.

B. Corps Conclusions. This BA addresses several new engineering analyses conducted by the Corps and various other scientific reports completed after the issuance of the 2000 BiOp. Based on a review of the new information and application to the Corps' action, the Corps concludes the following:

1. The RPA "spring rise" and summer flows below minimum service flows out of Gavins Point Dam recommended in the 2000 BiOp do not provide the intended physical attributes and biological effects. The recommended 2000 BiOp RPA flows were intended to restore and maintain sandbar and shallow water habitat, reconnect riverine and floodplain habitat, and provide for pallid sturgeon spawning cues below Gavins Point. Engineering studies show the recommended RPA spring rise flows would not be effective in building and maintaining additional habitat for terns and plovers or reconnecting the flood plain. Currently, there is scientific uncertainty about life cycle requirements, in particular pallid sturgeon spawning cues and the parameters of the sturgeon's spawning requirements (flows, temperatures, turbidity, habitat, etc.). Pallid sturgeon larvae have been sampled from the Missouri River in North Dakota and Missouri, indicating that some stretches of the Missouri River or its tributaries may have recently possess the necessary elements, which resulted in successful pallid sturgeon spawning. The Corps is therefore proposing a comprehensive research program to study these river reaches to determine the physical attributes that provide conditions resulting in successful sturgeon spawning. With respect to the low summer flows, engineering studies show that the recommended RPA summer low flows below minimum service levels would not be an effective means to attain significant amounts of additional shallow water habitat. In conclusion, the RPA flows out of Gavins Point Dam that are recommended in the 2000 BiOp do not provide the anticipated physical attributes and biological effects likely to avoid jeopardy to the species. Further, given the criteria that the alternative must be an action that can be implemented within the agency's authority, and in a manner consistent with the intended purpose of the action, e.g. operation of the Missouri Basin Projects to provide for the authorized project purpose of navigation, the flow components of the 2000 BiOp RPA may not comport with the criteria for an RPA. Based upon these factors, more fully described in this biological assessment, the Corps concludes that the 2000 BiOp RPA flows out of Gavins Point Dam are not reasonable and prudent based on the criteria described in Section I.A.

2. Based on the information obtained since the issuance of the 2000 BiOp, the Corps believes that this proposed action, rather than the flow regime called for in the 2000 BiOp RPA, will avoid jeopardizing the continued existence of all listed species. Alternative actions proposed by the Corps that can be taken in the near term to effectively conserve listed species and likely avoid jeopardy include, but are not limited to, accelerated habitat development, particularly throughout the BSNP; expanded and accelerated support to propagation efforts; a robust research, monitoring, and evaluation program (RM&E) that examines the multiple factors that may be limiting pallid sturgeon spawning and recruitment in all suitable reaches of the Missouri

River; and various flow tests at a number of project sites on the mainstem system. As noted earlier, implementing the variable flow releases associated with the RPA from Gavins Point Dam does not provide the necessary physical attributes, particularly those needed for the pallid sturgeon. As pointed out in the National Academy of Sciences' National Research Council (NRC) 2002 report entitled "The Missouri River, Exploring the Prospects for Recovery," because of the highly controlled and structured nature of the navigational portion of the Missouri River, providing a spring flood pulse in the absence of river-connective habitat is not likely to produce needed ecological benefits for those 734 river miles. Additionally, the existence of constructed habitat in the absence of changes in the hydrologic regime will likewise not render desired ecological benefits. The NRC 2002 report identified two essential shortcomings currently limiting the ability to make substantial progress toward the recovery of pallid sturgeon. First is the absence of sufficient river-connective, shallow water habitat in key reaches of the Missouri River. Second is the absence of necessary scientific information on the lifecycle requirements of the pallid sturgeon, and an understanding of the factors that are limiting spawning and recruitment. Hence, the rationale supporting the Corps' proposed action is straightforward: 1) initiate an aggressive and accelerated shallow water habitat development program on the BSNP, 2) initiate a robust RM&E program to gather as much scientific information as possible regarding the limiting factors to pallid sturgeon spawning and recruitment in the Missouri River, 3) initiate expanded and accelerated efforts to upgrade the capabilities of pallid sturgeon propagation hatcheries in order to augment the population with higher numbers and higher quality fish, 4) conduct a "3 year check-in," as described below, in order to assess scientific findings, progress and successes associated with other actions to make course adjustments, including potential flow adjustments from Gavins Point Dam.

3. An adaptive management approach to address critical scientific uncertainties and build upon current stakeholder efforts to develop a strategy to conserve the species will ultimately lead to greater success in recovery of the species and the ecosystem upon which they depend. This conclusion is derived from the NRC's 2002 report. The report underscores the importance of restoring river form and function and "natural river processes," and highlights adoption of an adaptive management approach, including broad stakeholder participation. The Corps proposes establishment of a Missouri River Recovery Implementation Committee (MRRIC). This approach builds upon the recommendations in the 2000 BiOp.

4. The Corps proposes to revisit the scientific findings of a robust RM&E program, the progress and success of accelerated habitat development, and other actions within three years of the issuance of a new BiOp is proposed. This is consistent with the adaptive management approach. Such a "3 year check-in" should be set within the context of a broad public forum involving a diverse array of stakeholders and other interested parties to examine scientific findings and determine changes and additional actions, as appropriate, to further enhance the conservation of listed species and the broader ecosystem values of the Missouri River.

5. Reinitiation of formal consultation is also required because of the recent designation of critical habitat for the northern Great Plains population of the piping plover with the USFWS. The USFWS designated critical habitat for the northern Great Plains population of the piping plover (67 FR 57638), including the Missouri River, in September 2002. On rivers, the physical primary constituent elements of the critical habitat include sparsely vegetated channel sandbars,

sand and gravel beaches on islands, temporary pools on sandbars and islands, and the interface with the river. On reservoirs, the physical primary constituent elements include sparsely vegetated shoreline beaches; peninsulas; islands composed of sand, gravel, or shale; and their interface with the water bodies. The Corps believes critical habitat for piping plovers may be affected by several components of the actions listed in the 2000 BiOp as well as the proposed action in this BA. These actions include operation of the mainstem system, creation/maintenance of the emergent sandbar habitat, development of shallow water habitat, and various components of proposed RM&E efforts.

II. ADAPTIVE MANAGEMENT FRAMEWORK

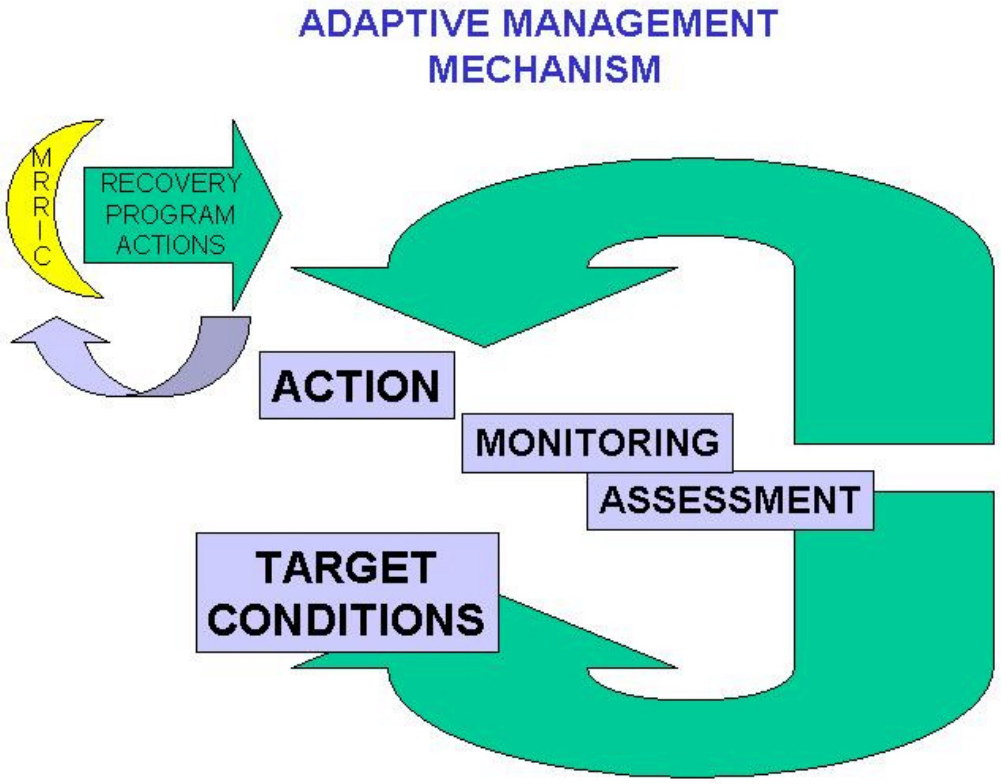
A. Adaptive Management. The 2000 BiOp recommended that the Corps adopt an adaptive management approach to implementing the various BiOp measures. The USFWS stated that the ***"adaptive management framework is a particularly effective way to address multiple species, ecosystem variability, and biological unknowns about the lifecycles, behaviors, and habitat requirements of the listed species."*** The National Research Council in its January 2002 report also recommended that adaptive management be adopted as an "ecosystem management paradigm" for the Missouri River. Key components of the NRC 2002 report include broad stakeholder involvement, an independent scientific peer review process, and a collaborative process to "learn about successes, failures, and potential management actions that could be usefully implemented in the Missouri River ecosystem." Further discussion of the NRC report and recommendations can be found in Appendix A, page 1.

The Corps embraces the concept of adaptive management. Adaptive management is not a new concept; but rather, a dynamic construct that is now commonly used throughout the world to help shape resource management decisions, policies, and approaches. There is an up-front recognition that all is not known about the complete life cycles and behaviors of species or their requisite habitat needs throughout their life cycles. Adaptive management is an overall strategy for addressing scientific uncertainty and modifying actions in response to new information. It promotes an environment for testing hypotheses and pursuing promising changes, based on sound scientific data and analyses.

Generally speaking, the adaptive management program envisioned by the Corps for the Missouri Basin Projects would: 1) aggressively implement on-the-ground actions to attain those physical and biological attributes that will result in beneficial effects for the listed species; 2) conduct a rigorous research effort to reduce the uncertainty surrounding essential attributes needed to insure the survival and recovery of listed species; and 3) adapt to the findings of an intensive and comprehensive monitoring and evaluation program. In carrying out the adaptive management approach to decision-making, some future actions may pose significant effects to the natural and/or human environment. In some cases, this may require that the Corps undertake an assessment of the effects in accordance with the National Environmental Policy Act (NEPA) prior to making any decisions to implement an action. The ultimate success of the adaptive management framework for the Missouri River Basin must also take into account that humans are integrated into the ecosystem and that natural ecosystems are not constrained within administrative boundaries and property lines.

B. <u>Missouri River Recovery Implementation Committee</u>. To effectively use the adaptive management approach, the Corps proposes the establishment of a recovery team, the Missouri River Recovery Implementation Committee (MRRIC), which will include broad and diverse stakeholder representation to ensure that public values are incorporated into recovery implementation. MRRIC will provide recommendations to the Federal agencies regarding recovery implementation and will be developed cooperatively with entities having an interest in recovery of listed species and the ecosystem on which they depend. Representation on MRRIC will include the full spectrum of basin interests. Committee membership will be comprised of representatives of Tribal and State governments and of non-governmental organizations that have an interest in the management of the river and recovery of the species and Missouri River ecosystem values.

The adaptive management framework and the establishment of the MRRIC are consistent with all applicable federal and state laws, American Indian trust responsibilities, and interstate compacts and decrees. The Corps recognizes that the USFWS and the Corps each have statutory responsibilities that cannot be delegated, and the establishment of MRRIC is not intended to abrogate any of the statutory responsibilities of the agencies. The Corps advocates that the MRRIC be a partner in recommending applicable future actions to be taken to benefit the listed species in the Missouri River. Consistent with this adaptive management framework, the Corps will adjust actions based on scientific findings and, when applicable, recommendations of the MRRIC. It is anticipated that basin establishment of the MRRIC will require a considerable amount of time. The structure of MRRIC itself will be the subject of adaptive management. A conceptual diagram of an adaptive management strategy to include the MRRIC follows.



The above discussion is a broad overview of an encompassing and dynamic adaptive management strategy. In reality, adaptive management would occur at several levels ranging from broader ecosystem management activities to day-to-day operations. For example, the ecosystem and species recovery actions will be the focus of the MRRIC. Whereas in the day-to-day operation of the mainstem system, the Corps communicates in real-time with the USFWS, other Federal, State, and local entities, basin Tribes, and numerous stakeholder organizations and individuals. Most of the real-time adjustments to system operations are not expected to be subject to consideration by the MRRIC. These day-to-day interactions will continue and are essential to effective real time operation of the mainstem system.

III. FLOW MODIFICATIONS

A. <u>Description of the 2000 BiOp RPA.</u> The 2000 BiOp states:

> ***Flow modifications at Gavins Point are needed to provide an ecologically improved hydrograph in the lower Missouri River (Galat 1999, Hesse, 1999). Such flows would restore and maintain sandbars and shallow water areas that serve as nesting and foraging habitat for least terns and piping plover, as well as nursery habitat for pallid sturgeon and other native fishes; trigger spawning activity in pallid sturgeon and other native fishes; and reconnect potential riverine and floodplain habitats inundating side channels, backwaters, and other off-channel areas needed as spawning and nursery areas for pallid sturgeon and forage fishes, as well as providing additional foraging areas for terns and plovers.***

In this section of the BA, information is presented from Corps engineering studies and analyses demonstrating that the flow modifications at Gavins Point Dam set forth in the 2000 BiOp RPA do not provide the intended physical attributes and biological effects originally thought, and therefore do not insure the Corps' action is avoiding the likelihood of jeopardizing the continued existence of the species. The Corps recognizes the importance of river hydrology on ecosystem health, however we do not propose to adopt the flow recommendations in the 2000 BiOp RPA without: 1) development of scientific information demonstrating flow measures that will provide the conditions the USFWS believes are necessary to provide sturgeon spawning cues, create new habitat, and reconnect the floodplain; and 2) an adequate monitoring program in place to measure biological responses (e.g. spawning and recruitment). Rather than implementing the flow measures called for in the 2000 BiOp from Gavins Point Dam, the Corps proposes actions to attain the habitat related objectives and attributes intended by the RPA by other measures and to continue gathering additional scientific information to make future decisions on Gavins Point flows.

B. Explanation as to Why the Corps Does Not Consider 2000 BiOp RPA Flow Measures to be Reasonable and Prudent.

1. **Habitat Creation**. The habitat related objectives of the RPA for Gavins Point flows were to: 1) restore, maintain, and create sandbar habitat for terns and plovers; 2) reconnect riverine and floodplain habitats; and, 3) increase the amount of shallow water habitat for pallid sturgeon. As discussed below, the Corps' technical analyses of the RPA flows show that these flows will not achieve the intended outcomes.

a. **Restore, Maintain, and Create Sandbar Habitat for Terns and Plovers**. Since the issuance of the 2000 BiOp, the Corps evaluated the RPA flows to determine their effectiveness in restoring, maintaining, or creating sandbar habitat for terns and plovers. The Corps' engineering analysis of the alluvial geomorphic process of the reach below Gavins Point Dam concludes the RPA flows would likely accelerate erosion of sandbars beyond that of the Current Water Control Plan (CWCP), and would not provide for a complimentary scouring/sandbar building event. It is important to realize that a change in the present alluvial processes will require a change in the dominant discharge class. The dominant discharge is that discharge (or discharge class) that transports the majority of the bed material sediment load. Determining the dominant discharge class requires flow-duration data and an adequate relationship between river discharge and sediment transport. Considering the sediment discharge rating curve for the Sioux City area and the flow-duration curve under the RPA, the slight shift in the discharge class caused by the spring rise would be insufficient to scour and maintain high elevation barren sandbars. The Corps' studies also show that the long-term net result of the RPA flows would be less available habitat. Further discussion of the engineering analysis can be found in Appendix A, page 3.

b. **Connectivity to Low-Lying Lands.** As stated in the 2000 BiOp:

> ***Floodplain connectivity refers to the seasonal flooding of areas adjacent to the river. The spring flood pulse often provides connectivity between the floodplain and the river. For native river fish like the pallid sturgeon, this floodplain connectivity, especially during May/June, provided spawning areas for forage species, increased phytoplankton production, and redistributed carbon to the river.***

This carbon, in the form of detritus scoured off of the floodplain, settled out in the shallow water areas along the river where the microscopic biota grew. As the pallid sturgeon hatched, the larval fish would float down the river until they were able to float into the shallow water areas, where they would reside during their fragile first months of life.

To better understand how much floodplain connectivity may be occurring along the lower river from Sioux City to the mouth, the Corps estimated the acreage and elevation of the low-lying lands (areas adjacent to oxbow lakes and chutes) that could be inundated by higher river flows. This information was then correlated with modeled flows under the CWCP and the 2000 BiOp RPA flows. The months of May and June were chosen because this is when a spring rise would normally occur. Duration plots of acres inundated versus percent of time were then generated. In

conclusion, the gains in connectivity in the low-lying areas with spring rise flow increases are relatively minor. In fact, there is effectively no increase in value downstream of the Omaha reach. By adding a spring rise of 20 kcfs, the gain in connectivity for the Missouri River from Sioux City to the St. Louis, a distance of 734 river miles, is estimated at 164 acres. Without additional habitat creation in the lower river, the spring rise will have minimal effectiveness in reconnecting the floodplain. This conclusion is supported by the NRC's commentary that hydrologic connections between river channel, floodplain, and backwater areas have been greatly disrupted. Further discussion of the floodplain connectivity analysis can be found in Appendix A, page 8.

c. **Shallow Water Habitat Along the Lower River and Summer Flows**. In its BiOp, the USFWS states that shallow water habitat has value to all life stages of native big river fish and other river organisms. Shallow water habitat is likely important during the first few months of the life of the larval pallid sturgeon. The Corps and USFWS agreed during the formal consultation for, and the review of, the 2000 BiOp, that 20 to 30 acres of shallow water habitat per mile may provide the habitat necessary for recovery of pallid sturgeon.

An analysis of existing shallow water habitat under the 2000 BiOp RPA flows and CWCP was conducted using data obtained from the physical habitat model developed by the Corps. As part of the development of that model, cross-sections were taken at a representative sub-reach of seven reaches of the lower river and hydraulically modeled. These data provided a basis for determining the amount of habitat fitting into a variety of depth and velocity classes for each of the seven reaches (habitat per mile times reach length). Shallow water habitat for the purpose of this analysis is habitat that is up to 5 feet deep with a velocity no greater than 2.5 feet per second. The amount of habitat in each depth and velocity class could be determined based on the amount of flow in each river reach. Using these relationships, the Corps developed a model that would provide duration plots of the acres of habitat per mile in each reach for any time frame of interest. The conclusion was that the 2000 BiOp RPA summer low flow releases from Gavins Point Dam would increase the shallow water habitat in Missouri River from Sioux City to the confluence with the Osage River, an approximate distance of 600 river miles, an estimated 1,200 acres (from an estimated 3,700 acres to 4, 900 acres). This additional 1,200 acres of shallow water habitat does not meet the identified goal of approximately 12,000 acres (based on 20 acres per mile for that portion of the Missouri River). Further discussion of the shallow water habitat analysis for the lower river can be found in Appendix A, page 11.

2. **Spawning Cue in the Lower River**. The 2000 BiOp RPA recommends a spring rise in flows from Gavins Point Dam to provide important physical attributes and biological conditions including a spawning cue for native river fish, especially the endangered pallid sturgeon. The 2000 BiOp RPA specifies a modified release pattern that has a spring rise of 15 to 20 kcfs above the full navigation service level on average of once every three years. The duration of this release is 2 weeks at its peak and a total duration of 4 weeks including the period over which the releases are gradually increased and decreased.

USFWS and Corps staff acknowledge that the parameters of the pallid sturgeon spawning requirements (flows, temperatures, turbidity, habitat, etc.) are currently not known. Pallid sturgeon larvae have been sampled from the Missouri River in North Dakota and Missouri

indicating that some stretches of the Missouri River or tributaries may have recently possess the necessary habitat and flows resulting in successful pallid sturgeon spawning. For instance, monitoring of the Missouri River downstream of Fort Peck Dam and the confluence with the Yellowstone River in 2002 found two larval pallid sturgeon. A comparable population assessment program is just beginning for the lower Missouri River below Gavins Point Dam to determine whether or not a spring rise component would result in successful spawning of pallid sturgeon. Additionally, an analysis of modeled flows at different locations on the lower Missouri River indicates that a spring rise of various magnitudes and durations is occurring. In the proposed research, monitoring and evaluation program, these areas would be studied to determine if spawning is occurring. Further discussion of this analysis can be found in Appendix A, page 17. The Corps believes it is essential to address the scientific uncertainties associated with the relationship between flow releases and spawning cues to insure the action avoids the likelihood of jeopardizing the continued existence of the species.

C. Description of the Corps' Alternative to the Gavins Point RPA (Proposed Action). It is important to recognize that the USFWS and the Corps are in agreement on the habitat attributes necessary to conserve listed species on the Missouri River as described in the 2000 BiOp. However, as previously described, the flow measures prescribed for Gavins Point Dam in the 2000 BiOp will not achieve these desired attributes. Consequently, the Corps is proposing a series of alternative near term and long term actions it believes will benefit and conserve listed species and avoid jeopardizing their continued existence. Such actions include modified Missouri River Mainstem Reservoir System (System) operations; a robust research, monitoring, and evaluation (RM&E) program to examine the multiple factors that may be limiting pallid sturgeon spawning and recruitment in all suitable reaches of the Missouri River; various flow tests at certain projects on the mainstem system; accelerated shallow water habitat development; and expanded support for propagation efforts. The Corps is also proposing, consistent with the proposed adaptive management approach, that the scientific findings associated with the RM&E program, the progress and success of accelerated habitat development, and other actions be revisited within three years of the issuance of a new BiOp to examine scientific findings and determine changes and additional actions, as appropriate, to further enhance the conservation of listed species and the broader ecosystem values of the Missouri River.

1. **Proposed System Operations**. The operation of the System is designed to serve Congressionally authorized project purposes, including flood control, hydropower, water supply, water quality, irrigation, navigation, recreation, and fish and wildlife. During periods of drought, service to all authorized purposes is maintained, though at reduced levels.

This proposed action measure has two basic flow features that are changed from the CWCP. First, more stringent drought conservation or retention of water in the upper three reservoirs is included. Second, a set pattern of intrasystem unbalancing is included. Also described in this section are proposed options for summer operations.

a. **Drought Conservation Measures**. During extended drought periods, or those lasting more than 1 year, navigation service would be reduced earlier under the proposed action than it is under the CWCP. This would allow more water to be stored in the upper three reservoirs. During the more severe droughts, such as the 1930 to 1941 drought, releases for

navigation would be curtailed at a higher total System storage level than under the CWCP. This proposed action measure was not specified in the USFWS 2000 BiOp RPA; however, all modeling conducted for the USFWS as it prepared the BiOp included more stringent drought conservation measures.

The drought conservation criteria included in the proposed action consists of "guide curves" for the determination of flow support for navigation and other downstream purposes and navigation season length. Under the proposed action, the navigation service level and season length would be reduced at higher system storage levels than they are currently under the CWCP. The March 15 System storage level at which navigation would not be served for that year was raised from 23.5 million acre-feet (MAF) under the CWCP to 31 MAF under the new drought conservation measures for this proposed action measure. Figures 1 through 3 compare the drought storage levels and the corresponding navigation service levels and season lengths of the CWCP and proposed action.

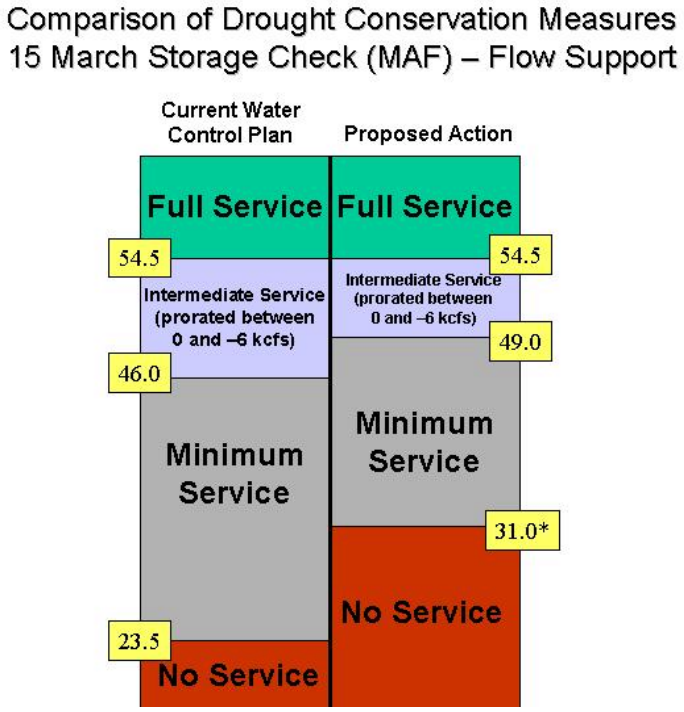


Figure 1. Comparison of drought conservation measures between the CWCP and the System operations under the proposed action based on the March 15 System storage check for Service Level.

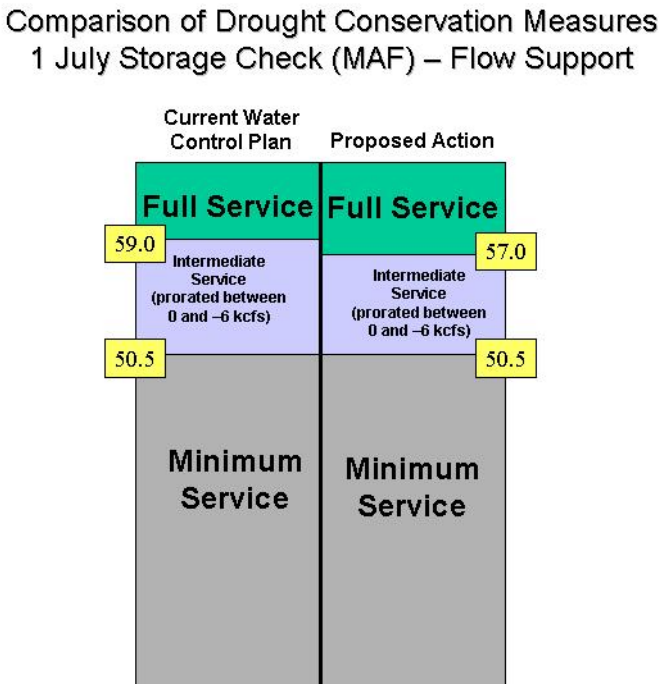


Figure 2. Comparison of drought conservation measures between the CWCP and the System operations under the proposed action based on the July 1 System storage check for Service Level.

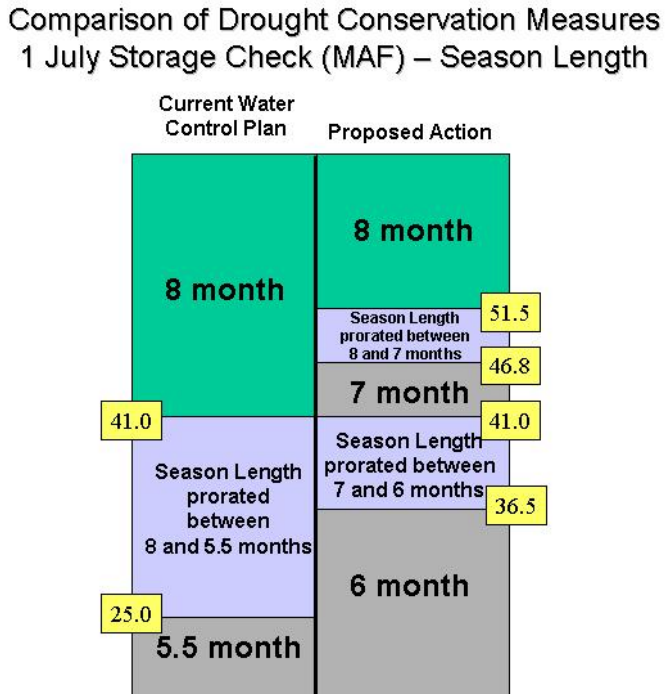


Figure 3. Comparison of drought conservation measures between the CWCP and the System operations under the proposed action based on the July 1 System storage check for Season Length.

The proposed water control plan presented in this BA calls for suspension of navigation service if System water-in-storage (storage) is at or below 31 MAF on 15 March of any year. It should be noted that the occurrence of System storage at or below 31 MAF would most likely coincide with a national drought emergency. If any of the reservoir regulation studies performed for the development of the Annual Operating Plan (AOP) indicate that System storage will be at or below 31 MAF by the upcoming 15 March, the Corps will notify the Secretary of the Army. Approval from the Secretary of the Army will be required prior to implementation of back-to-back non-navigation years. The Corps will ensure that basin stakeholders are promptly informed of the notification to the Secretary of the Army and of the Secretary's decision regarding suspension of navigation.

Table 1 compares the lowest elevations that would have occurred under the CWCP and this proposed action measure for each of the upper three lakes during the 1987 to 1993 drought. The figure also contains the minimum storage for the CWCP if the current drought conservation measures had been strictly followed. Inclusion of these measures would increase total system storage from 40.2 to 42.1 MAF for this proposed action measure during a similar drought.

Table 1. Lowest lake levels for the 1987 to 1993 drought (ft msl).

Lake	CWCP	Proposed Action
Fort Peck Lake	2,206	2,208
Lake Sakakawea	1,813	1,817
Lake Oahe	1,585	1,587

b. **Unbalancing of the Upper Three Lakes**. The Corps has the authority under the existing Master Manual and currently implements intrasystem unbalancing. Unbalancing of the lakes was also included as a feature of the 2000 BiOp RPA. Unbalancing under this proposed action consists of a set pattern of purposefully lowering one of the upper three lakes approximately 3 feet to allow vegetation to grow around the rim, and then refilling the lake to inundate the vegetation. The unbalancing would rotate among the three lakes on a 3-year cycle. Movement of water among the lakes as they are lowered and refilled provides benefits to fish and birds in both the intervening river reaches and the lakes. Higher spring releases will fill the downstream reservoir and provide a rising lake level for game and forage fish spawning. The subsequent 2 years of lower flows would expose sandbar habitat for use by the protected birds. Unbalancing would also provide more bare sandbar habitat around the perimeter of the lakes for the birds. In subsequent years, the inundated vegetation around the perimeter would be used by adult fish for spawning and by young lake fish hiding from predators.

Intrasystem unbalancing would be implemented in those years when there is not an excessive amount of flood control storage utilized or significant drawdown of the lakes due to severe drought conditions. To the extent possible, based on hydrologic conditions, a 3-year cycle would be followed for lowering the water level about 3 feet below normal the first year, followed by a refill of the lake to about 3 feet above normal the second year and declining lake levels (a “float” year) the third year. This 3-year cycle would be rotated among the upper three lakes on an

annual basis so that each year one lake is high, one is low and the third is floating. Table 2 describes the 3-year cycle of lake unbalancing.

Table 2. Unbalancing Schedule for Upper Three Lakes

	Fort Peck		Garrison		Oahe	
	March 1	Rest of Year	March 1	Rest of Year	March 1	Rest of Year
Year 1	High	Float	Low	Hold Peak	Raise and hold during spawn	Float
Year 2	Raise and hold during spawn	Float	High	Float	Low	Hold Peak
Year 3	Low	Hold Peak	Raise and hold during spawn	Float	High	Float

During the low year at a lake, the goal of the Corps would be to begin the runoff season on March 1 with a low lake elevation with respect to the other two upper lakes. Ideally, the lake would rise during the lake fish spawn and then hold the peak lake level for the remainder of the year. The following year, the high year, the lake would begin the runoff season high with respect to the other lakes, rise during the fish spawn, and then float downward during the remainder of the year. The float year, or third year, the lake would rise during the fish spawn and then drift downward for the remainder of the year so that it is in position to be at a low elevation the following year as the cycle repeats.

c. **Gavins Point Dam Summer Releases**. Summer releases under the proposed action will be adjusted when the Corps determines that birds have begun nesting. Flow support for navigation and other downstream purposes would be provided by adjusting releases as needed throughout the summer as tributary inflow varies to meet targets (flow-to-target); by providing a steady, flat release during the tern and plover nesting season at the flow level estimated to provide the desired navigation service support in August when tributary inflows have declined (steady-release); or by some combination of the two methods, as was implemented during the 2003 nesting season (steady-release – flow-to-target). The modeling done for the Missouri River Master Manual Review and Update process used a flat 28.5 kcfs as an estimate of the release needed to provide minimum service support, and 34.5 kcfs for full service support; however, the actual release would vary based on the hydrologic conditions at the time.

Adaptive management will be used to make decisions about the method to use during any given year and will be based on runoff, habitat availability, fledge ratios, and population conditions at that time. For example, if a moderately high runoff year is anticipated and sufficient habitat exists, a flat release may be used because, in general, it would evacuate more water during the summer months than would be released by following targets. If, on the other hand, the upper basin is experiencing a moderate to severe drought and the upper three large lakes are low, a flow-to-target or steady- release – flow-to-target operation may be followed through the summer season to conserve water in the system.

The evacuation of floodwaters would be delayed until mid-September whenever possible to minimize the impacts to the young-of-year native river fish. This delay may be done independently in any year flood water evacuation is needed after the nesting season, or in conjunction with one of the flow tests proposed as part of the proposed action. Additional

measures to minimize losses of the two listed bird species are taken by the Corps. Further details regarding these measures can be found in Appendix B, page 6.

2. **Research, Monitoring, and Evaluation**. As indicated above, the Corps proposes to operate the System using adaptive management including a robust research, monitoring and evaluation (RM&E) program and a re-evaluation of the science on flow modifications and other potential actions in three years.

a. **Comprehensive Pallid Sturgeon Research Project**. Research to determine the critical ecological factors that contribute to successful pallid and shovelnose sturgeon reproduction and survival in the Missouri River will include laboratory and field research. This research will provide new information on the physiology of reproduction and growth, survival across the life stages, status of populations, and taxonomy for sturgeon in the Missouri River, including quantitative assessment of how biology, hydrology, and water quality combine to provide suitable habitat and resources over a considerable spatial and temporal scale.

While a variety of factors have been suggested as contributing to the viability of pallid and shovelnose sturgeon, the significance and interaction of flow-related factors (such as hydrologic cues, temperature, turbidity, depth, and velocity) with in-channel habitat features and other factors (such as nutrition, competition, predation, productivity, water quality and contamination) is uncertain. An objective assessment of how multiple life stages and essential activities of the two sturgeon species respond to a range of potential stressors will provide rigorous and credible information for use in resolving the many issues surrounding pallid sturgeon recovery actions. This research is intended to provide the best understanding of sturgeon responses as functions of management variables, thereby providing stakeholders with an improved understanding of tradeoffs among management alternatives. Further details regarding the comprehensive research activities can be found in Appendix B, page 19.

b. **Regional Population Assessments**

1) **Interior Least Tern and Piping Plover.** In addition to the population assessment and monitoring efforts on the Missouri River being conducted in response to the 2000 BiOp, the Corps will develop and support a regional coordination process for the Missouri River piping plovers and least tern subpopulations. It has become apparent that if successful management actions are to occur for these species on the Missouri River the dynamics of their larger population structure must be understood. Greater understanding of regional population interactions such as immigration/emigration, source/sink populations, and seasonal presence/absence would provide greater sensitivity in assessing the long-term prospects for species persistence and allow more informed management decisions. Further information regarding this proposed action can be found in Appendix B, page 23.

2) **Pallid Sturgeon.** The pallid sturgeon in the Missouri River is part of a larger population that may extend to the middle and lower Mississippi River. If successful management actions are to be successful on the Missouri River, the dynamics of the larger population structure must be understood. Population parameters such as recruitment, survival and mortality must be understood and the role each river system and segment plays in the overall

success of the species must be determined. The Corps is currently involved in determining these parameters for Mississippi River pallid sturgeon populations and will coordinate population assessment studies done on the Missouri River to insure a broader regional assessment can be conducted.

c. **Flow Tests**. Due to the extent of required habitat, considerable new habitat will need to be created. Three tests would be conducted to determine the extent to which additional habitat can be constructed with flows into Lewis and Clark Lake, in the river reach downstream from Gavins Point Dam, and to determine if constructed sandbars can be conditioned to provide better habitat for the least terns and piping plovers.

1) **Gavins Point Reach Fall Test**. In the fall a flow test will be run in the river reach downstream from Gavins Point Dam after refill of the system following the current drought, and would be conducted when evacuation of the system is necessary. The test will consist of a release of approximately 60 kcfs for a period of approximately 60 days. The exact magnitude and duration of the test will be determined through pre-test investigations and public input. The test would be monitored for physical changes in sandbar distribution and characteristics in the reach of the river from Gavins Point Dam to Ponca State Park. Representative island/bars will be monitored to determine the factors that limit the initiation of scour, and tests would be performed on techniques that may aid the scouring process, e.g., vegetation removal prior to the test discharges, physical conditioning (i.e., disking) prior to the test, etc. This would increase the total amount of bare sandbar habitat in this reach and would allow for a redistribution of the habitat. This test would also provide a greater understanding of the benefits/impacts associated with any alternative release scenario from Gavins Point Dam. Further discussion of this flow test can be found in Appendix B, page 10.

2) **Fort Randall Reach Fall Rise**. A second flow test that includes a fall rise out of Fort Randall Dam will also be conducted. This action would consist of producing a controlled rise in releases from Fort Randall Dam, preceded by a lowering of the pool in Lewis and Clark Lake. This test would be conducted after Labor Day. The purpose of the rise is to further define sediment-flushing parameters and to modify the sediment deposits in the delta area. This would increase the amount of least tern and piping plover habitat in the reach below Fort Randall Dam and will further the understanding of the sediment flushing requirements. The releases from Fort Randall Dam could be as high as 60 kcfs, and the pool at Lewis and Clark Lake could be as low as 1180 feet mean sea level (ft-msl). The length of the test would depend on the rate that the Lewis and Clark Lake pool is refilled, which depends on the release rate from Gavins Point Dam. The test could be conducted at the same time as the fall rise test downstream from Gavins Point Dam, or it could be conducted independently. If it were run with the Gavins Point Dam fall rise, the duration could be up to 60 days. If it were run by itself, the estimated test length is 5 days. The exact magnitude and duration of the test will be determined through pre-test investigations and public input. Further discussion of this flow test can be found in Appendix B, page 11.

3) **Gavins Point Spring Sandbar Habitat Conditioning**. A third flow test, conditioning of constructed sandbar habitat, will be conducted downstream from Gavins Point Dam. Before running this test, new sandbar habitat would be constructed following the fledging of the least terns and piping plovers. As releases from Gavins Point Dam are increased the

following spring to meet the navigation service requirements, there will be additional releases in excess of those planned to serve navigation such that the new sandbar habitat would be inundated for a day or two. This is intended to consolidate the substrate and potentially mix organic material in the surface layer. The objective of this test is to determine if there is a difference in least tern and piping plover productivity between the conditioned habitat and the habitat that is constructed and not inundated. Further discussion of this flow test can be found in Appendix B, page 12.

4) **Fort Peck Tests**. The 2000 BiOp included release changes from Fort Peck Dam as a component of the RPA. Prior to full implementation of this release change, the RPA included two tests, the "mini test" and the "full test." The Corps' proposed action includes conducting these two tests. Preliminary biological data collection is essential to determine the responses and effects of the "mini" and "full tests" on pallid sturgeon and the target species that have been selected for this effort, and will provide science critical to recovering fish populations throughout the Missouri River Basin. After assessment of the results of these tests, and through the adaptive management framework, the Corps may implement a Fort Peck Dam release change as a component of System operations. However, this would require revision of the Water Control Plan. Additional information on the planned Fort Peck tests can be found in Appendix C, page 1.

3. **Accelerated Actions to Benefit the Species**.

a. **Shallow Water Habitat**. The Corps proposes to accelerate the construction of shallow water habitat surpassing the short-term goals recommended in the 2000 BiOp. This action will be taken in the lower river from Ponca State Park to the mouth. Additional information on existing and planned habitat development can be found in Appendix B, page 18.

b. **Propagation Support Improvements**. Pallid sturgeon propagation efforts had limited success when the 2000 BiOp was written. An understanding of rearing densities specific to pallid sturgeon had not been developed, and the design of existing facilities was similar to West Coast hatcheries propagating white sturgeon for commercial markets. Through experience, fish culturists now know the pallid sturgeon must be reared at very low densities to achieve normal growth and minimize the potential for disease outbreaks. The 2000 BiOp did not address specific needs related to infrastructure and facility improvements that may limit the population augmentation component of recovery. Additionally, since the completion of the 2000 BiOp, stocking plans have been revised utilizing more liberal stocking rates to supplement the year classes that are absent as a result of a lack of natural reproduction/recruitment and severely depressed wild populations. The USFWS and the Corps have prioritized a list of facility improvements with an emphasis on increasing production capabilities while improving water quality and water reliability to propagate pallid sturgeon of the highest quality possible. To achieve the increased production levels and improve the overall health of the progeny produced from the population augmentation program, the Corps proposes a series of expansions and/or modifications to hatchery facilities on an accelerated schedule.

In addition the Corps proposes an accelerated brood stock collection program to facilitate direct, intensive collection efforts by state and federal agencies to capture the genetic stocks that inhabit

the lower river. Specific efforts directed toward brood stock collection are essential to capture and represent the genetic variability and diversity of pallid sturgeon in the lower river. Successful collection, spawning, rearing, and stocking will partially offset the lack of natural reproduction and would help ensure these genetic stocks are perpetuated in the wild while solutions to habitat loss are addressed through the various means of habitat restoration (i.e., shallow water habitat projects). Further information on planned activities can be found in Appendix B, page 12.

4. **Three-Year Re-evaluation**. Consistent with the adaptive management approach, the Corps proposes that the status of the species, the scientific findings of the proposed robust RM&E program, the progress and success of other implemented measures to date, and other relevant new information be re-evaluated within 3 years following the issuance of a new BiOp. This re-evaluation will inform decisions concerning implementation of additional measures or modification of existing measures and strategies, including potential flow releases out of Gavins Point Dam. The "3 year check-in" would include input from The Missouri River Recovery Implementation Committee (MRRIC) to promote conservation of listed species and the broader ecosystem values of the Missouri River.

D. Discussion of Effects. This section of the BA provides the Corps' assessment of the effects of the proposed action on the five listed species on the Missouri River. These include the pallid sturgeon, least tern, piping plover, bald eagle, and Indiana bat. Specifically, the effects of the proposed System operation changes, the RM&E Program, and the accelerated actions to benefit species are assessed.

1. **Pallid Sturgeon**.

a. **System Operation Changes:** The proposed action includes two basic flow features that are changed from the CWCP: more stringent drought conservation measures and the establishment of an intrasystem unbalancing pattern. Also described in the proposed action are proposed options for summer operations.

1) **Drought Conservation Measures**. The drought conservation measures, aimed at conserving water during critical drought periods, will generally result in reduced flows below Gavins Point Dam earlier in the drought cycle. These lower flows will typically occur during the summer and fall months. The effects of this action on pallid sturgeon are not completely understood, however, with reduced flows there may be additional shallow water habitat in some reaches. The impact on shallow water habitat will vary year to year depending on the uncontrolled runoff from tributaries.

2) **Unbalancing of the Upper Three Lakes.** The effects of unbalancing the upper three reservoirs will have no effect on pallid sturgeon below Gavins Point. For the Fort Peck reach, the effects would vary year to year. In years when the project is refilling, releases from Fort Peck would be reduced and in other years, releases would be increased. Over time, it is expected that this operation would not adversely affect pallid sturgeon in the Fort Peck reach.

3) **Gavins Point Summer Releases**. Releases from Gavins Point Dam have been steady-release, flow-to-target or a combination of the two. The potential effect on approximately 800 miles of the Missouri River downstream of Gavins Point Dam from a flow-to-target would vary from year to year. Depending on channel configuration and tributary inflow, the amount of shallow water habitat available for use by young-of-the-year fish as refugia and nursery will be reduced in some parts of the river while other parts will increase.

b. **Research, Monitoring, and Evaluation:** Even though the knowledge base regarding the pallid sturgeon has been rapidly improving during the past decade, much of the basic life history is still unknown for the species. Although field sampling efforts have detected limited spawning success, much of the current understanding is inferred from studies and observations of other sturgeon species or other native big river fish species.
The Middle Basin Pallid Sturgeon Recovery Work Group recently identified the top five recovery needs as follows:

- Locate, quantify, and characterize pallid sturgeon spawning area, frequency, and behavior
- Locate, define, and characterize/quantify juvenile and rearing habitat
- Determine habitat use by larval pallid sturgeon
- Evaluate habitat restoration projects and efforts
- Locate, define, and characterize adult pallid sturgeon habitat

Documented information concerning the functioning of the Missouri River ecosystem and the habitat requirements needed for survival of pallid sturgeon is extremely limited. The proposed action will provide for a significant pallid sturgeon RM&E program seeking to acquire information and an understanding of the pallid sturgeon biological requirements, filling data gaps, and providing much needed information to guide research, management, and future recovery of the pallid sturgeon.

This RM&E Program will include studies to: 1) identify the causes for lack of reproduction, lack of recruitment, and hybridization; 2) identify and map the location of gravel/cobble/rock substrates that may provide potential spawning habitat for sturgeon within the prioritized river segments; 3) and investigate modifications to river channel structures to maintain and improve aquatic habitat diversity. This RM&E will include investigating areas with existing spring rises and significant amounts of shallow water habitat to locate pallid sturgeon spawning areas and quantify spawning requirements for the species. Data collected by this RM&E program is critical for the survival of the pallid sturgeon. This new information will be used in the adaptive management strategy to inform the recovery decision-making process. As part of the RM&E for all listed species, four flow tests are proposed.

1) **Gavins Point Fall Test**. The proposed action includes a pulsing 60,000 cfs test for 60 days to assess the effects on the physical structure of the island sandbar habitat from Gavins Point to Ponca for the benefit the listed terns and plovers. The effects of the flow test may be detrimental to larval and young of the year sturgeon. During the fall, the juveniles are at a critical stage in development and increasing flows at this time could affect their ability to hold station and may affect food availability. Also, these changes to the environment have the

potential of negatively impacting the sturgeon populations. Monitoring of the effects to pallid sturgeon will be part of the test.

2) **Fort Randall Fall Release**. This test would release water in the fall to inundate island and sandbar habitat. The proposed action is to pulse up to 60,000 cfs for 5 to 60 days. The purpose of the test would be to redistribute sandbar complexes below Fort Randall to benefit listed terns and plovers. The potential effects on the pallid sturgeon could be both positive and negative. Additional shallow water habitat will be created, which would be beneficial to pallid sturgeon, while increased flows may adversely affect any juvenile fish present during the operation because of the same considerations set forth for the Fort Gavins Point Fall Test.

3) **Gavins Point Spring Habitat Conditioning.** The proposed 1-2 day spring pulse will have positive effects on the pallid sturgeon as it will bring nutrients into the aquatic environment. Depending on the magnitude of the pulse, the ecological benefits range from insignificant to significant.

4) **Fort Peck Tests**. These tests are designed to provide positive effects to the sturgeon. The "mini test" is designed to test the efficacy of conducting longer-term pulse flows. The "full test" is designed to provide hydrograph attributes (turbidity, temperature, and volume) to determine biological responses from the sturgeon and other native fishes. This proposed action has positive effects on the pallid sturgeon and will provide valuable information for the adaptive management process.

c. **Accelerated Actions to Benefit Species**

1) **Hatchery Facility Improvements:** In addition to continuing the pallid sturgeon propagation and augmentation program, this measure will include improvements to existing pallid sturgeon hatchery facilities. It is anticipated that these hatchery improvements will increase pallid sturgeon production capabilities to fully meet all stocking requirements for the Missouri River basin. This will provide a beneficial effect to the pallid sturgeon by increasing the number of pallid sturgeon in all Recovery Priority Management Areas as identified in the Pallid Sturgeon Recovery Plan and the 2000 BiOp. This measure will also accelerate the collection of pallid sturgeon broodstock. This will enable the state and federal agencies to direct intensive collection efforts to capture the genetic stocks that inhabit the lower basin. Broodstock collection is essential to preserve the remaining genetic variability of pallid sturgeon in the Lower River. Successful collection, spawning, rearing, and stocking will ensure that these genetic stocks are not lost and prevent extirpation of existing pallid sturgeon populations in the Missouri River.

2) **Accelerated Shallow Water Habitat Construction:** In its 2000 BiOp, the USFWS states that shallow water habitat is valuable to all life stages of native big river fish and other river organisms. Shallow water habitat is thought to be especially important during the first few months of the life of the larval pallid sturgeon. The BiOp concluded 20 to 30 acres of shallow water habitat per mile is necessary to preclude jeopardy to the pallid sturgeon with an

interim goal of approximately 2,460 new acres by 2010, and a long-term goal of 8,180 new acres by 2020 (based on acquiring 20 acres per mile from Sioux City to the Grand River).

The Corps proposed action accelerates the creation of shallow water habitat resulting in a total of 5,870 acres of new shallow water habitat in the lower river by the year 2010. This accelerated habitat development will exceed the 2000 BiOp habitat goal for 2010 by nearly 3,300 acres. This will result in meeting the long-term shallow water habitat goal of 20 acres per mile from the Osage River to the mouth and nearly reaching the goal from Kansas City to the Osage River. Substantial gains will be made in the river reaches upstream from Kansas City. The Gavins Point reach already has 63 acres/mile, which is sufficient shallow water habitat.

Shallow water habitat is an indicator of the diversity of in-channel habitat conditions. A wide range of depth and velocity distributions and macro-habitat characteristics, such as emergent sandbars, side channels, sandbar pools, etc., were characteristic of the pre-channelized Missouri River. A dynamic alluvial process created and maintained these habitat types. The development of a more dynamic alluvial channel through this measure will provide greater diversity of depth and velocities over a wider range of flows. Further, the increased alluvial process will provide for an erosion/deposition pattern that will reflect the seasonal/annual variation of run-off and stage. The increase in shallow water habitat and the resulting alluvial process resulting from this measure may provide important habitat for early life stages of pallid sturgeon and other native riverine fish.

d. **Conclusion on the Effects to the Pallid Sturgeon:** The Corps believes that this proposed action will avoid jeopardizing the continued existence of pallid sturgeon. The actions that can be taken in the near term to effectively conserve listed species and would avoid the likelihood of jeopardizing the listed pallid sturgeon, include, but are not limited to, accelerated habitat development, particularly throughout the BSNP; expanded and accelerated support to propagation efforts; a robust research, monitoring, and evaluation program (RM&E) that examines the multiple factors that may be limiting pallid sturgeon spawning and recruitment in all suitable reaches of the Missouri River; and various flow tests at a number of projects on the System.

The proposed action by the Corps will: 1) create additional habitat likely to benefit pallid sturgeon and other native fishes; 2) significantly advance the scientific information and understanding of the life history and ecological requirements for survival of the endangered pallid sturgeon; 3) improve the pallid sturgeon propagation and augmentation program to upgrade the capabilities of pallid sturgeon propagation hatcheries in order to augment the population with higher numbers and higher quality fish; 4) and establish a "3 year check-in" to assess scientific findings, progress and successes associated with actions to make course adjustments, including potential flow adjustments from Gavins Point Dam. Based on the current scientific information on the pallid sturgeon, it is possible that the proposed action may have some unknown adverse affects to the species. However, the many known beneficial effects of the proposed action will significantly aid efforts to recover the pallid sturgeon. The proposed action as described in this BA, therefore, meets the objectives of the 2000 BiOp RPA concerning the pallid sturgeon and will likely avoid jeopardizing the continued existence of the pallid sturgeon.

2. **Interior Least Terns and Piping Plovers**. The following sections describe effects to the interior least tern and piping plover anticipated from the proposed action as described in this BA. Many life cycle requirements of the least tern and piping plover are similar, including habitat used for nesting and brood rearing. Therefore where appropriate, effects to these species will be considered together when evaluating effects of this action.

a. **System Operation Changes:**

1) **Drought Conservation Measures.** Drought conservation measures effects will be beneficial to both least terns and piping plovers in the short term with adverse effects over the long term if the drought conditions persist. In the short term, reduced releases would have the following benefits to the two species: barren sandbar habitat will increase, greater sandbar size will reduce predation losses, and more shallow water areas will increase the size of forage areas. However, if drought conditions continue for a long time, it is expected that barren sandbar habitat would decrease through natural erosion processes and vegetation encroachment.

2) **Unbalancing of the Upper Three Lakes.** The effects of unbalancing the upper three reservoirs will be positive for both least terns and piping plovers by replenishing beach habitat. Vegetation that grows up along the beaches during the low cycle will be inundated during the consequent refilling of the reservoirs during the high cycle. However, based on historic trends, the degree of benefit of the unbalancing will be different for the two species. Historically during low pool levels, Fort Peck Lake has been little used by either species, Lake Sakakawea has been used extensively by piping plovers, and Lake Oahe has been used extensively by both species. Therefore the beach habitat created once every three years by the unbalancing will provide the most benefit on Lake Sakakawea and Lake Oahe.

Least terns and piping plovers nesting below Fort Peck and Garrison Dams will also benefit from the unbalancing of the three reservoirs. The decrease in releases for a reservoir going into the high cycle will increase the amount of sandbar habitat, increase foraging habitat and reduce predation losses due to greater sandbar size. There will be a long-term benefit to both species when releases are increased when a reservoir goes into a low cycle. During the high releases vegetation will be scoured off of the inundated sandbars, thus regenerating habitat that will be exposed during lower releases. The benefits will vary. Most benefit will be below Garrison Dam, which historically has been the second most productive riverine reach for least terns and piping plovers. There will be less benefit on the reach below Fort Peck Dam because historically, piping plovers seldom use this reach.

3) **Gavins Point Summer Releases**. Releases from Gavins Point Dam have been steady-release, flow-to-target or a combination of the two. Steady-release flows have the advantage of minimizing take by preventing the two species from nesting on low sandbars that would be subject to inundation to meet flow targets in the navigation channel later in the nesting season. This regime has an adverse effect in that it decreases the amount of habitat available to the birds. By contrast, the flow-to-target regime provides additional habitat for both species during the early part of the nesting season. This regime however requires that tributary runoff later in the nesting season remain high enough to meet flow targets in the navigation channel.

b. **Research, Monitoring, and Evaluation:** This research monitoring and evaluation effort will provide scientific information and fill data gaps concerning biological cues of these species and their associated ecological processes. This information is critical to establishing appropriate management strategies and to their future success.

1. **Gavins Point Reach Fall Test.** It is expected that a test discharge of 60,000 cfs for 60 days from Gavins Point Dam would have a beneficial effect for least terns and piping plovers. This conclusion is based on productivity since the 1997 fall releases out of Gavins Point, in which releases were 70,000 cfs from September through mid-December. Both species have shown remarkable productivity in the six years following the event. The least tern fledge ratio is 1.38 fledglings per adult pair for 1998 through 2003, while the piping plover fledge ratio is 1.99 fledglings per adult pair for the same time period. As a comparison, the least tern fledge ratio for 1986 through 1997 was 0.50 and the piping plover fledge ratio for the same time period was 0.49. Though the 70,000 cfs releases in 1997 were of a greater magnitude and a longer duration (more than three months), it is predicted the results could be similar.

2. **Fort Randall Reach Fall Rise.** Depending on the magnitude and duration of a fall rise out of Fort Randall Dam, it is expected that there will be a beneficial effect for least terns and piping plovers. This conclusion is based on productivity since the 1997 fall releases out of Fort Randall. In 1997, releases were 65,000 cfs from September through mid-December. Since that high release regime both species have shown significant productivity in the six years following the event. The least tern fledge ratio is 0.88 fledglings per adult pair for 1998 through 2003 while the piping plover fledge ratio is 1.04 fledglings per adult pair for the same time period. As a comparison, the least tern fledge ratio for 1986 through 1997 was 0.22 and the piping plover fledge ratio for the same time period was 0.31. If the Fort Randall test is done in conjunction with the Gavins Point test with similar releases and duration, it is predicted the results could be similar to those from the 1997 releases. In addition to replenishing habitat on the Fort Randall reach, it would be expected that the test's flushing of sediment in the upper part of Lewis & Clark Lake would likewise have a beneficial effect on least terns and piping plovers by creating habitat.

3. **Sandbar Habitat Conditioning**. It is expected that a test flow to condition constructed sandbars would have an effect on least terns and piping plovers. It is hypothesized that this flow would benefit both species by consolidating substrate and mixing organic material in the surface layer, and this in turn would lead to greater productivity compared to sandbars that were constructed and not inundated. However, the test could show that there is no effect or even a detrimental effect on the two species. Conducting this test and analyzing the results will address this uncertainty.

4. **Fort Peck Dam Tests.** The Fort Peck Dam test releases will primarily benefit least terns since historically piping plovers seldom use this reach. Restoration of habitat by the removal of vegetation from the higher releases benefits both species. The release of warmer water through the Fort Peck Dam spillway may provide a benefit to the Missouri River ecosystem. This in turn may benefit the two bird species through an increase in forage species due to the warmer water.

c. **Accelerated Actions to Benefit Species**: The Corps concludes that the accelerated construction of shallow water habitat and propagation efforts for pallid sturgeon will have no effect on the least tern or piping plover.

d. **Conclusion on the Effects to the Interior Least Tern and Piping Plover.** While the proposed action as described in this BA will not completely ameliorate all of the adverse effects of the operation of the System on terns and plovers, the Corps has determined that the proposed action, in concert with the 2000 BiOp actions that are underway, will have many beneficial effects. The proposed action in conjunction with the on-going 2000 BiOp actions will: 1) meet the physical emergent sandbar habitat goals for nesting, brooding and foraging habitat; 2) provide critically significant gains in information and understanding of these species and their associated biological interactions within the ecosystem; 3) afford the opportunity to develop future courses of action through establishment of a recovery strategy to include broad stakeholder involvement in the management of the river and actions designed to benefit the listed species and critical habitat; 4) and meet the three year running average fledge ratio goals for the least tern (0.70 chicks/pair) and piping plover (1.13 chicks/pair), as described in the 2000 BiOp.

3. **Bald Eagle**. The Corps has concluded that the proposed action has no effect on the bald eagle.

4. **Indiana Bat**. The Corps has concluded that the proposed action has no effect on the Indiana bat.

IV. CRITICAL HABITAT FOR THE PIPING PLOVER

A. <u>Critical Habitat</u>. Critical habitat is the area designated necessary for the species to survive. It includes the primary biological and physical processes of the habitat necessary to create and maintain itself. The objective is to protect habitat that is considered essential to restoring the listed population. In determining areas essential to conserve the northern Great Plains breeding population of piping plovers, the USFWS used the best scientific and commercial data available.

The USFWS designated critical habitat for the northern Great Plains population of the piping plover (67 FR 57638), including the Missouri River, in September 2002. In Montana, critical habitat was designated on Fort Peck Lake (77,370 acres (31,310.6 ha.), and 125.4 miles (201.8 km) of the Missouri River below Fort Peck Dam (RM 1712.0 to RM 1586.6). In North Dakota, critical habitat includes 18.6 miles below Fort Peck Dam (RM 1586.6 to RM 1540.0), 179 miles of river on Lake Sakakawea above Garrison Dam (RM 154.0-RM 1389.0), 87 miles of river below Garrison Dam (RM 1389.0-RM 1302.0), and 70 miles of river on Lake Oahe (RM 1302-RM 1232.0). In South Dakota, critical habitat includes 159.7 miles on Lake Oahe (RM1232.0-RM 1072.3); 36 miles (57.9 km) below Fort Randall Dam (RM 880.0- RM 844.0), 32.9 miles (52.9 km) on Lewis and Clark Lake (RM 844.0-RM811.1); and 58.9 miles (94.8 km) below Gavins Point Dam (RM 811.1-752.2). The Kansas River was not designated as critical habitat.

B. Primary Constituent Elements of Critical Habitat.

> In accordance with the Endangered Species Act in determining which areas to propose as critical habitat, the Service is required to base critical habitat determinations on the best scientific and commercial data available and to consider physical and biological features (primary constituent elements) that are essential to conservation of the species, and that may require special management considerations and protection. These include, but are not limited to: (1) Space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing (or development) of offspring; and (5) habitats protected from disturbance or that are representative of the historic geographical and ecological distributions of a species. Primary constituent elements for the northern Great Plains population of piping plovers are those habitat components (physical and biological) essential for the biological needs of courtship, nesting, sheltering, brood rearing, foraging, roosting, intraspecific communication, and migration. Federal Register Vol. 67, No. 176 Sept. 2002.

The one overriding primary biological constituent element that must be present at all sites are the dynamic ecological processes that create and maintain piping plover habitat. Without these ecological processes the physical components of the primary constituent elements would not develop. These processes (biological and physical) develop a mosaic of habitats on the landscape that provide the essential combination of prey, forage, nesting, brooding and chick-rearing areas. The availability of the habitat patches is dependent on local weather, hydrological conditions and cycles, and geological processes. For a more in-depth discussion of critical habitat and primary constituent elements, please refer to the Federal Register (vol. 67, No. 176, September 2002).

In summary, primary constituent elements of the northern Great Plains population of the piping plover are those habitat processes (biological) and components (physical) essential for the biological needs of courtship, nesting, sheltering, brood rearing, foraging, roosting, intraspecific communication, and migration. The overriding primary constituent element (biological) necessary on all sites is the dynamic ecological processes that create and maintain the physical components of piping plover habitat. On rivers, the physical primary constituent elements include sparsely vegetated channel sandbars, sand and gravel beaches on islands, temporary pools on sandbars and islands, and the interface with the river. On reservoirs, the physical primary constituent elements include sparsely vegetated shoreline beaches; peninsulas; islands composed of sand, gravel, or shale; and their interface with the water bodies.

C. Anticipated Effects of Proposed Action and On-going Actions on Critical Habitat.
The biological effects on the piping plover designated critical habitat considered here, will include both the proposed action and those actions that are being implemented in response to the 2000 BiOp.

1. **Adaptive Management**. The implementation of adaptive management through MRRIC will likely have no direct adverse effect on the designated critical habitat. As the

adaptive management strategy is based on process and development of information, critical habitat will likely benefit through improved communication and coordination of all activities with the USFWS and other stakeholders.

2. **System Operation Changes**. System operation changes will produce flow changes in a planned, adaptive management process. Implementation of drought conservation measures may lower flows on the river below Gavins Point Dam and expose reservoir shore habitat during drought periods. Unbalanced intrasystem operations will periodically inundate and expose reservoir shoreline habitats. Gavins Point summer releases may vary year to year depending upon hydrologic conditions.

a. **Drought Conservation Measures.** The drought conservation measures, aimed at conserving water in the upper three reservoirs during drought periods, will generally reduce flows below Gavins Point Dam earlier in the drought cycle. The resulting lower flows will typically occur during the summer and fall months. The effects of this operation are complex and will have short and long term impacts to the critical habitat for the plover. In the short-term, lower flows will expose more sandbar and island habitat in the riverine environment below the dams. On the reservoirs, shoreline habitat will potentially continue to be exposed as storage is depleted. During the nesting and brooding season these actions would have a beneficial effect to the plovers by increasing available critical habitat. If the drought conditions persist, these short-term benefits may translate into long-term habitat loss if dynamic ecological processes required to create and maintain critical habitat are not implemented. (See discussion on page 57643 of FR Vol. 67, No. 176, September 2002)

b. **Intrasystem Unbalancing.** The unbalancing of the upper three lakes component of the proposed action would have no effect on riverine habitats. However, the water management strategy of fluctuating the reservoir levels on a three-year cycle introduces variability into the reservoir system. The reservoir biological primary constituent element (sparsely vegetated shoreline beaches, peninsulas, etc.) would be created and maintained by the introduced dynamic process of cyclic rising and falling. This action would allow the habitat to be maintained over time. This would be a positive effect to the critical habitat of the reservoirs.

c. **Gavins Point Summer Releases.** Releases from Gavins Point Dam have been steady-release, flow-to-target or a combination of the two. Steady-release flows have an adverse effect on piping plover critical habitat by inundating habitat early in the nesting season and making this habitat unavailable to the birds throughout the nesting season. By contrast, the flow-to-target regime provides additional piping plover critical habitat during the early part of the nesting season. This regime however requires that tributary runoff later in the nesting season remain high enough to meet flow targets.

3. **Hatchery Facility Improvements**. Hatchery facility improvements will have no effect on piping plover critical habitat.

4. **Accelerated Shallow Water Habitat Construction**. Accelerated shallow water habitat construction will have no effect on piping plover critical habitat as it does not occur within the bounds of the critical habitat designated by the USFWS.

5. **Artificially or Mechanically Created Habitat**. This action includes measures to create and maintain the physical elements of critical habitat through artificial methods. These methods may provide physical habitat elements without dynamic ecological creation processes. However, currently no data exist that demonstrate the ability of many of these methods (spraying, mowing, bulldozing piles of sand) to provide properly functioning biological habitat elements (food, shelter, habitat in the proper arrangement…) or address the effects of these methods on the physical primary constituents elements over large geographic and temporal scales. The production of physically suitable but ecologically non-functioning habitat that result in "ecological traps" is of particular concern. An intensive, experimentally based monitoring approach will be used to assess the value of these methods in providing the biological and physical elements of piping plover habitat. One action to address this issue is the proposed sandbar conditioning test. As this information is obtained and analyzed, the measures will be refined through the adaptive management process. The effects of several measures that are aimed at creating piping plover critical habitat are currently unknown, but are designed to increase knowledge and understanding of habitat creation and functionality processes. Addressing these uncertainties is a beneficial effect.

6. **Research, Monitoring, and Evaluation (RM&E)**. There are on-going and proposed RM&E efforts associated with least terns and piping plovers. These include riverine and reservoir habitat monitoring and evaluation, the forage ecology study, and the regional population assessments. These actions will provide for an improved regional understanding of the bird population dynamics, improved coordination and data storage, and will expand current efforts to include actions focused on the wintering grounds. This new information will be used in the adaptive management strategy to inform the recovery decision-making process. Gathering information aimed at improving management of the species will have no adverse effect on critical habitat.

The Corps' proposed action also includes a series of flow tests to gain essential information, the effects of which are described below.

a. **Gavins Point Reach Fall Test.** As described, 60,000 cfs for 60 days, will have beneficial effects on piping plover critical habitat by introducing some of the natural attributes of high flows to create and maintain sandbar habitat. Because of the fall timing of the release, there will not be a conflict with nesting piping plovers.

b. **Fort Randall Reach Fall Rise.** A pulse flow aimed at creating and maintaining habitat below Fort Randall Dam would have beneficial effects on piping plover critical habitat. The degree of the benefit will depend on the magnitude and duration of the flow. Because of the fall timing of the release, there will not be a conflict with nesting piping plovers.

c. **Gavins Point Spring Sandbar Habitat Conditioning.** This measure will inundate habitat for a short period of time in the spring. This action would potentially provide the primary constituent elements of piping plover critical habitat by consolidating substrate and mixing organic material in the surface layer and this in turn would lead to greater productivity compared to sandbars that were constructed and not inundated.

d. **Fort Peck Tests.** Benefits from this action will likely be improved habitat due to the scouring of vegetation through high flows. Another beneficial effect of the action will be the release of warmer water into the riverine environment below the dam. This could result in improved forage for piping plovers and increase production overall in the local ecosystem.

V. CORPS ACTIONS TO BENEFIT THE SPECIES

A. Maintain/Create Habitat. Considerable progress has been made toward reaching certain goals of the 2000 BiOp in the areas of shallow water habitat, flood plain reconnection, and emergent sandbar habitat. These actions are already being implemented by the Corps in response to the 2000 BiOp and are summarized below.

1. **Shallow Water Habitat**. Shallow water habitat may be achieved through flow management, river widening, (notching/dike modifications), restoration of side channels, or combinations thereof. The Corps has taken many steps toward achieving the 20 – 30 acres per mile of shallow water habitat goals prescribed in the 2000 BiOp. The most immediate goal is the development of 2,000 new shallow water habitat acres between 2000 and 2005. The second milestone is the creation of 5,870 acres of new shallow water habitat by 2010. During the period Fiscal Year (FY) 2001 through FY 2003, the Corps made modifications to the BSNP that resulted in the creation of 1,365 acres of shallow water habitat. Approximately 400 acres of those acres were created below the Grand River where the Corps estimates the shallow water habitat is close to the 20 acres per mile goal. Plans are in-place and the necessary real estate interests have been obtained for continuation of the shallow water habitat program to achieve the 2005 goal. Actions initiated to date to meet the goal of 2,000 additional acres of shallow water habitat by 2005, funded under the O&M program and the Missouri River Fish and Wildlife Mitigation Project, include: excavation of over 400 notches; construction of reverse dikes/notches at Marion and Plowboy Bends; side channel construction at Overton Bottoms, Tobacco Island, and California Bend (NE); buried dike excavation and notching at Overton; chevron construction and dike lowering near Nebraska City; and modification of dike maintenance at selected locations from Sioux City to the mouth to encourage aquatic habitat development. Construction activities planned for FY 2004 and FY 2005 include continuation of the river control structure modification and notching programs, where possible, and construction of chutes at Glovers Point (RM 712), Hole-in-the-Rock (RM 706), Lower Decatur Bend (RM 686), Lower Hamburg Bend (RM 552), and Kansas and Nishnabotna Bends (RM 543).

2. **Floodplain Reconnection**. Through the existing Mitigation Project, the Corps has obtained real estate interests in over 36,000 acres of land from Sioux City to the mouth. Floodplain reconnection has taken place on many of these areas through breaching or moving existing levees. Additionally, the Corps has restored numerous acres of agricultural lands to riparian forest, wetlands, and prairies.

Floodplain reconnection is already underway below Sioux City. Approximately 8,000 acres have been reconnected since the 2000 BiOp was published. An example of this effort is on the Overton North mitigation site where an existing agricultural levee was breached and 3,500 acres have been opened up to the river. This area has received floodwaters the past three springs for

periods of 2 to 8 weeks. Combined with the native vegetative plantings and natural re-growth of the area, this floodplain reconnection has greatly improved the floodplain habitat for a large variety of listed and non-listed species.

The existing Mitigation Project authorization allows the Corps to acquire and develop habitat on 166,750 acres. The Corps proposes to continue this project to enhance habitat opportunities for native fish during spring time flood flows by moving back or breaching existing levees wherever possible. The Corps will also continue native vegetative plantings to increase the amount of riparian forest habitat for the Bald Eagle.

3. **Emergent Sandbar Habitat**. The 2000 BiOp RPA specifies varying amounts of emergent sandbar habitat for the four reaches of the Missouri River currently used by least terns and piping plovers for nesting. By 2005, the recommended minimum habitat during the nesting season (to be measured in late July) is to be 40 acres per mile downstream from Gavins Point Dam, 40 acres per mile in Lewis and Clark Lake, 10 acres per mile downstream from Fort Randall Dam, and 25 acres per mile downstream from Garrison Dam. According to the 2000 BiOp, this habitat should be comprised of a minimum of 60 percent dry sand.

Based on these habitat goals, there would be a total of 6,255 acres of emergent sandbar habitat by 2005. The Corps is currently assessing the existing emergent sandbar habitat to determine how much additional acreage will need to be created. Until those data are available, the Corps' best estimate is that half of the 6,225 acres of emergent sandbar habitat already exists. Of the remaining 3,127 acres to be created, half would be created by vegetation removal procedures on existing sandbars and islands and the other half would need to be physically created.

All available habitat creation, enhancement, maintenance, and reconstruction methods will be used to provide suitable emergent sandbar habitat in the critical reaches, and new methods will be investigated. Further information on these actions can be found in Appendix C, page 9.

B. Propagation. Each year the Corps works with Federal and state fisheries agencies to prioritize propagation needs to facilitate achievement of the "Average Annual Shortfall" (Corps' responsibility) as identified in the 2000 BiOp. A prioritization list is generated and is used to determine where the Corps directs assistance for the population/augmentation program each year. The program has been structured to exceed propagation efforts related to the average annual shortfall. Further discussion of this program can be found in Appendix C, page 12.

C. Research Efforts and Other Studies. The Corps is continuing to conduct a variety of studies and focused research efforts on pallid sturgeon, least terns and piping plover. These include the following:

- Pallid Sturgeon Population Assessment Program.
- Least Tern and Piping Plover Population Assessment, Monitoring and Captive Rearing
- Least Tern and Piping Plover Focused Research
- Forage ecology study
- Bald Eagle/Cottonwood Population Assessment

Further details of these efforts can be found in Appendix C, page 11.

VI. CONCLUSIONS

The Corps and the USFWS are in agreement regarding the habitat attributes necessary to conserve listed species on the Missouri River. However, as described in this BA, engineering studies conducted by the Corps since the issuance of the 2000 BiOp indicate that not all of the needed and intended physical attributes and biological effects can be achieved through implementation of the component of the 2000 BiOp RPA associated with the flow release schedule for Gavins Point Dam. This marks the only key variation from the component elements of the 2000 BiOp RPA. Consequently, the Corps is proposing an alternative approach to conserving the listed species in lieu of providing "spring rise" flows and summer flows below minimum service levels out of Gavins Point Dam. The Corps is fully aware of the body of existing large river science that has documented the ecological importance of restoring some degree of natural river-based processes, including appropriate flow regimes. However, as pointed out in the National Research Council's 2002 report, providing a spring flood pulse in the absence of river-connective habitat is not likely to produce needed ecological benefits. The reverse is also true. The existence of constructed habitat in the absence of changes in the hydrologic regime will not produce needed ecological benefits. Because the flow releases prescribed in the 2000 BiOp will not achieve the intended physical attributes and biological effects, the Corps does not believe it is practicable to implement this component element of the BiOp RPA at this time.

Two important factors were strong influences in the development of the Corps alternative approach to the conservation of listed species on the Missouri River. First was the recognition that there is a relative scarcity of river-connective, shallow water habitat along key reaches of the Missouri River. Hence, the modified flow regime out of Gavins Point Dam prescribed in the 2000 BiOp would not render needed ecological benefits. The second factor is the absence of necessary scientific information on the life cycle requirements of the pallid sturgeon and an understanding of the factors that are limiting spawning and recruitment. Therefore, the rationale supporting the Corps' proposed action is clear: 1) initiate an aggressive and accelerated program to develop shallow water habitat along the navigation portion of the Missouri River; 2) initiate a robust RM&E effort to gather scientific information regarding the limiting factors to pallid sturgeon spawning and recruitment; 3) and initiate expanded and accelerated efforts to upgrade the capabilities of pallid sturgeon propagation facilities in order to augment the population with higher numbers and higher quality fish. The Corps also proposes that a "3 year check-in" be conducted within the context of a broad public forum involving a diverse array of stakeholders and other interests to examine the scientific findings and determine changes and additional actions that may need to be taken, including potential flow adjustments out of Gavins Point Dam. This effort would be consistent with the adaptive management approach advocated by the Corps in this BA, by the USFWS in its 2000 BiOp, and by the National Research Council in its 2002 report.

The Corps believes that its proposed action as described in this BA, is a reasonable and rational near-term approach to the conservation of listed species avoids the likelihood of jeopardizing the continued existence of the interior least tern, the piping plover, and pallid sturgeon, and does not result in an adverse modification of piping plover critical habitat.

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APPENDIX A

NEW INFORMATION SINCE THE 2000 BIOP

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APPENDIX A

NEW INFORMATION SINCE THE 2000 BIOP

Since the U.S. Fish and Wildlife Service (USFWS) completed the 2000 Biological Opinion (BiOp), considerable new information has become available to both the U.S. Army Corps of Engineers (Corps) and the USFWS. This information includes: 1) completion of a report by the National Academy of Sciences' National Research Council (NRC) entitled "The Missouri River: Exploring the Prospects for Recovery", 2) further analyses of the recommended changes in System releases included in the 2000 BiOp Reasonable and Prudent Alternative (RPA), 3) continued monitoring and study of listed species, 4) development of a new model to better analyze use of reservoir habitat by the least tern and piping plover, and 5) the USFWS designation of critical habitat on the Missouri River for the piping plover that became effective on October 11, 2002. This appendix of the Biological Assessment (BA) discusses this new information. Finally, additional information has been provided to the Corps and USFWS by various entities and individuals since the 2000 BiOp was completed.

Two of the categories of new information listed above are broken down further in this section. Discussion of the analyses of the recommended changes in System releases included in the 2000 BiOp RPA is very detailed. It is broken down into subsections on the analyses of the effects of the releases on 1) the natural processes and tern and plover habitat, 2) connectivity to the floodplain, 3) shallow water habitat for river fish, and 4) spawning cue in the Lower River. The continued monitoring discussion focuses on 1) existing shallow water habitat on the Lower River, 2) results of Fort Peck monitoring, 3) the pallid sturgeon in the Fort Peck reach and 4) the historic mortality of least terns and plovers.

During the timeframe this new information was being developed and evaluated, the Corps and the USFWS entered into informal Endangered Species Act (ESA) consultation on the Missouri and Kansas River projects in May 2002. During the course of this consultation, the full range of measures to benefit the species were identified and discussed. These measures include proposed flow tests, fish hatchery improvements, accelerated broodstock collection, accelerated shallow water habitat construction, additional research, monitoring, and evaluation, and development of a programmatic approach to adaptive management for species recovery. While the new information since the completion of the 2000 BiOp will be discussed in this section, this informal consultation effort has resulted in the Corps bringing forth new measure that were not considered during the preparation of the 2000 BiOp. Even though these measures are new information, the detailed discussion of these will be included in the next separate section called the "Proposed Action".

NATIONAL RESEARCH COUNCIL'S 2002 REPORT

The National Academy of Sciences' National Research Council (NRC) released a 2002 Report entitled "The Missouri River, Exploring the Prospects for Recovery" in response to a request from the Corps and the U.S. Environmental Protection Agency. These two federal agencies asked the NRC to characterize the historical and current ecological status of the Missouri River, review existing scientific information and prioritize scientific information needs, and recommend

policies and institutional arrangements to improve scientific knowledge and promote adaptive management of the Missouri River and floodplain ecosystem.

The NRC recognized the challenges to any plan for improving the ecology of the Missouri River. The report underscores the importance of restoring "natural river processes," and places emphasis on restoring river form and function. Further, the report recognizes that there are key uncertainties regarding how and to what degree the ecosystem will respond to different habitat restoration and river management actions. The NRC proposed that future actions leading to recovery of the ecosystem be framed within an adaptive management approach, which includes broad stakeholder participation. The report states:

> "Restoring some portion of the Missouri River's pre-regulation physical processes is the key to ecological improvements. Movement toward river recovery will necessarily be incremental, and should be framed within an adaptive management approach. Details of the timing and the extent of specific management actions should be established through collaboration among scientists, managers, and the public. Restoration efforts should be implemented within a basinwide framework that recognizes the relationship of tributaries to the mainstem, of upstream areas to downstream areas, and of the river system's main channel and floodplain. The recommendation to cast management actions within a basinwide framework is not meant to imply that all actions should be conducted simultaneously across the basin. On the contrary, a more reasoned approach, consistent with an adaptive management paradigm, would be to first identify and implement management actions that appear to offer substantial ecological improvements with minimal disruptions to people and flood plain infrastructure (the "low hanging fruit"). Management actions that are taken should be conducted in a spatially-coordinated manner that considers mainstem-tributary, upstream-downstream, and main channel floodplain relations through the entire river system."

During the current informal consultation with the USFWS, the Corps recognized that to restore natural river processes, the NRC recommendation of a broader approach to include diverse stakeholder participation was necessary. In the "Proposed Action" section of this BA, and consistent with the NRC recommendation, the Corps proposes a broader unified process that builds upon current stakeholder efforts to develop a program that would ultimately lead to greater success in the survival and recovery of the listed species and the ecosystem upon which they depend. This program involves taking actions in habitat and propagation with known biological improvements, conducting and monitoring tests to reduce the uncertainties of ecological responses to various flows, and having a time certain check-in to reconsider flow changes in response to the scientific information gained.

NATURAL PHYSICAL PROCESSES AND TERN AND PLOVER HABITAT

Natural Alluvial Geomorphologic Processes on the Missouri River

The Missouri River is an alluvial stream, and by definition, transports sediment whenever water is flowing between the high banks. Channel geometry (width, depth, slope, plan form, etc.) is a function of 1) the predominant hydrology, 2) the amount and characteristics of available sediment, and 3) the local/regional geology. All three of these factors are somewhat

interdependent, but hydrology and sediment yield are more closely related. When viewed over a long temporal scale the river attempts to reach a state of "dynamic equilibrium", or "natural stability", where the channel geometry is created/maintained by a dominant discharge, or dominant discharge class. The dominant discharge is defined as the discharge (or discharge class) that transports the majority of bed material sediments through a river reach. Major flood events (25-, 50-, 100-year) can transport an enormous amount of sediment in a short period of time, cause severe bed and bank erosion/build up, and create large channel evulsions. Their infrequent occurrence and relative short duration, however, do not allow them to play a major role in determining the natural stability of a river reach. Rather, the natural stability is determined by normal flows and/or smaller floods with a higher return frequency and longer durations. These flows overtop point bars and medial sandbars at a great enough depth and for a sufficient duration to initiate scour. Natural stability does not imply static conditions. Erosion/deposition processes are ongoing. As high banks erode, point bars advance, and medial sandbars migrate downstream. In a naturally stable river reach over a long time period, the sediment transported into the reach will equal the sediment transported out.

Status of Alluvial Processes in the Present Missouri River

The above discussion represents the alluvial processes of the uncontrolled Missouri River. Presently the hydrology and sediment supply of the Missouri River is largely controlled by six large mainstem dams upstream of Yankton, South Dakota (RM 811), and by channelization downstream of Ponca State Park, Nebraska (RM 753).

Dams impact alluvial processes in two ways. First, dams change the hydrology of the river. Peak flows are reduced to provide flood protection, and base flows are increased for water supply, hydropower, etc. Channel evulsions associated with flood events become very rare and the floodplain ceases to contribute to the sediment supply. Flow regulation causes a shift in the dominant discharge class, usually to a lower discharge. Dams further impact the alluvial processes by preventing sediments from the upper basin from entering the reach below the dam, causing a sediment-starved reach below the dam. This leads to degradation of the riverbed and channel widening. The absence of large floods does not allow the river to rebuild high bank land. This process results in lower water surface profiles, flatter slopes, and a general decrease in the dynamic alluvial processes of erosion/deposition. In general, point bars do not advance as rapidly, medial sandbars move slower (some not at all) due to less over topping, and side channels tend to fill and/or drain. The alluvial processes that once took place across the entire floodplain are now confined to the area between the high banks. These slower, less dynamic alluvial processes can lead to vegetation encroachment that can further retard the alluvial processes.

The un-channelized Missouri River was a wide river with multiple channels of varying depths that resulted from erosion, channel evulsions, etc. In contrast, the channelized Missouri River is a single channel characterized by a greater depth-to-width ratio and nearly uniform velocities. Channelization has removed the banks as a source of sediment, leaving only the riverbed and tributary contributions to maintain the alluvial processes. This further exacerbates the degradation process, particularly in the reach above the Platte River. The net result is little or no exposed point bars/sandbars and very little alluvial variability.

Relationship of the Hydrologic and Geomorphic Processes to the Missouri River Ecosystem Form and Function

The Missouri River before man's influence was characterized by a highly variable flow regime both within and between years. This flow regime and the associated sediment it transported drove many of the physical and biological processes thought to be important in maintaining a healthy, functioning ecosystem. The high-flow periods maintained a connection between the river and its floodplain and the constantly moving sediment along with the eroding and filing of the bank line maintained the channel morphology. The resulting channel morphology, in conjunction with the river flow, created the physical habitat template on which endemic Missouri River species are adapted. The distribution and abundance of species associated with a river is highly dependent on this physical habitat structure (Poff and Ward 1990). Naturally variable flows are thought to create and maintain the dynamics of the in-channel and floodplain habitat that are essential to aquatic and riparian species. Important ecological functions are thought to be associated with natural flows (Poff et al 1997). As an example, sediment transport through channels flushes organic matter. Woody debris washed into the channel can help create high quality habitat. Flood flows act to flush organisms and nutrients back to the river.

Poff et al. (1997) thought a river's flow was so important that they concluded it could be considered a "master variable". This conclusion was based on the assumption that stream flow was highly correlated with many critical physical characteristics of a river such as channel geometry and habitat diversity. Richter (1996) further defined the important characteristics of stream flow so that they could be quantified and evaluated. These characteristics include: magnitude, timing, frequency, duration, and rate of change of flow. Each of these characteristics has associated biological relevance. Magnitude refers to the mean of the daily water conditions. It is a measure of the habitat availability and suitability and, thereby, defines the volume of habitat on any given day. Timing, or when a flow event occurs, determines whether critical life cycle requirements can be met. Frequency is a measure of how often the flow event occurs and influences reproduction and mortality. Duration refers to how long the flow event occurs and determines whether life cycle phases can be completed. Rate of change is a measure of how rapidly flow changes and can influence an organism's ability to respond.

Effect of the CWCP and the BiOp RPA on the Alluvial Geomorphologic Processes in Relation to Tern and Plover Habitat

As stated above, the geomorphic processes are a product of the hydrology, sediment availability, and geology. Because the 2000 BiOp RPA does not include a change in sediment availability and the geologic controls are unchanged, those aspects will not be discussed further. It is important to realize that a change in the present alluvial processes will require a change in the dominant discharge class. The dominant discharge is that discharge (or discharge class) that transports the majority of the bed material sediment load. Determining the dominant discharge class requires flow-duration data and an adequate relationship between river discharge and sediment transport. For the reach below Gavins Point Dam, the Sioux City gage is the nearest gage with an adequate sediment discharge record. Although this gage is not in the reach immediately below Gavins Point Dam, it is appropriate for this analysis as the hydrology of this gage is dominated by releases from Gavins Point Dam. To create a change in the alluvial geomorphology of the reach below Gavins Point Dam, the flow duration curve would need to be

rotated clockwise sufficiently to change the dominant discharge class to the 55- to 70-thousand cubic feet per second (kcfs) class. Based on survey data, this is the discharge needed to inundate a significant number of medial sandbars to a depth that would initiate scouring.

The first step in determining the impacts of the 2000 BiOp RPA on the alluvial processes required the development of flow duration curves for the current Water Control Plan (CWCP) and the 2000 BiOp RPA System operation recommendation. These curves were developed using the daily flow models and are shown in Figure A-1. Examination of the flow-duration curves shows little change between the CWCP and the 2000 BiOp RPA. The second step was to determine the percent of the average annual sediment for each flow class. This was accomplished by merging the sediment discharge rating curve data from "Suspended Sediment Data Assessment Study, Missouri River at Sioux City, Iowa, MRR Sediment Series Report No. 39a, January 2001" and the flow duration curves, then dividing the sediment yield for each class by the total yield. The results are shown in Figure A-2. Examination of Figure A-2 indicates the distribution of sediment yield by discharge class for the 2000 BiOp RPA is shifted to the left (lower class) rather than to the right. The slight shift in the 55- to 70-kcfs discharge class is not sufficient to scour and maintain high elevation barren sandbars. In fact, the data suggest that, if any changes were to occur, the most likely scenarios would be for existing barren sandbars to convert to islands and channel border fills, with barren sandbars being maintained at a much lower elevation.

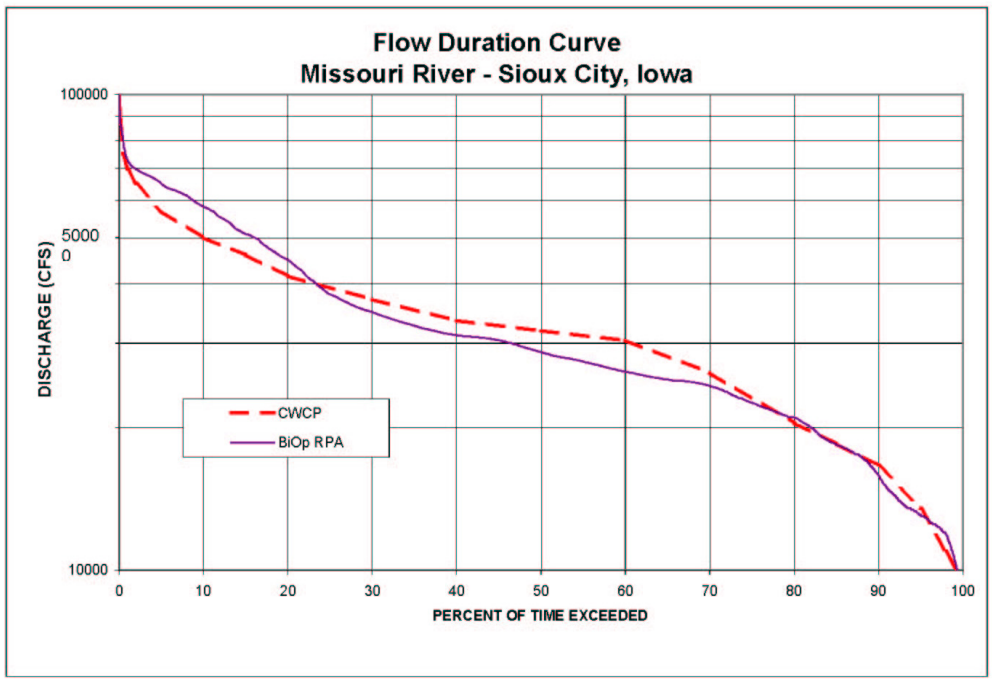

Figure A-1. Flow duration curve at Sioux City, Iowa for the CWCP and 2000 BiOp RPA.

As the distance from Gavins Point Dam increases, the impacts of any changes in the release pattern decreases even further. This is due to the tributary inflow, both water and sediment, as well as the river's attempt to re-establish a new "natural stability". The stabilization and channelization downstream of Sioux City further restricts the natural alluvial processes. In the

reach below Sioux City, the alluvial processes will be nearly identical for both the CWCP and the 2000 BiOp RPA.

Additional data were gathered in the fall 2002 concerning the quantity and quality of sandbar habitat in the reach below Gavins Point Dam. Nine randomly selected sandbars were surveyed in an attempt to determine the total amount of available sandbar habitat at various flows. Sandbar area was broken into three categories: 1) total sandbar, 2) potential habitat, and 3) safe habitat. Potential habitat was defined as having less than 25 percent vegetation cover with a beach slope of less than 1:10. Safe habitat was defined as potential habitat that is more than 18 inches above the water surface. The survey data were integrated with rating curves for each site to develop a habitat-discharge relationship for each site. The area from the nine sites was prorated based on 2000 data (last year for which data exist) to estimate the total habitat for the reach below Gavins
Point Dam. The results of this investigation are shown in Figure A-1. It is important to note that, in Figure A-3 the Total Emergent Sandbar line approximates the conditions of the reach in 1998 (following 1997 high flows). Lack of a true scouring/sandbar building event has allowed erosion and the vegetation encroachment to reduce the amount of habitat.

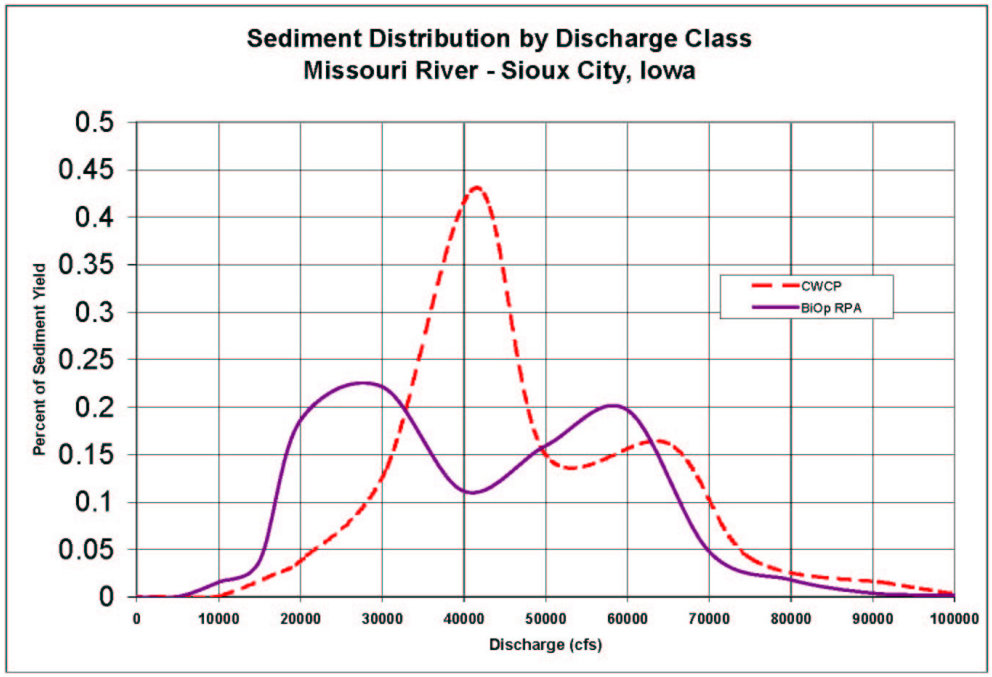

Figure A-2. Sediment distribution by discharge class for the Missouri River at Sioux City for the CWCP and 2000 BiOp RPA.

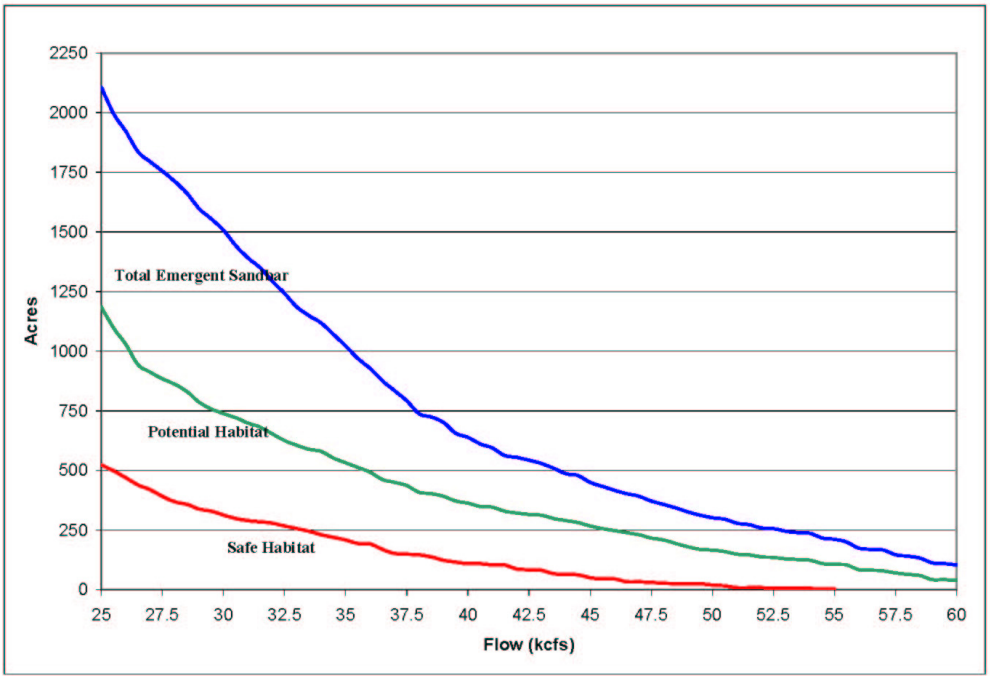

Figure A-3. Relationship between flows (25 to 60 kcfs) and acres of emergent sandbar, potential habitat, and safe habitat on the Missouri River between Gavins Point Dam and Ponca, NE, Fall 2002.

Erosion is a natural process that would take place whenever stages drop to the point that flowing water concentrates in the main channel(s) of the river. This process, however, is likely more pronounced in an incised/degradational reach like the one below Gavins Point Dam. In a natural river setting, this erosion loss would be offset by the presence of a scouring/sandbar building event. The BiOp RPA, with its two low flow periods (summer and winter), would likely accelerate this erosion process beyond that of the CWCP, but it does not provide for a complimentary scouring/sandbar building event. The long-term net result would be less available habitat.

CONNECTIVITY TO LOW-LYING LANDS

As stated in the 2000 BiOp, "Floodplain connectivity refers to the seasonal flooding of areas adjacent to the river. The spring flood pulse often provides connectivity between the floodplain to the river. For native river fish like the pallid sturgeon, this floodplain connectivity, especially during May/June, provided spawning areas for forage species, increased phytoplankton production, and redistributed carbon to the river". This carbon, in the form of detritus scoured off of the floodplain, settled out in the shallow water areas along the river where the microscopic biota grew. As the pallid sturgeon hatched, the larval fish would float down the river until they were able to float into the shallow water areas, where they would reside during their fragile first months of life.

To better understand how much floodplain connectivity may be occurring along the Lower River from Sioux City to the mouth, the Corps estimated the acreage and elevation of the low-lying

lands (areas adjacent to oxbow lakes and chutes) that could be inundated by high river flows. The elevations were then converted to river stages for the output nodes of the Daily Routing Model (DRM) hydrologic model used for the Master Manual Study to determine when the spring rises were inundating these areas. The months of May and June, the period when the spring rise was modeled in the DRM simulation runs, were checked to see how many acres were flooded for a varying number of days for the CWCP and 2000 BiOp RPA.

The graphical results of the analyses of connectivity are duration plots of acres inundated versus percent of the time. Duration plots were developed for inundation for at least 2 days up to over 10 days. As the number of days is increased, the amount of acres inundated diminishes, and the curves shift towards the lower left on the plots. The duration plot of the 2-day analysis is shown as Figure A-4. This figure shows that the CWCP and the 2000 BiOp RPA provide similar duration plots of connectivity with the number of acres of connectivity for 2 days sometime during May or June increasing with the addition of a spring rise at Gavins Point Dam. This figure also includes the duration plot for a run-of-river (ROR) scenario to provide a perspective for how often these low-lying lands would have been inundated for 2 days with no flow control. This flow scenario has considerably higher values across the entire range of the plot from near zero percent to near 100 percent.

Table A-1 presents the total values for the 25th percentile (lower quartile) from Figure A-4 with a breakdown among the reaches making up the total reach from Sioux City to the mouth. The 25th percentile was selected for presentation because the BiOp RPA was designed to have spring rises about one-third of the time, and the 25th percentile falls within the range when spring rises may be affecting the amount of connectivity.

The CWCP provides a total of 3,282 acres of connectivity. The 2000 BiOp RPA has only a slightly higher total value (+164 acres) because only two reaches have substantially higher values—the Sioux City and Omaha reaches.

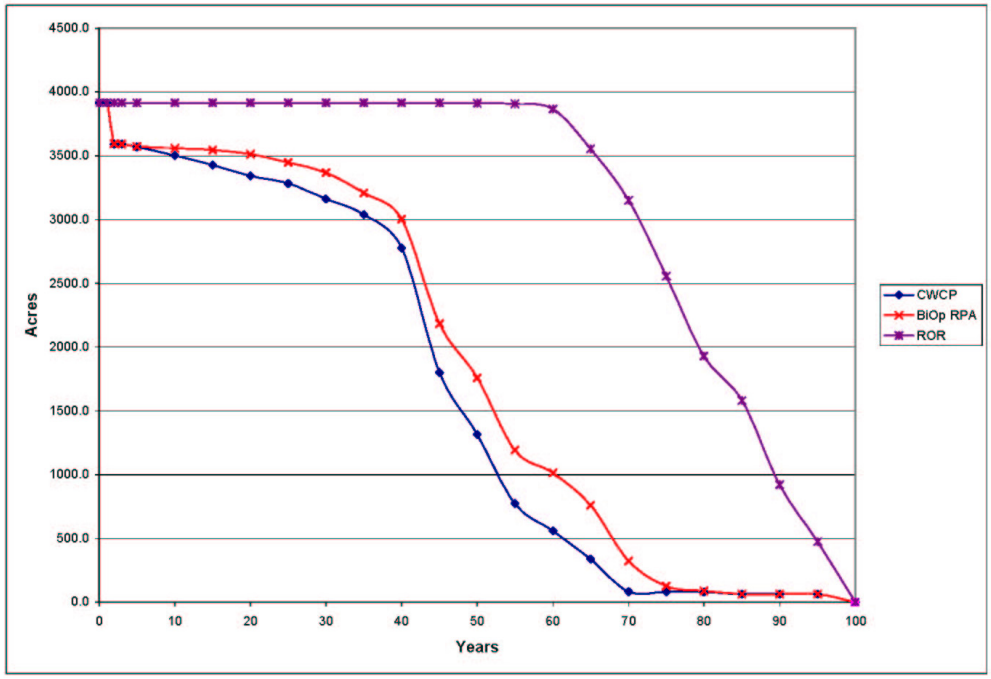

Figure A-4. Acres of connectivity for 2 days in May and June for the CWCP, 2000 BiOp RPA, and ROR scenario.

Table A-1. Connectivity to low-lying lands for 2 days in May and June (acres for the 25th percentile).

River Mile	Reach	CWCP	BiOp RPA
734-648	Sioux City	249	332
648-597	Omaha	270	344
597-497	Nebraska City	136	137
497-374	St Joseph	287	287
374-250	Kansas City	265	272
250-130	Boonville	768	768
130-0	Hermann	1,307	1,307
Total		**3,282**	**3,446**

In conclusion, the gains in connectivity in the low-lying areas with flow increases via spring rises are relatively minor. In fact, there is effectively no increase in value downstream of the Omaha reach. By adding a spring rise of 20 kcfs, the gain in connectivity is only 164 acres. These data indicate that the spring rise should not be added based on the gains in connectivity that could occur with the increased flows.

Another way of looking at the end result of connectivity, or the flushing of detritus into the river, is to think about how this type of material gets into the river. The 2000 BiOp RPA, according to the data presented above, would inundate approximately 3,500 acres of low-lying lands for 2 days during the May through June timeframe. This is approximately 5.5 square miles. A small tributary to the Missouri River is likely to be several times larger than 5.5 square miles, and a

rainfall event on the drainage area for each tributary flushes detritus into the tributary, which ultimately gets carried into the Missouri River. There are many thousands of acres that drain into the Missouri River, and many of the tributaries carry heavy sediment loads into the river during major rainfall events. These tributaries are, and will continue to be, the main source of detritus to the Missouri River no matter how the System is operated.

SHALLOW WATER HABITAT ALONG THE LOWER RIVER

In its 2000 BiOp, the USFWS states that shallow water habitat has value to all life stages of native big river fish and other river organisms. As stated in the introductory remarks of the connectivity analysis discussion, shallow water habitat is especially important during the first few months of the life of the larval pallid sturgeon, an endangered species. The Corps and USFWS agreed during the formal consultation for, and the review of, the 2000 BiOp, that 20 to 30 acres of shallow water habitat per mile may provide the habitat necessary for initial recovery of pallid sturgeon. This section focuses on the amount of shallow water habitat occurring in the Lower River for the CWCP and 2000 BiOp RPA.

The analysis of existing shallow water habitat under the various alternatives was conducted using data obtained for the physical habitat model developed by the Corps as one way of assessing impacts of alternatives. As part of the development of that model, cross sections were taken at a representative sub-reach of seven reaches of the Lower River and hydraulically modeled. These data provided a basis for determining the amount of habitat fitting into a variety of depth and velocity classes for each of the seven reaches (habitat per mile times reach length). Shallow water habitat for the purpose of this analysis is habitat that is up to 5 feet deep with a velocity no greater than 2.5 feet per second. The amount of habitat in each depth and velocity class could be determined based on the amount of flow in each river reach. Using these relationships, the Corps developed a model that would provide duration plots of the acres of habitat per mile in each reach for any timeframe of interest. Generally, the Corps looked at individual months; however, the lowest flows for one of the alternatives occur from mid-July to mid-August. Data were computed for this period for the seven Lower River reaches and are presented in Figure A-5. Integration of the area under the duration curve leads to the average daily value per mile for shallow water habitat for each reach. TableA-2 presents these data for all seven sub-reaches modeled. This table also presents historic data (prior to the construction of the navigation channel) to provide some insight into habitat losses due to the construction that has taken place on the river. Figure A-6 shows the acres per mile for the six reaches from Sioux City to the Osage River for the CWCP and BiOp RPA. Data are not presented for the reach downstream from Gavins Point Dam because there is already adequate habitat (63.8 acres per mile for the CWCP) in this reach. Using the acres per mile from Figure A-6 and Table A-2, the total acreage available in each reach of the Lower River from Gavins Point Dam to the Osage River (River Mile 130) can be computed. The data for five reaches are presented in Table A-3 on a reach and total basis (data combined using data from two locations for the Sioux City to Omaha reach) for the CWCP, BiOp RPA, and the ROR scenario (no control of system inflows by the Mainstem Reservoir System).

Table A-2. Expected daily shallow water habitat for representative sub reaches from mid-July to mid-August (acres/mile).

Reach	CWCP	BiOp RPA	ROR	Historic
Gavins Point	63.8	71.6	64.9	106.6
Sioux City	2.2	5.8	3.6	107.0
Omaha	1.9	5.1	3.3	107.0
Nebraska City	4.5	6.0	5.1	103.4
St. Joseph	4.8	7.9	6.2	100.3
Kansas City	1.4	1.7	1.2	-
Boonville	18.3	18.7	17.4	-

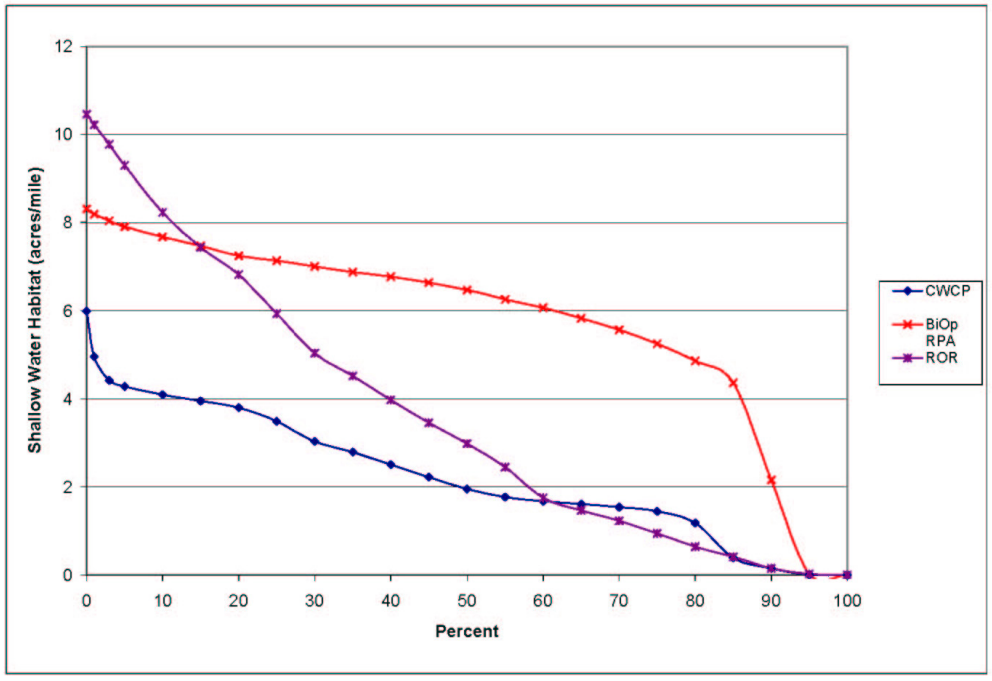

Figure A-5. Duration Plot of Shallow Water Habitat during the mid-July to mid-August Period - Sioux City Reach.

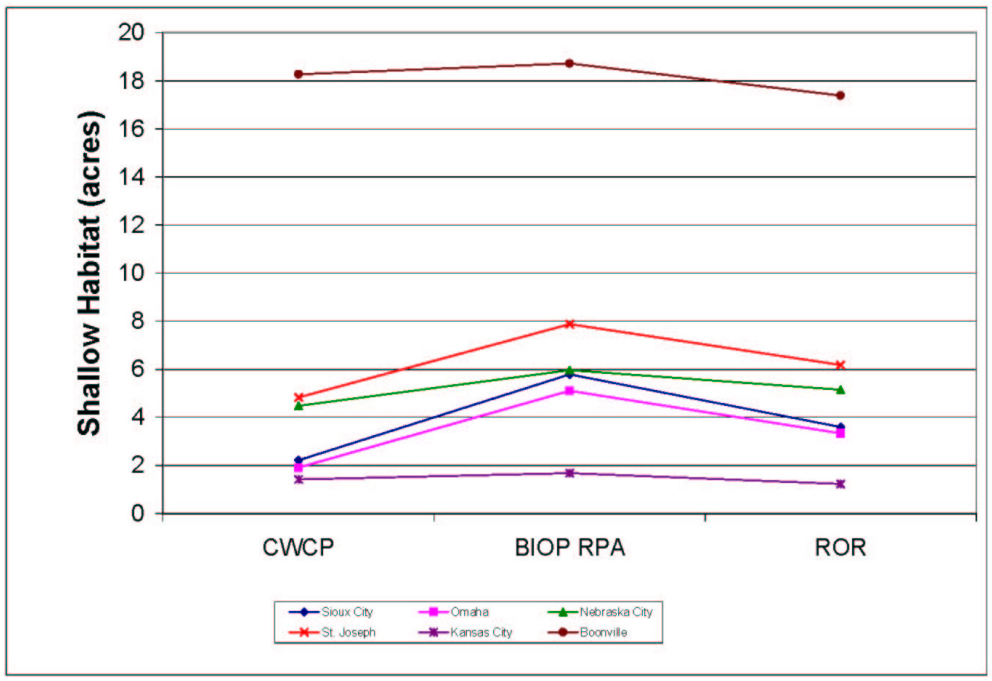

Figure A-6. Expected Daily Shallow Water Habitat for River Fish.

Table A-3. Expected daily shallow water habitat available from mid-July to mid-August (acres).

Reach	CWCP	BiOp RPA	ROR	20 Ac/mile
Sioux City to Omaha	288	757	479	2,740
Omaha to Nebraska City	144	191	165	640
Nebraska City to Kansas City	929	1,513	1,187	3,840
Kansas City to Grand River	164	200	144	2,320
Grand River to Osage River	2,193	2,245	2,086	2,400
Total	**3,717**	**4,906**	**4,061**	**11,940**

The CWCP provides 3,717 acres of shallow water habitat for the five reaches. The greater share of this habitat is provided between the Grand and Osage Rivers in the central part of the State of Missouri: 2,193 acres, or 59.0 percent of the total. Operation with the lower summer split season release of 25/21 kcfs under the BiOp RPA provides an increase of 1,189 acres more than the CWCP. If the flows were to be completely uncontrolled, as they would be under the ROR, the amount of total shallow water habitat would be less than it is for the 2000 BiOp RPA but 344 acres more than for the CWCP.

The shallow water habitat model was modified to create an output file of the average daily habitat values for each year. This data set allowed the creation of Figure A-7. This figure compares the annual values for the CWCP and the 2000 BiOp RPA. Reducing the summer Gavins Point Dam release to 21 kcfs during this mid-summer period, as operations under the BiOp RPA would, results in more shallow water habitat in most years. Both the CWCP and BiOp RPA provide a wide range of habitat from year to year. This results from the year-to-year

variability in flows, which indicates that flow should not be relied upon to provide the required amount of shallow water habitat.

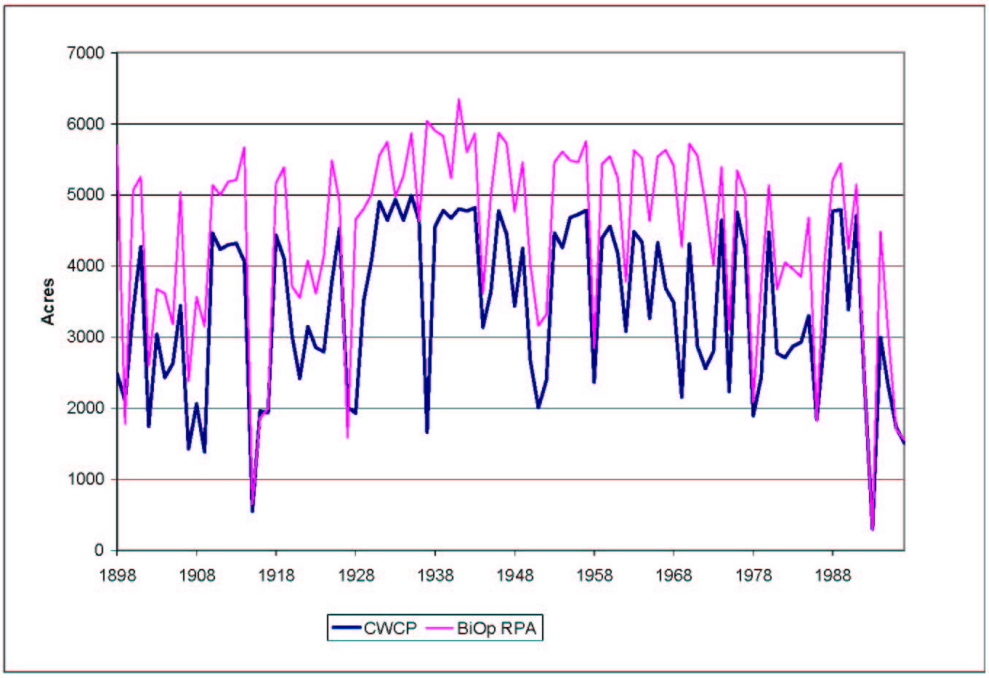

Figure A-7. Annual Average Daily Acres of Shallow Habitat from Sioux City to the Osage River from mid-July to mid-August.

Additional discussion is needed regarding the amount of habitat that exists per mile in the reaches from Sioux City to the Osage River. With the exception of the Grand River to Osage River reach, habitat acreage is well below the minimum of 20 acres per mile that the Corps and USFWS agreed was a necessary attribute for the continued survival of the pallid sturgeon. Even though there are some increases in shallow water habitat (as discussed above and shown in Figure A-6), the gains provided by release changes alone are also not enough to provide, on average, the minimum 20 acres per mile. Because of this, the USFWS included in its 2000 BiOp RPA the recommendation for the Corps to construct additional shallow water habitat. The changes in flow primarily have an impact on the amount of additional habitat that needs to be provided through channel alternation methods. For example, the 2000 BiOp RPA may reduce the amount of required acres to be constructed, on average, by 1,189 acres. This amounts to only 10 percent of the total of 11,940 acres required to meet the 20 acres per mile requirement.

As flows in the Lower River decrease, shallow water habitat associated with the Corps' mitigation, Section 1135 habitat enhancement projects, and other off-channel habitat sites are affected. Figures A-8 through A-10 identify the changes in habitat with flow for the CWCP and BiOp RPA. For the sites in the Sioux City to the Platte River reach (Figure A-8), the BiOp RPA reduces the habitat by about 150 acres at the median value with its 21-kcfs release from Gavins Point Dam in the mid-July to mid-August timeframe. Similarly, habitat is lost in the Platte River to Rulo reach (Figure A-9), with the loss for the 2000 BiOp RPA being about 50 acres at the median value. Finally, the loss at sites further downstream is anticipated to be minimal, as evidenced by the relatively minor loss at the Jameson Island site, which became aquatic habitat

resulting from BANP maintenance activities following the 1993 flood and is now part of the USFWS's Big Muddy Refuge (Figure A-10). The total of about 200 acres of lost habitat would reduce the increase in shallow water habitat provided by the flow changes of the 2000 BiOp RPA.

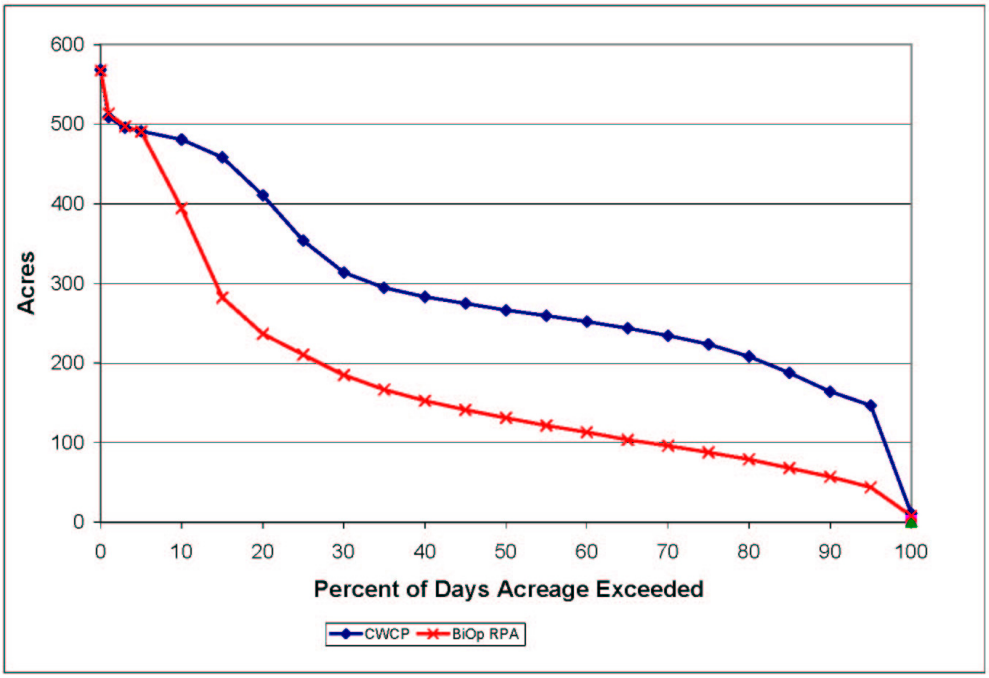

Figure A-8. Impacts on existing mitigation and Section 1135 projects - Missouri River, Sioux City to the Platte River.

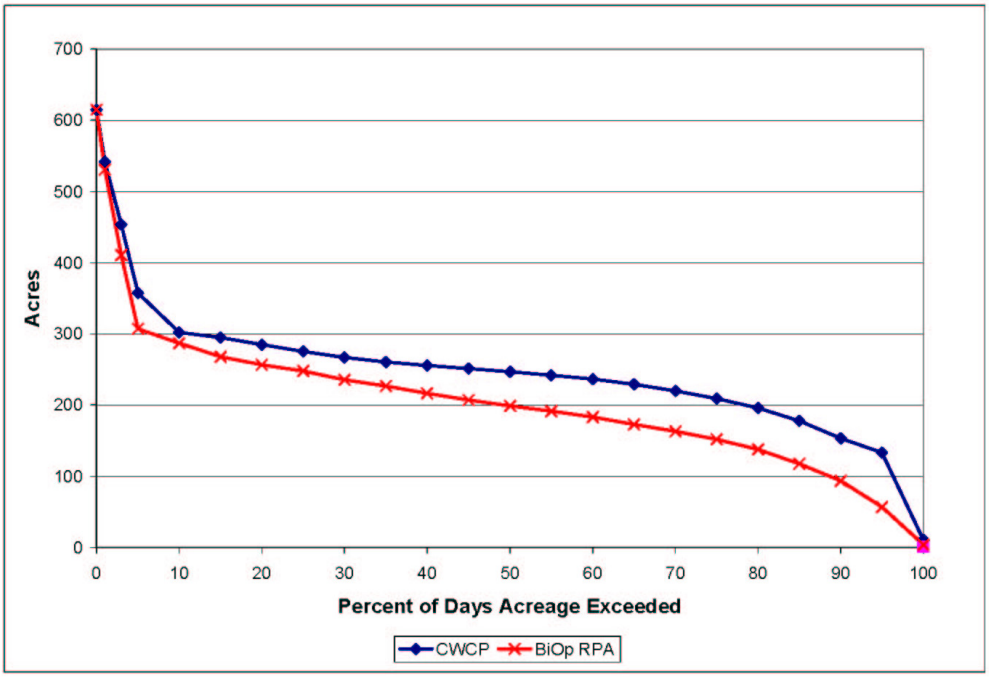

Figure A-9. Impacts on existing mitigation and Section 1135 projects - Missouri River, Platte River to Rulo.

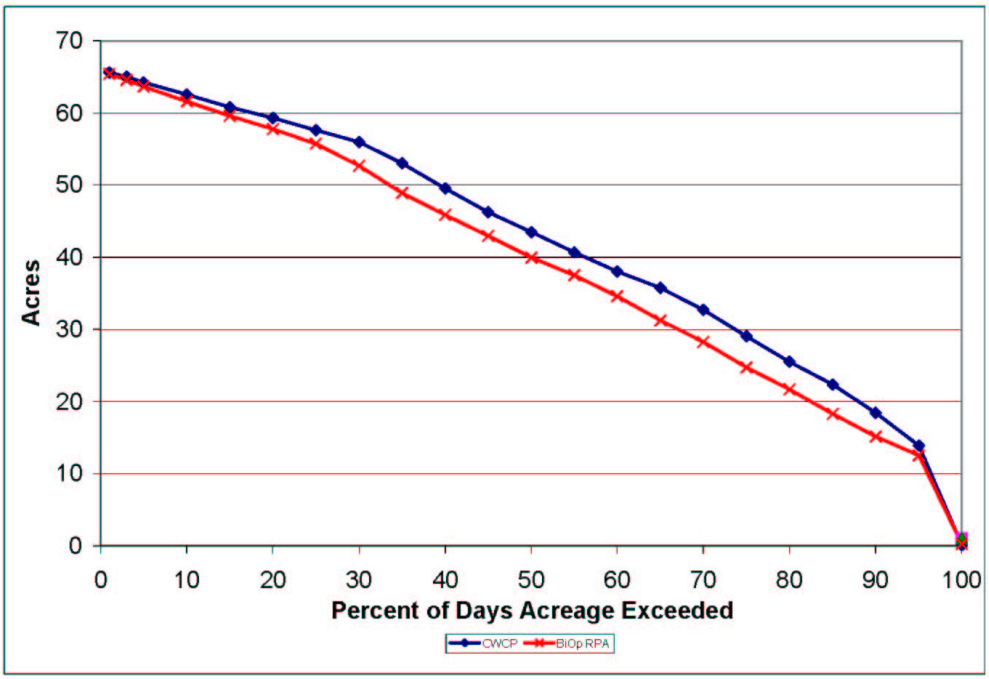

Figure A-10. Impacts on existing mitigation site – Jameson Island.

SPAWNING CUE IN THE LOWER RIVER

The 2000 BiOp RPA recommends a spring rise release from Gavins Point Dam to provide, among other biologically important functions, a spawning cue for native river fish, especially the endangered pallid sturgeon. The 2000 BiOp RPA specifies a modified annual release pattern that has a spring rise above the full navigation service releases of 15 to 20 kcfs. This release is to have a duration of 2 weeks at its peak and a total duration of 4 weeks including the period over which the releases are gradually increased and decreased. Discussions between the USFWS and Corps staff determined that the spawning cue requirements of the pallid sturgeon are basically unknown at this time.

In an e-mail sent to the Corps on January 22, 2001, the USFWS requested the Corps to conduct a set of hydrologic analyses. This set of analyses included a spring rise analysis. The USFWS requested, "For gage sites downstream of Gavins Point, document spring rise spawning cues. Rises should be defined as increases of discharge of at least 20 percent above the mean discharge prevailing for the preceding 15 days, during the period May to July. The rise should take place over three days or less". The USFWS provided no information on what duration of rise to analyze. This lack of information supported the general understanding between the Corps and USFWS staffs that the required spawning cue is basically unknown at this point in time. Corps staff understood that the aforementioned criteria were hypothetical, and they did not have supporting data, analysis, and documentation of associated spawning success. A discussion of the analysis conducted for evaluating a spawning cue follows.

A model was developed that would access the daily flow data for each DRM node location from Gavins Point Dam to the mouth. A running average of the daily flows for the previous 15 days was conducted using the data starting on May 1 and ending on June 30 of each year. (The likelihood of spawning cues after June 30 is low, so it was not checked.) The flows for May 1, 2, and 3 were checked to determine if the flows over this 3-day period exceeded the prior 15-day average by at least 20 percent. If the flows on one of the days met the 20 percent increase, the model would continue to check the daily average flow until it dropped to less than 20 percent of the flows for the 15 days prior to May 1. The model continued the day by day check of the prior 15 days, computed an average, and counted the number of days the flows continued to be at least 20 percent above that prior 15-day average. This continued up to June 30.

In various years there were some short periods and some longer periods. The model recorded the longest period in terms of days. The longest period was recorded for each year, and then the 100 years of data were analyzed. The 100 annual values were sorted from highest to lowest with the highest value assigned a 1 (for equaled or exceeded 1 percent of the time) and the lowest value was assigned a 100 (for equaled or exceeded 100 percent of the time). A plot of these data is called a duration plot, and Figure A-11 is an example of such a plot for the CWCP. This figure shows the duration plots for the CWCP at all of the gage locations in the DRM simulation output files for the Lower River from Sioux City downstream. A similar plot was completed for the 2000 BiOp RPA. Another set of curves was developed for the ROR scenario (no control of inflows to the mainstem of the Missouri River). Sets of curves were compiled for each gage location using this first set of curves, as shown on Figure A-12. The second set of curves, one for each gage location in the DRM, provides the spawning cues for a full range of days. For example, to determine how often a 20 percent increase in flow occurred for a total of 21

consecutive days, one would go to the point where the 21-day line crosses the duration curves. Next one would slide down and read off the percent of time from the bottom axis of the graph for each curve. In the case of the CWCP curve on the figure, this point is located at 7 percent of the time. Similarly, it is 36 percent of the time for the 2000 BiOp RPA.

Because the USFWS did not specify a length for the spawning cue, a 21-day length was selected for analysis based on the spring rise recommended in the 2000 BiOp RPA. The total rise occurs over a 28-day period. If it takes 3 days to go up 20 percent, there will also be 3 days at the end of the spring rise where the releases will drop below the 20 percent value. This means that the spawning cue lasted 22 days (28 minus 6). Based on this basic consideration, a 3-week, or 21-day, length was evaluated for the spawning cue. Figure A-13 shows a bar plot of the resulting data for all of the gage locations included in the DRM. The bars shown on this plot shift upward for shorter lengths of spawning cues, and vice versa.

Figure A-13 shows that the CWCP and 2000 BiOp RPA have spawning cues that occur for differing percents of time. The values are presented in Table A-4. For example, the Sioux City line on the plot shows that the percent of time increases for the CWCP in a downstream direction, with a 21-day spawning cue occurring 7 percent of the years at Sioux City and a maximum of 38 percent of the years at Hermann. The 2000 BiOp RPA increases the percent of years values for most of the reaches to 33 percent or greater. The exception is for the St. Joseph reach. Generally, for the reaches from Kansas City upstream, the values are higher moving across the figure because of the spring rise included in the 2000 BiOp RPA. Downstream from Kansas City, however, the value for the percent of the time the spawning cue occurs remains relatively constant with the values ranging from 38 to 39 percent. The ROR scenario has more spawning cues because the uncontrolled flows were historically much higher than the modeled spring rises, with the percent values ranging from high on the reaches closest to Sioux City (78 or 79 percent) to the lowest value occurring at Hermann (54 percent).

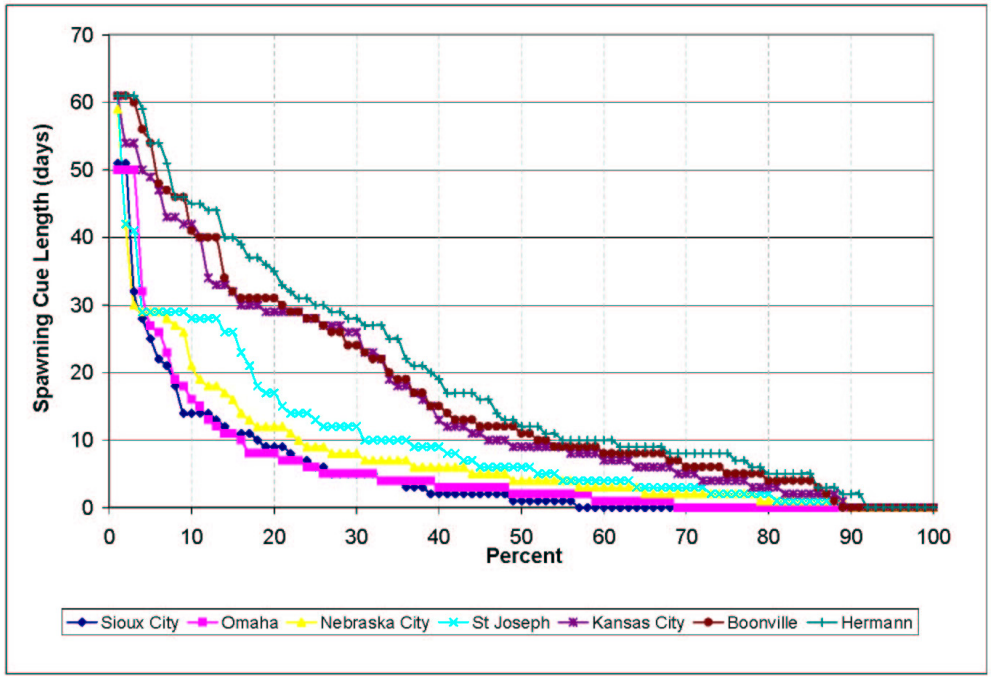

Figure A-11. Duration plot of spawning cue length during May and June for the CWCP.

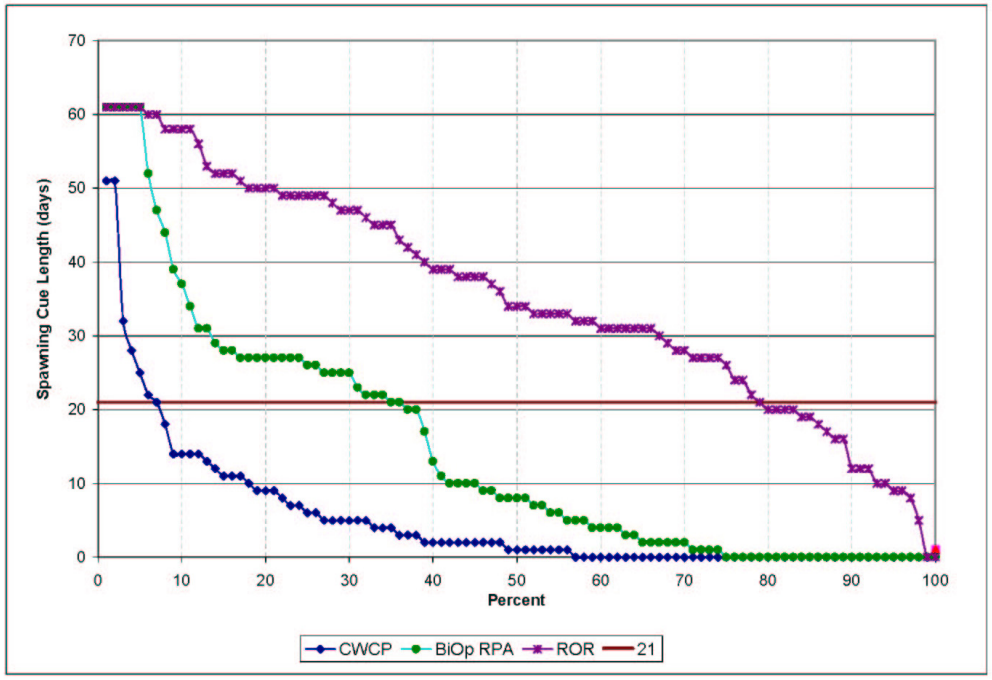

Figure A-12. Duration plot of spawning cue length during May and June at Sioux City.

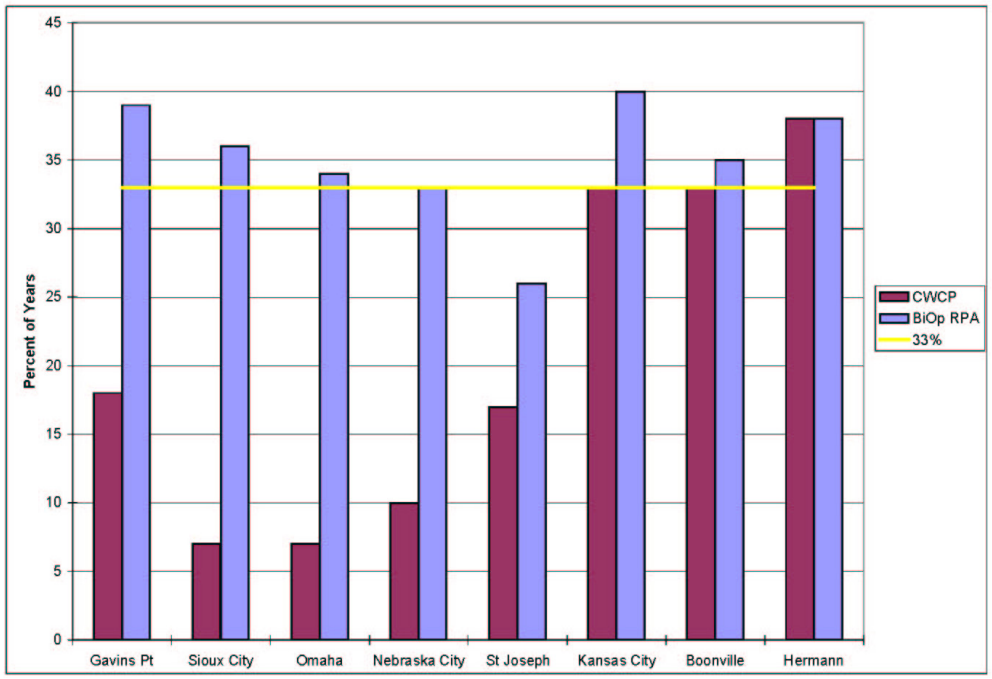

Figure A-13. Percent of years with a 21-day spawning cue at various locations.

Table A-4. Percent of years with a 21-day spawning cue at Lower River gaging stations.

Reach	CWCP	BiOp RPA	ROR
Gavins Point Dam	18	39	78
Sioux City	7	36	79
Omaha	7	34	79
Nebraska City	10	33	68
St Joseph	17	26	63
Kansas City	33	40	62
Boonville	33	35	62
Hermann	38	38	54

To demonstrate what happens when shorter length spawning cues are used in the analysis, a 14-day and 7-day spawning cue lengths were analyzed. As stated earlier, the shorter the spawning cue, the more often it occurs (duration plots shift upward). Figure A-14 shows that this is indeed the case. All of the bars in the graph have shifted upward. For the 7-day spawning cue length (Figure A-15) and the CWCP, the minimum percent of years is over 20 percent, and all of the reaches from Nebraska City to Boonville have this spawning cue length in over 33 percent of the years. The 2000 BiOp RPA has a 7-day spawning cue in 50 percent or more of the years for all of the reaches.

This brief analysis demonstrates how important it is to have a definitive length for a spawning cue. The CWCP comes very close to meeting the one-third requirement for a relatively short spawning cue, and it has a 34.5-kcfs flat release from Gavins Point Dam in many years. This release value is equivalent to a spring rise of about 5 to 6 kcfs in the May timeframe. The Corps' understanding of the primary purpose of the spring rise is to cue the pallid sturgeon to spawn; however, the absolute length and magnitude of the required flow to provide an adequate spawning cue are not known at this time.

The criticality of the spawning cue length is also demonstrated using another analysis that provides more insight into the relationship between spawning cues and shallow water habitat. For the pallid sturgeon to receive the greatest potential for future growth in numbers, the larval fish need to have adequate shallow water habitat following the spawn. Figure A-16 shows 2000 BiOp RPA plots of both spawning cue length and shallow water habitat over the period of analysis from 1898 to 1997 for the Sioux City reach. The spawning cue lengths range from zero days up to 61 days, and the shallow water habitat areas range from zero up to 8.0 acres per mile. The spawning cue length is affected by the spring flows, with the higher flows generally resulting in longer cue lengths. Conversely, the shallow water habitat size is affected by the summer flows, with the lower flows resulting in greater amounts of habitat. Because they are driven by different factors, they may not always coincide, as shown in the figure. The Sioux City data were selected for display because of the wider variation between the cue and habitat values.

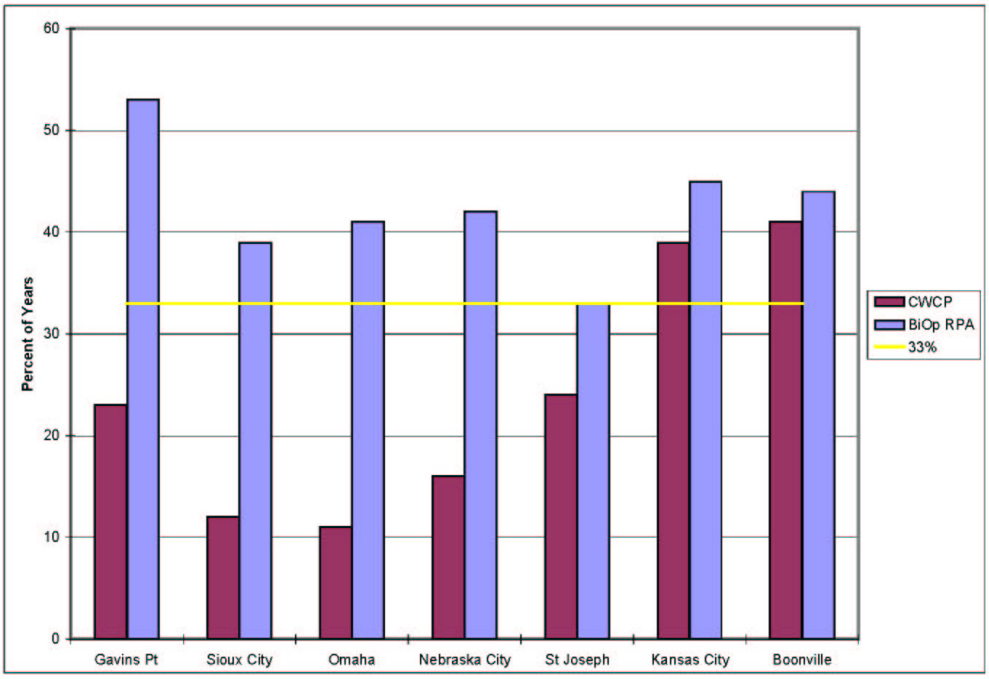

Figure A-14. Percent of years with a 14-day spawning cue.

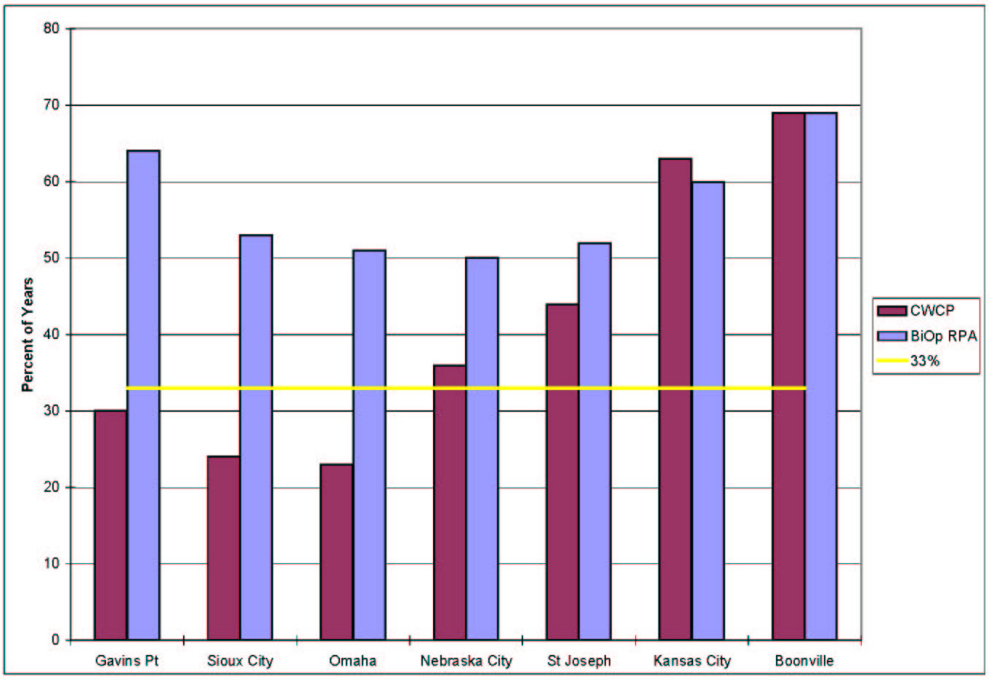

Figure A-15. Percent of years with a 7-day spawning cue.

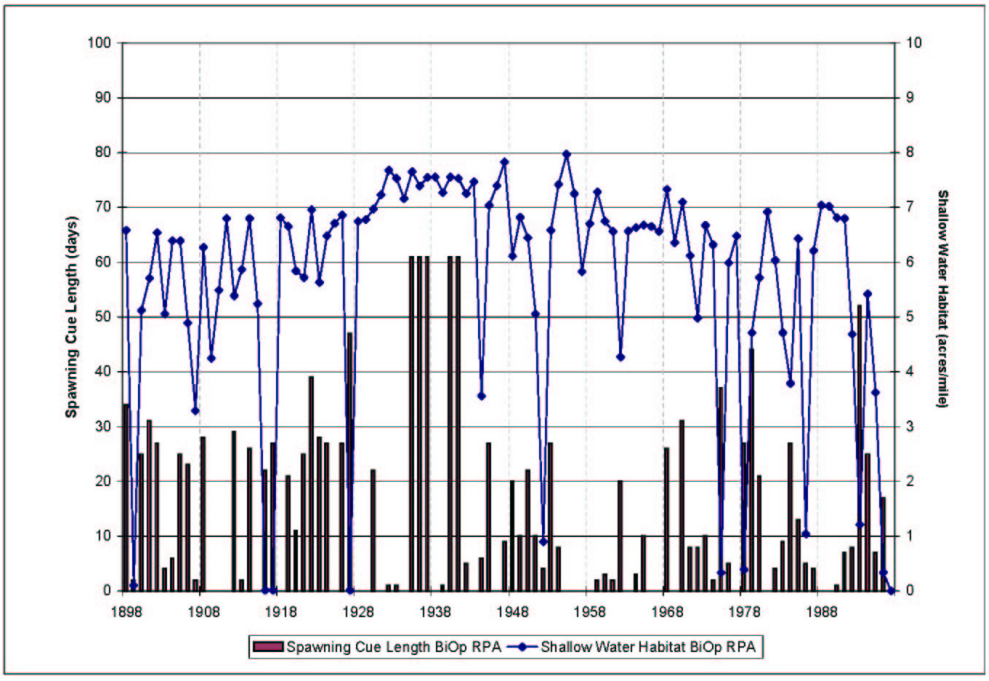

Figure A-16. Annual values for spawning cue length and shallow water habitat at Sioux City for the BiOp RPA.

To assist with the identification of years in which these two values are coincident, an Excel spreadsheet model was developed to identify whether the two are coincident in each year, with the shallow water habitat held constant and the cue length allowed to be variable. Four different cue lengths were run to develop the output for the Sioux City reach. The output file was plotted and is shown on Figure A-17. This figure shows that the percent of the years the shallow water habitat availability and spawning cue coincide increases as the spawning cue length decreases. A considerable percentage increase across the range of spawning cue lengths occurs between the CWCP and the 2000 BiOp RPA. One can also determine the spawning cue length required to have both factors coincide in 33 percent of the years (note 33 percent line on the plot). To have at least 2 acres per mile of shallow water habitat available for the 2000 BiOp RPA, a spawning cue length of at least 14 days has a coincident rate of 33 percent. In conclusion, shorter spawning cues of 14 days have to result in successful spawning to have a spawning cue with at least 2 acres per mile of shallow water habitat in 33 percent of the years. This analysis was based on the spawning cue occurring in May or June and the shallow water habitat being measured in the period from mid-July to mid-August.

Similar analyses were done for the Nebraska City and Boonville reaches. The results are shown on Figure A-18 for at least 3 acres per mile of shallow water habitat in the Nebraska City reach and on Figure A-19 for at least 15 acres per mile in the Boonville reach. For the Nebraska City reach, the BiOp RPA meets the 33 percent level as long as spawning cues can be as short as 16 days to count as a spawning cue. For the Boonville reach, the spawning cue requirement needs to be no longer than 12 days for the BiOp RPA if there are to be coincidental spawning cues and at least 15 acres of shallow water habitat in the same year for 33 percent of the years. If longer spawning cues are required, smaller habitat requirements are needed. Conversely, if more habitat requirements are needed, an "adequate" spawning cue needs to be shorter.

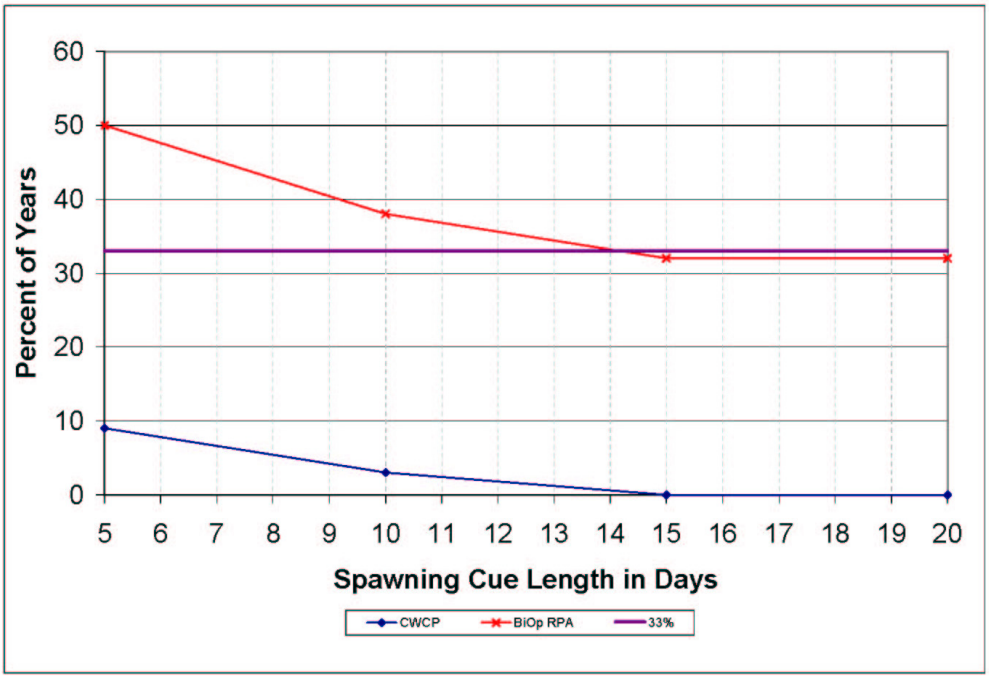

Figure A-17. Percent of years when spawning cue length and shallow water habitat (2 ac/mi) coincide at Sioux City

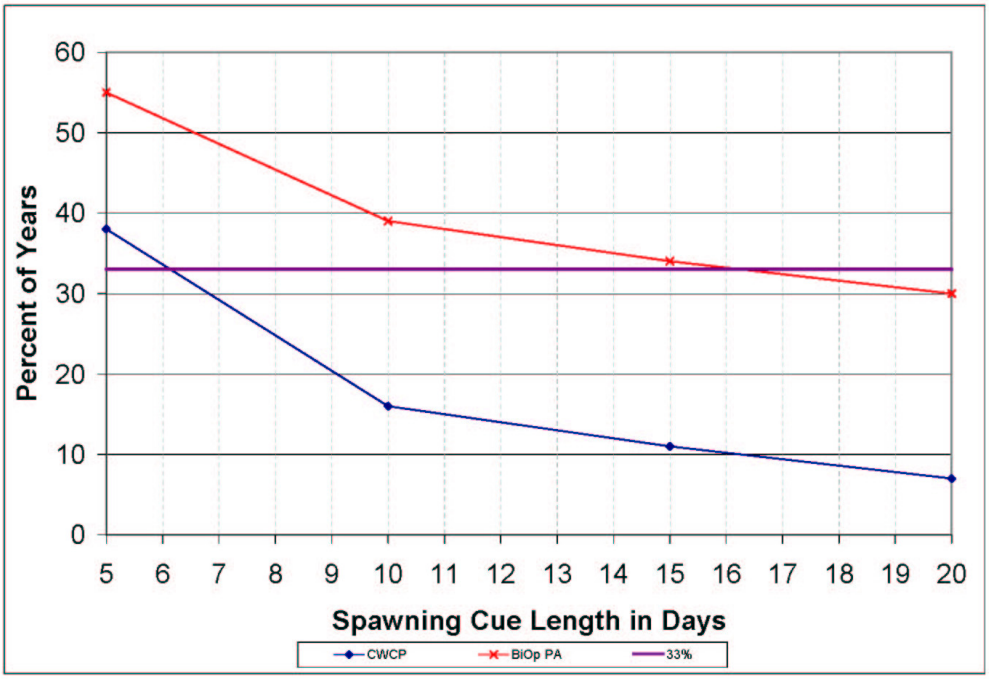

Figure A-18. Percent of years when spawning cue length and shallow water habitat (3 ac/mi) coincide at Nebraska City.

Spawning cues of greater magnitude were also evaluated to determine their frequency at the Lower River gaging stations for the two alternatives. The results are shown in Figure A-20, which shows that the differences between the CWCP and 2000 BiOp RPA diminish in a downstream direction. Also, the percent of years that the specified percent increase in spring flow occurs diminishes as the percent increase gets larger. Finally, this figure shows that the higher spring rises cannot meet the third-of-the-time requirement for even the 2000 BiOp RPA at all sites for magnitudes of rises that are 30-percent or greater. This demonstrates that the necessary magnitude may not be able to meet the desired frequency with any of the alternatives if the spawning cue requirement of the pallid sturgeon is greater than a 30-percent increase in flow.

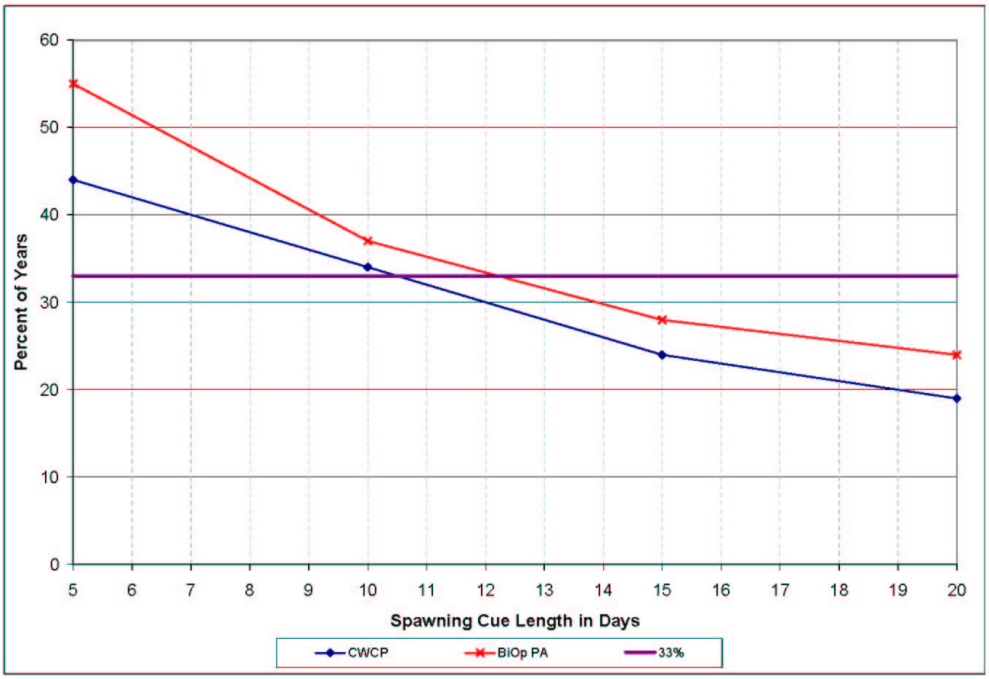

Figure A-19. Percent of years when spawning cue length and shallow water habitat (15 ac/mi) coincide at Boonville.

Water temperature is also an important factor in initiating spawning in sturgeon. The 2000 BiOp stated the shovelnose sturgeon is believed to provide a good indication of the spawning requirements of the pallid sturgeon. Shovelnose sturgeon in the un-channelized Missouri River downstream of Gavins Point Dam were thought to spawn in swift water in or near the main channel (Moos 1978). Moos (1978) studied the spawning timing and duration during 1968 and 1969. He observed that spawning initiation and duration was related to water temperature. In 1968, water temperatures increased steadily during the later part of May and early June to 18 to 19 degrees C, then rose rapidly in July to near the summer maximum. In 1969, water temperatures were more variable over the same time period. The differences he observed between the two years with regard to initiation and duration of spawning correlated with a faster increase in water temperature, subsequent fluctuations in temperature, and higher flow rates in the second year. Spawning in the second year was thought to be less successful because of the variability in these factors. The summer hydrographs for 1968 and 1969 are shown in Figure A-21.

Hurley and Nickum (1984) studied shovelnose sturgeon spawning and early life history on the Mississippi River in the tail waters of Lock and Dam 12 to Pool 13 (downstream from Dubuque, Iowa) during 1983. They concluded sturgeon probably spawned between May 21 and June 28 when water temperatures were between 16 and 24 degrees C. Peak spawning was thought to be in mid-June when water temperatures were 21 to 24 degrees C. Peak catches of males running milt occurred during periods of stable flows and rising water temperatures. Pallid sturgeon spawning is also directly related to water temperature (USFWS 2000). When water temperature increases to 16.7 to 18.3 degrees C, pallid sturgeon initiate spawning. Optimum spawning temperature for pallid sturgeon spawning in hatcheries was determined to be 15.5 to 18.5 degrees C.

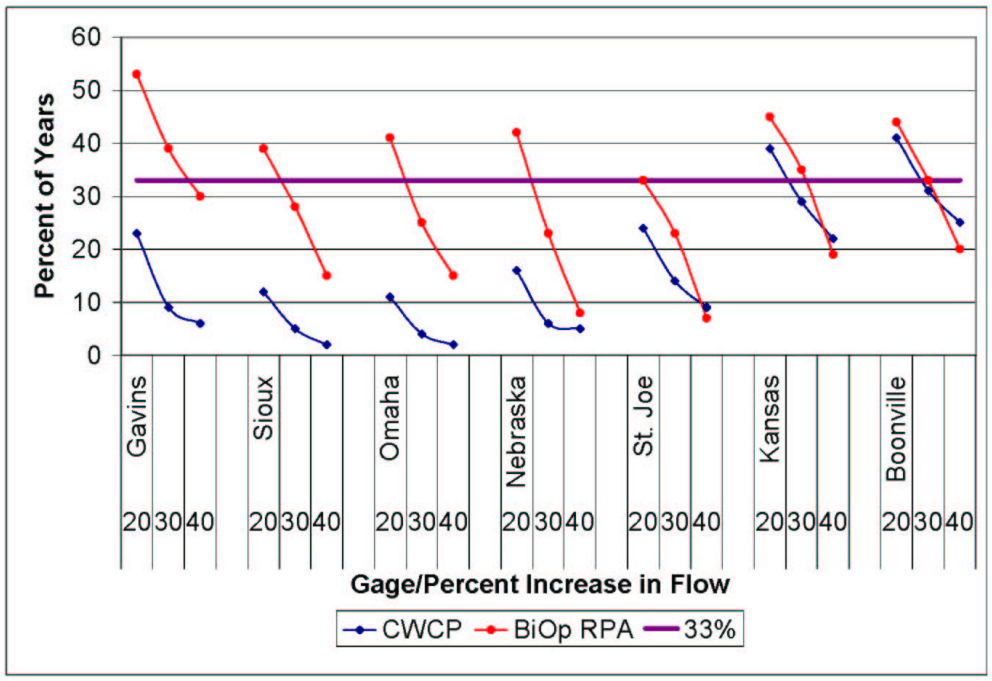

Figure A-20. Percent of years that a 14-day spawning cue is provided for three different magnitudes of spawning cues (20-, 30-, and 40-percent increase in flow).

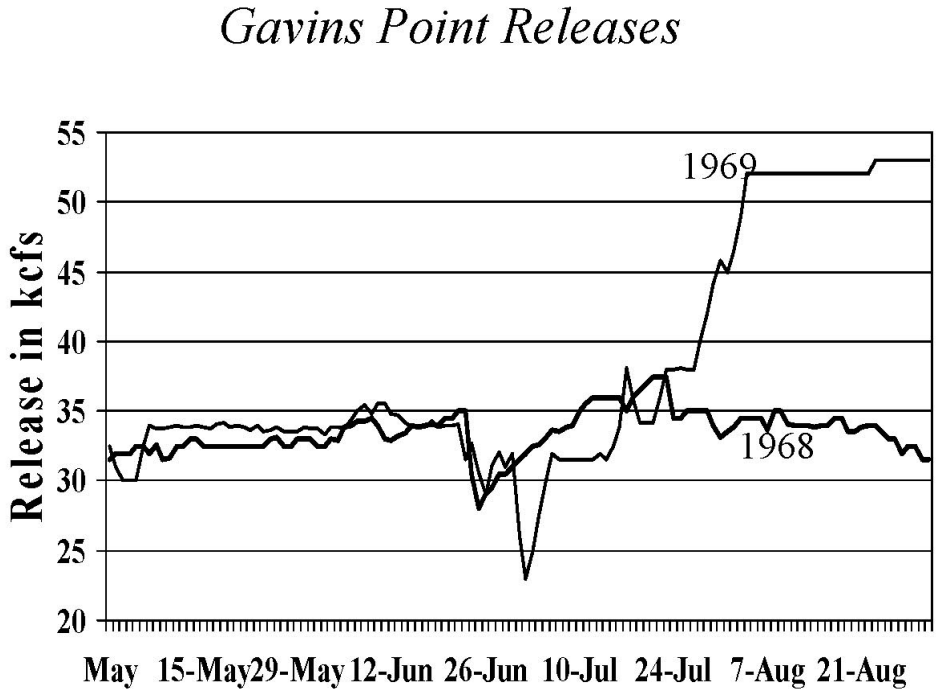

Figure A-21. Hydrograph during shovelnose sturgeon spawning for 1968 and 1969 below Gavins Point Dam (Corps of Engineers unpublished data).

In conclusion, greater knowledge of what constitutes an adequate spawning cue is required. If the primary reason for having a spring rise is to provide an adequate spawning cue for the pallid sturgeon so this species can recover, better definition of an adequate spawning cue is essential. The relationship of water temperature and flow to pallid sturgeon spawning is unknown. A robust Research Monitoring & Evaluation (RM&E) program that examines the multiple factors that may be limiting pallid sturgeon spawning and recruitment will fulfill this need.

FINDING OF RECENT MONITORING EFFORTS

Existing Shallow Water Habitat in the Lower River

It should be noted that Table 22 of the 2000 BiOp states that comparable data of existing SWH was not available for segments 14 and 15. New data provided by the Corps in the Supplemental BA for the 2002-2003 Annual Operating Plan (Corps 2003) shows that the Lower River, from the mouth of the Grand River (RM 250) to the mouth of the Osage River (RM 130), averages 18.3 acres/mile of existing SWH. Due to the local channel geometry and the reach hydrology, it is reasonable to assume that from the mouth of the Osage River (RM 130) to the mouth of the Missouri River (RM 0) the quantity and quality of SWH would be at least equal to that in the Grand to Osage River reach. The fact that 250 miles of the Lower River already averages nearly 20 acres/mile of SWH is very significant as the Corps tries to identify what measures are needed to save the pallid sturgeon.

Results of Fort Peck Monitoring

Monitoring and evaluation on the Missouri River below Fort Peck Dam has been occurring since spring 2001. This monitoring and evaluation was designed to comply with the 2000 BiOp. The monitoring and evaluation plan has multiple components, covers several years of data collection, and can be revised to address new information. The Corps intends to conduct a comprehensive evaluation at the conclusion of the data collection, but evaluation is also occurring throughout the data collection.

Preliminary findings exist which provide additional or new data for consideration. The Corps will continue to monitor and evaluate the new data. Because all of the activities planned for evaluating these finding have not been completed, consideration should be given to the following:

- Two larval pallid sturgeon were sampled in September 2002 in the Missouri River downstream of the confluence with the Yellowstone River. This provided the first documented account of larval pallid sturgeon in the Missouri River reach downstream of Fort Peck Dam and indicates that successful spawning by pallid sturgeon occurred in 2002. The potential spawning timeframe for these larval sturgeon can be estimated based on size and degree of maturity.

- Additional larval drift rate studies were conducted in 2003 to more thoroughly evaluate drift behavior and drift rate of larval sturgeon at higher velocities. These studies were conducted in the laboratory (USGS, Conte Anadromous Fish Research Center; report in preparation) and in a side channel of the Missouri River downstream from Fort Peck Dam (MTFWP, Fort Peck; USGS, Fort Peck; report in preparation). The preliminary indications are that the larva drift at the same rate as the water flows.

- Water temperatures were recorded at Frazer Rapids in 2001 and 2002. The water temperatures at Frazer Rapids were not sustained at 18 degrees C at any time during these two years.

Average historic surface lake temperatures have a high degree of variation from year to year, between 50 and 70 degrees F for the month of June. The Corps is still analyzing surface temperature ranges near the spillway during the summer months. To attain 64 degrees F (18 degrees C) at Frazer Rapids, a surface temperature in excess of 64 degrees F in the lake would be necessary before running the full test.

Estimation of Pallid Sturgeon Extirpation in the Fort Peck Reach

A remnant population of pallid sturgeon exists in the riverine portion of the Missouri River system below Fort Peck Dam (Fort Peck Dam to the headwaters of Lake Sakakawea) including the lower Yellowstone River. This area is recognized as Recovery Priority Management Area #2 (RPMA) of the Pallid Sturgeon Recovery Plan (USFWS 1993). Naturally reproduced young-of-the-year pallid sturgeon were collected during trawling efforts in September 2002 (David Fuller, MTFWP & Patrick Braaten, USGS, personal communication); however, recruitment is lacking as the size structure of this population is void of any smaller pallids. The existing wild

population is dominated by large pallids exceeding 50 pounds. This population is declining, and extirpation of this aging population is projected as early as 2016, based on a population estimate conducted using data from 1991 through 2001 (Kapuscinski, 2002). The population estimate for wild pallid sturgeon in this reach of the Missouri River indicates the population to be 178 fish. 95% Confidence Intervals indicate as few as 96 and as many as 351 fish remaining in this population.

Least Tern and Piping Plover Reservoir Habitat Model

The Corps received feedback on the RDEIS regarding the lack of an analysis of the habitat that least terns and piping plovers, particularly piping plovers, were using on Lake Sakakawea and Lake Oahe. Historically, over 98 percent of the least tern and piping plover habitat within the Missouri River have occurred on the two lakes. This situation was discussed with the field biologists that monitor these birds annually to determine if development of such a model could be accomplished. As a result of this inquiry, the Reservoir Habitat Model (RHM) for least terns and piping plovers was developed in 2002. The RHM is a GIS model that combines elevation grids on these two lakes with end-of-month lake water surface elevations to quantify defined habitat type for each year of the 100-year period of record modeled. Modeling was ultimately conducted for approximately 25 percent of the area around each lake.

End-of-May elevations were selected because the majority of piping plovers have arrived on Lake Sakakawea and Lake Oahe by this time and have initiated nesting activities. The majority of least terns arrive shortly thereafter during the first 2 weeks of June. An inundation elevation was also required for the modeling, and the second largest end-of-month elevation in the previous 12 months was used. This was done to ensure a high probability that areas being classified as inundated had actually been inundated for a sufficient length of time during the previous year to reestablish suitable habitat conditions.

Three-dimensional digital representations of the lake floors were developed from pre-dam (1943 Lake Sakakawea, 1947 Lake Oahe) topographic paper maps. A grid of the river channel bottom at the upstream end of each lake was included in the lake elevation grids. A distance attribute was added to the elevation grid with the zero distance located at the upstream end of the model area.

Factors that were included in the modeling effort included slope of the exposed bottom (less than 1:10 was acceptable), years post inundation (amount of suitable habitat diminished as years following inundation increased), and distance from the water (100 meters maximum). The amount of suitable habitat included only areas connected to the main body of each lake. For example, a deep pool in a bay with high ground between it and the main lake pool was not included unless the water surface elevation was high enough to top the high ground and fill the pool. The May end-of-month elevation was used to calculate the miles of river that became exposed during each year. The first four years' data were not "good data" because the period of post inundation had not been fully engaged until the fifth year. All subsequent years had the factor fully engaged and were, therefore, based on all of the same factors.

A primary factor leading to the development of the model was the concern that increased conservation during droughts, which all alternatives undergoing detailed analysis included,

would result in less habitat around the lakes. For this reason, the model was developed with the goal of being able to understand relative differences in habitat among the alternatives (versus being able to identify the absolute amount of habitat for a specific alternative). The modeling determined that the increased conservation actually provided an increase in average annual habitat. Also the alternatives with spring rises and lower summer flows had increased levels of habitat, compared to that of the CWCP. Furthermore, any gains in riverine habitat for the alternatives being evaluated at that time would not be offset by losses of habitat around the lakes. Both riverine and lake average annual habitat amounts increased with these alternatives.

Historic Least Tern and Piping Plover Mortality Report

The Corps has compiled and evaluated all available current and historic information from these assessment activities to document natural loss and the impacts of System operations on avoidable and unavoidable take of least tern and piping plover nests, as described in the 2000 BiOp. This analysis evaluated the impacts of take from 1) daily dam operations, including storage and releases; 2) flood control operations; 3) uncontrolled local inflow; and 4) predation, weather, abandonment, human disturbance, livestock, and erosion. The report on this analysis has been provided to the USFWS by separate transmittal.

CRITICAL HABITAT DESIGNATION

The USFWS designated critical habitat for the northern Great Plains population of the piping plover (67 FR 57638) including the Missouri River in September 2002.
In Montana, critical habitat was designated on Fort Peck Lake (77,370 acres (31,310.6 ha.), and 125.4 miles (201.8 km) of the Missouri River below Fort Peck Dam (RM 1712.0 to RM 1586.6). In North Dakota, critical habitat includes 18.6 miles below Fort Peck Dam (RM 1586.6 to RM 1540.0), 179 miles of river on Lake Sakakawea above Garrison Dam (RM 154.0-RM 1389.0), 87 miles of river below Garrison Dam (RM 1389.0-RM 1302.0), and 70 miles of river on Lake Oahe (RM 1302-RM 1232.0). In South Dakota, critical habitat includes 159.7 miles on Lake Oahe (RM1232.0-RM 1072.3); 36 miles (57.9 km) below Fort Randall Dam (RM 880.0- RM 844.0), 32.9 miles (52.9 km) on Lewis and Clark Lake (RM 844.0-RM811.1); and 58.9 miles (94.8 km) below Gavins Point Dam (RM 811.1-752.2). The Kansas River was not designated as critical habitat.

Primary constituent elements of the northern Great Plains population of the piping plover are those habitat processes (biological) and components (physical) essential for the biological needs of courtship, nesting, sheltering, brood rearing, foraging, roosting, intraspecific communication, and migration. The overriding primary constituent element (biological) necessary on all sites is the dynamic ecological processes that create and maintain the physical components of piping plover habitat through dynamic hydrological processes. On rivers, the physical primary constituent elements include sparsely vegetated channel sandbars, sand and gravel beaches on islands, temporary pools on sandbars and islands, and the interface with the river. On reservoirs, the physical primary constituent elements include sparsely vegetated shoreline beaches; peninsulas; islands composed of sand, gravel, or shale; and their interface with the water bodies.

ADDITIONAL INFORMATION SUBMITTED BY OTHERS

Following the 2000 BiOp, additional biological information was provided to the Corps and the USFWS by other entities and individuals. This information has been provided to the Corps by separate transmittal.

CONCLUSION

In light of the new information presented in this BA, the Corps has concluded that the RPA flows at Gavins Point are not reasonable and prudent. The new information was used in the development of the Corps' proposed action and helps support the Corps' conclusions. The Corps believes the new information is significant and substantive, and meets the threshold for reinitiation of consultation between the Corps and the USFWS.

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APPENDIX B

DETAILED DESCRIPTION OF THE CORPS' ALTERNATIVE TO THE 2000 BIOP GAVINS POINT RPA

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APPENDIX B

DETAILED DESCRIPTION OF THE CORPS' ALTERNATIVE TO THE 2000 BIOP GAVINS POINT RPA

ADAPTIVE MANAGEMENT

The 2000 BiOp recommended that the Corps adopt an adaptive management approach to implementing the various BiOp measures. The USFWS stated that the "adaptive management framework is a particularly effective way to address multiple species, ecosystem variability, and biological unknowns about the lifecycles, behaviors, and habitat requirements of the listed species." The National Research Council in its January 2002 report titled, "The Missouri River Ecosystem: Exploring the Prospects for Recovery", also recommended that adaptive management be adopted as an "ecosystem management paradigm" for the Missouri River. Key components included broad stakeholder involvement, an independent scientific peer review process, and a collaborative process to "learn about successes, failures, and potential management actions that could be usefully implemented in the Missouri River ecosystem."

The Corps, in this proposed action measure, embraces the concept of adaptive management. Adaptive management is not a new concept; but rather, a construct that is now commonly used throughout the world to help shape resource management decisions, policies, and approaches. There is an up-front recognition that all is not known about the complete life cycles and behaviors of the threatened and endangered species or the requisite habitat needs throughout the species' life cycles. Adaptive management is an overall strategy for dealing with change and scientific uncertainty. It promotes an environment for testing hypotheses and pursuing promising changes, based on sound scientific data and analyses.

Generally speaking, adaptive management: 1) aggressively implements on-the-ground actions to attain those biological attributes that will result in beneficial effects for the listed species; 2) conducts a rigorous research effort to reduce the uncertainty surrounding essential attributes needed to insure the survival and recovery of listed species; and 3) adapts to the findings of an intensive and comprehensive monitoring and evaluation program. In carrying out an adaptive management approach to decision-making, some future actions may pose significant effects to the natural and/or human environment. In some cases, this may require that the Corps undertake an assessment of the effects in accordance with the NEPA, prior to making any decisions to implement an action. The ultimate success of the adaptive management framework for the Missouri River basin must also take into account that humans are integrated into the ecosystem and that natural ecosystems do not recognize property lines and administrative boundaries.

Understanding this, the Corps proposes the first part of the adaptive management framework, the development of the Missouri River Recovery Implementation Program (MRRIP). MRRIP is a comprehensive and integrated set of measures to be undertaken by the Corps in collaboration with the USFWS, working with the States, Tribes, and other stakeholders in the basin. MRRIP

will be undertaken to protect and recover threatened and endangered species listed under the ESA and the ecosystem upon which they depend.

MRRIP will include recovery actions on the mainstem of the Missouri River from Three Forks, Montana, to St. Louis, Missouri, and on select tributaries of the Missouri River, including the Kansas River, while taking into consideration other Congressionally authorized and traditional uses of the river. The actions undertaken for MRRIP will be relied on by the Corps, USFWS, and others to avoid the likelihood of 1) jeopardy to the three listed species (piping plover, least tern, and pallid sturgeon) in the Missouri River, 2) adverse modification to designated critical habitat, and 3) violation of the take prohibitions of Section 9 of the ESA.

The basic components of the initial ecosystem recovery program, either those actions being implemented in response to the 2000 BiOp or set forth in details in this proposed action include:

- **Habitat creation, enhancement, and maintenance for pallid sturgeon, piping plover, and least tern.** Under this category, the Corps' existing efforts to create shallow water habitat for the pallid sturgeon and emergent sandbar habitat for the least tern and piping plover will continue and be expanded. Additional habitat enhancement efforts will be undertaken to provide even more and potentially better habitat for all three species.

- **Hatchery support including facility improvements, accelerated brood stock collection, and accelerated stocking for the pallid sturgeon**. In 2003, the Corps is enhancing pallid sturgeon propagation activities at six rearing facilities to assist in achieving annual stocking goals. The facilities have been able to upgrade water systems, fish transport units, holding and rearing capabilities as well as a variety of miscellaneous items. The continuation and enhancement of these activities as part of the recovery program will enable propagation and augmentation efforts to be maintained and expanded. Successful collection, spawning, rearing, and stocking will partially offset the lack of natural reproduction.

- **Population assessments of the pallid sturgeon, piping plover, and least tern**. The Corps has implemented a comprehensive least tern and piping plover monitoring program, which has provided state-of-the-art information on habitat and birds that has become critical to river management decisions. With this recovery program action, the Corps will continue this successful assessment program and seek ways to improve and modernize the monitoring and evaluation techniques and data delivery and communication tools. Sampling efforts for the pallid sturgeon population assessment were initiated in 2001 and have gradually been expanded. The effort is to be fully implemented in the spring 2004 with crews conducting standardized assessments in all of the high priority river segments.

- **Intense research, monitoring, and evaluation of all three species.** The Corps recognizes that a complete monitoring and evaluation program should be a central and operational component of all management activities. As a focal point of this action, the Corps will incorporate a monitoring and evaluation program that provides data to further our understanding and resolve the wide range of uncertainties.

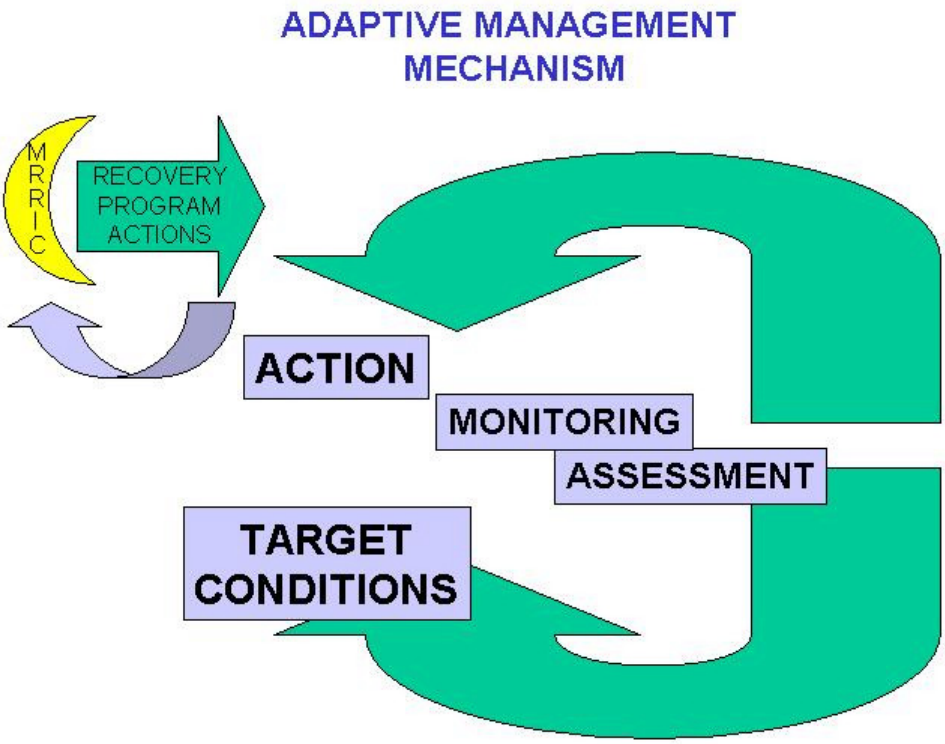
- **Flow tests as part of an adaptive management strategy.** Flow tests to create and condition emergent sandbar habitat for the interior least tern and piping plover and potentially improve flow conditions for the pallid sturgeon are included in the recovery program. Due to their experimental nature, any future actions would be addressed in an adaptive management strategy. Flow tests would not be included in the revision of the Master Manual; however, consideration of System operations is included as part of MRRIP.

Part of the adaptive management approach is to conduct research to reduce the uncertainties surrounding the limiting factors to survival and recovery of the species. The critical uncertainties for the pallid sturgeon include identifying physical cues for initiating spawning and conditions necessary for the early stages of the young-of-year. If hydrologic conditions are critical to initiate spawning, then the magnitude, frequency, and duration of those events must be identified. Conditions that allow for the growth and survival of early life stages of pallid sturgeon are also uncertain. The Research Program outlined in the Description of the Action section describes how these uncertainties will be reduced.

MRRIP actions will be discussed and coordinated with a Missouri River Recovery Implementation Committee (MRRIC), which will include broad and diverse stakeholder representation to ensure that public values are incorporated into recovery implementation. It will provide recommendations to the Federal agencies regarding recovery implementation and will be developed cooperatively with entities having an interest in recovery of listed species and the ecosystem on which they depend. Representation on MRRIC will include the full spectrum of basin interests. Committee membership will be comprised of representatives of Tribal and State governments and of non-governmental organizations that have an interest in the management of the river and recovery of the species and ecosystem.

The proposed action measure for adaptive management is consistent with all applicable federal and state laws, Native American trust responsibilities, and interstate compacts and decrees. The Corps recognizes that the USFWS and the Corps each have statutory responsibilities that cannot be delegated, and the establishment of MRRIC is not intended to abrogate any of their statutory responsibilities. The Corps, however, advocates that MRRIC be a partner in recommending applicable future actions to be taken to benefit the listed species in the Missouri River. Consistent with the adaptive management framework, the Corps will pursue alternative courses of actions based on the scientific findings of Corps efforts and, when applicable, recommendations of MRRIC.

It is anticipated that basin development of MRRIC will require a considerable amount of time. The structure of MRRIC itself will be the subject of adaptive management. A conceptual diagram of an adaptive management strategy to include MRRIC is provided below.



The above discussion is a broad overview of an encompassing adaptive management strategy. In reality, adaptive management would occur at several levels. For example, in the day-to-day operation of the System, the Corps communicates daily with the USFWS; other Federal, State, and local entities; basin Tribes; and numerous stakeholder organizations and individuals. Many of the issues raised and subsequent decisions by the Corps are minor and would not be the subject of review by MRRIC. These day-to-day interactions will continue and are essential to real time operation of the System.

All of the measures included in the Corps' proposed action will be subject to an overall adaptive management strategy. Further, the Corps currently implements adaptive management in its operation of the Missouri and Kansas River Projects and will continue that strategy while MRRIC is being developed. Initiation of the measures identified in this proposed action will proceed in the context of an overall adaptive management strategy, irrespective of the status of MRRIC.

Immediate implementation of measures that benefit the pallid sturgeon is particularly important in light of the potential imminent extirpation of that species from certain reaches of the Missouri River. The USFWS has indicated there is a high likelihood that the pallid sturgeon may become extirpated from the reach below Fort Peck Dam on Missouri River within the next decade. To ensure that certain populations are not extirpated, immediate action and continual re-evaluation of species response to actions is critical. The Corps proposes a re-evaluation of the status of the

species and success of implemented measures to date be conducted within 3 years following the Final BiOp. This re-evaluation will ensure that there is adequate time for implementation of additional measures or modification of existing measures and strategies to ensure that the pallid sturgeon is not extirpated from the Missouri River, while development of MRRIC is potentially still occurring.

The National Research Council, in its 2002 report, identified the following four steps that should be taken to help lay the groundwork for adaptive management strategies and actions.

1. Congress must legitimize and empower Missouri River managers with the authority and responsibility to actively experiment with river operations that aim to enhance ecological resources.
2. A representative stakeholder committee should be empowered and convened by the appropriate agencies to develop a basin wide strategy, conduct assessments, review plans, and provide oversight over the implementation of adaptive management initiatives.
3. Congress must require the development of long-term goals and short-term measurable objectives for adaptive management action so that successes and failures can enhance public understanding.
4. Given our imperfect knowledge of ecological dynamics and social preferences, Federal agencies must be mandated by Congress to work with stakeholders to build commitment to and acceptance of changes to the current pattern of benefits delivered from the river and reservoir system.

The National Research Council also indicated the following principles are important to ensure the stakeholder group's effectiveness:

- Participation by a broad spectrum of interest groups
- Inclusion of Tribal interests
- Continuous two-way communication with the public
- Visible participation by federal, state, and tribal governments and non-government organizations
- Support from an independent, interdisciplinary scientific panel
- Provision by the federal government, with support from the states and tribes, of secure funding for stakeholder involvement effort over the lifetime of the activity
- Participation by representatives of Congress and of the state legislatures of Missouri River basin states
- Consensus decision making by the stakeholder group

As the Corps moves forward in its efforts to implement adaptive management through MRRIP, the Corps will formulate much of its efforts with the National Research Council's steps and principles in mind.

MAINSTEM SYSTEM OPERATION CHANGES

The operation of the System is designed to serve the Congressionally authorized project purposes including flood control, hydropower, water supply, water quality, irrigation, navigation,

recreation, and fish and wildlife. During periods of drought, service to all authorized purposes is maintained, though at reduced levels.

This proposed action measure has two basic flow features that are changed from the CWCP. First, more stringent drought conservation, or retention of water, in the upper three reservoirs, is included. Second, a set pattern of intrasystem unbalancing is included. These two features were changed to address some of the major concerns expressed by upper basin interests as the 1987 to 1993 drought occurred. More detailed information on the changes follows. Flow changes at Fort Peck and Gavins Point Dams are also discussed in this section.

Drought Conservation Measures

a. **Drought Conservation Measures**. During extended drought periods, or those lasting more than 1 year, navigation service would be reduced earlier under the proposed action than it is under the CWCP. This would allow more water to be stored in the upper three reservoirs. During the more severe droughts, such as the 1930 to 1941 drought, releases for navigation would be curtailed at a higher total System storage level than under the CWCP. This proposed action measure was not specified in the USFWS 2000 BiOp RPA; however, all modeling conducted for the USFWS as it prepared the BiOp included more stringent drought conservation measures.

The drought conservation criteria included in the proposed action consists of "guide curves" for the determination of flow support for navigation and other downstream purposes and navigation season length. Under the proposed action, the navigation service level and season length would be reduced at higher system storage levels than they are currently under the CWCP. The March 15 System storage level at which navigation would not be served for that year was raised from 23.5 MAF under the CWCP to 31 million acre-feet (MAF) under the new drought conservation measures for this proposed action measure. Figures B-1 through B-3 compare the drought storage levels and the corresponding navigation service levels and season lengths of the CWCP and proposed action.

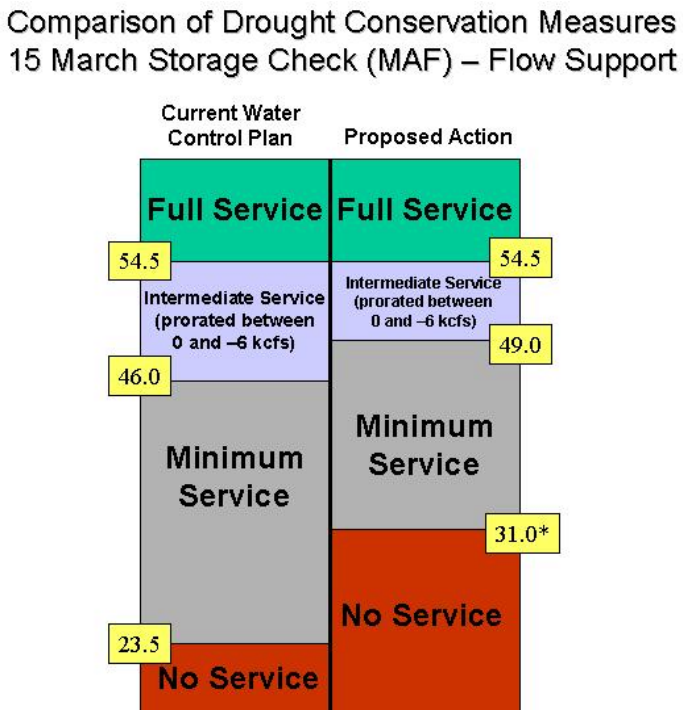


Figure B-1. Comparison of drought conservation measures between the CWCP and the System operations under the proposed action based on the March 15 System storage check for Service Level.

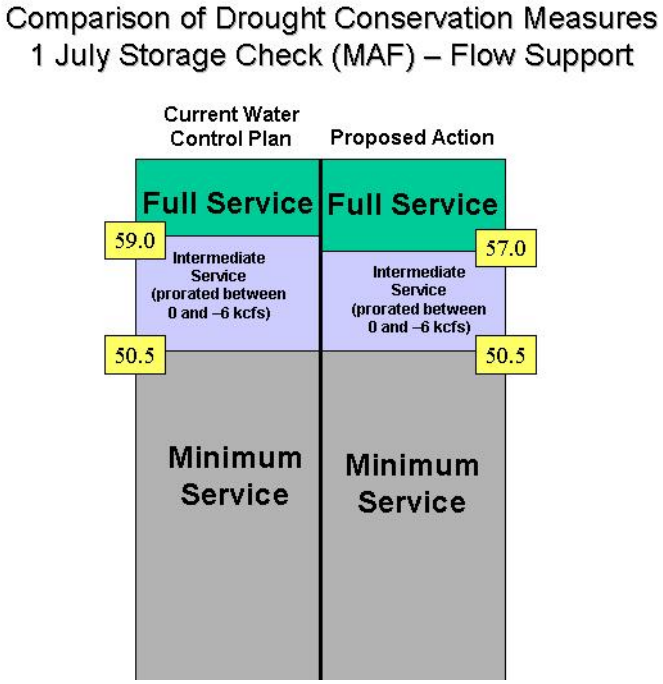


Figure B-2. Comparison of drought conservation measures between the CWCP and the System operations under the proposed action based on the July 1 System storage check for Service Level.

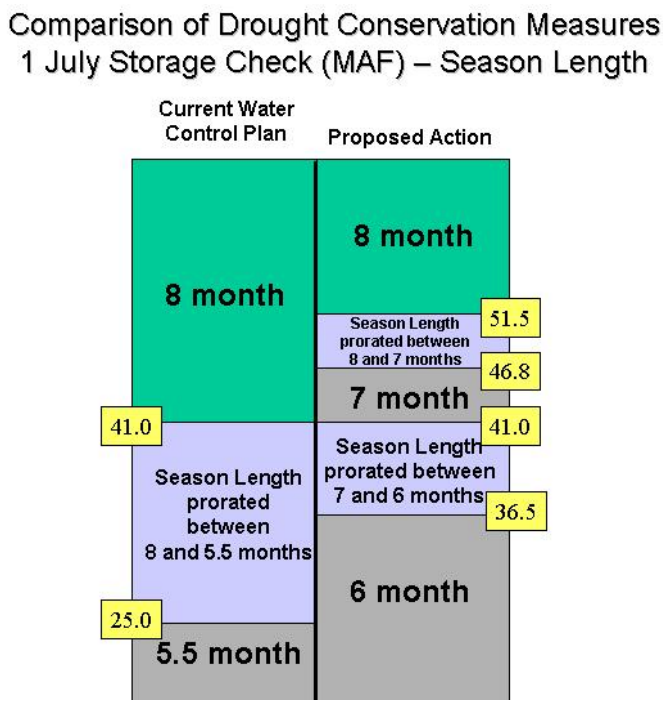


Figure B-3. Comparison of drought conservation measures between the CWCP and the System operations under the proposed action based on the July 1 System storage check for Season Length.

The proposed water control plan presented in BA calls for suspension of navigation service if System water-in-storage (storage) is at or below 31 MAF on 15 March of any year. It should be noted that the occurrence of System storage at or below 31 MAF would most likely coincide with a national drought emergency. If any of the reservoir regulation studies performed for the development of the Annual Operating Plan (AOP) indicate that System storage will be at or below 31 MAF by the upcoming 15 March, the Corps will notify the Secretary of the Army. Approval from the Secretary of the Army will be required prior to implementation of back-to-back non-navigation years. The Corps will ensure that basin stakeholders are promptly informed of the notification to the Secretary of the Army and of the Secretary's decision regarding suspension of navigation.

Table B-1 compares the lowest elevations that would have occurred under the CWCP and this proposed action measure for each of the upper three lakes during the 1987 to 1993 drought. The figure also contains the minimum storage for the CWCP if the current drought conservation measures had been strictly followed. Inclusion of these measures would increase total system storage from 40.2 to 42.1 MAF for this proposed action measure during a similar drought.

Table B-1. Lowest lake levels for the 1987 to 1993 drought.

Lake	**CWCP**	Proposed Action
Fort Peck Lake	2,206	2,208
Lake Sakakawea	1,813	1,817
Lake Oahe	1,585	1,587

Gavins Point Dam Release Changes

The 2000 BiOp included release changes from Gavins Point Dam in the form of a spring rise and lower summer releases. Neither of these release changes is included as a feature of the proposed action, but they could be implemented at some future date if they are scientifically determined to be essential conditions that contribute to the survival of the pallid sturgeon. Included, as a feature of the proposed action, is a Comprehensive Pallid Sturgeon Research Project, which will determine the critical ecological factors that contribute to successful pallid and shovelnose sturgeon reproduction and survival in the Missouri River. If a spring rise or lower summer flows were found to be necessary for pallid sturgeon survival, the Corps would then pursue implementation of the release changes through the adaptive management process after performing another NEPA analysis, if needed.

Summer releases under the proposed action will be adjusted when the Missouri River Basin Water Management Division is notified by the Omaha District, Operations Division, Threatened and Endangered Species Section that birds have begun nesting. Flow support for navigation and other downstream purposes could be provided by adjusting releases as needed throughout the summer as tributary inflow varies to meet targets (flow-to-target), by providing a steady, flat release during the tern and plover nesting season at the flow level estimated to provide the desired service support in August when tributary inflows have declined (steady-release), or by some combination of the two methods, as was done during the 2003 nesting season (steady-release – flow-to-target). The modeling done for the RDEIS and FEIS used a flat 28.5 kcfs as an estimate of the release needed to provide minimum service support, and 34.5 kcfs for full service support; however, the actual release would vary based on the hydrologic conditions at the time.

The decision on which method to use during any given year would be made within the adaptive management framework and would be based on runoff, habitat availability, fledge ratios, and population conditions at that time. For example, if a moderately high runoff year is anticipated and sufficient habitat exists, a flat release may be used because, in general, it would evacuate more water during the summer months than would be released by following targets. If, on the other hand, the upper basin is experiencing a moderate to severe drought and the upper three large lakes are low, a flow-to-target or steady-release – flow-to-target operation may be followed through the summer season to conserve water in the System. These methods are dependent on the Corps retaining the flexibility to adjust releases during the summer months to provide the required downstream flow support and comply with the ESA by ensuring that the operation of the System does not jeopardize the continued existence of the interior least tern and the piping plover.

In addition to the proposed action for Gavins Point Dam release during the nesting season, the following measures to minimize losses of the two listed bird species are also included as part of a more comprehensive proposed action.

1. The Corps will conduct an adult census and weekly productivity monitoring of all known and potential piping plover and least tern nesting sites within the Kansas and Missouri Rivers, beginning the last week of April through the end of the breeding season.

2. As recognized in the 2000 BiOp, the Corps will maintain its "state-of-the-art" least tern and piping plover recovery program. This will include a 16-hour Productivity Monitoring and Survey Techniques course (including nest-moving methods) for all seasonal staff and permanent staff, including contractors working with least tern and piping plover activities.

3. The Corps will maintain an aggressive coordination effort between the USFWS, Water Management Division, dam operators, and the Omaha District's Endangered Species Section to evaluate and minimize losses due to water management.

4. Outreach efforts include the production of a new interagency brochure on the least tern, piping plover and pallid sturgeon; the placement of additional interpretive signs at area boat ramps; endangered species programs at public venues; and public service announcements.

5. Predator management efforts will continue with the placement of predator exclosures over piping plover nests, evaluation of open-topped cages for least terns, electrified predator barrier fences, and livestock exclosure fences on reservoir shorelines.

6. Garrison and Fort Randall Dam releases will be restricted, including limiting hourly peaking, during the least tern and piping plover nesting to minimize losses.

7. The Corps will move nests threatened by rising water on river and reservoir reaches to higher, more secure habitat when possible using recognized techniques.

8. The TESDMS will be used during the nesting season. The use of the TESDMS, when coupled with gage data, helps reduce the likelihood of inundation by providing near-real-time survey and monitoring data to water managers.

9. During periods when the downstream flow target is at Kansas City, the Corps will release water from the Kansas River projects, as Congressionally authorized and described in the Kansas River Master Manual, to minimize least tern and piping plover losses.

10. Before increasing releases from Gavins Point Dam, an evaluation of the location of tows will be made to determine if release increases can be delayed without negatively impacting navigation.

11. In any year that the July 1 storage check shows an increase in service level for the remainder of the navigation season, the increase will be delayed until the end of the nesting season.

12. Law enforcement activities will include the posting of nesting sites with restriction signs and fencing to reduce human disturbance. Also, the Corps will increase coordination of law enforcement patrols of nesting areas and integrate law enforcement activity logs into the TESDMS.

For the benefit of pallid sturgeon and other native river fish, the evacuation of floodwaters would be delayed until mid-September when possible. Delayed evacuation in the late summer and early fall would benefit the young-of-year native river fish: the bigger that young-of-year native river fish are at the time of evacuation, the greater their chance of survival. This delay may be done independently in any year flood water evacuation is needed after the nesting season or in conjunction with one of the flow tests proposed as part of the proposed action.

Unbalancing of the Upper Three Lakes

The Corps has the authority under the existing Master Manual and does implement intrasystem unbalancing. Unbalancing of the lakes was also included as a feature of the RPA identified in the November 2000 BiOp.

Unbalancing consists of purposefully lowering one of the upper three lakes approximately 3 feet to allow vegetation to grow around the rim, and then refilling the lake to inundate the vegetation. The unbalancing would rotate among the three lakes on a 3-year cycle. Movement of water among the lakes as they are lowered and refilled provides benefits to fish and birds in both the intervening river reaches and the lakes. Higher spring releases will fill the downstream reservoir and provide a rising lake level for game and forage fish spawning. The subsequent 2 years of lower flows would expose sandbar habitat for use by the protected birds. Unbalancing would also provide more bare sandbar habitat around the perimeter of the lakes for the birds. In subsequent years, the inundated vegetation around the perimeter would be used by adult fish for spawning and by young lake fish hiding from predators.

Under this proposed action measure, intrasystem unbalancing would be implemented in those years when there is not an excessive amount of flood control storage utilized or significant drawdown of the lakes due to severe drought conditions. Both the MRNRC and MRBA have provided recommended reservoir elevation guidelines that could be used to initiate unbalancing. The MRNRC guidelines have been presented in Annual Operating Plans (AOPs) since 2001. Unbalancing would be accomplished within an adaptive management framework and would be opportunistic in regards to each year's plains and mountain snowpack. To the extent possible, based on hydrologic conditions, a 3-year cycle would be followed for lowering the water level about 3 feet below normal the first year, followed by a refill of the lake to about 3 feet above normal the second year and declining lake levels (a "float" year) the third year. This 3-year cycle would be rotated among the upper three lakes on an annual basis so that each year one lake is high, one is low and the third is floating. Table B-2 describes the 3-year cycle of lake unbalancing.

Table B-2. Unbalancing schedule for upper three lakes

	Fort Peck		Garrison		Oahe	
	March 1	Rest of Year	March 1	Rest of Year	March 1	Rest of Year
Year 1	High	Float	Low	Hold Peak	Raise and hold during spawn	Float
Year 2	Raise and hold during spawn	Float	High	Float	Low	Hold Peak
Year 3	Low	Hold Peak	Raise and hold during spawn	Float	High	Float

During the low year at a lake, the goal of the Corps would be to begin the runoff season on March 1 with the lake low with respect to the other two upper lakes. Ideally, the lake would rise during the lake fish spawn and then hold the peak lake level for the remainder of the year. The following year, the high year, the lake would begin the runoff season high with respect to the other lakes, rise during the fish spawn and then float downward during the remainder of the year. The float year, or third year, the lake would rise during the fish spawn and then drift downward for the remainder of the year so that it is in position to begin the following year low as the cycle repeats.

The results of unbalancing will be carefully monitored and evaluated under an adaptive management framework.

Fort Peck Dam Release Changes

The 2000 BiOp included release changes from Fort Peck Dam as a component of the RPA. Prior to full implementation of this release modification, the RPA included two tests, the "mini test" and the "full test". These two tests are included as "Actions Implemented in Response to the 2000 Biological Opinion". Depending on the results of the tests, the Corps may implement a Fort Peck Dam release modification; however, full implementation is not included as part of the proposed action.

FLOW TESTS

Due to the extent of required habitat, considerable new habitat will need to be created. Three tests would be conducted to determine the extent that additional habitat can be constructed with flows into Lewis and Clark Lake and in the river reach downstream from Gavins Point Dam and to determine if constructed sandbars can be conditioned to provide better habitat for the least terns and piping plovers.

Gavins Point Reach Fall Test

One flow test will be run in the river reach downstream from Gavins Point Dam in the fall after the System has been refilled following the current drought. The test would be conducted opportunistically when evacuation of the System is necessary. The test will consist of a release of approximately 60 kcfs for a period of approximately 60 days. The exact magnitude and duration of the test will be determined through pre-test investigations and public input. The test would be monitored for physical changes in sandbar distribution and characteristics in the reach of the river from Gavins Point Dam to Ponca State Park. Representative island/bars will be monitored to determine the factors that limit the initiation of scour, and tests would be performed on techniques that may aid the scouring process, e.g., vegetation removal prior to the test discharges, physical conditioning (i.e., disking) prior to the test, etc. This would increase the total amount of bare sandbar habitat in this reach and would allow for a redistribution of the habitat. Further, any "spring rise – summer low flow" release scenario from Gavins Point Dam may result in an increase in the occurrence of high flows in the fall months. This test would, therefore, also provide a greater understanding of the benefits/impacts associated with any

potential alternative release scenario from Gavins Point Dam with a spring rise or lower summer flow.

Besides the condition that System storage be adequate to provide the water for this test, several other conditions would have to be met prior to implementation. These include:

- The hydrologic conditions in the lower basin would have to be normal or drier.
- NEPA compliance would have to be completed. It is anticipated that only an environmental assessment would be required for a single test.
- Pretest data would have to be collected. This would consist of surveys of the reach of the river between Gavins Point Dam and Ponca State Park, aerial photography, and detailed mapping of selected sandbars.
- Extensive stakeholder buy-in is required. Storage and evacuation needs will play a large role in stakeholder buy-in.
- Appropriate economic mitigation measures and stop protocols will need to be in place to minimize adverse impacts on the Lower River. Economic mitigation measure could include portable pumps to aid in interior drainage, temporary protection of non-federal flood control projects, etc. Stop protocols may include discharge trigger on tributary streams, stage maximums on the Missouri River, threats to vital infrastructure, etc.

The primary reason for conducting the test in the fall rather than in the spring is to minimize the impacts to authorized project purposes, primarily flood control. This test, however, would minimize the impacts to other project purposes, as the test would use water that is in excess of that required for full service System operations.

Fort Randall Reach Fall Rise

A second flow test that includes a fall rise out of Fort Randall Dam will also be conducted. This action would consist of producing a controlled rise in releases from Fort Randall Dam preceded by a lowering of the pool in Lewis and Clark Lake to be conducted after Labor Day. The purpose of the rise is to further define sediment-flushing parameters and to modify the sediment deposits in the delta area. This would increase the amount of least tern and piping plover habitat in the reach below Fort Randall Dam and will further the basin's understanding of the sediment flushing requirements. The releases from Fort Randall Dam could be as high as 60 kcfs, and the pool at Lewis and Clark Lake could be as low as 1180 feet mean sea level (ft-msl). The length of the test would depend on the rate that the Lewis and Clark Lake pool is refilled, which depends on the release rate from Gavins Point Dam. It could be conducted at the same time as the fall rise test downstream from Gavins Point Dam or it could be conducted independently. If it were run with the Gavins Point Dam fall rise, the duration could be up to 60 days. If it were run by itself, the estimated test length is 5 days. The exact magnitude and duration of the test will be determined through pre-test investigations and public input.

This test has many of the same conditions as the fall rise from Gavins Point Dam. These include:

- Storage in the system would have to be adequate to support the test. Also, the Lewis and Clark Lake elevation would have to be no greater than 1185 ft-msl.

- NEPA compliance would be completed.
- Pretest data would be collected. This would consist of surveys of the reach of the river between Fort Randall Dam and fore set of the delta and aerial photography.
- The test would be suspended or canceled if higher than normal discharges were to come from the Niobrara River. High flows from the Niobrara River will cause excessive flooding in the confluence area and will alter the nature of the sediment-flushing test.

The primary reason for conducting the test after Labor Day is to minimize the recreational impact on Lewis and Clark Lake and to minimize the impacts to other authorized project purposes. This test is likely to cause some high ground water problems and possibly some overbank flooding in the Niobrara Area; however, flowage easements have been obtained on much of the impacted area, and a fall test would have fewer residual impacts.

Sandbar Habitat Conditioning

A third flow test, conditioning of constructed sandbar habitat, will be conducted downstream from Gavins Point Dam. Before running this test, new sandbar habitat would be constructed following the fledging of the least terns and piping plovers. As releases from Gavins Point Dam are increased the following spring to meet the navigation service requirements, arrangements will be made to make releases in excess of that planned to serve navigation such that the new sandbar habitat would be inundated for a day or two. This is intended to consolidate the substrate and potentially mix organic material in the surface layer. The objective of this test is to determine if there is a difference in least tern and piping plover productivity between the conditioned habitat and the habitat that is constructed and not inundated.

This test would also have some conditions that would have to be met prior to the test. These include:

- NEPA compliance would be completed.
- Pretest baseline conditions data would be collected.

Emergent sandbar habitat is also susceptible to change as the river flows vary from year to year. To be responsive to the changes, the Corps will monitor the habitat annually as plans for construction and maintenance of this habitat progress from year to year.

HATCHERY FACILITY IMPROVEMENTS

The 2000 BiOp RPA element VI A outlines the Corps' responsibility for pallid sturgeon propagation and population augmentation. This RPA is specifically related to all aspects of propagation (i.e., broodstock collection, spawning, rearing, tagging, stocking and subsequent monitoring). To address this RPA element, an existing program is now in place providing annual support for the population augmentation efforts. This program will continue on an annual basis in addition to the action described below.

At the time the 2000 BiOp was written, pallid sturgeon propagation had been met with limited success. Knowledge of rearing densities specific to pallid sturgeon were not developed and

existing facilities were designed in similar fashion to West Coast hatcheries propagating white sturgeon for commercial markets. Through experience, fish culturists now know the pallid sturgeon must be reared at very low densities to achieve normal growth and minimize the potential for disease outbreaks. The 2000 BiOp did not address specific needs related to infrastructure and facility improvements that may be limiting to the population augmentation component of recovery. Additionally, since the completion of the 2000 BiOp, stocking plans have been revised utilizing more liberal stocking rates to supplement the year classes that are absent as a result of a lack of natural reproduction/recruitment and severely depressed wild populations.

A series of limitations have been identified by the Propagation Workgroup to enhance the capabilities of the propagation program. These limitations are compiled in Table B-3 and are outside any guidance of the 2000 BiOp. The USFWS and the Corps have prioritized this list jointly with an emphasis on increasing production capabilities while improving water quality and water reliability to propagate pallid sturgeon of the highest quality possible. To achieve the increased production levels and improve the overall health of the progeny produced for the population augmentation program, a series of expansions and/or modifications are necessary. The Corps is seeking funding for the following hatchery facility improvements.

The actions highlighted in Table B-3 are further described in order of priority below:

These improvements include additional broodstock holding capabilities (Broodstock Building and Well Water/Tower) at the Gavins Point NFH, which is the only facility currently holding future broodstock. Future broodstock are held captive as a safety net in the event that wild fish are unavailable for continuation of the program. Currently, the Gavins Point NFH is at its maximum capacity. Facility expansion to accommodate the holding of the future broodstock will provide a reduced stress environment by reducing holding densities. This expansion also enables the facility to participate as the lead facility in spawning efforts, as the expansion would provide space for holding wild broodstock. This action increases options for holding/spawning lower basin pallid sturgeons (wild) captured in conjunction with accelerated broodstock collection efforts. Additionally, this expansion would enable the facility to use the existing infrastructure for production and stocking of pallid sturgeon, essentially doubling the capabilities of the hatcheries current production.

Additional facility improvements include building expansion and construction of a pallid sturgeon culture building at the Neosho NFH. Currently, the facility has the ability to rear approximately 3,000 pallid sturgeon (9-inch fish). These facility expansions would triple the production capabilities and enable the facility to spawn wild pallid sturgeon collected from the Lower River and the Middle Mississippi River.

A fatty liver condition has been identified in most all of the pallid sturgeon reared in the hatcheries that are on commercial feeds. Commercial feeds utilized for salmonids and other species are not adequate diets for sturgeon; however, limited suites of feeds are available for sturgeon culture. The Bozeman FTC has the expertise to develop and manufacture specialty feeds for a variety of species. This facility has conducted research regarding feed development and conducted feed trials evaluating performance, growth and overall health on multiple species

Table B-3. Prioritized List of Hatchery Facility Improvements to Alleviate or Mitigate the Limiting Factors Associated with Pallid Sturgeon Propagation

Facility	Description	Priority	Comments	Benefits/Rationale
GPNFH	Broodstock Building	1	All components included (i.e. filtration &UV)	Double production capabilities from 2,500-5,000 (minimum) and enable the facility to hold representative fish to serve as future captive broodstock Fish Health Experts Feel UV Treatment Systems are essential
NNFH	Building Expansion	2	Essential Components included (i.e. filtration &UV)	Increase capacity to 4,000 5,000 from current level of 3,000 fish yielding 9-inch fish
NNFH	New Building	3	Essential Components included (i.e. filtration &UV)	With above building expansion, would increase facility capacity from 4,000-5000 to 10,000 fish (9-inch fish) Fish health experts feel UV treatment systems are essential
BZFTC	Feed Development Equipment	4	Vacuum coater, oven, furnace, deionizer & still	Liver analysis of pallids propagated on commercial feeds has been shown to have a fatty liver condition. Improved diets are essential to ensure quality specimen to recover the species
BPSFH	Lake Dredging	5	Improve water storage capabilities	Enhanced water reliability for future pallid culture activities
BPSFH	Water Chiller	6	Provide ability to moderate temps during hot conditions. Ability to chill up to 200 GPM	Maintain water temperatures at suitable levels for pallid sturgeon culture
BPSFH	Renovation/Building	7	Remove raceways, Replace w/ circulars	Double Production Capabilities from 6,000 to 14,000 (9-inch fish)
BPSFH	Water Supply Line	8	Must be done in conjunction with lake dredging	Upgrading water supply line essential for increasing capabilities
GDNFH	Increase Power Capabilities	9	Can Corps provide power?	
GDNFH	Boiler 2.295 BTU; 675 KW	10	Ideal way to heat water if power is available	Boiler is not an option without an increase in power
GDNFH	Heat Pumps (6)	11	Not necessary if increase Power Capabilities	Boiler is better option, simpler, fish health. Heat pumps have seasonal feasibility
GDNFH	Reuse System	12	Not necessary if increase Power Capabilities	Boiler is better option, simpler, fish health
GPNFH	New Well/Water Tower	13	Increased well water for brood building	Enhancing well water capabilities would provide additional cool water for pallid sturgeon production and broodstock holding
MCSFH	Building Expansion	14	Move adult brood (spawning) holding tanks out of main building.	Production fish would remain in the main bldg. This expansion would isolate production fish from the spawning activities reducing the potential for disease transmission. Broodstock would not displace production space during spawning efforts in the spring
MCSFH	Water Supply Improvement	15	Fish Health Issue; altering the water supply would allow for increased natural settling of solids that would otherwise need to be filtered.	By decreasing the solids and clarity in the water, an increase in effectiveness of the UV system would reduce the likelihood of disease transmission and parasite infestations.
MCSFH	Modify Drain System	16	Increasing production in accordance with item 14 will require modification of the existing drain line	Water drain system will no longer be a limiting factor to increasing production
BZFTC	Distribution Truck w/ Tank	17	Fish transport truck and tank for stocking production fish	Well designed, reliable fish transport systems are essential to ensure that the final product of the propagation efforts are successfully stocked in the Missouri River

over the past decade. Special formulations and development of compatible and suitable feeds requires a variety of unique equipment. Pallid sturgeon propagation and augmentation have been identified as an essential component to the recovery of pallid sturgeon (at least initially); therefore, it is critical to produce and stock fish of the highest quality possible. Proper nutrition is a necessity to achieve this goal.

The Blind Pony SFH has a single water source (Blind Pony Lake) that is currently affected by the drought conditions. Four interrelated modifications have been identified for the Blind Pony facility.

- Lake Dredging
- Water Supply Line
- Water Chiller
- Building Renovation/Expansion

Because the facility relies on a single water source, the storage capacity of the water supply would be improved by dredging. The increased water storage would maintain a more constant temperature less susceptible to rapid temperature spikes and dips that are common with small impoundments.

Simultaneously with the dredging operation, the original water supply line leading from the lake to the endangered species portion of the facility needs to be replaced. The existing pipeline (transit pipe) is original and water reliability is questionable. Water supply upgrade will provide a reliable water delivery system to the modified and expanded facility for pallid sturgeon spawning and propagation.

During extreme heat conditions, the facility does not have the capability of moderating water temperatures that may impose lethal levels of stress on the fish. A water chiller would provide the relief during the extreme heat conditions by enabling the crew to blend cooler water with the ambient lake water.

Currently, concrete raceways are being used for sturgeon production. These structures are covered by a metal roof, but lack both security and protection from predation. An enclosed pole shed would provide security and protection from vandalism, predation and weather conditions. A portion of the raceways would be removed in conjunction with this renovation and upgraded to circular tanks. The upgraded water supply line would be installed to accommodate these renovations.

The combination of facility improvements at the Blind Pony SFH would increase production capabilities from 6,000 to 14,000 fish annually (9-inch fish).

Lake Sakakawea is the water source for the Garrison Dam NFH. Although the lake provides an abundance of water, the temperature range is below the requirements needed to obtain growth in an intensive culture environment for the pallid sturgeon. As a result, water must be heated to provide suitable temperatures necessary for spawning and rearing activities. Several potential options have been explored. The best option is to increase the power capabilities to the hatchery and install boilers to heat the water. Other options include installing heat pumps in conjunction with a water reuse system. This option is less ideal because of water quality issues associated with reuse systems and the increased potential for disease and parasite outbreaks. Additionally, heat pumps would be ineffective during the winter months at maintaining temperatures suitable to achieve growth in pallid sturgeon.

Increasing the power capabilities and installing boilers at the Garrison Dam NFH would provide the ability to mimic ambient river temperatures that correspond with photoperiod. Currently, the existing heat exchangers are run at the most efficient times to offset ambient river temperatures. As a result, the "normal" ambient water temperatures that these fish would experience in the river are delayed by approximately 4-6 weeks from spring to fall. The additional boiler system provides the culturist with the ability to mimic water temperatures of the Missouri River, which are naturally synchronized with photoperiod.

The Miles City SFH has undergone minor modifications in the past couple of years to accommodate pallid sturgeon propagation activities. An addition to the existing building would enable the facility to hold broodstock in the spring separate from production fish. Currently, the broodstock holding tanks displace production tanks (rearing space) during spawning activities. The building expansion would double production capabilities for the facility and reduce the risk of disease transmission because the wild broodstock would be held separately (isolated) from production fish.

The existing water supply system at the Miles City SFH contains a high sediment load. Renovation of the existing supply system would increase natural settling of particles that otherwise would require multiple filtering prior to passing through the ultraviolet disinfection system. Renovation of the existing water supply system improves water quality and reduces the potential for disease and parasite outbreaks.

The geographic range that these pallid sturgeon need to be distributed across (from Montana to Missouri) to meet the needs of the propagation and augmentation program requires that well designed fish transport units are available. Fish distribution is the final step of the propagation effort and reliable transport systems are essential to ensure that the progeny are transported safely to the stocking location. Dependable fish transport units will help ensure that fish are transported to stocking locations safely with minimal stress and loss associated with the stocking event.

The above-described components of the proposed action for hatchery facility improvements are based on several assumptions:

- Reducing densities and improving the environment in which these fish are propagated will increase survival and enhance overall fish health
- Efforts to spawn "wild" broodstock are based on the ability to continue to be successful in the collection of broodstock in the future
- Population augmentation plans will not be halted as a result of non-physical factors (i.e., fish health issues)
- The captive broodstock program will be successful in that these fish will mature and produce viable progeny for continuation of population/augmentation efforts in the event that broodstock cannot be collected from the river
- Genetic studies and their results will continue to support population/augmentation efforts

ACCELERATED BROODSTOCK COLLECTION

To date, broodstock collection efforts in the lower basin have relied upon acquiring adult fish from commercial fishermen on the Middle Mississippi River. No successful spawning of fish in the Lower River (downstream of Gavins Point Dam) has taken place since 2001, when the Blind Pony SFH last spawned pallid sturgeon captured by a commercial fishermen in the Middle Mississippi River. The Missouri Department of Conservation is considering closing commercial fishing for sturgeon (shovelnose). In response to this action, the commercial fishermen have announced that they will no longer provide support for the broodstock collection efforts on which that program has grown to rely.

In 2002 and 2003, pallid sturgeon progeny resulting from adults captured in the Missouri and Yellowstone Rivers in North Dakota and Montana, were stocked in the Lower River; however, genetics are limiting in the upper basin with aging fish and a dwindling population. It is now necessary to capture and propagate the remaining gene pool in the Lower River. Current broodstock collection efforts targeting Lower River pallid sturgeon to fulfill propagation and stocking goals for the Missouri River are inadequate.

Accelerated broodstock collection would facilitate direct, intensive collection efforts by state and federal agencies to capture the genetic stocks that inhabit the Lower River. Specific efforts directed toward broodstock collection are essential to capture and represent the genetic variability and diversity of pallid sturgeon in the Lower River. Successful collection, spawning, rearing, and stocking will partially offset the lack of natural reproduction and would help ensure these genetic stocks are perpetuated in the wild while solutions to habitat loss are addressed through the various means of habitat restoration (i.e., SWH projects).

Expansion of the hatchery facilities to accommodate the holding of these fish is essential to the success of this effort. The Gavins Point NFH and the Neosho NFH are currently used to capacity and would be unable to accommodate these additional fish for spawning. The Blind Pony SFH has limited space available; however, water reliability is questionable, especially during drought times. Improvements to each of these facilities would provide multiple options for holding and spawning these Lower River broodfish.

ACCELERATED SHALLOW WATER HABITAT CONSTRUCTION

The following proposed action to accelerate the construction of shallow water habitat to exceed the short-term goals outlined in the 2000 BiOp. This action will be taken in the Lower River from Ponca State Park to the mouth.

Ponca State Park

Design has been completed on a backwater complex at Ponca State Park, the extreme downstream end of Segment 10. The overall goal of the project is to restore aquatic habitat areas that have degraded as a result of hydrology and sediment transport changes in the adjacent reach of the Missouri River. Included in this restoration is 29 acres of low velocity backwaters, 15

acres of connected wetlands, and 41 acres of tallgrass prairie (Corps 2003). Construction is scheduled to begin during late FY 2004, pending completion of necessary real estate easements and available funding.

Ponca State Park to Rulo, Nebraska

A goal has been set to construct an additional 1,000 acres of habitat in the reach between Sioux City, Iowa and the Platte River and an additional 960 acres in the Kenslers Bend reach upstream from Sioux City by 2010. These two reaches are important because the current level of habitat is relatively scarce, averaging about 2 acres per mile in the reach downstream from Sioux City (Table 7.7-7 of the Revised Draft EIS for the Master Manual Study). The USFWS has indicated that habitat work in the reaches where the greatest deficits exist should proceed as quickly as possible. The Corps is in the final design stages of chute/backwater projects at Glovers Point Bend (RM 712), Hole-in-the-Rock (RM 706), Lower Hamburg Bend (RM 553), and Kansas Bend (RM 546). Construction of major dike modifications is underway in the Nebraska City area, and additional site plans are being prepared for implementation in FY 2004 and 2005. These sites include Tobacco Island, Langdon Bend, and Boyer Bend. The Corps is also working with the Omaha and Winnebago Tribes to develop projects on reservation lands, and will pursue structure modification on lands owned by the state of Iowa. The Corps' Omaha District and the Papio-Missouri River Natural Resources District are currently constructing a Section 1135 Project for SWH at Blair, Nebraska.

Rulo, Nebraska to the Mouth

The current notching program to enhance and diversify existing SWH areas will be continued and accelerated where possible, as long as private property interests are not impacted. This program consists of strategically placed 50' to 100' notches constructed in some of the existing 3,500 rock structures below Rulo. The notches are placed to increase flow between structures during normal to high river stages. The effect is to diversify and enhance the habitat currently present within existing high banks. This program will ensure no net loss of existing SWH. Currently, structure modifications are being constructed at Overton Bottoms, and a side channel is in the design phase for Worthwine Island. Initial planning efforts are underway to design and construct extensive structure modifications and/or side channels at Marion Bottoms, Eagles Bluff, Franklin Island, Jameson Island, and Baltimore Bend. The goal is to complete this work by the end of 2005.

RESEARCH, MONITORING, AND EVALUATION

Comprehensive Pallid Sturgeon Research Project

Research to determine the critical ecological factors that contribute to successful pallid and shovelnose sturgeon reproduction and survival in the Missouri River will include laboratory and field research. This research will provide new information on the physiology of reproduction and growth, survival across the life stages, status of populations, and taxonomy for sturgeon in the Missouri River, including quantitative assessment of how biology, hydrology, and water

quality combine to provide suitable habitat and resources over a considerable spatial and temporal scale.

While a variety of factors has been proposed as contributing to the viability of pallid and shovelnose sturgeon, the significance and interaction of flow-related factors (such as hydrologic cues, temperature, turbidity, depth, and velocity) with in-channel habitat features and other factors (such as nutrition, competition, predation, productivity, water quality and contamination) has not been clarified. The research tasks will provide definitive information on the effects of flow-related factors on sturgeon but will not be restricted to these factors. An objective assessment of how multiple life stages and essential activities of the two sturgeon species respond to a range of potential stressors will provide rigorous and credible information for use in resolving the many issues surrounding pallid sturgeon recovery actions. This research is intended to provide the best understanding of sturgeon responses as functions of management variables, thereby providing stakeholders with an improved understanding of tradeoffs among management alternatives.

Research tasks include:

- Understanding the reproductive physiology of Missouri River sturgeon – Objective is to further the understanding of the reproductive physiology of Missouri River sturgeon to assess if environmental conditions are adequate for gamete maturation and release.
- Spawning of Missouri River sturgeon – Evaluate sturgeon stocks in several representative reaches of the Missouri River to examine the chronology of spawning activity.
- Characterization of optimal conditions for normal development and hatch of Missouri River sturgeon embryos – Characterize the exposure response relationships for several important water quality parameters during embryo development through hatch, evaluate egg quality, and determine contaminant doses for commonly detected contaminants of concern in water and sturgeon tissues. Apply this information to an assessment of embryo survival at likely or know spawning sites.
- Determinants of post-hatch survival of larval Missouri River sturgeon – Examine the influence of water temperature and sediment levels on initiation of feeding, growth, and morphological development of post-hatch sturgeon. Identify food habits, food availability, and habitat used by post-hatch sturgeon. Examine river hydraulic processes as mechanisms of larval sturgeon transport.
- Environmental factors affecting Missouri River sturgeon from the larval feeding to juvenile life stage – Continuation of previous research as larval sturgeon shift from internal to external feeding. Tasks include the determination and examination of ecomorphology, environmental factors, diet, predation, habitat use, and drift.
- Determination of the critical ecological factors that contribute to successful survival of Missouri River sturgeon from juvenile to 1 year of age – Examination and determination of preferred habitat, food habits, growth rates, and over wintering of juvenile to 1-year-old sturgeon.
- Survival and growth of Missouri River sturgeon from year-one to reproduction – Determine habitat use as compared to availability, nutrition and feeding, and growth and maturation rates.
- Develop population-forecasting models that can be used to predict future population size and distribution of sturgeon in the Missouri River.

- Examination of morphological and molecular characteristics to determine the identification of pallid and shovelnose sturgeon and hybrids.
- Develop a database of sturgeon information, including Web-based format for access by the public.

Pallid Sturgeon Genetic Analysis

Pallid and shovelnose sturgeon are closely related and, therefore, resemble one another when evaluated based on phenotypic characteristics. Morphological measurements have facilitated the development of a variety of indices to distinguish between the two species. Current indices are valuable in differentiating between the two species; however, these techniques have limitations and are subjective due to the precise requirements in collecting morphological measurements. Shovelnose sturgeon is a common species native to the Mississippi, Missouri, and Ohio Rivers. Pallid sturgeon is a rare and endangered species with a distribution from the Missouri headwaters to the mouth of the Mississippi but not the upper Mississippi or Ohio Rivers. Adults of either species are distinguishable by subtle differences in the placement of barbels and by the larger size and more flattened head profile of pallid sturgeons. Distinguishing young fish is far more difficult. Young-of-year (YOY) shovelnose and pallid sturgeon are virtually indistinguishable at sizes less than 22-23 mm using various morphological indices. As a result, morphological based indices have been criticized on the basis that they do not work for smaller specimens.

Previous studies to distinguish between the Missouri River sturgeons have failed. Morphological measurements have been combined with the use of allozymes and mitochondrial DNA to differentiate between pallid, shovelnose, and hybrid sturgeon. The lack of success of these previous efforts may be due to recent common ancestry and/or a slow rate of genetic evolution of the markers employed. However, the use of microsatellite loci, which are the most rapidly evolving class of molecular markers yet discovered, indicate that pallid and shovelnose sturgeons from the same geographic areas had significantly different allele frequencies. A series of primer sequences for 70 polymorphic microsatellite loci have been published for *Scaphirhynchus*. The use of multiple loci may produce a high degree of certainty in identifying individual fish to species and may be useful in determining parentage of progeny.

With this proposed action measure, the Corps will develop a genetic analysis that would distinguish between the species. This technique would have several benefits. This type of analysis eliminates the limitations of differentiating sturgeons of smaller size. It is critical to obtain the ability to accurately identify smaller sturgeon to the species level to determine whether natural reproduction is occurring in pallid sturgeon. Additionally, the chemical analysis would be applicable to all life stages ranging from newly hatched sturgeon fry to adult. This analysis may be useful in locating spawning areas through larval sampling efforts downstream of spawning locations and could be used to refine the morphological indices to improve field identification. Presently, there are no tools available to differentiate between pallid and shovelnose sturgeon eggs. The genetic analysis would also be valuable in monitoring the exploitation of caviar through commercial avenues.

Depending upon the precision of the genetic analysis, parentage of stocked pallid sturgeon may be identified through this type of chemical analysis. Genetic samples of all adult pallid sturgeon

contributing to the propagation program are currently collected and archived. Chemical (genetic) analysis may serve as a tool, aiding in the identification of hatchery produced versus naturally produced pallid sturgeon; thus providing diversification in the population augmentation program and enabling larval and smaller juvenile fish to be stocked (unmarked fish). The ability to identify genetic stocks would help to facilitate the evaluation of additional stocking strategies and likely improve the species chances of recovery. Southern Illinois University has been conducting the latest research in this arena and currently has a proposal to conduct this type of detailed analysis.

Survival and Habitat Use of Stocked Pallid Sturgeon

The pallid sturgeon population assessment program has been designed to incorporate the evaluation of stocked pallid sturgeon regarding survival, growth, and habitat use in the Missouri River. Additional strategies proposed by the Corps in this proposed action measure may provide enhanced results in a reduced time frame.

Likewise, the propagation augmentation program has been based on a series of assumptions. For example, survival rates have been projected based on similar programs working with white sturgeon. Concern has arisen regarding over winter survival due to the lack of capture during population assessment surveys in 2003. Over 7,400 juvenile pallid sturgeon were stocked at three primary stocking locations (Mulberry Bend, NE; Bellevue, NE; Booneville, MO) in the Lower River in April 2002. A small portion of these juveniles was recaptured during the summer and fall sampling efforts in 2002. However, continued sampling efforts throughout the winter and into the summer of 2003 have proven to be less successful. As a result of this, a telemetry project using juvenile pallid sturgeon may help to address this issue. Additional stocking efforts are underway in 2003. Stocking numbers will be similar to those efforts accomplished in 2002.

In addition to monitoring efforts included within pallid sturgeon population assessment activities, the Corps proposes a telemetry project using juvenile pallid sturgeon in the unchannelized (Gavins Point Dam to Ponca, NE) and the channelized (near Booneville, MO) portions of the Missouri River to provide a better understanding of these fish following stocking. The telemetry project would incorporate Geographic Positioning System (GPS) coordinates for all relocations. Physical habitat data would be collected at each relocation (i.e., turbidity, temperature, depth, velocity, and substrate). Fish relocation sites would be classified into macrohabitats and mesohabitats consistent with the standardized habitat classification system that has been developed for the pallid sturgeon population assessment program. These telemetry efforts will provide specific information related to the movements of pallid sturgeon, habitat use and preference, overwinter survival, and better survival rate data. These data would provide important feedback for the propagation augmentation program when determining suitable stocking rates for fish inhabiting these vastly different portions of the Missouri River.

Scaphirhynchus sp. **Spawning Behavior and Habitat Selection Analysis**

Pallid and shovelnose sturgeon are believed to exhibit similar characteristics regarding spawning and habitat selection in the Lower River. This is not the case, however, for upper basin pallid

sturgeon and shovelnose sturgeon, where shovelnose sturgeon spawn in the tributaries to the Missouri and Yellowstone Rivers. In all river reaches, the pallid sturgeon is in very low relative abundance when compared to shovelnose sturgeon. Both species have been artificially spawned in captive environments in equal temperatures and photoperiods with the use of synthetic hormones. Hybrid sturgeons have also been produced in these controlled environments. An increase in hybridization has, however, been documented in the Lower River.

With this proposed action measure, the Corps will develop a study focusing on spawning, spawning behavior, and habitat preferences that would provide information regarding the causes for increased hybridization. If the cause of the increase in hybridization can be attributed to a limiting factor, actions can then be taken to address this limiting factor.

Interior Least Tern, Piping Plover, and Pallid Sturgeon Regional Population Assessment

In addition to the population assessment and monitoring efforts on the Missouri River proper being conducted in response to the 2000 BiOp, the Corps will develop and support a regional coordination process for the subpopulations of which Missouri River piping plovers and least terns are part. It has become apparent that, if successful management actions are to occur for these species on the Missouri River, the dynamics of their larger population structure must be understood. Greater understanding of regional population interactions such as immigration/emigration, source/sink populations, and seasonal presence/absence would provide greater sensitivity in assessing the long-term prospects for species persistence and allow more informed management decisions.

The Missouri River piping plover population is an important component of the Northern Great Plains piping plover population. The Northern Great Plains population extends across the northern Great Plains of the United States into Prairie Canada. Piping plovers are found in the alkali wetlands of North Dakota and Saskatchewan, wetland areas of Alberta and Montana, along the Missouri River from eastern Montana to northeastern Nebraska, and along Nebraska rivers. Remnant populations are found in Manitoba, Colorado, Kansas, Minnesota, and Iowa. These populations do not exist in isolation from one another and annual coordination of population assessment information from the Northern Great Plains piping plovers should to be done to facilitate recovery of the birds on the Missouri River. This proposed action measure includes establishment of a central data collection center for piping plover productivity surveys and adult censuses that are annually conducted during the nesting season. Partners in data collection would include the Canadian Wildlife Service, USFWS, Corps, The Nature Conservancy, various states, provincial and Tribal natural resource agencies, and private entities. The Corps would establish the database for its own use. In coordination with the other interests, the database may serve as a repository for all data being collected by the other agencies. In conjunction with this effort, the partners would continue to support the International Piping Plover Adult Census, next scheduled to be conducted in 2006.

The interior least tern nests on the major interior rivers of the United States. This includes the Missouri, Mississippi, Rio Grande, Canadian and Arkansas Rivers and their tributaries. Missouri River tributaries with nesting least terns include the Kansas, Platte, Elkhorn, Loup, Niobrara, Cheyenne and Yellowstone Rivers. To determine actual population and recovery trends on the

Missouri River, the least terns need to be assessed on other rivers. This proposed action measure includes establishment of a central data collection center for least tern productivity surveys and adult censuses that are annually conducted during the nesting season. Partners in data collection would include the USFWS, Corps, various states and Tribal natural resource agencies, and private entities. The Corps would set up the database for its own use. In coordination with the other interests, the database may serve as the repository for all data being collected by the other agencies. In conjunction with this effort the Corps will set up a task force to coordinate recovery efforts between Corps Districts. This team may be of assistance to the USFWS as it coordinates a new recovery plan using all data and information accumulated since the 1990 plan.

Additionally, of critical importance to the recovery of least terns and piping plovers are adequate and sustainable areas of wintering habitat. The Corps proposes with this proposed action measure to seek partnerships with various foreign and state natural resources agencies and private organizations to learn of opportunities for perpetuating sustainable wintering habitat.

Pallid Sturgeon Regional Population Assessment

The pallid sturgeon in the Missouri River is part of a larger population that may extend to the middle and lower Mississippi River. If successful management actions are to be successful on the Missouri River, the dynamics of the larger population structure must be understood. Population parameters such as recruitment, survival and mortality must be understood and the role each rivers system and segment plays in the overall success of the species must be determined. The corps is currently involved in determining these parameters for Mississippi River pallid sturgeon populations and will coordinate population assessment studies done on the Missouri River to insure a broader regional assessment can be conducted.

APPENDIX C

CORPS ACTIONS TO BENEFIT THE SPECIES

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APPENDIX C

CORPS ACTIONS TO BENEFIT THE SPECIES

The main elements of the 2000 BiOp Reasonable and Prudent Alternative (RPA) are adaptive management; flow enhancement including unbalanced intrasystem regulation; habitation restoration/creation/acquisition; and species-specific measures for the terns/plovers, pallid sturgeon and bald eagle. Specific details of the actions implemented in 2001 and 2002 can be found in the 2001 Annual Report dated August 30, 2002 and the 2002 Annual Report dated October 31, 2003 for the 2000 BiOp. The following discuss specific actions to benefit listed species that the Corps intends to continue to implement subject to congressional appropriations. These are discussed to provide context to the proposed action in this BA.

FORT PECK SPRING RISE TESTS

The 2000 BiOp included release changes from Fort Peck Dam as a component of the RPA. Prior to full implementation of this release change, the RPA included two tests, the "mini test" and the "full test". These two tests are included as features in response to the 2000 BiOp. Depending on the results of the tests, the Corps may implement a Fort Peck Dam release change, however, inclusion of this as an element in a revised Water Control Plan is not part of the Proposed Action.

Preliminary biological data collection is an essential component in determining the responses and effects of the mini and full tests on pallid sturgeon and the species that have been selected for this project. The multiple components of this data collection will provide science critical to recovering fish populations throughout the Missouri River basin. The two tests are planned to determine the potential effects of warmer water releases at a rate higher than normal on the integrity of the Fort Peck Dam spillway, downstream river reach (bank and bed erosion, cultural resource exposure, etc.), and (based on the main purpose of a warmer water spring rise) on native river fish. Low Fort Peck Lake levels resulting from the current drought have delayed the mini test. The full test will be conducted in the spring following the mini test if adverse impacts resulting from the mini test are acceptable and if the level of Fort Peck Lake is adequate.

Mini Test

The initiation of the mini test will be a specified date set between May 15 and June 1, depending on weather and other logistical concerns. This date will be set a minimum of 1 month prior to the test, and public notice will be made. The discharge rates and timing of flows are described in Table C-1.

Table C-1. Mini Test Scenarios.

Mini Test Scenarios			
Duration (days)	Spillway Release (1000 c.f.s.)	Power House (1000 c.f.s.)	Combine Release Total (1000 c.f.s.)
Adjustment: Initial powerhouse release at 8K, reduce to 4K while increasing spillway release from 0 to 4K.			
4	4	4	8
Adjustment: Increase powerhouse release from 4 to 8K while reducing spillway release from 4 to 0K.			
1[1]	0[1]	8	8
Adjustment: Increase powerhouse release from 8 to 11K. Reduce powerhouse release from 11 to 7K while increasing spillway release from 0 to 4K.			
4	4	7	11
Adjustment: Increase powerhouse release from 7 to 14K while reducing spillway release from 4 to 0K.			
4	0	14[2]	14[2]
Adjustment: Reduce powerhouse release from 14 to 11K while increasing spillway release from 0 to 4K.			
4	4	11	15
Adjustment: Reduce powerhouse release from 11 to 7K while increasing spillway release from 4 to 8K (maintain a maximum total of 15K). Further reduce powerhouse release from 7 to 4K.			
4	8	4	12
Adjustment: Increase powerhouse release from 4 to 7K.			
4	8	7	15
Adjustment: Reduce powerhouse release from 7 to 4K while increasing spillway release from 8 to 11K (maintain a maximum total of 15K).			
4[3]	11	4	15
1[4]	11 (no fish barrier)	4	15
Adjustment: Day 1 – Reduce spillway release from 11 to 5K while increasing powerhouse release from 4 to 7K. Day 2 – Reduce spillway release from 5 to 0K while increasing powerhouse release from 7 to 9K. Day 3 – Further reduce powerhouse release from 9K to desired release (7 or 8K).			
NA	0[1]	Normal	Normal

1. Monitoring Period. Spillway release will be stopped during a 4-12 hour period to perform scour hole and exit channel surveys. The monitoring is scheduled to start at approximately 0830 after the listed spillway releases are stopped. After completion of monitoring, the spillway and powerhouse releases will be adjusted to the next release combination.
2. Approximate powerhouse release will vary depending upon pool elevation.
3. Release combination duration may vary from 4-9 days depending upon monitoring results.
4. Release combination duration as required may vary to provide data without the fish barrier.

For the purpose of blending releases and altering Missouri River water temperature, the mini test scenarios require a series of combinations between the power plant release rate and the spillway release rate. Local interests have indicated that a varying river level affects the functioning of the irrigation intakes; therefore, each change in releases will be phased such that the total release

remains roughly the same. As the spillway release is altered (raised or lowered), a corresponding change in the powerhouse release is required to maintain a constant combined flow total.

The spillway exit channel enters the Missouri River at an angle, which may direct releases toward the opposite or left bank. To minimize spillway release impacts on the left bank, powerhouse releases will be used to provide a backwater effect on the spillway exit channel. When the release scenario causes an increase in the combined total release, the increase will first be accomplished with the powerhouse to the extent practical. After the river is stabilized, powerhouse releases will be reduced while spillway releases are increased.

Constant releases from both the spillway and powerhouse are required for the duration of each release combination. Severe winds or extreme inflows may affect the lake elevation enough that the spillway releases vary during the test. Spillway release measuring equipment will be monitored during the mini test. If the monitoring equipment indicates a spillway release change greater than 500 cubic feet per second (cfs), adjustments to the spillway gate setting will be performed. No adjustment to powerhouse release is expected during the constant release period. Powerhouse peaking or variation from a constant release will not be allowed during the mini test. If unforeseen powerhouse release variation occurs, the test period will be lengthened accordingly.

Due to uncertainty in runoff and operation releases, the Fort Peck Lake evaluation during the test period is unknown. The Corps will proceed with the assumption that spillway releases will occur if possible. To provide adequate head for warm releases from the spillway (2225 mean sea level (msl), the minimum elevation of Fort Peck Lake should be 2230 msl.

The Milk River flows will be addressed in the specific mini test "stop" protocol. If a test segment is interrupted due to the "stop" protocol, that segment will be restarted from the beginning after the issue is addressed. If the test is delayed for 20 days or until August 1, the remainder of the test would be cancelled and the mini test may be rescheduled if necessary.

If the mini test "stop" protocol results in a stop or adjustment during a 4-day constant release data collection period, the mini test will be restarted at the 4-day constant release stage when it was stopped after the "stop" protocol item has been cleared. This will add a corresponding period of time to the mini test corresponding to the "stop" protocol delay time. An underlying assumption is that the water will be available for a restart. If the water is not available, the test will continue until the available water is exhausted, at which time, the success of the mini test will be evaluated and a decision will be made to either redo the mini test or move to the full test.

Appropriate National Environmental Policy Act (NEPA) documentation is required before this test can be conducted. Appropriate "stop" protocols have been identified.

Full Test

The full test will continue to address concerns about long-term spillway operations with engineering tests and will collect data for verification of a water temperature relationship model. In addition, biological data and physical data regarding the full test will be collected to evaluate

and analyze the biological response. The full test will be as described or as modified, based on the results of the mini test.

The full test will occur the first year following the mini test that lake elevation and runoff criteria can be met, regardless of the intrasystem unbalancing cycle.

After pre-test releases are adjusted between the powerhouse and the spillway, the spillway flows will be increased by approximately one-sixth of the flow needed to reach the target flow each day for 2 consecutive days and then the flow is held constant for 4 consecutive days. The increase in flow each day of the test is expected to be in the 3.2 thousand cubic feet per second (kcfs) range or less. The raise cycle is a 2-day increase with a 4-day constant peak flow. The constant flows are necessary during the test to allow appropriate data collection. The flows will be lowered at the same rate as the rise until the pre-determined post-test release is reached. The test is expected to last for a total duration of 32 days.

The Milk River flow will be determined prior to each adjustment in flow and appropriate adjustments in spillway discharges will be made.

Also, a full test "stop" protocol will be developed that addresses stopping or adjusting the releases if there are high tributary flows, endangered cultural resources, structural damages, etc. The peak full test release may be adjusted from 23 kcfs to 20 kcfs if high tributary flow causes a delay to the test.

If the full test "stop" protocol results in a stop or adjustment during a 4-day constant release data collection period, the full test will be restarted at the 4-day constant flow stage when it was stopped after the "stop" protocol item has been cleared. This will add a period of release time to the full test corresponding to the "stop" protocol delay time. An underlying assumption is that the water will be available for a restart. If the water is not available, the test will not continue. The success of the full test would then be evaluated and a decision will be made whether or not to redo the full test.

If the test is delayed for 20 days or until August 1, the remainder of the test would be cancelled and the full test may be rescheduled if necessary.

The initiation of the full test will be a specified date set within a 2-week summer window. The window for the conducting the test will be established based on the temperature information from the mini test and data collected during monitoring. The start date for the full test will be set a minimum of one month prior to the test, and public notice will be made.

Monitoring and Evaluation of the Missouri River Reach Below Fort Peck

A biological data collection plan has been developed by the USGS and Montana Fish, Wildlife and Parks (MTFWP) and reviewed by the Upper Basin Pallid Sturgeon Workgroup. The Fort Peck Flow Modification Biological Data Collection Plan is a monitoring plan designed to

evaluate the influence of proposed release changes from Fort Peck Dam on physical and biological response of pallid sturgeon and other native fishes. Components of the monitoring program include:

- Measuring water temperature and turbidity at several locations downstream from Fort Peck Dam
- Examining movements by pallid sturgeon that inhabit areas immediately downstream from Fort Peck Dam[1], and supporting the examination of pallid sturgeon movements within the confluence between the Yellowstone River and Missouri River.
- Examining flow- and temperature-related movements of paddlefish *Polyodon spathula*, blue suckers *Cycleptus elongatus*, and shovelnose sturgeon *Scaphirhynchus platorynchus*,
- Quantifying larval fish distribution and abundance

This plan is being implemented and it currently is in its third year of data collection. Data collection efforts will continue through the mini and full tests. Data collected prior to these tests will serve as preliminary data that will facilitate viable comparisons following the tests. Evaluation of pallid sturgeon movement would also include data from a USFWS study evaluating movements of adult pallid sturgeon in the Missouri and Yellowstone Rivers and other relevant studies.

The initial monitoring plan will address approximately 7 years. It is anticipated that this will include 4 "no test" years, a mini test year, a full test year, and a subsequent "no action" year, provided there is sufficient water in the Fort Peck Lake. At the end of the 7-year period, the data will be given a comprehensive evaluation, and the plan will be reevaluated. If the tests cannot occur due to lack of available water, corresponding years may be added to the 7-year initial plan evaluation period. The Corps is currently in the third "no test" year due to low lake levels.

Research Associated with the Fort Peck Spring Rise Tests

Through ongoing scoping for the tests, the Corps has become aware of some data gaps that may affect the ultimate goal of getting sturgeon to spawn below Fort Peck Dam. These gaps have been converted into hypotheses and research proposals, which are in various stages of completion. The data gaps include:

- Food habits of piscivorous fishes in the Missouri River
- Drift behavior of larval sturgeon
- Sturgeon larvae survival in the headwaters of Lake Sakakawea
- Imprinting tendencies of pallid sturgeon

The food habits analysis began at the same time as the first year of monitoring and evaluation. An additional component was initiated in 2003 to evaluate the behavior and drift characteristics of sturgeon. The first field component drift test was initiated in June 2003 using shovelnose sturgeon rather than pallid sturgeon to ensure that the evaluation of the pallid sturgeon propagation and augmentation program was not compromised. Additional efforts utilizing pallid

[1] This component has not been implemented due to the inability to capture adult pallid sturgeon below Fort Peck Dam.

sturgeon are being conducted in laboratory experiments by the USGS. Interrelated with this project, river travel time models are being developed, based on discharge and water velocities. Based on these findings, model transport of larval pallid sturgeon will be developed. Additionally, the Corps will conduct an evaluation of survival of larval sturgeon in headwater areas in 2004. Recently, questions were raised by sturgeon fisheries scientists with regard to the potential imprinting tendencies of pallid sturgeon. The Corps is in the process of developing a scope of work for this effort. Adaptive management provides for modification of actions if data from these studies so indicate.

HABITAT RESTORATION/CREATION/ACQUISITION

The fourth major element of the 2000 BiOp RPA is habitat restoration, creation, or acquisition. Considerable progress has been made toward reaching the 2000 goals in the areas of emergent sandbar habitat, shallow water habitat, flood plain reconnection, and riverine and reservoir habitat monitoring and evaluation. Program management plans and budgets have been developed that will allow the Corps to meet the 2005 and 2010 goals.

Shallow Water Habitat

Shallow water habitat (SWH) may be achieved through flow management, river widening, (notching/dike modifications), restoration of side channels, or combinations thereof. As mentioned above, the Corps has taken many steps toward achieving the SWH goals prescribed in the 2000 BiOp. The most immediate goal is the development of 2,000 new SWH acres between 2000 and 2005. The second milestone is the creation of 5,870 acres of SWH by 2010.

During the period Fiscal Year (FY) 2001 through FY 2003, the Corps made modifications to the Bank Stabilization and Navigation Project (BSNP) that resulted in the creation of 1,365 acres of SWH. Plans are in-place and the necessary real estate interests have been obtained for continuation of the SWH program to achieve the 2005 goal. Actions initiated to date to meet the goal of 2,000 additional acres of SWH habitat by 2005, funded under the O&M program and the Missouri River Fish and Wildlife Mitigation Project include: excavation of over 400 notches; construction of reverse dikes/notches at Marion and Plowboy Bends; side channel construction at Overton Bottoms, Tobacco Island and California Bend (NE); buried dike excavation and notching at Overton; chevron construction and dike lowering near Nebraska City; and modification of dike maintenance at selected locations from Sioux City to the mouth to encourage aquatic habitat development. Construction activities planned for FY 2004 and FY 2005 include continuation of the river control structure modification and notching programs, where possible, and construction of chutes at Glovers Point (RM 712), Hole-in-the-Rock (RM 706), Lower Decatur Bend (RM 686), Lower Hamburg Bend (RM 552), and Kansas and Nishnabotna Bends (RM 543) (see Figure C-1 for general locations on the river). In addition to the construction activities, several design and monitoring efforts are underway to ensure that construction of SWH can continue to meet the prescribed goals for 2010.

Figure C-1. Location of chutes where shallow water habitat will be constructed in FY 2004 and FY 2005 to meet the 2005 goals of the 2000 BiOp.

These actions will require collection of physical and biological baseline data, NEPA documentation, and design and construction work. To meet these goals, river conditions must be conducive to construction work. Extremely high river stages would prevent construction from proceeding on schedule, and extended periods of low flow would slow a number of construction efforts. Low flows have the greatest likelihood of impacting the short-term goals. Long-term goals should not be impacted.

Measurement of SWH acres will be based on the depth distribution for a 50 percent exceedence flow in the month of August. To determine the success of future or past SWH development projects, the Corps will conduct physical monitoring of selected sites to determine the amount of habitat created and available. Monitoring will consist of collecting bathymetry, velocity, and bed material data. A smaller set of sites will be modeled in detail in an attempt to determine long-term viability. The results of the monitoring effort will be integrated with basin-wide biological monitoring efforts to determine the biological effects of the created SWH.

In future years as habitat development progresses and the biological needs of the pallid sturgeon are better understood, the SWH program can be easily adapted to meet the critical needs of the species.

Floodplain Reconnection

The 2000 RPA recommended improvements to terrestrial floodplain habitat be made to avoid the likelihood of jeopardizing the pallid sturgeon, least tern, and piping plover and to provide incidental benefits to native candidate species and other non-listed species in the Missouri River. Implementation of these "ecosystem" elements is recommended to offset jeopardy to the listed species and the ecosystem upon which the continued existence of these species depend, and may possibly help preclude the listing of other species. Through the existing Mitigation Project, the Corps has obtained real estate interests in over 36,000 acres of land from Sioux City to the mouth. Floodplain reconnection has taken place on many of these areas through breaching or moving existing levees. Additionally, the Corps has restored numerous acres of agricultural lands to riparian forest, wetlands, and prairies.

The Corps is committed to reconnecting the river to its floodplain wherever possible; however, several conditions must be met to ensure the goals can be attained. These include:

- Acquisition of necessary real estate interests (willing seller requirement and easements);
- Receipt of appropriate funds;
- Land acquired must allow floodplain reconnection without induced damages to neighboring lands; and
- Existing project purposes such as navigation and flood control are not adversely impacted.

Floodplain reconnection is already underway below Sioux City. Approximately 8,000 acres have been reconnected since the 2000 BiOp was published. An example of this effort is on the Overton North mitigation site where an existing agricultural levee was breached and 3,500 acres have been opened up to the river. This area has received floodwaters the past three springs for periods of 2 to 8 weeks. Combined with the native vegetative plantings and natural regrowth of the area, this floodplain reconnection has greatly improved the floodplain habitat for a large variety of listed and non-listed species.

The existing Mitigation Project authorization allows the Corps to acquire and develop habitat on 166,750 acres. The Corps proposes to continue this project to enhance habitat opportunities for native fish during spring time flood flows through moving back or breaching existing levees, wherever possible. The Corps will also continue native vegetative plantings to increase the amount of riparian forest habitat for the Bald Eagle.

Emergent Sandbar Habitat

The 2000 BiOp RPA specifies varying amounts of emergent sandbar habitat (ESH) for the four reaches of the Missouri River currently used by least terns and piping plovers for nesting. By 2005, the recommended minimum habitat during the nesting season (to be measured in late July)

is to be 40 acres per mile downstream from Gavins Point Dam, 40 acres per mile in Lewis and Clark Lake, 10 acres per mile downstream from Fort Randall Dam, and 25 acres per mile downstream from Garrison Dam. According to the 2000 BiOp, this habitat should be comprised of a minimum of 60 percent dry sand.

Plans will be developed by January 1, 2004 articulating how habitat goals, as recommended in the 2000 BiOp, will be achieved. Implementation of the plans will start in the spring 2004. Work can begin prior to spring 2004 if all National Environmental Policy (NEPA) compliance is complete. Plans will emphasize opportunities to supplement and maintain flow-created habitat recognizing that most habitat will be created during flood and high water events. Plans will include expected frequency (from historical data) of potential habitat creating high water events.

Based on these habitat goals, there would be a total of 6,255 acres of ESH by 2005. The Corps is currently assessing the existing ESH to determine how much additional acreage will need to be created. Until those data are available, the Corps' best estimate is that half of the 6,225 acres of ESH already exists. Of the remaining 3,127 acres to be created, half would be created by vegetation removal procedures on existing sandbars and islands and the other half would need to be physically created.

All available habitat creation, enhancement, maintenance, and reconstruction methods will be used to provide suitable ESH in the critical reaches, and new methods will be investigated. These methods include, but are not limited to, the following:

- Increasing the height of existing submerged sandbars using dredges to pump and place material to create exposed sandbar conditions.
- Mechanical manipulation of existing sandbars by pushing submerged sand to exposed elevations utilizing bulldozers, and/or excavators.
- Contouring existing sandbars to either minimize high dunes or to add minor topographical height variations using bulldozers, front-end loaders, scrapers, and/or excavators.
- Contouring existing sandbars to provide depositional areas for organic material, wetted areas, and/or shallow ephemeral pools to increase forage production and forage availability.
- Investigate supplemental nutrification of sites with poor or insufficient forage production.
- Set up and removal of sand fences on existing habitat areas to add important microhabitat features and/or create dunes to add topographical variations.
- Short-term armoring of productive nesting areas with temporary materials such as logs or bales.
- Vegetation removal by spraying with aquatically approved pre- or post-emergent herbicide application (e.g., glyphosate or imazapyr), by using scrapers, mowers, discs, chippers, or similar type machines, or by burning.
- Creating dynamic sandbar complexes by cutting shallow water channels through existing large sandbars.
- Reducing localized predator impacts by removal of land bridges and perches.

- Enhancing terrestrialized linear habitats with livestock enclosures and enclosures and peninsula cutoffs and providing site security through slope reductions and/or substrate modifications.

O&M of the BSNP

Since 1974, the Corps has restored some side-channel connections and increased habitat diversity in the channelized Missouri River by notching dikes or otherwise modifying channel structures (Burke and Robinson 1979). As of 1981, the Kansas City District had excavated openings in 200 structures, left unrepaired openings in 400 structures and constructed 150 new structures with notches and 80 rootless structures (no connection to the bank). The Omaha District has notched 320 structures and left unrepaired sections in 30 structures (USFWS 1980). Both Districts continue to modify structures as the opportunities arise, provided impacts are not expected to occur to navigation and private property.

Notching is designed to prevent shoaling around a wing dike from accreting to the adjacent bank. It is one way to maintain aquatic habitat and improve fisheries habitat value associated with those structures. Notching dikes or revetments adjacent to publicly owned lands (e.g., Jameson Island, MO) can increase channel width and diversity, and create substantial shallow-water/sandbar complexes at certain river stages. After the 1993 flood, revetment repairs that allowed continued riverine connection to off-channel scours and chutes have also helped maintain habitat diversity and value, particularly for riverine fishes. Because of limited monitoring, however, the Corps currently cannot quantify the extent of habitat benefits from those efforts.

Since 2001 the Corps has coordinated the Missouri River BSNP maintenance schedule with the USFWS Columbia Field Office. The purpose of this coordination is to: (1) assure no net loss of SWH, and (2) look for opportunities to increase environmental value of the river through alternative maintenance practices. This coordination will continue.

Riverine and Reservoir Habitat Monitoring and Evaluation

A comprehensive habitat monitoring and evaluation program is crucial to insure that habitat goals in the 2000 BiOp are met, and that the habitat requirements of the species are being fulfilled. The Corps will expand its ongoing habitat assessment program to provide annual monitoring of riverine (emergent sandbars) and reservoir (island, shoreline) habitats. This program integrates remote sensing information with a statistically based sampling design to provide estimates of habitat quantity and quality. Program measurements include known habitat characteristics of importance, such as vegetation structure and dynamics, physical and topographic characteristics, substrates, forage resources, and juxtaposition of habitat types. Currently unknown factors may be integrated, as their significance becomes known.

The Corps' riverine and reservoir habitat monitoring program is designed to:

- Provide annual estimates of habitat quantity and quality for emergent sandbar and reservoir habitats, and provide estimates of the effects of future operational scenarios on habitat attributes
- Measure the effect of operational and management activities on emergent sandbar and reservoir habitat attributes
- In conjunction with least tern and piping plover productivity monitoring, address the effects of emergent sandbar and reservoir habitat conditions on population, productivity, and survival rates
- Address the monitoring and evaluation needs of ESH creation, enhancement, maintenance, and reconstruction projects, and provide pre- and post-test data for flow tests to determine the effectiveness and efficiency of various habitat creation methodologies
- Identify areas for habitat improvement projects and provide structured methodologies for prioritizing tasks.

The long-term objective of the Corps is to attain the quantity of habitat at the level of the goals specified in the 2000 RPA and to maintain it at those levels.

SPECIES-SPECIFIC MEASURES

The last element of the RPA specified measures specific to pallid sturgeon, least tern, and piping plover, and bald eagle. In addition to the RPA, the Incidental Take Statement identified reasonable and prudent measures with its terms and conditions to minimize take for pallid sturgeon, least tern, piping plover and bald eagle. The following sections address specific actions being taken for each of these species. Detailed information on all of the reasonable and prudent measures can be found in the 2001 and 2002 Annual Reports for the 2000 BiOp.

Pallid Sturgeon Propagation Support

The 2000 BiOp RPA states, "To partially offset jeopardy to the pallid sturgeon as a result of system operations, the Corps shall assist in pallid sturgeon propagation and augmentation efforts and subsequent monitoring of the stocked pallid sturgeon juveniles in those recovery priority areas in the Missouri River Basin that are identified in the Pallid Sturgeon Recovery Plan. That program shall start in 2001 and continue through 2011, with an evaluation of the propagation and augmentation efforts in 2003." In 2003, the Corps is enhancing pallid sturgeon propagation activities at six rearing facilities to assist in achieving annual stocking goals. These include the Bozeman Fish Technology Center (FTC), Garrison Dam National Fish Hatchery (NFH), Gavins Point NFH, and Neosho NFH, all operated by the USFWS; the Miles City State Fish Hatchery (Montana SFH); and the Blind Pony State Fish Hatchery (Missouri SFH). The locations of these hatcheries are shown in Figure C-2. Funding will continue to be provided by the Corps for these types of activities.

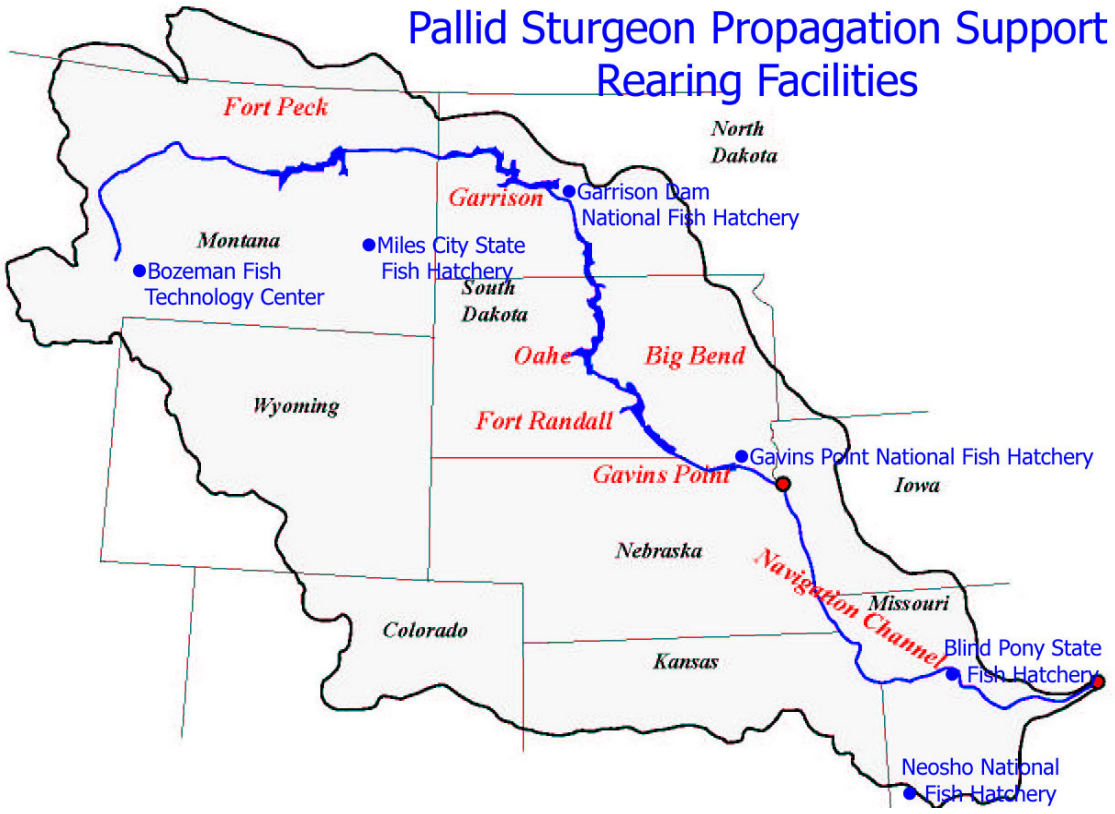

Figure C-2. Fish hatcheries providing pallid sturgeon propagation support.

Propagation efforts are coordinated through the Upper and Middle Basin Workgroups as well as a Propagation Workgroup to achieve annual stocking goals. The "Propagation Workgroup" was cooperatively established by the Corps and the USFWS in 2002 and comprises members representative of the Corps, USFWS, and the States of Montana and Missouri possessing the unique knowledge and experience critical to successful propagation of pallid sturgeon. The Propagation Workgroup prioritizes propagation needs each year to facilitate achievement of the "Average Annual Shortfall" (Corps' responsibility) as identified in RPA Element VIA of the 2000 BiOp. A prioritization list is generated and is used to determine where the Corps directs assistance for the population/augmentation program each year. The program has been structured to exceed propagation efforts related to the average annual shortfall.

Annually, the workgroup members submit their supplemental needs to fulfill stocking requests for each of the Recovery Priority Management Areas (RPMAs). The Corps provides supplemental support to each facility producing pallid sturgeon. The level of support provided to each facility is determined by a priority ranking system that is administered by the Propagation Workgroup.

Additionally, the Corps has provided Passive Integrated Transponder (PIT) Tags and accessories for use in hatchery produced pallid sturgeon. The Corps provides training in PIT tagging of juvenile pallid sturgeon as well as providing assistance with tagging operations, fish distribution, and stocking activities. The Corps has also provided cryopreservation equipment for pallid sturgeon milt storage to ensure that genetic material is available if wild fish and/or captive

broodstock are unavailable. Currently, milt from all males collected for spawning purposes is preserved to ensure that the genetic material of each specimen is not lost.

The program has enabled the facilities to upgrade water systems, fish transport units, holding and rearing capabilities, and a variety of miscellaneous items. Water intake systems have been modified to improve water quality through filtration and ultraviolet disinfection, reducing the risk of disease and parasite outbreaks. Transport trailer and tank replacement have provided improved capabilities of the broodstock transport from the river back to the hatcheries for spawning. The upgraded system reduces handling and stress on the adult fish, reducing the risk of mortality associated with the propagation program. The Corps is committed to continuing the cooperative efforts and support for the pallid sturgeon propagation and augmentation program.

In 2002 and 2003, support for the population augmentation program has facilitated enhancement of propagation and stocking to a level exceeding all previous efforts. In 2002, 13,550 pallid sturgeon juveniles were stocked into four primary areas of the Missouri River. These areas include RPMAs 1-4, as identified in the Pallid Sturgeon Recovery Plan, and are (numbers of fish stocked in 2002): 1) the Missouri River above Fort Peck Lake (2,058); 2) the Missouri and Yellowstone Rivers downstream of Fort Peck Dam (3,061); 3) the Missouri River downstream of Fort Randall Dam and (1,025); and 4) the Missouri River From Gavins Point Dam to the mouth (7,406). Table 23 of the 2000 BiOp identifies an annual total maximum target of 4,700 fish. Included in this total are the annual needs to develop the future captive broodstock (9 families of up to 50 individuals per family). The Corps' share of the total production target is 2,973 fish, the "Annual Average Shortfall."

Additional stocking efforts have been accomplished in 2003 utilizing age-1 hatchery reared juveniles (2002 year class). The following stocking activities occurred through a series of stocking efforts from April through October 2003. 4,124 juvenile pallid sturgeon were stocked in the Missouri River's Fort Peck Reach including the lower 70 miles of the Yellowstone River during the summer of 2003. Additional progeny from the 2002-year class were stocked in the Fort Randall reach and the reach extending from Gavins Point Dam to the mouth in July 2003. In the Fort Randall reach, 300 juvenile pallid sturgeon were stocked in the Missouri River at Sunshine Bottoms and another 300 were stocked at Standing Bear Bridge (Fort Randall reach). In the Lower River (Gavins Point Dam to the mouth), 7,848 pallid sturgeon were stocked at the 3 primary stocking locations (Mulberry Bend (NE) Bellevue (NE) and the Franklin Island State Park near Booneville, Missouri). The total stocking effort of the 2002-year class was 12,573. Recent propagation efforts have met stocking requests in each of the RPMAs and have fulfilled the requirements of the "Average Annual Shortfall." The propagation program will enable augmentation efforts to exceed the requirements identified in the 2000 BiOp.

Population Assessments

The 2000 RPA states, "The Corps has the primary responsibility for, and shall monitor the biologic resources and responses of threatened and endangered species to changes in Missouri and Kansas River operations, maintenance, or habitat restoration projects. Monitoring is needed to assess the biologic value of Corps management decisions." The Corps recognizes that a complete monitoring and evaluation program should be a central and operational component of

all management activities. As a focal point of this action, the Corps will incorporate a monitoring and evaluation program that provides data to further the understanding of, and resolve, the wide range of uncertainties, including assessing population status, establishing causal relationships between habitat (or other) attributes and population response, and assessing the effectiveness of operational or management actions.

The Corps proposes an assessment program through monitoring and evaluation that will address four major groupings of questions:

- What is the status of least tern, piping plover, and pallid sturgeon populations; does that status change through time?
- What are the environmental conditions in reaches showing different least tern, piping plover, and pallid sturgeon abundance or productivity; are there systemic patterns suggesting that specific natural or operational factors affect least tern, piping plover, and/or pallid sturgeon population dynamics?
- Is there a cause and effect relationship between operational or management actions and least tern, piping plover, and/or pallid sturgeon population responses in the basin or across a regional extent?
- Have operational or management actions been implemented; have they been implemented appropriately and in their entirety?

Conducting monitoring and evaluation effectively will require that both data collection and the implementation of any Corps operational or management actions continue to be highly coordinated. Actions will be conducted in the context of an experimental framework that will offer the greatest opportunities for detecting responses in the shortest amount of time. Data collection will be conducted in a standardized manner, and data will be reported and managed in reach, basin, and regional databases. Maintaining a scientifically rigorous, coordinated monitoring program will be imperative to supporting adaptive management decisions based on "good science".

Existing Population Assessment

The USFWS (Great Plains Fish and Wildlife Management Assistance Office and the Columbia Fishery Resources Office) and the Nebraska Game and Parks Commission (NGPC) are currently conducting population assessment activities on the Missouri River (Fort Randall Reach, Platte River to the Kansas River, and Glasgow to the mouth). Sampling efforts consist of year-round surveys and are guided by protocols in the draft document "Long-Term Pallid Sturgeon and Associated Fish Community Assessment for the Missouri River." The Pallid Sturgeon Population Assessment Team has developed these guidelines. The Montana Fish, Wildlife and Parks (MTFWP) have conducted additional monitoring efforts in the Fort Peck reach. These efforts have been funded and supported primarily by other sources, including Western Area Power Administration (WAPA). The Corps provided funds to the Missouri Department of Conservation (MDC) in 2001 to initiate its "Sturgeon Monitoring Program"; however, the continued program is supported primarily through the MDC. It is the intent of the Corps to integrate and expand population assessment activities with these crews. In August 2003, the Corps met with the MTFWP and is working with the USFWS to achieve implementation of the

standardized assessment program in the Fort Peck reach. State and Federal agencies (SDGFP, USFWS, IDNR, MDC) have provided budget estimates for conducting assessment activities on various portions of the Lower River that are currently not being sampled (the Gavins Point Dam to Ponca segment, the Ponca to the Platte River segment, the Kansas River to the Grand River segment, the Grand River to Glasgow segment and the Kansas River downstream of the Johnson County Weir). The Corps intends to reach full implementation of this program by the spring 2004.

Wild and hatchery-reared pallid sturgeon have been sampled by all crews during these assessment activities. In 2002, 22 pallid sturgeon were captured in the Lower River by the USFWS and NGPC crews, in addition to 12 hybrid sturgeon and nearly 5,000 shovelnose sturgeon. Slight declines in pallid sturgeon relative abundance continue in comparison to shovelnose sturgeon. Catch per Unit Effort has decreased for shovelnose sturgeon over the past 5 years (Pers. Comm. Vince Travnichek, MDC).

The standardized gears for these sampling efforts provide additional information on other benthic fish species ranging from small cyprinids (i.e., chubs) to larger catastomids such as the blue sucker *Cycleptus elongatus*. Information that has been absent from previous sampling efforts related to associated community species will provide the start of baseline data to compare long-term trends.

Sampling efforts in 2003 have already yielded the collection of approximately 70 pallid sturgeon. The majority of these are the result of previous stocking efforts initiated in the late 90's as 50 of the 70 pallid sturgeon collected during surveys have been in the Fort Randall reach.

Data is also being collected on a variety of species representative of the benthic fish community. These data would supplement benthic fish data collected during 1995-1997, providing valuable biological information. Rather than just collect data when pallid sturgeon are collected, habitat characteristic data is collected as a part of all fishery sampling to provide information related to habitat characteristic preferences (i.e., velocity, turbidity, substrate). Over time, these data will provide information regarding population trends of pallid sturgeon and a variety of warm water benthic fish species. With this action the Corps will continue funding these cooperative assessment projects.

Corps' Pallid Sturgeon Population Assessment in Response to the 2000 BiOp.
The 2000 BiOp RPA calls for the Corps to develop a Pallid Sturgeon Population Assessment Program. The RPA states:

> "The endangered species and habitat-monitoring program shall be designed to detect annual improvement in the ecosystem. This will be accomplished by documenting pallid sturgeon reproduction and recruitment, physical habitat improvements, improvements of the warm water benthic fishery (surrogate species), hydrograph improvements in form and function, improved water temperature regimes, and increased aquatic nutrient cycling, sediment transport, and in turbidity.

> Pallid sturgeon population assessment shall include: (1) total number of fish captured and tag number; (2) GPS coordinates of capture sights, distribution, recapture incidences, and numbers; (3) channel and substrate mapping of the habitats used by the fish; (4) tributary use and concentrations by pallid sturgeon; (5) temperature, surface and bottom velocity, turbidity, and depth at capture locations, (6) length of fish frequency; (7) morphological measurements of fish and meristic counts; (8) species characterization utilizing morphological measurements; (9) genetic analysis of fish; and (10) productivity and recruitment. Additional information needs and priorities for the monitoring program should be developed through a cooperative effort between the Service, Corps, and Recovery Team."

The structure of the Corps' program includes sampling seasons and strategies that focus on pallid sturgeon as well as the associated fish community. The program, when fully implemented, will provide a "Pulse Rate" for pallid sturgeon and Missouri River fishes over time.

The following objectives have been established to guide the program:

- Document current and long-term trends in pallid sturgeon population abundance, distribution, and habitat usage throughout the Missouri River.
- Document survival, growth, and habitat use of stocked pallid sturgeon in the Missouri River.
- Document pallid sturgeon reproduction and recruitment in the Missouri River.
- Document current and long-term trends in native Missouri River fish species abundance, distribution, and habitat usage, with emphasis on the warm water benthic fish community.

A Pallid Sturgeon Population Assessment Team comprised of Missouri River basin biologists, sturgeon experts, and other scientists has been assembled to develop sampling strategies and standardized protocols to achieve the objectives. The Team has partitioned the Missouri River into sampling segments based on differences in the physical attributes of the river (e.g., degrading stream bed, tributary influence, natural hydrograph, etc.). Sampling strategies have been outlined into two primary sampling seasons, a sturgeon season and a fish community season. Standardized protocols for habitat classification, gears and techniques, habitat characteristic data collection, data recording and data sheets have been developed and guide current sampling efforts.

The Pallid Sturgeon Population Assessment Team has selected a representative group of native Missouri River fishes to serve as surrogate species to detect improvements in the warm water benthic fish community. Among the species selected are: Sand Shiner *Notropis stramineus*, Sicklefin Chub *Macrhybopsis meeki*, Sauger *Stizostedion canadense*, Shovelnose Sturgeon *Scaphirhynchus platorynchus*, Plains minnow *Hybognathus placitus,* Western silvery minnow *Hybognathus argyritis*, Speckled Chub *Macrhybopsis aestivalis*, and Sturgeon Chub *Macrhybopsis gelida.* Additional information may be collected on these species related to age, growth, and body condition (relative weight information).

When fully implemented, all high priority Missouri River segments, as identified in the 2000 BiOp, will be sampled providing trend information on pallid sturgeon and the fish community. Each segment will represent a piece of the entire puzzle. Jointly, these pieces will be representative of the overall trends and status of pallid sturgeon and the fish community of the Missouri River. The Corps recognizes the significance of the Missouri River tributaries to the species (i.e., Yellowstone, Platte). The comprehensive biological baseline program will be expanded to include these tributaries within the standardized sampling efforts. The fully implemented program will also provide information on the success of the propagation augmentation program and provide data addressing the 2000 BiOp recommendations to evaluate survival, movements and habitat use of juvenile pallid sturgeon. The program is to be fully implemented in the spring of 2004 with crews conducting standardized assessments in all of the high priority river segments as identified in Table 21 of the 2000 BiOp.

Diet Evaluation

The Corps will continue to fund the research project currently underway in the Fort Randall reach to evaluate food habits of juvenile pallid and shovelnose sturgeon. The objective of this project is to compare food habits between juvenile pallid sturgeon and shovelnose sturgeon. This effort will include comparisons by season to determine if food habits are different at different times of the year. The Pallid Sturgeon Workgroup has identified this effort, as an information gap and a priority to better understand the species. Currently, the diet evaluation research project is being conducted in conjunction with population assessment activities in the Fort Randall reach. Gastric lavage (non-lethal) is being used to flush and collect stomach contents. Support for this effort will continue to completion.

The results of this project will provide insight to the feeding habits of various year classes of pallid sturgeon juveniles in the Fort Randall reach. Additionally, condition and growth of juvenile pallid sturgeon in the Fort Randall reach will be used to determine the suitability of this stretch of river for continued stocking and recovery efforts.

Least Tern and Piping Plover Population Assessment, Monitoring and Captive Rearing

Since 1999, the Corps has funded Dr. Roger L. Boyd, of Baker University, to conduct annual breeding surveys of the least terns and piping plovers nesting on the Kansas River. These surveys include collecting and evaluating productivity, habitat, and other pertinent data needed for the Corps to decide whether the Kansas River provides a source or sink for these species. This evaluation will be made by the Corps after the 2005 nesting season. Annual breeding survey reports are prepared for the Corps by Dr. Boyd and coordinated with the USFWS. The Manhattan office of the USFWS has agreed with the Corps' plan to use data from these annual breeding survey reports to make the "source or sink" evaluation in 2005.

In conjunction with the monitoring program, the Corps has undertaken, and will continue with this action, several management activities that are proposed during the breeding season to increase nesting and fledging success. Through the Threatened & Endangered Species Data Management System (TESDMS), nest and fledgling status and locations will be coordinated with all management and enforcement partners. Use of the TESDMS allows the Corps' biologists and water managers to minimize flooding threats, coordinate law enforcement efforts, and inform other federal and state agencies of nest status. Management actions to be continued

include reducing threats from predation, human disturbance, inundation, and shoreline erosion. In addition, the Corps proposes to significantly augment its outreach and interpretive programs to enhance public awareness of endangered species.

The 2000 BiOp commended the Corps for its comprehensive least tern and piping plover monitoring program, which has provided state-of-the art information on habitat and birds critical to river management decisions. The Corps will continue this successful assessment program and seek ways to improve and modernize the monitoring and evaluation techniques and data delivery and communication tools.

Corps management of Missouri River and Kansas River operations for least terns and piping plovers is a highly coordinated effort. Intensive field monitoring activities provide not only important population assessment information but also inform water managers and policy makers of near real time information from which decisions are made. The Corps will continue monitoring birds and their associated communities beginning in late April, as the first piping plovers arrive in the Missouri River basin, through the end of August, when the last birds depart for the wintering grounds. Monitoring currently includes, and will continue to include, identification of least tern and piping plover nesting sites, record keeping of nest locations, and observation of chicks from hatching to fledging. An adult census of both species will be conducted to assess population trends. Monitoring personnel are, and will continue to be, trained by Corps biologists in least tern and piping plover biology and survey techniques to ensure the capture of consistent and quality data. The Corps also proposes to complete the comprehensive review of its captive rearing program. On February 26-27, 2003, an Animal Husbandry and Health Team conducted a focused "best practices" review of the physical facilities; the collection, incubation, brood rearing, and release protocols; animal handling and care practices; veterinary care guidelines; diet sources and food preparation; contamination containment and prevention; handling and disposal of mortality specimens; and operational guidelines for facility personnel. This inspection included a detailed review of products and technologies being used to ensure the most current state-of-the-art products and methods are put in practice with the captive rearing program.

The Corps is identifying a process to complete the second track of the Corps' peer review. This effort would deal with the broader perspectives and questions of captive rearing as a long-term management tool for these species, including:

- Does the captive rearing program represent a sustainable approach to management and recovery of these species?
- Is its operation consistent with the goals of Endangered Species Act (ESA) and current understanding of conservation biology?
- What are the ramifications of long term management that focuses on captively reared birds?
- Under what conditions should captive rearing be considered a viable and acceptable management tool?

Efforts will include a broad review of the impacts of captive rearing on species recovery, System operations, social values and the Corps' Threatened and Endangered Species Program. This

effort will be completed in 2004 and results will be formally included in the 2004 Annual Report for the 2000 BiOp.

Bald Eagle/Cottonwood Population Assessment.
The 2000 BiOp states that the Northern States population of the bald eagle has exceeded recovery goals. Missouri River bald eagles have contributed to those recovery goals and continue to grow in numbers despite the adverse effects of operations on the Missouri and Kansas Rivers and the BSNP. The long-term impacts of operations of the Missouri River on nesting and wintering habitat will continue unless management of this habitat is improved. The indirect effects of System operations on wintering habitat have yet to be fully realized. To reduce the impacts of declining wintering habitat on the Missouri River, conservation recommendations provided by the USFWS will be implemented and include:

- Conduct or participate in annual wintering and nesting bald eagle surveys
- Determine population dynamics of wintering and nesting birds
- Protect and manage bald eagle habitat
- Exercise Section 10/404 permit authority to protect, maintain, and enhance riparian forest usable by bald eagles
- Pursue restoration of stands of cottonwoods and sycamores in the Kansas River floodplain in all permit reviews
- Where cottonwood regeneration is lacking and could affect the bald eagle, pursue restoration opportunities through existing authorities.
- Develop a management plan for riverine forest areas not experiencing over bank flooding that will allow for natural regeneration, periodic seed germination, and seedling establishment at a sufficient rate such that regeneration is maintaining pace with or exceeding mortality.

The bald eagle/cottonwood model, contracted with the Corps of Engineers Research and Development Center (ERDC) that has been initiated, will help the Corps and other agencies address the conservation recommendations of the USFWS. The model includes mapping and evaluating the health of the cottonwood forests that currently provide or may provide wintering, non-breeding, and breeding habitat for bald eagles on the Missouri River.

Least Tern and Piping Plover Focused Research

The 2000 BiOp recognized the paucity of information concerning various aspects of least tern and piping plover life history and identified the importance of research, monitoring, and evaluation (RM&E) to the future recovery process. The 2000 RPA identified a "piping plover forage ecology study on the Missouri River" to document forage abundance and availability. This study will be concluded in 2003, and, under this effort, the Corps proposes to continue its focused research effort by investigating the relationship between nest initiation chronology of least terns and piping plovers, the timing of hydrologic events, and forage abundance and availability. This focused research project will further advance the information gained through the forage ecology study and provide insight into the importance of the timing of hydrologic events in driving the energetics and productivity of these species within the Missouri River basin.

APPENDIX D

RELEVANT REPORTS/REFERENCES

APPENDIX D

RELEVANT REPORTS/REFERENCES

The following documents were used in developing this BA. References for the various studies, analysis and species descriptions may be found in these documents.

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