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Annual Report for the Missouri River Biological Opinion

2002 ANNUAL REPORT

IMPLEMENTATION OF THE BIOLOGICAL OPINION FOR THE MISSOURI RIVER MAIN STEM SYSTEM, MISSOURI RIVER BANK STABILIZATION AND NAVIGATION PROJECT, KANSAS RIVER RESERVOIR SYSTEM

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Biological Opinion on the
Operation of the Missouri River Main Stem System,
Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and
Operation of the Kansas River Reservoir System
2002 Annual Report

Summary

The Endangered Species Act (ESA) requires that the Corps of Engineers (Corps), in coordination with the appropriate resource agencies, will ensure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of any federally listed threatened or endangered species or result in the destruction or adverse modification of critical habitat. Formal consultation between the U.S. Fish and Wildlife Service (Service) and the Corps under Section 7 of the ESA culminated with the "Biological Opinion on the Operation of the Missouri River Main Stem System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project (BSNP), and Operation of the Kansas River Reservoir System" (Bi-Op), dated November 30, 2000. The Bi-Op concludes that the existing operation of Missouri River Main Stem System, the maintenance and operation of the BSNP and operation of the Kansas Reservoir System jeopardizes the existence of the endangered interior least tern and pallid sturgeon and the threatened piping plover. It also concludes there will be an incidental take of bald eagles.

In its Bi-Op, the Service recommends a Reasonable and Prudent Alternative (RPA) with numerous elements; Reasonable and Prudent Measures (RPM) to minimize take/harm of the noted species; and Conservation Recommendations (CR) that would benefit the species. Main elements of the RPA are adaptive management, flow enhancement, unbalanced system regulation, habitat restoration/creation/acquisition, and species-specific measures to avoid jeopardy. The RPA and RPM are recommended actions, and the CR are discretionary actions specific to the four species.

Adaptive management is the first element of the RPA. It is a process that allows modification of management actions in response to new information and changing environmental conditions. Under this element, an Agency Coordination Team (ACT) was established, a comprehensive threatened and endangered species monitoring plan is being developed, and this annual report, which documents Corps actions to implement the Bi-Op, has been prepared.

The flow enhancement element of the RPA recommends that releases be modified from two main stem Reservoirs and studied for a third main stem reservoir. Fort Peck Dam releases were to be increased in the spring and be made primarily over the spillway from the warmer surface water of the lake.

Currently, releases from Fort Peck Dam in May and June are volumetrically smaller and colder than FWS biologists feel are needed to provide the attributes that the pallid sturgeon need to spawn and, ultimately, to preclude jeopardy. To ensure that the spillway can handle the multiple releases, two test releases are planned by the Corps. Drought conditions in 2001 resulted in lake

levels too low to allow spillway releases for the first of two tests, known as the mini-test, in 2002. As soon as sufficient lake levels occur at Fort Peck Dam, the spring flow mini-test will be conducted to determine the long-term integrity of the spillway, to test data collection methodology, and to obtain data on temperature, based on various combined flows from the spillway and the powerhouse. A larger, full test will be conducted the year after the mini-test if there is, again, sufficient water and NEPA requirements are met. In the meantime, portions of the overall monitoring plan are being implemented.

The unbalanced intrasystem regulation element specifies that a pattern of lower lake levels followed by normal levels be implemented for the three upper lakes - Fort Peck Lake, Lake Sakakawea, and Lake Oahe. Each lake would go through a 3-year cycle of lowering, refilling, and responding to system inflows. Each of these three lakes would have the cycle staggered so no two reservoirs were in the same stage of the cycle. This form of regulation benefits species in both the lakes and the river reaches. Unbalanced intrasystem regulation was not implemented in 2002 due to insufficient water in the system.

Under the Habitat element of the RPA, the Service recommends that the Corps restore, create, and acquire habitat to benefit the listed species. Specifically, additional shallow water habitat to benefit the pallid sturgeon and sandbar habitat to benefit the terns and plovers would be provided. Two shallow water habitat restoration goals listed in the Bi-Op are 2,000 acres by 2005 and 19,565 acres by 2020. Sandbar habitat acreage goals vary by year and river reach.

For 2002, shallow water habitat (defined as less than 5 feet deep with a velocity less than 2 feet per second) was created under the BSNP Missouri River Fish and Wildlife Mitigation Project. This effort created approximately 530 acres of shallow water habitat and 1,200 acres of reconnected floodplain in FY 2002. A plan was also developed for reaching the 2,000 acre shallow water habitat goal by 2005 in reaches 10 through 16 (Appendix B).

The Corps continued to enhance and manage emergent sandbar habitat through flows, reservoir intrasystem regulation, and by mechanical manipulation. Habitat creation included diking and island construction, overburden removal and fencing of peninsula habitat, dewatering, vegetation removal, and use of flows and pool management to rejuvenate degrading habitat. Other efforts in 2002 focused on describing habitat, determining factors that affect nesting success, and measuring rates of habitat degradation due to vegetation encroachment and erosion.

Elements applicable to specific species includes, for terns and plovers: determining the value of the Kansas River to benefit the birds; meeting recruitment goals; and conducting a piping plover foraging ecology study. Sturgeon recommendations include propagation and augmentation support; and conducting a pallid sturgeon population assessment on the Missouri River.

The Corps continued to monitor tern and plover fledge ratios, as has been done for the last 13 years on the Missouri River and 6 years on the Kansas River. Fledge ratio goals were met on the System in 2002 with a running three-year average of 1.18 for least terns and 1.64 for piping plovers. The Great Plains piping plover ecology study initiated in 2001 continued through the 2002 season.

Support by the Corps in 2002 for pallid sturgeon propagation and augmentation included supplies and materials assistance to Blind Pony State Fish Hatchery, Neosho National Fish Hatchery, the Gavin's Point National Fish Hatchery, Miles City State Fish Hatchery, Bozeman Fish Technology Center, and Garrison National Fish Hatcheries in excess of $640,000.

Population assessment activities were funded by the Corps in high priority river segments in 2002. Several state agencies and the Service conducted pallid sturgeon population assessment surveys in accordance with the "Pallid Sturgeon Population and Habitat Monitoring Plan for the Missouri and Kansas Rivers" (Draft-2001).

Reasonable and prudent measures implemented in 2002 included development of a community index model for the cottonwood plant community, with suitable habitat for the bald eagle, continuation of the tern and plover nesting surveys, captive rearing of terns and plovers, evaluation and implementation of operational changes to avoid take, predator aversion efforts for the birds, and a comprehensive public outreach program for both the birds and the sturgeon.

Pallid sturgeon work under the CR included identifying impacts and extent of commercial harvest in the basin on pallid sturgeon, development of sturgeon genetic techniques to ensure genetic variation, participation as a partner in regional pallid sturgeon recovery work groups, providing assistance to the Service and other partners with fish health issues as they relate to pallid sturgeon, providing assistance to the Service and other partners with cryopreservation banking of pallid sturgeon sperm.

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym/Abbreviation	Phrase
ACT	Agency Coordination Team
AOP	Annual Operating Plan for the Missouri River
AZAA	American Zoo and Aquarium Association
Bi-Op	Biological Opinion on the Operation of the Missouri River Main Stem System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System dated November 30, 2000.
BSNP	Missouri River Bank Stabilization and Navigation Project
CENWD	Corps of Engineers Northwestern Division
CITES	Convention on International Trade in Endangered Species
cfs	cubic feet per second
CR	Conservation Recommendations
Corps	U.S. Army Corps of Engineers
CWA	Clean Water Act
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ERDC	Engineering Research Development Center
ESA	Endangered Species Act
FY	Federal Fiscal Year from October 01 to September 30
GPS	Global Positioning System
GIS	Geographic Information System

IP	Implementation Plan
MNRR	Missouri National Recreational River
MRNRC	Missouri River Natural Resources Committee
msl	Mean sea level
MTFWP	Montana Department Fish, Wildlife and Parks
NGPC	Nebraska Game and Parks Commission
NPS	National Park Service
NRCS	Natural Resources Conservation Service of the U.S. Department of Agriculture
PgMP	Program Management Plan
RM	River mile
RPA	Reasonable and Prudent Alternative
RPM	Reasonable and Prudent Measures
Service	U.S. Fish and Wildlife Service
T&E	Threatened and Endangered
TESDMS	Threatened and Endangered Species Data Management System
USGS	U.S. Geological Survey
WSRA	Wild and Scenic Rivers Act

Introduction

An annual report is provided to interested parties in accordance with reporting requirements of the Biological Opinion (Bi-Op) on the Operation of the Missouri River Main Stem System, Operation and Maintenance of the Missouri River Bank Stabilization and Navigation Project, and Operation of the Kansas River Reservoir System dated November 30, 2000. This report also acts to evaluate the effectiveness of Corps' conservation activities for the endangered interior least tern and pallid sturgeon and the threatened piping plover.

This report is formatted similar to Table 24 of the Bi-Op for the ease of cross-referencing. Only those items that are required for 2002 or have been accelerated in the Bi-Op schedule, are included. Table 24 is included as Appendix D to this report. It is anticipated future annual reports will follow a similar format.

Reasonable and Prudent Alternative

I. Adaptive Management

I.A. Establish an Agency Coordination Team (ACT)

I.A.1. Coordination Meetings

There were no formal ACT coordination meetings in Fiscal Year (FY) 2002. The March 2002 meeting was postponed while awaiting release of the new Master Manual. An informal consultation meeting between the U.S. Army Corps of Engineers (Corps) and the U.S. Fish and Wildlife Service (Service) was held June 13, 2002 in Denver, Colorado. The meeting was held to discuss the Supplemental Biological Assessment the Corps prepared to document why some actions in 2001 had differed from actions proposed in the Reasonable and Prudent Alternative (RPA) section of the 2000 BiOp.

Another meeting between the Corps and the Service was held September 27, 2002. The purpose of this meeting was to discuss the Annual Operation Plan (AOP) for 2003; to further develop a Research, Monitoring and Evaluation plan (RM&E plan) for the threatened and endangered species, and discuss recent designation of critical habitat for piping plover.

I.B. Develop Endangered Species Monitoring Plan

I.C. Annual Report

This report meets this requirement.

II. Flow Enhancement

II.B. Fort Peck Dam

II.B.1. Implement mini-test

The Corps proposed to test flow changes out of Fort Peck Dam following specifications outlined in the Bi-Op. These tests are proposed to increase discharge and enhance water temperatures during late May and June. This may provide spawning cues and enhance environmental conditions for pallid sturgeon (*Scaphirhynchus albus*) and other native fishes. In contrast to "normal" cold-water releases through Fort Peck Dam, water from Fort Peck Reservoir would be released over the spillway during flow tests to enhance water temperature conditions.

The Fort Peck Flow Test includes: (a) mini-test (up to 15,000 cubic feet per second (cfs) maximum peak discharge), (b) full-test (up to 23,000 cfs), and (c) data collection in support of the Fort Peck flow tests. The objectives of the mini-test are: (a) to test the long-term integrity of the spillway; (b) to test data collection methodology to be used; (c) to gather data on temperature, based on various combined flows from the spillway and the powerhouse. The objectives of the full-test are similar to the mini-test, using higher flows (23,000 cfs). The full-test would also be used to measure the biological response of the pallid sturgeon to the flow tests.

The original schedule for the flow tests was to conduct the mini-test during 2001 and conduct the full-test in 2002. However, insufficient water levels in Fort Peck Reservoir during spring 2001 and 2002 precluded conducting the mini-test and full-test. As a prerequisite to the mini-test, sufficient water has to be available in Fort Peck Lake for the Corps to be able to discharge a known volume of water through the spillway gates. For the mini-test to run as described, for the duration described, and to gain the best information on discharge volume and resulting temperatures, at least five feet of water elevation is needed above the spillway gates. Due to the ongoing drought in Montana, upper quartile or greater runoff would have to occur during the winter and spring of 2004 in order to run the mini-test during June 2005 (Corps, Final EA, Fort Peck Flow Modification Mini-Test). The Corps Final EA on the Fort Peck Flow Modification Mini-Test has not yet been publicized.

The Omaha District Corps of Engineers (Omaha District) has developed a Monitoring Plan for the Fort Peck reach to address collection of both physical and biological data. Specific work items for the Fort Peck Flow Test supported by the Omaha District and implemented by various agencies completed in 2002 include the following:

1. The Draft Environmental Assessment (EA) for the mini-test was sent to the public on 10 April 2002. The comment period was extended to 9 August 2002 in response to public and Congressional requests for extension. Given the lack of available water to perform the mini-test, additional information was collected to address comments in the Final EA. The Final EA will be completed during calendar year 2003.

There was also U.S. Fish and Wildlife Service and USGS support and data collection. The monitoring started in FY 2001 and is to be continued through FY 2008. The monitoring completed in FY 2002 by the various agencies included:

Montana Department of Fish, Wildlife and Parks

a. measuring water temperature and turbidity in the Missouri River downstream from Fort Peck Dam;
b. seasonal use, telemetry, and movement of adult pallid sturgeon in the Missouri River downstream from Fort Peck Dam;
c. examining flow and temperature related movements of paddlefish, blue suckers, and shovelnose sturgeon;
d. quantifying larval fish distribution and abundance;
e. quantifying the distribution and abundance of young-of-the-year sturgeon;
f. food habits of piscivorous fishes;
g. planning for the Fort Peck fish barrier occurred during 2002 fish will be tagged in the vicinity of the spillway from April through July during the years the spillway will be in operation; and
h. assisting the USFWS with broodstock collection.

U.S. Fish and Wildlife Service in Bismarck, ND

a. examining movements of the adult pallid sturgeon in the area of the confluence of the Yellowstone and Missouri Rivers.

U.S. Fish and Wildlife Service (Bozeman Fish Technology Center in Bozeman, MT)

a. performing laboratory evaluation of survival within the river/reservoir transitional areas.

3. Work on the traditional cultural properties inventory and cultural properties inventory contract for the Fort Peck reach began in 2002 and was completed by the Fort Peck Tribes in early FY 2003.

4. The contractor (Golder Associates Inc.) completed design for the fish barrier on the spillway to prevent fish going over the spillway during flow tests.

5. The phase II spillway evaluation contract with Golder Associates, Inc. was awarded in FY 2002 and the phase III spillway evaluation will be awarded in FY 2004.

6. The Omaha District will continue with the existing erosion monitoring activities.

7. The contract with Roosevelt County Conservation District, Montana to provide an inventory of pumps and intakes on the Missouri River between the Fort Peck Dam and the North Dakota Border was completed. The NRCS has provided $300,000 to the area Conservation Districts to allow the landowners to make adjustments to their water intakes

to accommodate variable flow elevations. The Corps of Engineers Northwestern Division (CENWD) has provided "Stop Protocol" information to the Conservation Districts in support of this activity.

8. The Omaha District is developing a model for river water temperature with the data that has been collected.

II.B.2. Implement full-test

The full-test will be implemented the first year after the mini-test if there is sufficient water in Fort Peck Lake. All test flows are dependent on adequate inflows to Fort Peck Reservoir and adequate water levels in the reservoir.

III. Unbalanced Intrasystem Regulation

The 2001-2002 Annual Operating Plan (AOP) includes provisions for unbalancing the Fort Peck, Garrison, and Oahe reservoirs for Upper Quartile and greater runoff scenarios. Unbalancing is intended to benefit threatened and endangered species production in the long term by maintaining and exposing sandbar and shoreline habitat. The unbalancing is also beneficial to reservoir fisheries in the long term by ensuring a periodic rise in reservoir elevation sufficient to provide good spawning conditions and inundating vegetation, thereby increasing young-of-the-year fish survival.

Due to drought, Fort Peck Lake could not balanced in 2002, but it is anticipated that Fort Peck will be high, Garrison low, and Oahe allowed to float (normal operation) should Upper Quartile or greater runoff occur in subsequent years. This unbalancing is computed based on the percent of the carryover multiple purpose pool that remains in Fort Peck Lake, Lake Sakakawea, and Lake Oahe. In terms of elevations, Fort Peck would be 4.0 feet high, Garrison would be 3.0 feet low, and Oahe would be balanced on March 1, 2003, for Upper Decile and Upper Quartile. This would permit the Fort Peck threatened and endangered species flow modification test of 20,000 to 30,000 cfs in the spring of 2003. Median or lower runoff did not sufficiently refill the reservoir in 2002 and no unbalancing occurred. The unbalancing would alternate at each project; high one year, float (normal operation) the next year, and low the third year as shown in Table 1. Table 2 shows the lake elevations proposed by the Missouri River Natural Resources Committee (MRNRC) at which the unbalancing would be terminated. The unbalancing did not occur in 2002 because of insufficient reservoir water elevations. Table 2 indicated that no reservoir unbalancing should occur for any of the five run-off scenarios in 2002 since Fort Peck Lake is below elevation 2227 feet msl on March 1, 2002. However, it is important to implement unbalancing to benefit endangered species should Upper Quartile or greater runoff occur. No reservoir unbalancing is shown for the Median, Lower Quartile, and Lower Decile studies.

TABLE 1
RESERVOIR UNBALANCING SCHEDULE

	Fort Peck		Garrison		Oahe	
Year	**March 1**	**Rest of Year**	**March 1**	**Rest of Year**	**March 1**	**Rest of year**
2002	Unbalanced	High	Balance	Low	Balance	Float
2003	High	Float	Low	Hold peak	Raise and hold during spawn	Float
2004	Raise & hold during spawn	Float	High	Float	Low	Hold peak
2005	Low	Hold peak	Raise & hold during spawn	Float	High	Float

Notes:
Float year: Normal operation, then unbalance 1 foot during low pool years or 3 feet when System storage is near 57.1 MAF on March 1.
Low year: Begin low, then hold peak the remainder of the year.
High year: Begin high, raise and hold pool during spawn, then float.

TABLE 2
MRNRC RECOMMENDED RESERVOIR ELEVATION
GUIDELINES FOR UNBALANCING

	Fort Peck	**Garrison**	**Oahe**
Implement unbalancing if March 1 reservoir elevation is above this level.	2234 feet msl	1837.5 feet msl	1607.5 feet msl
Implement unbalancing if March 1 reservoir elevation is in this range and the pool is expected to raise more than 3 feet after March 1.	2227-2234 * feet msl	1827-1837.5 feet msl	1600-1607.5 feet msl
Scheduling Criteria	Avoid lake level decline during spawn period which ranged from April 15 – May 30	Schedule after spawn period of April 20 – May 20	Schedule after spawn period of April 8 – May 15

Notes:
*See AOP text for unbalanced implementation rationale for Upper Quartile and Upper Decile

IV. Habitat Restoration/Creation/Acquisition

IV.A. Restoration of Submerged Shallow Water Habitat (Goal: restoration of 19,565 total acres)

IV.A.1. Ensure no-net-loss of existing shallow water habitat from O&M in lower river

As part of the Bank Stabilization and Navigation Project (BSNP) maintenance program, no net loss of habitat was accomplished by incorporating notches where appropriate, and by deferring maintenance in areas where the risk to the navigation channel is minimal. The notches help to maintain any existing habitat downstream of the repaired structures. The exception is dikes that are repaired where the landowner adjacent to the structure has concerns about bank erosion adversely affecting a levee or other structure. Notching is not done on these structures until an easement or some other form of permission is acquired from the landowner.

The notching effort also started creating habitat. One hundred fifty six notches were constructed between Missouri River miles 456 and 110. Notches averaged 75 feet wide with a bottom depth of -4 feet below construction reference plane (CRP). The sizing and placement of these notches varied widely according to the particulars of each location. Approximately 100 were large notches excavated along public property with the cooperation of the landowner. These large notches were excavated immediately adjacent to the bank or into the bank to encourage erosion of the high bank. As the river widens, shallow water habitat (SWH) will develop between the new high bank and the navigation channel. The remainder of the notches were smaller notches constructed at least 100' riverward of private property. The smaller notches are intended to diversify existing SWH without eroding the high bank. Maintenance was deferred in a five-mile reach above Nebraska City.

The Missouri River Bank Stabilization and Navigation Fish and Wildlife Mitigation Project (Missouri River Mitigation Project) effort created approximately 530 acres of Shallow water Habitat and 1200 acres of reconnected floodplain in FY 2002. Complete details and locations are available in the Missouri River Mitigation Project Annual Implementation Report dated January 2003. A copy of this report is attached as Appendix A.

IV.A.2. Develop habitat restoration plans and strategies in segments 10 through 16

For Segment 10, a 90% design has been completed for the restoration of 46.5 acres of shallow water habitat on newly acquired land at Ponca State Park in Nebraska. Plans and Specs for the project will be completed in early FY 2004, and construction contract should be awarded in the third quarter of FY 2004.

For Segments 11-15, a Program Management Plan (PgMP) was produced for development of SWH. The PgMP outlines work per reach, cost estimates, available

programs, and accounting metrics for a comprehensive program. This report will be updated annually to provide a history of work completed, assessment of effectiveness of the measures in providing the intended physical environment, and to convey lessons learned. The shallow water habitat plan to create habitat in Segments 11 through 15 is attached as Appendix B titled, "Missouri River Streambank Stabilization and Navigation Project Action Plan for Creating 2000 acres of Shallow Water Habitat by 2005".

IV.B. Restoration of Emergent Sandbar Habitat

IV.B.2. Provide Reservoir beach and island habitat

IV.B.2.a. Maintain reservoir habitats through intra-system regulation

As described above in, "Unbalance Intrasystem Regulation," the 2001-2002 AOP includes provisions for unbalancing the Fort Peck, Garrison, and Oahe reservoir for Upper Quartile and greater runoff scenarios. Unbalancing is intended to benefit threatened and endangered species production in the long term by maintaining and exposing sandbar and shoreline habitat. The unbalancing is also beneficial to reservoir fisheries in the long term by ensuring a periodic rise in reservoir elevation sufficient to provide good spawning conditions and inundating vegetation, thereby increasing young-of-the-year fish survival. Unbalancing did not occur in 2002 because of insufficient reservoir water elevations.

IV.B.3. Artificial or Mechanically Created Habitat

IV.B.3.a Provide created sandbar habitat on Segments 2, 4, 8, 9, 10 to supplement natural sandbar habitat

An Implementation Plan (IP) is being developed for the non-flow creation and maintenance of Emergent Sandbar Habitat (ESH) to comply with the 2000 Bi-Op. The purpose of the IP would be to describe non-flow methods of creating and maintaining ESH. The Corps did not complete any ESH work in FY 2002 as an official program. Potential non-flow habitat creation and maintenance methods include, but are not limited to the following:

1. Increasing the height of existing submerged sandbars utilizing dredges to pump and place material to create exposed sandbar conditions.
2. Mechanical manipulation of existing sandbars by pushing submerged sand to exposed elevations utilizing bulldozers, and/or excavators.
3. Contouring existing sandbars to either minimize high dunes or to add minor topographical height variations utilizing bulldozers, front-end loaders, scrapers, and/or excavators.
4. Contouring existing sandbars to provide depositional areas for organic material, wetted areas, and/or shallow ephemeral pools to increase forage production and forage availability.

5. Investigate supplemental nitrification of sites with poor or insufficient forage production.
6. Set up and removal of sand fences on existing habitat areas to add important microhabitat features and/or create dunes to add topographical variations.
7. Short term armoring of productive nesting areas with temporary materials such as logs or bales.
8. Vegetation removal by aquatically approved pre-or post-emergent herbicide application (i.e. glyphosphate), or, by utilizing scrapers, mowers, discs, chippers, or similar type machines or by burning.
9. Creating dynamic sandbar complexes by cutting shallow water channels through existing large sandbars.
10. Reducing localized predator impacts by removal of land bridges and perches.
11. Enhancing terrestrialized linear habitats with livestock exclosures and enclosures, peninsula cutoffs, and providing site security through slope reductions, and/or substrate modifications.

IV.C. Initiate studies of the lack of sediment transport and impacts on habitat regeneration and turbidity

The Corps completed a conceptual sediment flushing study for Lewis and Clark Lake (Gavins Point). The study has lead to scoping of other research into the feasibility of sediment management on a system wide basis. A detailed discussion of the special study and its findings is available in the report, "A Scoping Study of Water Quality Conditions in the Missouri National Recreational River Reach from near Gavins Point Dam to Ponca State Park, Nebraska" (U.S. Army Corps of Engineers – Omaha District, March 2002) and is attached as Appendix C.

A special water quality study was conducted on the Missouri National Recreational River (MNRR) below Gavins Point Dam during August and September of 2001. A total of nine locations on the Missouri, James, and Vermillion Rivers were monitored weekly for water quality. Sampling sites consisted of four types: thalweg, backwater, special turbidity, and tributaries. Near-surface water quality samples were collected at all site types, and near-bottom samples were also collected at the thalweg sites. Field measurements taken included: water temperature, dissolved oxygen, pH, conductivity, Secchi depth, and GPS location. Water samples were collected and taken to a laboratory for analysis of turbidity, total suspended solids, total organic carbon, total phosphorus, total Kjeldahl nitrogen, total ammonia, nitrate-nitrite nitrogen, chlorophyll *a*, atrazine, alachlor, and metolachlor. The water quality data were assessed using: 1) descriptive statistics (mean, median, minimum, maximum); 2) box plots to visually display data distribution; and 3) simple, two-tailed, paired t-test for testing for significant differences between monitoring locations and sampling sites.

The findings of the special water quality study indicated that the overall water quality of the MNRR reach appeared to be good. All the water quality parameters monitored in the MNRR reach during the special study met the appropriate state water quality standards adopted pursuant to the Federal Clean Water Act. Significant longitudinal variation

through the reach was observed for the monitored parameters of conductivity, dissolved oxygen, Secchi depth, turbidity, total suspended solids, and total phosphorus. The longitudinal variation of all these parameters, except dissolved oxygen, appears to be largely attributed to the inflows of the James and Vermillion Rivers. Little difference was observed between near-surface and near-bottom thalweg water quality conditions and near-surface thalweg and backwater water quality conditions. It is noted that these observations are based on a limited sampling period (i.e., late August through September of 2001) and are probably seasonally biased. The following water quality management concern was noted in the report:

> A water quality management concern is the seemingly contradictory water quality management goals identified for the MNRR reach under the Federal Endangered Species Act (ESA), Clean Water Act (CWA), and Wild and Scenic Rivers Act (WSRA). The initial Biological Opinion (BiOp), developed pursuant to the ESA, directs the Corps to increase turbidity and suspended solids in the MNRR. The BiOp states that sediment transport and turbidity need to be restored to functional levels in the MNRR reach to improve habitat conditions for the jeopardized species inhabiting the reach. State water quality standards (i.e., South Dakota and Nebraska) adopted pursuant to the CWA require that suspended solids and turbidity levels be maintained at "reduced" levels in the MNRR reach, and imply that increasing turbidity and suspended solids levels in the reach could represent a degradation of water quality conditions and a possible impairment of a designated beneficial use. South Dakota has specifically adopted water quality standards criteria to manage total suspended solids levels in the MNRR reach. One of the beneficial uses South Dakota designates on the MNRR reach is "warm water permanent fish life propagation." Protection of this use requires that total suspended solids levels are to be $\leq$ 158 mg/l as a daily maximum, and $\leq$ 90 mg/l as a 30-day average. Management of the MNRR reach as a recreational river under the WSRA requires that the values for which it was designated as a recreational river (i.e., its outstanding remarkable recreational, fish and wildlife, aesthetic, historical, and cultural values) be protected and enhanced. Increasing suspended solids and turbidity levels in the MNRR reach may degrade the habitat for recreationally important fish species that were present in the reach when it was designated as a recreational river. The existing water quality literature suggests that elevated levels of turbidity adversely impact the recreational and aesthetic values of a water body. The U.S. Environmental Protection Agency's "Red Book" states; "Turbid water interferes with recreational use and aesthetic enjoyment of water" (USEPA, 1976). The USFWS should enter consultation with EPA Regions VII and VIII, and possibly the NPS, to discuss coordinating the water quality aspects of the BiOp,

CWA, and WSRA to ensure that there are consistent water quality management goals on the MNRR reach.

Elements Applicable to Specific Species

V. Least Tern and Piping Plover

V.A. Operate the Kansas River to provide overall benefits to conservation of least terns and piping plovers

V.A.1. Develop a Study Plan

During the nesting season, the Corps has continued to coordinate extensively with the Manhattan office of the Service to avoid adverse impacts. In general, the altered lake operation has involved reducing target stages on the Kansas River to avoid flooding existing nests with releases from Corps lakes. In coordination with the Service, several times a week, field observations are made of nest elevations and a river elevation selected that will provide protection for the nests. No water is released from Corps lakes, which would increase river stages and inundate nests.

Releases from Corps lakes are only increased when there is a decrease in the base flow of the Kansas River and then only enough to maintain the existing river stage. Releases from Corps lakes are reduced when a rise in the unregulated base flow of the Kansas River occurs upstream. The Service is consulted after unregulated high flow events occur on the river which flood nests and also prior to resuming normal lake operations. This operation leads to abnormal storage of water in Corps lakes within the Kansas River basin.

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. An 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 are coordinated with the Service. The Service's Manhattan office has agreed with the Corps' plan to use data from these annual breeding survey reports to make the "source or sink" evaluation in 2005.

V.B. Provide habitat to meet or exceed fledge ratio goals of 0.70 for least terns and 1.13 for piping plovers

Table 3 shows the Corps has exceeded the three-year (2000-2002) fledge ratio 0.70 for least terns with a 3-year fledge ratio of 1.18. Table 4 shows the Corps has exceeded the 3-year (2000-2002) fledge ratio 1.13 for piping plovers with a 3-year fledge ratio of 1.64. Emergent sandbar habitat created by the high water flows in 1997 provided habitat for

terns and plovers. This has allowed the Corps in subsequent years to reach the required fledge ratio for the terns and plovers.

TABLE 3
3-YEAR (2000-2002) FLEDGE RATIO FOR
LEAST TERNS (REQUIRED 0.70)

	Adult Census	Fledged Juveniles	Fledge Ratio
2000	575	350	1.22
2001	653	341	1.04
2002	731	465	1.27
3 Yr. Total (2000-2002)	1959	1156	1.18

TABLE 4
3-YEAR (2000-2002) FLEDGE RATIO FOR
PIPING PLOVERS (REQUIRED 1.13)

	Adult Census	Fledged Juveniles	Fledge Ratio
2000	796	637	1.60
2001	1054	740	1.40
2002	1134	1073	1.89
3 Yr. Total (2000-2002)	2984	2450	1.64

V.C. Initiate and conduct a piping plover foraging ecology study on the Missouri River.
Implementation Date: 2005

This effort is ahead of schedule. The Piping Plover Foraging Ecology research project was begun in 2001. The Corps and Virginia Polytech University in cooperation with the Nature Conservancy, USFWS-Ecological Services, Audubon National Wildlife Refuge, and the Audubon Wetland Management District are evaluating piping plover forage ecology on four habitat types within the Missouri River Basin.

Specific goals for the project include:

1) Determine factors limiting piping plover reproductive output on the Missouri River, with an emphasis on the role of the prey base.
2) Compare reproductive output on the Missouri River to reproductive output on "high quality" alkali wetland sites.
3) Identify characteristics of high quality plover foraging habitat in the Great Plains.
4) Determine factors affecting nest site selection on the Missouri River.

To achieve these goals a series of hypotheses about the relationships among foraging habitat, foraging rates, and plover reproductive output will be tested. Hypotheses to be tested include:

1) Invertebrate abundance near nesting sites limits chick fledging success.
2a) Higher parental quality results in higher probability of chicks fledging.
2b) Parental quality is lower in lower quality sites (lower invertebrate abundance).
3) Invertebrate abundance is related to habitat characteristics.
4) Habitat selection is a function of habitat characteristics and invertebrate abundance.

The final field season will be undertaken in 2003. For more information, contact U.S. Army Corps of Engineers, P.O. Box 710, Yankton, SD 57078.

Reference Reports: Thesis Working Plan, Danielle Le Fer, Virginia Polytech University
Annual Report: 2002 Field Season, Piping Plover Foraging Ecology

VI. Pallid Sturgeon

VI.A. Support, assist, and increase pallid sturgeon propagation and augmentation efforts

Six hatcheries are currently involved in pallid sturgeon propagation efforts to augment wild populations in the Missouri River basin. Four hatcheries are operated by the Service: Bozeman Fish Technology Center (Bozeman FTC); Garrison Dam National Fish Hatchery (Garrison Dam NFH); Gavins Point National Fish Hatchery (Gavins Point NFH); and the Neosho National Fish Hatchery (Neosho NFH). The remaining two facilities are operated by state agencies: The Miles City State Fish Hatchery (Miles City SFH); and the Blind Pony State Fish Hatchery (Blind Pony SFH) with the Missouri Department of Conservation.

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 Service in 2002 and comprises members representative of the Corps, Service, 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 VI.A. of the Bi-Op. A prioritization list was generated and has been utilized to determine where the Corps directs assistance for the population/augmentation program each year.

Fish health issues have inhibited population/augmentation efforts since 1998 when an iridovirus was detected in hatchery reared shovelnose and pallid sturgeon. Population augmentation has been minimal from 1998 through 2001 as fish health experts researched the virus and pallid sturgeon workgroups and the recovery team weighed the risks associated with the virus and the consequences of "stocking" vs. "not stocking". Currently, virus positive fish may be stocked (depending on fish health assessments) since the virus has been detected in pallid or shovelnose sturgeon throughout the

Missouri River basin and in hybrid pallid X shovelnose sturgeon from the Mississippi River.

In 2002, for the first time, progeny originating from parentage within the upper basin were stocked in the lower basin (below Gavins Point Dam). This precedent provides greater opportunity to augment dwindling wild populations in the lower Missouri River. Plans to stock upper basin progeny in the lower basin are planned again in 2003.

The Corps provided a variety of assistance for propagation enhancement in 2002. Through Military Inter-departmental Purchase Requests (MIPRs) and contracts, the Corps supported pallid sturgeon propagation/population augmentation throughout the Missouri River basin. In August 2002, "End of Year" funding was acquired and directed toward correcting some of the limiting factors at the hatcheries to improve propagation capabilities yielding both immediate and long-term benefits for pallid sturgeon propagation program. Refer to Table 5 for Corps expenditures to improve the capabilities of the hatcheries.

The Propagation Workgroup developed a needs list for each facility for propagating pallid sturgeon. The Propagation Workgroup consolidated this list into a single list which was then prioritized top to bottom. Several limiting factors were identified and given priority during this exercise. The focus of the "End of Year" funding targeted:

- Increasing Production Capabilities
- Improve Water Supply
- Enhance Cryopreservation Capabilities
- Feed and Feed Storage
- Fish Marking
- Miscellaneous Items

TABLE 5
PROPAGATION RELATED PROJECTS
AND EXPENDITURES FOR FY 2002

Description/Project Title	Cooperator	Expenditure
Propagation Activities, Infrastructure Improvements	Blind Pony State Fish Hatchery	$37,200
Propagation Activities, Infrastructure Improvements	Neosho National Fish Hatchery	$62,190
Propagation Activities, Infrastructure Improvements	Gavins Point National Fish Hatchery	$164,213
Propagation Activities, Infrastructure Improvements	Garrison Dam National Fish Hatchery	$54,533
Propagation Activities, Infrastructure Improvements	Miles City State Fish Hatchery	$191,360
Propagation Activities, Infrastructure Improvements	Bozeman Fish Technology Center	$11,637
Passive Integrated Tags and Accessories	Direct Purchase by Corps	$119,462
Total Propagation Support		**$640,595**

The Corps provided assistance and training in Passive Integrated Transponder (PIT) tagging and assisted with pallid sturgeon stocking efforts. The Corps also modified computer programs to record data for recording PIT tag numbers synchronized with individual fish, length and weight, stocking locations, family cross, year class and culture facility. Stocking efforts included assisting with transporting of juvenile pallid sturgeon from "Upper" basin hatcheries (upstream of Gavins Point Dam) to stocking sites in the "Lower" basin (downstream from Gavins Point Dam). These stocking efforts marked the first time that pallid sturgeon originating from parentage of the "Upper" basin were stocked into the "Lower" basin.

The Blind Pony SFH received over 2000 pallid sturgeon from the Garrison Dam NFH in April of 2002. These fish were the "runts" of the propagation efforts at Garrison and were transferred to Blind Pony where they would be grown to the prescribed size for tagging and stocking. The fish were in poor body condition at the time of transfer and none of the fish survived.

On April 17, 2002, the Blind Pony SFH was able to acquire brood pallid sturgeon via commercial fisherman from the middle Mississippi River. Complications were encountered when ambient water temperatures were elevated to unseasonably high temperatures (record temperatures). The adult pallid sturgeon were subjected to a series of cumulative stressors related to capture, handling and uncontrollable stressors imposed by environmental conditions (high water temperatures). Four of the adult sturgeon died prior to any spawning activities. The Missouri Department of Conservation decided to

release the remaining adult sturgeon rather than risking additional losses that were highly probable resulting from the unseasonable temperature changes.

Although the facility was unsuccessful in spawning and propagation efforts, a variety of facility upgrades were completed to enhance propagation potential for future propagation efforts.

The staff at the Blind Pony facility assisted with pallid sturgeon stocking efforts targeting the lower Missouri River from fish that were spawned and reared in the upper basin (Garrison Dam NFH). Their assistance was vital to the success of the 2002 stocking effort. (Blind Pony SFH Summary 2002)

The Neosho NFH received pallid sturgeon juveniles (2-5 inches) via transfer from the Miles City SFH in the winter of 2002. The Miles City staff transported the pallids (surplus to their needs and capabilities) to Yankton, South Dakota where they were met by the staff of the Neosho NFH. The fish were transferred onto the Neosho fish distribution truck and transported back to Neosho. The purpose of this transfer was to alleviate overcrowding at the Miles City facility and to utilize these fish for population augmentation in the lower Missouri River.

In March of 2002, mortality rates increased and iridovirus testing determined that these fish were indeed "virus positive". After severe losses (82% mortality), the survivors were reared to a 9-inch average size (fork length). In October 2002, 956 pallid sturgeon were PIT tagged and released at the 3 primary stocking locations in the lower Missouri River (Mulberry Bend (Vermillion, South Dakota), Bellevue, Nebraska and Booneville, Missouri).

The Corps provided support for a variety of facility improvements such as tanks and re-circulation pumps to increase propagation capabilities, ultraviolet treatment equipment to improve water quality and reduce the potential for disease outbreaks, and cryopreservation equipment for the storage of pallid sturgeon milt to enhance future propagation opportunities. (Neosho NFH Summary 2002)

The Gavins Point NFH continued to rear and stock pallid sturgeon in 2002. Additionally, the facility continues to hold the only future captive broodstock as a safety net to preserve living genetic representatives of the species as existing wild populations continue to decline. Gavins Point is currently holding captive broodstock from the 1997, 1998, 1999, 2001 and 2002-year classes. Maintaining the future captive broodstock at the facility is a vital component of the program; the facilities stocking efforts decrease each year as less and less space is available to propagate fish targeting annual stocking goals to accommodate the holding of the future broodstock.

In addition to holding the future captive broodstock, the facility stocked 182 pallid sturgeon juveniles in the Fort Randall Reach and 567 in the lower Missouri River. The facility also participated in stocking efforts with the Garrison Dam NFH to transport pallid sturgeon to the lower Missouri River (downstream of Gavins Point Dam).

The facility has plans for expansion to accommodate the future captive broodstock program, but the expansion phase is not scheduled for completion until 2008. These plans for expansion will enable the facility to propagate pallid sturgeon targeting annual stocking goals as well as providing long-term holding space for future captive broodstock. This expansion will double the current production capabilities.

The Corps provided support for the purchase of all the tanks and plumbing accessories for this expansion in 2002. Corps support also provided for a variety of fish cultural needs for the pallid sturgeon ranging from fish feed, automatic feeders, tank screens, electrical modifications and materials, repair of water supply well and various miscellaneous items. (Gavins Point NFH Summary 2002)

The Garrison Dam NFH was one of the primary facilities involved in pallid sturgeon spawning efforts in 2002. Three females and 12 males were captured near the confluence of the Yellowstone and Missouri Rivers west of Williston, North Dakota. Eggs were successfully collected from 2 of the 3 females. The third female died prior to spawning. Milt was collected from 8 of the 12 males. A total of 6 family groups were created; however, the majority of the eggs were from a single female. After spawning, the second female died as well as two of the adult males. Overall, spawning success was highly variable.

Ten thousand eggs were shipped to the Miles City SFH. All of these eggs were representative of a single cross (1 male, 1 female). Additionally, nearly 21,000 three-week-old fry were transferred to the Gavins Point NFH representing five half-sibling family lots.

The Garrison Dam NFH stocked 2001-year class pallid sturgeon in several locations. In the Fort Peck reach, 1,626 pallids were stocked at 5 sites representative of 5 half-sibling crosses. In the Fort Randall reach, 560 fish representing 8 family groups were stocked in April. In the lower Missouri River (below Gavins Point Dam), 6,452 pallid sturgeon were stocked at 4 locations in the lower Missouri River (St. Helena, Nebraska; Vermillion, South Dakota; Bellevue, Nebraska; and Booneville, Missouri).

All pallid sturgeon stocked into the river system from Garrison Dam NFH were PIT tagged prior to release. A portion of these fish experienced reduced growth and were too small at the time to accommodate a PIT tag. Therefore, in early April, 2,196 small pallid sturgeon (runts) from the 2001-year class were transferred to the Blind Pony SFH. Although the intention was to further advance the growth of these fish and then stock them in the lower Missouri River, none of these fish survived; therefore, no stocking activity occurred from Blind Pony SFH for these fish. An additional 525 pallid sturgeon (9 families) that were not stocked were transferred to the Gavins Point NFH and incorporated in the future captive broodstock program.

The Corps provided support for a variety of propagation related activities and equipment such as screening material for tanks, ultraviolet disinfection tube for improving water

quality, cryopreservation supplies to enhance future propagation potential, a broodstock trailer to transport adult pallid sturgeon to and from collection sites and hatchery facilities, a variety of equipment to increase efficiency levels for heating water and a digital camera compatible with a microscope to monitor egg development. (Garrison Dam NFH Summary 2002)

Broodstock collection efforts near the confluence of the Yellowstone and the Missouri Rivers provided 1 adult female and 3 males for the Miles City SFH (in addition to the adults sent to Garrison Dam NFH). The Miles City SFH spawned this female and crosses were made with two of the three males. The third male never produced milt. A third half-sibling cross was made utilizing milt from one of the males that was used at the Garrison Dam NFH. All spawning procedures appeared to be have been successful; however, none of the eggs developed.

Approximately 10,000 eggs were transported from the Garrison Dam NFH to Miles City SFH. These eggs served as the only viable progeny representative of the 2002-year class on station.

Pallid sturgeon on hand from the 2001-year class tested positive for the iridovirus. The majority of these fish were too small to accommodate a PIT Tag. The fish that were large enough were PIT tagged and the remainder of the fish were double tagged using Elastomer and Coded Wire tagging.

A total of 1,277 pallid sturgeon were stocked in July of 2002 at 2 sites in the Fort Peck reach and 3 sites on the Yellowstone River.

The Corps supported a variety of upgrades at the Miles City SFH including a chiller to improve the temperature regime during the summer months, an ultraviolet disinfection system and drum filters to improve water quality and reduce the potential for parasite related fish health and disease problems. (Miles City SFH Summary 2002)

Broodstock collection efforts above Fort Peck Reservoir were successful; however, the streamside spawning efforts resulted in the loss of the lone female available for spawning in this reach. This female produced very few viable eggs. Following spawning, eggs were shipped to the Bozeman Fish Technology Center and Garrison Dam NFH.

One female and five male pallid sturgeon were spawned streamside above Fort Peck Reservoir and two females and four males were spawned at the Miles City SFH. Progeny from these spawning efforts were transferred to the Garrison Dam NFH and Bozeman Fish Technology Center for rearing. Continued monitoring of the status of the iridovirus at the facility are ongoing. The Corps purchased a variety of cryopreservation equipment identified under conservation measures.

The Corps provided 20,000 PIT tags and accessories to accommodate the need to be able to identify the hatchery propagated pallid sturgeon as well as "mark" (tag) pallid sturgeon collected in conjunction with population assessment activities.

Pallid sturgeon spawned in FY 2002 will continue to be reared in FY 2003 at which time they may be stocked throughout the Missouri River pending approval of fish health experts, the pallid sturgeon workgroups, and the Pallid Sturgeon Recovery Team. For more information concerning the Corps pallid sturgeon propagation and augmentation efforts, contact the U.S. Army Corps of Engineers, P.O. Box 710, Yankton, SD 57078.

VI.B. Conduct pallid sturgeon population assessment including habitat parameters

In 2002, the Corps supported Population Assessment activities in high priority river segments. Several state agencies and the Service conducted pallid sturgeon population assessment activities in accordance with guidelines outlined in the document "Pallid Sturgeon and Associated Fish Community Assessment for the Missouri River (Draft-2002)." In addition to supporting population assessment activities, the Corps provided quality assurance for the program during field sampling activities and data review. Refer to Table 6 for pallid sturgeon population expenditures for 2002.

The year 2002 marked the second field season of data collection for the Fort Peck monitoring plan in support of the mini-test and full-test. Data was collected in a team effort by the U.S. Geological Survey (USGS) and Montana Fish Wildlife and Parks (MTFWP). Pre-test data collection continued to target the four monitoring components in 2002: 1) measuring water temperature and turbidity at several locations downstream from Fort Peck Dam; 2) examining flow and temperature-related movements of paddlefish (*Polyodon spathula*), blue suckers (*Cycleptus elongates*) and shovelnose sturgeon (*Scaphirhynchus platorynchus*). Complimentary of these efforts, the Service is conducting telemetry of known-sex adult pallid sturgeon; 3) quantification of larval fish distribution and abundance and; 4) examining food habits of piscivorous fishes to evaluate possible impacts of predation on sturgeon recruitment.

The Nebraska Game and Parks Commission (NGPC) completed a study evaluating the use of a benthic trawl as a tool for sampling sturgeon on the Missouri River. Success in sampling sturgeon is limited with existing trawl types and existing designs. This study allows for the comparison of similar design with varying mesh sizes of the inner cod. This study is being conducted in Missouri River Segments 8-13. This sampling is conducive to the collection of fish community data that may provide support to ecosystem improvements as habitats are modified via mechanically or through flow enhancement. In addition to the trawl evaluation study, the NGPC conducted sampling on the Missouri River targeting population assessment of pallid sturgeon and the associated fish community. Sampling efforts were in accordance with draft plans targeting assessment of pallid sturgeon and the associated fish community. A total of 8 pallid sturgeon were collected during sampling activities. The majority of these fish collected were stocked through the population augmentation program. Additionally, fish community data was collected which includes a variety of native fish species that are categorized as "Species of Concern." The NGPC and the Service have taken the lead in working with Innovative Net Systems to improve the designs of trawls to increase

efficiency by modifying features in design. (Pallid Sturgeon Population and Habitat Survey)

The Corps funded additional population assessment activities with the Columbia Fishery Resource Office, Service. This assessment included year round sampling which has been divided into three sampling seasons (spring, fall and winter seasons). A variety of gears were utilized targeting pallid sturgeon and the associated fish community. River Segments 14 and 15 were sampled during this assessment. Sampling efforts were in accordance with draft plans targeting assessment of pallid sturgeon and the associated fish community. Twelve pallid sturgeon were collected, 8 of which were presumed to be wild fish; however, many of these fish had scars from PIT tagging, but when scanned no PIT Tag was found. A portion of these fish presumed to be wild may have been propagated and then stocked. Two wild fish were identified by PIT Tag codes as recaptures. The 1st had been sampled just a month earlier in the same location and the 2nd had been collected 3 years prior and was located approximately 1.3 miles from the previous collection site. This fish had only grown 4mm during this 3-year interval. Fish community data was collected in addition to pallid sturgeon. (Annual Report for the Lower Missouri River Pallid Sturgeon Monitoring and Population Assessment Project)

In 2001, the Corps purchased a variety of equipment to facilitate the Missouri Department of Conservation's (MDC) "winter sampling" of sturgeon species in the winter of 2002. This project has continued and targets sampling efforts in the lower Missouri River as well as the Mississippi River where these rivers border the State of Missouri. Trend information resulting from these sampling efforts have shown significant declines in Catch Per Unit Effort of shovelnose sturgeon. This is believed to be in response to increased pressure targeting commercial markets for caviar and flesh as pressure has shifted from foreign (Soviet) markets to the United States. Pallid sturgeon have been illegally taken during commercial harvest of shovelnose sturgeon and documented by MDC Conservation Officers (Personal Communication, Vince Travnichek, MDC, Columbia, Missouri).

TABLE 6
PALLID STURGEON
POPULATION ASSESSMENT EXPENDITURES
FOR FY 2002

Description/Project Title	Cooperator	Expenditure
Pallid Sturgeon Population and Habitat Survey	Nebraska Game and Parks Commission, Lincoln, NE	$100,000
Annual Report for the Lower Missouri River Pallid Sturgeon Monitoring and Population Assessment Project	U.S. Fish and Wildlife Service, Columbia Fishery Resource Office, Columbia, MO	$113,000
Pallid Sturgeon Assessments Recovery Priority Management Area III Lewis and Clark Lake, South Dakota & Nebraska	U.S. Fish and Wildlife Service, Great Plains Fish and Wildlife Management Assistance Office, Pierre, SD	$20,000
Telemetry of Post-Spawn Pallid Sturgeon	U.S. Fish and Wildlife Service, Missouri River Fish and Wildlife Management Assistance Office, Bismarck, ND	$43,000
Monitoring of Sturgeon Populations in Missouri	Missouri Department of Conservation, Jefferson City, MO	$0

For more information concerning the Corps pallid sturgeon population assessment activities, contact U.S. Army Corps of Engineers, P.O. Box 710, Yankton, SD 57078.

VI.B.1. Identify the causes for the lack of reproduction and recruitment, causes for hybridization and identify restoration actions

The USGS has proposed a detailed research investigation to identify some of the specifics of these issues (hybridization, lack of reproduction/recruitment). The population assessment efforts would also aid in the identification of the causes.

VI.B.2. Identify and map spawning habitat

The Corps provided support for the pallid sturgeon telemetry study conducted by the Service in river Segments 8 and 9. Western Area Power Administration (WAPA) and the Service also provided funding for this project in FY 2002. This telemetry study utilized hatchery-reared juveniles and a couple of adult pallid sturgeon that were not returned to the Fort Peck reach (following propagation efforts) due to Montana's State Fish Health Policy. This project will be terminated in 2003 as the battery life of the tags is expiring.

The results of this project may provide valuable information relating to habitat use and preference of both juvenile and adult pallid sturgeon that may be applied to other river segments to facilitate future management decisions and provide valuable information for habitat modification projects. Additionally, the USGS (CERC), conducted bathymetric mapping and side-scan sonar on several known locations of juvenile and adult pallid sturgeon to map the habitats and the specific physical attributes that pallid sturgeon selected. (Reference Report: Pallid Sturgeon Assessments Recovery Priority Management Area III, Lewis and Clark Lake, South Dakota & Nebraska)

Reasonable and Prudent Measures to Minimize Take

Bald Eagle

Measure 1. Map and evaluate current health of cottonwood forests on Missouri River

Measure 1.1. Identify stands with periodic flooding
Measure 1.2. Determine baseline mortality and tree vigor

In June of 2002, the Corps and the Engineering Research Development Center (ERDC) sponsored a cottonwood/bald eagle workshop in Yankton, South Dakota. The purpose was to construct a community index model for the cottonwood plant community, with suitable habitat for the bald eagle. Participants were from Federal, state, and tribal organizations and academia. The model will be applicable to a subset of the Missouri River with the potential for expansion in future versions. The model is intended to provide a simple mechanism to evaluate current cottonwood conditions and plan restoration activities to maintain and expand cottonwood stands. The model is currently in developmental stage at ERDC.

Terns and Plovers

Measure 1. Monitor all tern and plover nesting sites on Missouri and Kansas Rivers.

Measure 1.1. Population survey information
- **a. Total number of colonies**
- **b. Total number of birds**
- **c. Map nest site locations**

Monitoring of tern and plover nesting sites on the Missouri River was conducted by Corps personnel on the Missouri River below Fort Peck, Garrison, Fort Randall and Gavins Point Dams, on Lake Sakakawea, Lake Oahe, Lake Francis Case, and Lewis & Clark Lake. Service personnel monitored Fort Peck Lake and Lake Audubon National Wildlife Refuge under a contract. Dr. Roger Boyd, Biology Department, Baker University monitored the Kansas River under a contract.

Personnel from the Corps (29), the South Dakota Game, Fish and Parks (3), the Service (1), and the Fort Peck Tribal Game and Fish (6) were trained on monitoring techniques in May and June of 2002. Four training sessions were held, one at each of the following locations: 1) Oahe Project Office, Pierre South Dakota; 2) Gavins Point Project Office, Yankton South Dakota; 3) Garrison Project Office, Riverdale, North Dakota; and 4) Fort Peck Project Office, Fort Peck, Montana. Monitoring on the Missouri began in early May and continued until late August of 2002.

An adult census of all habitat sites was conducted during the last two weeks in June of 2002. Surveys were conducted on five to ten-day cycles. Nests were found, mapped and tracked until the eggs hatched or the nest was otherwise terminated. Chicks were tracked from hatching to fledging. The results of the 2002 adult census and monitoring efforts for the piping plover and least tern can be found in Table 8 and Table 9. Data collected in the field was then inputted into the Threatened and Endangered Species Data Management System (TESDMS). After a quality control check by biologists with Omaha District's Threatened and Endangered Species Section, the data was made available on the TESDMS. The TESDMS was assessable via the Internet to appropriate federal and state personnel.

The TESDMS saw further refinement and improvement for the 2002 nesting season. Four more hand held computers with global positioning system (GPS) equipment were added to the surveys to augment the six that were used in 2001. One unit went to the Fort Peck Project and one went to the Mobridge Office of the Oahe Project. These offices did not have the units in 2001. The other two units went to the Garrison Project so that four crews could run surveys daily. A new report was added to the TESDMS in 2002, "Nest Timeline." This report shows the estimated nest hatching date and brood fledging date by species and reach. This information was used by the Corps' Water Management Center to administer water releases from the dams more efficiently.

TABLE 7
RESULT OF 2002 ADULT CENSUS AND
MONITORING EFFORTS OF THE
INTERIOR LEAST TERN

	Adult Census	Nests	Nest Hatched	Nest (a) Success	Total Chicks Fledged	Fledge (b) Ratio
Fort Peck Lake	0	0	0	0.0	0	0.00
Missouri River Below Fort Peck Dam	34	23	10	43.5	10	0.59
Lake Sakakawea	21	17	12	70.6	9	0.86
Missouri River below Garrison Dam	126	77	64	83.1	115	1.83
Lake Oahe	106	58	42	72.4	70	1.32
Missouri River below Fort Randall Dam	84	71	25	35.2	30	0.71
Lewis and Clark Lake	46	37	13	35.1	24	1.04
Missouri River below Gavins Point Dam	314	216	157	72.7	207	1.32
Total	**731**	**499**	**323**	**64.7**	**465**	**1.27**

(a) = nests per 100 attempts
(b) = fledged chicks per pair of adult birds (doesn't include collected fledged)

TABLE 8
RESULT OF 2002 ADULT CENSUS AND
MONITORING EFFORTS OF THE
PIPING PLOVER

	Adult Census	Nests	Nest Hatched	Nest (a) Success	Total Chicks Fledged	Fledge (b) Ratio
Fort Peck Lake	2	1	1	100.0	2	2.00
Missouri River Below Fort Peck Dam	2	1	0	0.0	0	0.00
Lake Sakakawea	469	218	193	88.5	388	1.65
Missouri River below Garrison Dam	119	88	55	62.5	121	2.03
Lake Oahe	203	100	85	85.0	219	2.16
Missouri River below Fort Randall Dam	35	31	8	25.8	18	1.03
Lewis and Clark Lake	44	24	17	70.8	37	1.68
Missouri River below Gavins Point Dam	260	161	126	78.3	288	2.22
Total	**1134**	**624**	**485**	**77.7**	**1073**	**1.89**

(a) = nests per 100 attempts
(b) = fledged chicks per pair of adult birds (doesn't include collected fledged)

Nest sites located on the Missouri River and reservoirs were mapped using GPS equipment and hand drawn site maps. The nest site data was then incorporated into the U.S. Army Corps of Engineers, Omaha District, Geographic Information System (GIS). Nest sitemaps can be obtained by contacting the Omaha District's Threatened and Endangered Species Section.

Measure 1.2. Monitoring information

a. **Total number of nests and nest fates**
b. **Total number of fledged chicks/pair and other chick fates**
c. **Elevation of nests above water level**

TABLE 9
TOTAL NUMBER OF NESTS AND NEST FATES
FOR PIPING PLOVER AND INTERIOR LEAST TERN
FOR THE YEAR 2002

	Piping Plover	**Interior Least Tern**
Total Nests	624	499
Hatched	485	323
Collected	3	6
Destroyed Flooded	25	17
Destroyed Weather	18	21
Destroyed Predation	21	43
Destroyed Human Disturbance	10	1
Destroyed Livestock	1	0
Destroyed Bank Erosion	1	3
Destroyed Unknown Cause	24	22
Fate Unknown	16	30
Abandoned	18	26
Non-viable Eggs	2	7

The total number of fledged chicks/pair and other chick fates for piping plover is 1,073 fledglings/567 adult pairs. For the least tern, the number of fledged chicks/pair and other chick fates is 465 fledglings/365.5 adult pairs.

During site visits, nest elevations were determined as being eighteen inches above or below the water level. Those found to be below eighteen inches elevation were flagged in TESDMS. The nests were then closely monitored by the Threatened and Endangered Species Section and the Water Management Section to prevent loss from flooding.

Measure 2. Compile and evaluate the previous impacts to take from:

Measure 2.1. Daily and hourly release fluctuations below dams
Measure 2.2. Changes in releases due to maintenance or other isolated causes
Measure 2.3. Changes in releases to prevent downstream flood impacts

This is a major work effort requiring considerable effort including significant data entry, review of past operational scenarios, and significant data analysis. A report is anticipated to be done in November 2003.

Measure 3. The Corps shall continue to evaluate operational changes to avoid take.

The following is a summary of reservoir regulation activities for threatened and endangered species and fish population enhancement taken from the 2001-2002 AOP.

Fort Peck will have a 4,000 cfs reduction in flows during the tern and plover nesting season for Upper Decile runoff and a 5,000 cfs reduction for the Upper Quartile scenario. The resulting stage difference will provide excellent nesting habitat. Median runoff and below will have a constant 8,500 to 9,000 cfs discharge through the nesting season. This release scenario should result in good habitat conditions for nesting terns and plovers.

If flood flows enter the Missouri River below the project during the nesting season, hourly releases will be lowered to no less than 3,000 cfs in order to keep traditional riverine fish rearing areas continuously inundated while helping to lower river stages at downstream nesting sites. April releases should be adequate for trout spawning below the project. A rising pool in the April-to-May sport fish spawning season will be dependent upon the ever changing daily inflow pattern to the reservoir but appears possible with all AOP Simulations. The T&E flow modification "mini-test" will only be possible under the Upper Decile and Upper Quartile runoff scenarios. The test involves releasing water though the spillway for 4 weeks beginning in late May or early June. Fort Peck Lake must be at elevation 2229 msl to allow releases through the spillway.

Garrison will have a reduction in flows during the tern and plover nesting season under all runoff scenarios. The reductions will be in the 500 to 1,000 cfs range. Hourly peaking will be limited to no more than 30,000 cfs for 6 hours if the daily average release is lower than 28,000 cfs. This will limit peak stages below the project for nesting birds.

Lake Sakakawea elevations will not reach levels considered necessary for optimum fish spawning during the month of May for any of the runoff scenarios. In addition to the runoff conditions, the actual timing of the rise in lake elevation will be dependent upon the pattern of inflow at that time.

Oahe releases in the spring and summer will back up those from Gavins Point. Oahe's elevation in the spring will be steady or rising given median or higher runoff. Under all AOP Simulations, the Oahe pool will fall during the summer.

Fort Randall will be operated to provide for a pool elevation near 1355 during the fish spawn period, and the lake will not be drawn down below elevation 1337.5 feet msl in the fall to ensure adequate supply for water intakes. Hourly releases from Fort Randall, during the 2002 nesting season will be limited to 37,000 cfs. Daily average flows may be increased every third day to preserve the capability of increasing releases later in the summer if conditions turn dry.

For the Upper Quartile and below scenarios, based on the results of last year's operation, releases will not be increased at Gavins Point in May when terns and plovers begin to

initiate nesting. The release rate will be based on an assessment of flows needed to support the immediate navigation target. This will result in increased flows during the nesting season. Based on 2001 nesting season results, it is anticipated that sufficient habitat will be available above the release rates to provide for successful nesting thereby saving water in the upstream reservoirs. A steady release rate will be undertaken for the Upper Decile condition. The release would be set in mid-May at the flow anticipated to be needed to evacuate excess flood storage from the System. The resulting steady release prevents inundation of nests and chicks. Flows during the nesting season will be near or above what they were this past nesting season for all runoff conditions. Cycling releases every third day is not planned during the 2002 nesting season except during downstream flood control operations.

The Gavins Point pool will be operated near 1206.0 feet msl in the spring and early summer with variations day to day due to rainfall runoff. Greater fluctuations occur in the river, increasing the risk of nest inundation in the upper end of the Gavins Point pool. Several factors contribute to the increased risk of nest inundation in the upper end of the Gavins Point pool. First, because there are greater numbers of endangered species nesting below the Gavins Point project that must be preserved, Gavins Point releases are restricted during the nesting season. Second, unexpected rainfall runoff between Fort Randall and Gavins Point can result in sudden pool rises because the Gavins Point project has a smaller storage capacity than the other System reservoirs. Third, the operation of Gavins Point for downstream flood control may necessitate sudden release reductions to prevent downstream bird losses. And finally, high releases recommended in wet years make nest inundation more likely. When combined, all these factors make it difficult and sometimes impossible to prevent inundation of nests in the upper end of Lewis and Clark Lake. The pool will be increased to elevation 1208.0 feet msl following the nesting season.

Measure 4. The Corps shall follow the "Contingency Plan for Protection of Least Tern and Piping Plover Nests and Chicks" and the "Captive Rearing Protocol"

Measure 4.1. Continue captive rearing program, coordinate with Service

The Corps continued to operate the captive rearing facility in 2002. Refer to Tables 10 through 13 for a summation of captive rearing activities, egg fates and release information for piping plovers and least terns. In 2002, Canada and the United States (US) cooperated in an operation to salvage piping plover eggs threatened by inundation on Lake Diefenbaker, Saskatchewan. Above normal rainfall in the region resulted in record water levels in the reservoir. All attempts were made to maintain viable nesting sites. With permission from the Service, personnel from Environment Canada's Canadian Wildlife Services collected eggs for transport to the Corps Captive Rearing Facilities in Yankton. Permits were obtained from the Canadian government under authority of, "The Wildlife Act." State, Convention on International Trade in Endangered Species (CITES) and Endangered Species Federal permits were obtained to allow the transport of eggs across international borders. Both eggs and chicks had to clear customs inspection during transport. Enbridge Pipeline Inc. of Canada funded the

flights to the US and the chicks return to Canada. Fledged juveniles were returned to Chaplin Lake, a Western Hemisphere Shorebird Reserve south of Lake Diefenbaker for release.

The rescue was part of the Canadian Piping Plover Recovery Plan, which has a goal of recovering the species and increasing their numbers in the Canadian prairie region. The story engendered a lot of news coverage. A front-page article appeared in the July 19, 2002 Omaha World Herald. The Canadian media covered the July 29, 2002 release of the piping plovers at Chaplin Lake extensively. Environment Canada estimated the Media Reach (potential number of people reached) from 4 newspaper articles, 2 radio stations, and 4-television stations coverage to be:

Print (southern Saskatchewan)	80,000
Radio / TV (Sask / Manitoba / Alberta)	300,000
TOTAL number of people:	**380,000**

Combining Canada's estimates with the coverage in the Omaha World Herald, the cooperative effort and model of international cooperation was well publicized.

Due to increased releases from Fort Randall to meet flow to target releases and subsequent increases, 9 piping plover and 13 least tern eggs were collected. All attempts were made to maintain viable nesting sites per the contingency plan.

TABLE 10
CAPTIVE REARING ACTIVITIES
FOR 2002

Species	**Date Collect**	**Reach**	**Site**	**Eggs**	**Reason Collected**
Piping Plover	20-23 June 2002	N/A	Lake Diefenbaker, SK, Canada	(79)*	Rising Lake Level
Piping Plover	1 July 2002	Ft. Randall	RM 869 RM 854 RM 851.6	9	Increase Releases from Fort Randall
Least Tern	1 July 2002	Ft Randall	RM 869 RM 854	13	Increase Releases from Fort Randall
Total				**(79) 22**	

Notes:
Numbers in parenthesis are for activities conducted for outside the US

TABLE 11
2002 EGG FATES

Species	Hatching Success	Fledging Success	Number Released
Piping Plover	77 percent	100 percent	(65)* 9
Least Tern	92 percent	83 percent	10

Note:
Eleven of the Canadian piping plover eggs did not hatch, eight were addled, three infertile. Two Canadian plovers died within 24 hours of hatching, their deaths are attributed to stress from transport. One Canadian plover died in the flight pen. One least tern egg was addled and failed to hatch. Two tern chicks died within 48 hours of hatching (dehydration).
Numbers in parenthesis are for activities conducted for outside the US

TABLE 12
2002 RELEASE INFORMATION
FOR PIPING PLOVER

Number of Birds	Release Date	Reach	Site Name
(52)	31 July 2002	N/A	Lake Diefenbaker, SK Canada
4	31 July 2002	Ft. Randall	RM 869
(13)	13 Aug 2002	N/A	Chaplin Lake, SK Canada
5	21 Aug 2002	Gavins Point	RM 795.3
9 Total Birds			

Notes:
Numbers in parenthesis are for activities conducted for outside the US

TABLE 13
2002 RELEASE INFORMATION
FOR INTERIOR LEAST TERN

Number of Birds	Release Date	Reach	Site Name
10	21 Aug 2002	Gavins Point	Lake Diefenbaker, SK Canada

Measure 4.2. Initiate a peer review on Captive Rearing Protocol

The Corps Threatened and Endangered Species personnel initiated contact with members of the American Zoo and Aquarium Association (AZA), State Game Fish and Parks agencies, various universities and the U.S. Fish and Wildlife Service's National Wildlife Health Lab to serve on the peer review team. Once the team is assembled they will meet in Yankton, South Dakota to conduct a focused review of the physical facilities and captive rearing protocols.

Measure 4.3. Continue research into the effectiveness of the captive rearing program

Following is a summary of the captive reared plovers re-sighted during 2002.

1. 19 June 2002: a plover with light blue flag observed by FWS personnel at Nelson Reservoir, Montana

2. 11 June 2002: a plover with a light blue flag on its lower right leg and metal band on its lover left leg observed sitting on nest 027057, at RM 869 within the Fort Randall reach

3. 26 June 2002: a plover with light blue flag found dead after severe storm at RM 833 at Lewis and Clark Lake. USFWS band # 1001-20836. This was a wild reared bird banded as part of the captive rearing study (1998-2000)

4. 15 May 2002 and 11 June 2002: a plover with a light blue flag (upper left) and a plover with a light blue flag (upper right) was observed at RM 756.7 within Gavins Point reach

5. 19 June 2002 and 26 June 2002: a plover with a light blue flag (upper left) was observed at RM 756.8

6. 27 June 2002: a plover with a light blue flag (upper right) was observed at RM 759, some green paint was also visible from on the flag, which indicates it was banded during the captive rearing study (1998-2000)

Measure 5. The Corps shall implement public information and educational programs to increase public awareness and reduce disturbance to nesting sites

Public information and educational programs:

In addition to the media coverage of the Canadian "piping plover rescue' the Gavins Point Project Office conducted an interpretive program on endangered species during the summer of 2002.

Human disturbance reduction measures:

Lake Sakakawea:

The Williston Office reconstructed barriers and placed a "road closed" sign at the Little Egypt Recreation Area parking lot to prevent off road vehicles from accessing the shoreline near a piping plover nesting site. The Riverdale Office fenced off the West Totten boat ramp parking lot to prevent off road vehicles from accessing the West Totten piping plover nesting area.

Missouri River below Garrison Dam:

Restriction signs were placed around nesting sites on sandbars at RM 1361.0, 1319.5, 1319.3 and 1308.0

Lake Oahe:

"No off road vehicle" signs were put up along the banks of Blue Blanket (RM 1189), Moose Flats (RM 1197), Kenel (RM 1231), and State Line (RM 1232). "Do Not Enter-Endangered Species" signs were put up at the old railroad grade (RM 1199). "No Trespassing" signs were put up at Fort Manuel (RM 1229) and Demery Island (RM 1231.5). Okobojo Creek sites were signed and fenced with baling twine.

Missouri River below Fort Randall Dam:

Islands at River Miles 833.0, 848.5, 854.0, 854.5, and RM 869.0 were fenced and signed. A deterrence patrol was conducted on July 4th and 5th from River Mile 880.0 to River Mile 848.5.

Lewis & Clark Lake:

Restriction signs and orange twine fencing were placed around nesting sites at River Mile 833.0

Missouri River below Gavins Point Dam:

Restriction signs and orange twine fencing were placed around nesting sites on sandbars at River Miles 801.5, 798.0, 797.7, 795.3, 794.0, 788.5, 778.7, 777.7, 759.0 and 756.7. Law enforcement officers from the U.S. Fish & Wildlife Service, South Dakota Game, Fish & Parks Department and personnel from the Corps of Engineers did deterrence patrols on July 4th and July 5th from River Mile 806.0 to River Mile 756.0.

U.S. Fish & Wildlife Service special agents in Sioux Falls SD, Pierre SD and Bismarck ND were given access to the Threatened and Endangered Species Data Management System to track nesting activity.

Measure 6. The Corps shall implement aversive action to reduce predation on least tern

In 2002, 227 piping plover nests were caged to protect the nests from predators. Of these, 187 hatched for a nest success of 82.4%. In 2002, 397 plover nests were not caged. Of these, 298 hatched for a nest success of 75.1%.

Pallid Sturgeon

Measure 1. The Corps shall evaluate and modify operational changes and maintenance activities to avoid take

Operational changes that would impact sturgeon are primarily associated with flows. These flow changes are being evaluated as part of the Master Manual EIS process and will be part of the final EIS.

Measure 2. The Corps shall increase awareness of the pallid sturgeon on the Missouri River and develop support for recovery and conservation measures

Threatened and endangered species have been incorporated into the Corps interpretive programs at the projects along the Missouri River system. Project visitor centers highlight the three species of focus providing information regarding their life histories and current status. A brochure is under revision providing information and awareness for the public regarding these species. This brochure is scheduled for completion and dissemination in 2003.

The Gavins Point Aquarium (located at the Gavins Point National Fish Hatchery) has developed a touch screen system for visitors to learn more regarding threatened and endangered species and increase public awareness. Specific sections were developed in 2002 for the pallid sturgeon, the interior least tern and the piping plover. This system will be functional for the 2003 visitation season (April 2003).

Pallid sturgeon stocking events included multiple agencies in the lower Missouri River. In conjunction with the Missouri River Natural Resource Conference in April, a ceremonial stocking was held at the Ponca State Park in Nebraska. The Corps' Omaha District Engineer, Colonel Ubbelohde along with the Service's Mary Gessner and John Blankenship (Region 6) stocked pallid sturgeon as part of a media event featuring the cooperation between the agencies targeting recovery of the endangered pallid sturgeon. Several other folks participated in the stocking event. Media stocking events were also held in conjunction with pallid sturgeon stocking efforts at the Franklin Island State Park near Booneville, Missouri. These events were captured by journalists and have made the press throughout the Missouri River system.

Pallid sturgeon propagation and augmentation, population assessment and research activities are presented to Upper and Middle Basin Pallid Sturgeon Workgroups annually.

Handling protocols developed by the Pallid Sturgeon Recovery Team have been incorporated into all Corps supported pallid sturgeon projects to ensure that "take" is not occurring. Teams developing standardized sampling have made recommendations to the Recovery Team to modify, clarify, and update handling protocols.

Conservation Recommendations

Recommendations Applicable to Single Species

1. **Bald Eagle**
2. **Least Tern and Piping Plover**
3. **Pallid Sturgeon**

Pallid Sturgeon

3. Assist the Service and State's with identifying impacts and extent of commercial harvest in the basin on pallid sturgeon.

The Missouri Department of Conservation has been conducting sturgeon surveys through intensive winter gill netting efforts in the lower Missouri and middle Mississippi Rivers for since 1999. Catch per unit effort data in shovelnose and pallid sturgeon have showed a dramatic decline since the beginning of this sampling effort. Sex ratios in shovelnose sturgeon are currently 5:1 (male to female). During this time, commercial fishing harvest for flesh and caviar markets have increased on these systems in response to the closure of foreign commercial harvest of sturgeon and the collapse of the Soviet Republic. In addition to this information, law enforcement officers of the Missouri Department of Conservation found two pallid sturgeon at the residence of what they had considered to be a "trustworthy" commercial fisherman. The Missouri Department of Conservation is actively pursuing the closure of commercial harvest on the lower Missouri River.

4. Provide funding to continue development and conduct sturgeon genetic techniques to ensure genetic variation.

Dr. Bernie May, University of California (Davis) has conducted genetic analysis of adult pallid sturgeon to maximize the genetic variability in supplementation progeny by crossing the most unrelated parents. Each year, the adult pallid sturgeon captured for use in the propagation and augmentation program are analyzed. Genetic pairing recommendations are provided to the facilities to maximize the genetic variation of the progeny. This effort will be incorporated directly into the pallid sturgeon propagation and augmentation program in 2003.

8. Evaluate the cumulative effects of bank stabilization. The cumulative programmatic EIS was scoped to include all bank stabilization projects, not just those potentially constructed under the Section 33 program. The contract was renewed for another year of study. A draft of the study is anticipated in early 2004.

10. Participate as a partner in regional pallid sturgeon recovery work groups.

The Corps' Biologists are regular and active participants in the Upper and Middle Basin Pallid Sturgeon Workgroups. These workgroups have served as a network for all pallid sturgeon projects. Partnerships have been developed within these workgroups to facilitate the development of standard operating procedures for the pallid sturgeon population assessment program. This program incorporates a fish community approach as recommended within the Bi-Op. Additionally, the Corps is directly involved in prioritization exercises conducted through these Workgroups.

13. Assist the USFWS and other partners with fish health issues as they relate to pallid sturgeon.

Representative fish health sampling of propagated pallid sturgeon is required by the Service and in some cases by State fish health policies at each facility involved in culture efforts of pallid sturgeon. The Propagation Plans that were developed by the Pallid Sturgeon Propagation Workgroup have adopted the guidelines established by the State and Federal Agencies current policies. The Missouri River Iridovirus has been an obstacle in achieving stocking goals since the late 1990's. The virus has been detected at facilities in Montana, North Dakota, South Dakota, Missouri and in the "wild" in hybrid pallid/shovelnose sturgeon in the lower Mississippi River. The virus is believed to be naturally occurring. Ongoing efforts to develop a more accurate methodology for analyzing samples for the iridovirus are being explored by the University of California, Davis and the Bozeman Fish Health Center (USFWS). Polymerase Chain Reaction (PCR) testing has been developed and used diagnostically for an iridovirus common in White Sturgeon. This methodology is highly accurate and reliable; however, unique cell lines of the virus must be isolated and tested to develop the PCR test specific to the Missouri River Iridovirus. Current techniques rely on histology thus reducing the likelihood of detection.

14. Assist the USFWS and other partners with cryopreservation banking of pallid sturgeon sperm.

Through the propagation and augmentation program, the Propagation Workgroup identified the need for increased cryopreservation capabilities. As a result, cryopreservation capabilities were increased throughout the Missouri River basin. All 6 of the facilities rearing pallid sturgeon are now equipped with at least one 35 liter milt storage unit. This upgrade provides increased storage capabilities to ensure that milt is available for perpetuation of future genetic stocks. All systems are alarm equipped to notify staff prior to reaching critical levels of liquid nitrogen in the storage units. This enhancement will enable the storage of backups of each preserved genetic sample at a minimum of two facilities to protect against loss of individual genetic samples.

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Appendix A: Missouri River Mitigation Annual Implementation Report

US Army Corps of Engineers ®

Missouri River Bank Stabilization and Navigation Project, Fish and Wildlife Mitigation Project

View of the new side channel constructed at the mitigation site located at the Deroin Bend Conservation Area, Atchison and Holt Counties, Missouri

Annual Implementation Report
January 2003

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INTRODUCTION

AUTHORITY

This report presents the current status and future plans for implementation of the Missouri River Fish and Wildlife Mitigation Project, Iowa, Nebraska, Kansas, and Missouri, hereinafter referred to as the "Project". Congress first authorized construction of the Project in Section 601(a) of the Water Resources Development Act of 1986 (Public Law 99-662). The authorization included acquisition and development of 29,000 acres of land, and habitat development on an additional 18,200 acres of existing public land in the States of Iowa, Nebraska, Kansas and Missouri. The total amount of land authorized for mitigation was 48,100 acres.

In 1999, Congress passed another WRDA bill. Section 334(a) of the Water Resources Development Act of 1999 included modifying the Project by increasing the amount of acreage to be acquired and/or restored by 118,650 acres. Thus the new total amount of land authorized for mitigation is currently 166,750 acres.

BACKGROUND

The original authorization for the Project was based upon a report of the US Army Corps of Engineers, Chief of Engineers, dated April 24, 1984, entitled Missouri River Bank Stablilization and Navigation Project Final Feasibility Report and Final EIS for the Fish and Wildlife Mitigation Plan. The authority to prepare the Feasibility Report was the 1958 Fish and Wildlife Coordination Act (P.L. 85-624). The Final Feasibility Report described the fish and wildlife and habitat losses that have, and will, occur due to the Missouri River Bank Stabilization and Navigation Project. Also described in the Report are various measures to mitigate for these losses and a recommended plan to restore, preserve, or develop 48,100 acres of habitat.

This project is 100 percent Federally funded for real estate, design, construction, and operation and maintenance. However, even though there is not a cost share sponsor, Federal and State fish and wildlife agencies participate in the implementation of the Project. The agency participation is primarily through an Agency Coordination Team that was developed to formulate and decide upon the various acquisition sites and appropriate development plans for the sites. Participants include the Iowa Department of Natural Resources, the Nebraska Game and Parks Commission, the Kansas Department of Wildlife and Parks, the Missouri Department of Conservation, the Environmental Protection Agency, and the U.S. Fish and Wildlife Service.

Approximately 60 percent of the original project is within the Kansas City District (CENWK) and 40 percent within the Omaha District (CENWO). For ease of dealing with the affected states, CENWK is working on sites in Missouri and Kansas, while CENWO is responsible for all Nebraska and Iowa sites.

Preconstruction Engineering and Design (PED) for the Project was initiated in December 1989. As a part of PED work, a "Reaffirmation Report" for implementation of the Project was completed. The Reaffirmation Report was approved by the Corps of Engineers' Missouri River Division in August, 1990. The purpose of the Reaffirmation Report was to confirm that the plan recommended in the 1984 Feasibility Report and Final EIS was still viable. PED was completed in September 1991 and this Project has been in a "Construction" status since that time. The Reaffirmation Report explains the various aspects of the Project such as the approval process, funding levels, costs, schedules, documentation and involvement of other State and Federal agencies. In accordance with the Reaffirmation Report, Annual Implementation Plans are required to be created.

A "Real Estate Design Memorandum No. 1" for land acquisition activities for the Project was completed by the Kansas City District in March 1990. This report was endorsed by the Corps of Engineers' Missouri River Division in July 1990, and approved by Corps of Engineers' Headquarters in May 1991. This report established the real estate requirements for the acquisition in fee or easement of 29,900 acres of privately owned lands and for any real estate requirements for development of 18,200 acres of existing public lands within the four affected States.

WRDA 99 expanded the amount of acres authorized for the project from 48,100 acres to a new total of 166,750 acres. This is a significant change to the project and an update to the original EIS was required. In August 2001, the Corps of Engineers began to prepare a Supplemental Environmental Impact Statement (SEIS). The draft SEIS was published in September 2002. The Final SEIS is currently being prepared.

The Corps of Engineers worked with the Agency Coordination Team to develop a cost estimate to implement the additional acres authorized by WRDA99. In December 2001, the Corps completed a document titled "Missouri River Mitigation Project, Missouri, Kansas, Iowa, and Nebraska, Report to Congress, in Compliance with the Water Resources Development Act of 1999". This document presented a cost range of modified Project of from $740 million (includes development of 7,000 acres of shallow water habitat) to $1.33 billion (includes development of 20,000 acres of shallow water habitat).

In November 2000, the US Fish and Wildlife Service issued a Biological Opinion (Bi-Op) to the Corps of Engineers for impacts to the pallid sturgeon by construction and operation of the Bank Stabilization and Navigation Project. The Bi-Op stated that the Corps had severely altered, and continue to alter, the natural hydrology and shallow water habitat on the Missouri River within the Project area. The Bi-Op stated that the Corps has to perform "Reasonable and Prudent

Alternative" actions to restore, enhance and conserve shallow water habitat in the amount of 20-30 acres per mile for the 735 mile Project area.

In September 2002, the Corps drafted "Supplement No. 1 to Real Estate Design Memorandum No. 1". This update included the new acres of the expanded mitigation program. This document stated that the acquisition of additional lands for the project will not reflect a defined amount to be acquired between public or private acres. Also, this document assumed that the additional acres will be equally proportioned by state based on the amount of riverbank miles.

REPORT PURPOSE AND FORMAT

Programmatic updates of the Reaffirmation Report are accomplished through Annual Implementation Reports. This document is the ninth such report. The purpose of the Annual Implementation Reports is to create an administrative record of mitigation efforts that have already occurred, complete a status of the mitigation efforts that are underway, and outline a plan for continued mitigation in the future.

This report is divided into three main parts: Past Mitigation Efforts for FY02 and Prior, Current Mitigation Efforts, FY03, and Future Mitigation Efforts FY04 to Completion. Within these three main parts, the four main elements of the Project (Real Estate, Habitat Development, Operation and Maintenance, and Monitoring and Evaluation) are detailed. Thus, this report is a programmatic effort to explain the past activities, current status, and future activities for the entire mitigation effort for both the Omaha and Kansas City Districts.

PAST MITIGATION EFFORTS FOR FY02 AND PRIOR

FUNDING (FY02 and Prior)

As of 30 Sep 02, the only funds budgeted for this project were based upon the WRDA86 authorized 48,100 acres. It is required that the proper NEPA documentation be completed prior to budgeting for and requesting funds on the modified project. Therefore, the funding amounts for FY02 and Prior were provided for the original authorized WRDA86 project only.

The original WRDA86 authorized project divided the funding up into broad categories: Land Acquisition; Planning, Engineering and Design; Habitat Development; Construction Management; and O&M During Construction costs. Funds for Monitoring and Evaluation were considered a minor part of the project and were therefore provided under Design and Construction Management categories. Construction, General funds began to be provided in Fiscal Year 1992. From FY92 through FY02, the Corps has spent a total amount of $73,039,000 on the mitigation efforts. Table 1 gives a breakdown of costs expended by category.

TABLE 1

BREAKDOWN OF TOTAL COSTS TO DATE (AS OF 30 SEP 02)

Cost	CENWK (1,000)	CENWO (1,000)	TOTAL (1,000)	% of Total Cost
Land Acquisition	$19,808	$12,510	$32,318	44
Planning, Engineering, and Design	7,554	4,539	12,093	17
Habitat Development	9,656	14,606	24,262	33
Construction Management	1,174	1,630	2,804	4
O&M During Construction	678	884	1,562	2
TOTAL	**$38,870**	**$34,169**	**$73,039**	**100**

Note: Information in this table is estimated because database is inoperable during FY03 Continuing Resolution Authority funding period.

REAL ESTATE (FY02 and Prior)

Non-Public Lands Authorized by WRDA86.

As stated previously, the original authorized Project allowed for acquisition of 29,900 acres of privately held land. During the Feasibility effort, it was clear that each State had been affected by the Bank Stabilization and Navigation Project (BSNP). Through coordination with the four affected States and the U.S. Fish and Wildlife Service, the 29,900 acres was divided up between the States proportional to the amount of fish and wildlife losses attributed to each State. An additional effort was completed in order to distribute the lands between habitat types. However, now that the project has been underway, shifting of some of the lands between the States to accommodate timing of willing sellers, availability of public lands, etc. was necessary. The current approved plan for the 29,900 acres is indicated in Table 2.

TABLE 2

ACQUISITION OF NON-PUBLIC LANDS
TOTAL AUTHORIZED BY WRDA86

State	Preserve Existing Aquatic Habitat (ac)	Acquire & Develop New Aquatic Habitat (ac)	Acquire & Develop New Terrestrial Habitat (ac)	Total (ac)	Percentage
Missouri	--	1,150	12,050	13,200	44
Kansas	--	100	2,250	2,350	8
Iowa	200	200	6,800	7,200	24
Nebraska	--	250	6,900	7,150	24
TOTAL	**200**	**1,700**	**28,000**	**29,900**	**100**

During the public involvement process for the EIS and Feasibility Report for the Project, a policy of obtaining lands only from willing sellers was established. The Corps of Engineers maintains their authority for condemnation, however, it has been agreed that this authority will not be used on the Project so as to minimize the impacts on future acquisitions. Other real estate criteria have been developed to guide the acquisition process to insure the best possible results. These are discussed in detail in the "Real Estate Design Memorandum No. 1."

Working with the Agency Coordination Team, the Corps of Engineers developed a list of priority acquisition sites that have potential for wildlife mitigation. With the priority in hand, the Corps completed a survey of willing sellers near the priority areas. These planning efforts identified sufficient amount of lands to accomplish the original authorized project. As of 30 Sep 02, 25,177 acres of non-public land has been acquired for the Project. This is 84 percent of the 29,900 acres originally authorized. The status of the acquisition of non-public lands as of 30 Sep 02 (FY02 and prior) is displayed in Table 3.

TABLE 3

ACQUISTION OF NON-PUBLIC LANDS
TOTAL ACQUIRED BY STATE
(AS OF 30 SEP 02)

State	Authorized WRDA 86 (ac)	Total Acquired as of 30 Sep 02 (ac)	Percentage of Authorized Amount	Amount Remaining to be Acquired to meet WRDA 86 (ac)
Missouri	13,200	12,741	97	459
Kansas	2,350	2,111	90	239
Iowa	7,200	3,310	46	3,890
Nebraska	7,150	7,015	98	135
TOTAL	**29,900**	**25,177**	**84**	**4,723**

As of 30 Sep 02, real estate has been acquired from willing sellers at twenty-two locations that were formerly non-public lands. The title for these lands were obtained in fee and the ownership is now held by the Corps of Engineers. Nine of the locations are within the State of Missouri, one is in Kansas, six are in Iowa, and six are in Nebraska. A breakdown by site of the amount of non-public land acquired for mitigation for the States of Missouri, Kansas, Iowa, and Nebraska are given in Tables 4, 5, 6 and 7, respectively. Locations of these sites are given in the Location Maps as a part of Appendix 1.

TABLE 4

ACQUISITION OF NON-PUBLIC LANDS
TOTAL ACQUIRED WITHIN STATE OF MISSOURI
(AS OF 30 SEP 02)

Missouri Sites	Location	Approx. River Mile	Descending Bank	Total Acquired (ac)
Berger Bend	Franklin County	93 – 90	R	414 (1)
Corning	Holt County	518 – 512	L	1,193 (1)
Lower Hamburg Bend	Atchison County	554 – 546	L	2,265 (1)
Nishnabotna	Atchison County	545 – 537	L	1,283 (1)
Overton Bottoms - North	Cooper County	188 – 185	R	1,355
Overton Bottoms - South	Cooper, Moniteau Counties	185 – 178	R	3,662
Rush Bottom Bend	Holt County	502 – 499	L	775 (1)
Tate Island	Callaway County	113 – 110	L	422
Thurnau	Holt County	512 – 508	L	1,372 (1)
TOTAL				**12,741**

(1) Acquisitions are still underway at this site

TABLE 5

ACQUISITION OF NON-PUBLIC LANDS
TOTAL ACQUIRED WITHIN STATE OF KANSAS
(AS OF 30 SEP 02)

Kansas Sites	Location	Approx. River Mile	Descending Bank	Total Acquired (ac)
Benedictine Bottoms	Atchison County	429 – 424	R	2111
TOTAL				**2,111**

TABLE 6

ACQUISITION OF NON-PUBLIC LANDS
TOTAL ACQUIRED WITHIN STATE OF IOWA
(AS OF 30 SEP 02)

Iowa Sites	Location	Approx. River Mile	Descending Bank	Total Aquired (ac)
Auldon Bar	Harrison County	580 – 577	L	588 (1)
Blackbird Bend	Monona County	697 - 694	L	223 (1)
Copeland Bend	Fremont County	571 – 565	L	1,092 (1)
Louisville Bend	Monona County	685 – 682	L	84
Noddleman Island	Mills County	587 – 583	L	1,232 (1)
Tieville Bend	Monona County	694 – 692	L	91
TOTAL				**3,310**

(1) Acquisitions are still underway at this site

TABLE 7

ACQUISITION OF NON-PUBLIC LANDS
TOTAL ACQUIRED WITHIN STATE OF NEBRASKA
(AS OF 30 SEP 02)

Nebraska Sites	Location	Approx. River Mile	Descending Bank	Total Aquired* (ac)
Hamburg Bend	Otoe County	556 – 552	R	1,544 (1)
Kansas Bend	Nemaha County	547 – 544	R	1,056 (1)
Langdon Bend	Nemaha County	532 - 528	R	921 (1)
Middle Decatur Bend	Burt County	689 – 686	L	876
Tieville Bend	Burt County	694 – 692	L	1,014
Tobacco Island	Cass County	589 – 586	R	1,604 (1)
TOTAL				**7,015**

(1) Acquisitions are still underway at this site

Existing Public Lands Authorized by WRDA86

In addition to the acquisition of mitigation sites on non-public lands, the WRDA86 authorization allowed for restoration and development of mitigation sites on 18,200 acres of existing public land. For habitat development on existing public lands, "no cost" easements are being obtained to allow the Corps of Engineers to construct Project features on land not owned by the Corps.

Through coordination with the four affected States and the U.S. Fish and Wildlife Service, the amount of public land was distributed by State and between habitat types. However, shifting of some of the public lands between the States was necessary to accommodate availability of public lands, etc. The current approved plan for the 18,200 acres of existing public land authorized under WRDA86 is indicated in Table 8.

TABLE 8

EXISTING PUBLIC LANDS
TOTAL AUTHORIZED TO BE RESTORED/DEVELOPED UNDER WRDA 86

State	Preserve Existing Aquatic Habitat (ac)	Acquire & Develop New Aquatic Habitat (ac)	Acquire & Develop New Terrestrial Habitat (ac)	Total (ac)	Percentage
Missouri	0	550	15,200	15,750	87
Kansas	0	0	0	0	0
Iowa	500	200	1,700	2,400	13
Nebraska	0	50	0	50	0
TOTAL	**500**	**800**	**16,900**	**18,200**	**100**

Currently, there is a lack of public land within the Project area in the States of Kansas and Nebraska. However, through coordination with the four affected States and the US Fish and Wildlife Service, existing public lands were studied for potential development. A list of priority for mitigation was completed and included into the decisions of funding and scheduling of development.

As of 30 Sep 02, easements and/or licenses have been obtained on 10,855 acres of existing public land for the Project. This is 60 percent of the 18,200 acres originally authorized. The status of obtaining easements and/or licenses on existing public lands as of 30 Sep 02 (FY02 and prior) is displayed in Table 9.

TABLE 9

EXISTING PUBLIC LANDS
TOTAL EASEMENTS/LICENSES ACQUIRED BY STATE
(AS 30 SEP 02)

State	Authorized WRDA 86 (ac)	Total Acquired as of 30 Sep 02 (ac)	Percentage of WRDA86	Amount Remaining to be Acquired to meet WRDA 86 (ac)
Missouri	15,750	7,527	48	8,223
Kansas	0	0	100	0
Iowa	2,400	3,195	187	-795
Nebraska	50	133	266	-83
TOTAL	**18,200**	**10,855**	**60**	**7,345**

As of 30 Sep 02, existing public land has been acquired through no-cost easements at twenty-one locations along the river. These easements were taken on lands already owned by Federal and State agencies. Fourteen sites are within the State of Missouri, six sites are in Iowa, and one site is in Nebraska. There are no mitigation sites established to date on existing public lands in the State of Kansas. A breakdown by site of the amount of easements taken on existing public land in the States of Missouri, Iowa, and Nebraska are given in Tables 10, 11 and 12, respectively.

TABLE 10

EXISITING PUBLIC LANDS
TOTAL EASEMENTS/LICENSES ACQUIRED WITHIN STATE OF MISSOURI
(AS OF 30 SEP 02)

Missouri Sites	Location	Approx. River Mile	Descending Bank	Total Acquired (ac)
Berger Bend	Franklin County	93 - 90	R	60 (2)
Columbia Bottom	St. Louis County	4 - 0	R	4,108 (1)
Corning	Holt County	518 – 512	L	695 (1,2)
Deroin Bend	Atchison and Holt Counties	520 – 517	L	1,082
Eagle Bluffs	Boone County	174 – 170	L	571
Grand Pass	Saline County	273 – 266	R	5
Marion Bottoms	Cole County	164 – 158	R	0 (4)
Nishnabotna	Atchison County	545 – 537	L	1 (3)
Overton Bottoms - North	Cooper County	188 – 185	R	332
Plowboy Bend	Moniteau County	172 – 169	R	0 (4)
Rocheport Cave	Boone County	183	L	51
Rush Bottom Bend	Holt County	502 – 499	L	37 (4)
Thurnau	Holt County	512 – 508	L	0 (1)
Worthwine Island	Andrew County	460 – 456	L	585
TOTAL				**7,527**

(1) Acquisitions are still underway at this site
(2) Acquisition reflects residual fee on an existing WRP easement that was purchased from a private land owner at this site
(3) COE purchased 1.34 acre road easement at this site
(4) Acreage includes lands considered 'Navigational Servitude'

TABLE 11

EXISITING PUBLIC LANDS
TOTAL EASEMENTS/LICENSES ACQUIRED WITHIN STATE OF IOWA
(AS OF 30 SEP 02)

Iowa Sites	Location	Approx. River Mile	Descending Bank	Total Acquired (ac)
Blackbird Bend	Monona County	697 – 694	L	799 (1)
California Bend	Harrison County	652 – 649	L	420
Louisville Bend	Monona County	685 – 682	L	1,012
Middle Decatur Bend	Monona County	689 – 686	L	324
Upper Decatur Bend	Monona County	692 - 689	L	640
Winnebago Bend	Woodbury County	711 - 708	L	0 (2)
TOTAL				**4,495**

(1) Acquisitions are still underway at this site
(2) Winnebago Bend was an existing Corps owned property obtained at no cost to the Project, however funds to develop and maintain habitat have been expended at this site.

TABLE 12

EXISTING PUBLIC LANDS
TOTAL EASEMENTS/LICENSES ACQUIRED WITHIN STATE OF NEBRASKA
(AS OF 30 SEP 02)

Nebraska Sites	Location	Approx. River Mile	Descending Bank	Total Acquired (ac)
Middle Decatur Bend	Burt County	689 - 686	L	133
TOTAL				**133**

All Lands Authorized in WRDA99.

WRDA 99 expanded the amount of acres authorized for the Project from 48,100 acres to a new total of 166,750 acres. This is an increase in authorized acreage in the amount of 118,650 acres. During FY02, the Corps of Engineers continued working on completion of a Supplemental Environmental Impact Statement (SEIS). Once completed, the SEIS will define the Preferred Alternative to acquire and develop the additional acreage for the Project.

Work on how the additional acreage will be distributed has begun. The plan proposed in the SEIS is that the acquisition of additional lands for the Project will not reflect a defined amount to be acquired between public or private acres. Also, it is assumed that the additional acres will be acquired proportionally by state based on the amount of riverbank miles. If acquisitions are completed in this manner, the breakdown of the additional acreage by State is displayed in Table 13, below.

TABLE 13

ACQUISTION OF ALL LANDS
TOTAL AUTHORIZED BY WRDA99

State	Riverbank miles	Number of Affected Counties	All Lands Authorized WRDA99 (ac)	Percentage of WRDA99
Missouri	939	25	75,791	64
Kansas	115	4	9,282	8
Iowa	175	6	14,125	12
Nebraska	241	10	19,452	16
TOTAL	**1,470**	**45**	**118,650**	**100**

Acquisitions against the new authorized acreages will not take place until the SEIS is completed, some time in Spring 2003. Throughout the remainder of the project, the Corps will be working with the Agency Coordination Team to track acquisitions. As the plan changes over the life of the project, the current plan for distribution of the authorized acres as approved by the Agency Coordination Team will be presented annually in future annual reports.

HABITAT DEVELOPMENT (FY02 and Prior)

The intent of this Project is to restore and/or preserve fish and wildlife habitats that were native to the Missouri River floodplain. This, of course, covers an entire array of different habitat types. The Project has completed mitigation of many different habitat types. The variety and implementation of habitats into different areas of the floodplain is part of the development process of the Project. To date, no one species nor one habitat type has been focused upon for restoration. The habitat development has been of an "ecosystem" approach where all habitat types are considered into development decisions.

Restoration and preservation of shallow water aquatic habitat has been accomplished at numerous mitigation sites. This effort has emphasized restoring side channels and chutes and completing within-river improvements. This was accomplished primarily by dike notching, river structure modifications, excavation and dredging. Through 30 Sep 02, shallow water habitats have been created, or work has been started, at 17 mitigation sites.

Reconnecting the floodplain habitats to the river during springtime flood pulses is also a restoration effort that has been emphasized. Several mitigation sites had levees that were close to the river channel. In some cases, the levee was moved landward from the Missouri River. At some locations, such as Overton North, an existing levee was breached in several places to allow high flows to inundate terrestrial habitats and provide valuable organic matter to the river's water. As of 30 Sep 02, reconnecting floodplain habitats to the river have been completed, or work started, at 5 mitigation sites.

Increasing the amount of wetlands within the Missouri River floodplain is a Project goal. Restoration of migratory waterfowl habitat has been accomplished by construction of low dikes, berms, wells, pumps, water delivery systems, and drainage control structures. Through 30 Sep 02, wetland habitats have been created, or work has been started, at 6 mitigation sites.

Development of terrestrial habitat such as bottomland hardwood and prairie grassland habitats has been a key to the restoration of the ecosystem of the Missouri River. Terrestrial habitats support food plot establishment, nesting cover, insect production, and a whole array of necessary biological functions to keep the ecosystem alive and functioning. Development of terrestrial habitat has been dependent upon the type of existing land use and management objectives. The pre-existing land use at many of the new mitigation sites was agricultural production. The terrestrial habitat development to date has included vegetative plantings and land grading. Through 30 Sep 02, bottomland hardwood and prairie grassland habitats have been developed at 14 and 12 mitigation sites, respectively.

Table 14 displays the different habitat types created at each of the mitigation sites established to date. Following Table 14 is a summary of the habitat development efforts at specific mitigation sites. If a particular site is listed in Table 14 as "Undeveloped", then a detailed description is not included. Location maps for all of the mitigation sites can be found in Appendix 1.

TABLE 14

HABITAT TYPES DEVELOPED BY SITE
(AS OF 30 SEP 02)

Site Name	SW	FR	W	P	BH	O	U
Berger Bend, MO							X
Columbia Bottom, MO		X					
Corning, MO							X
Deroin Bend, MO	X			X	X		
Eagle Bluffs, MO		X	X				
Grand Pass, MO	X						
Marion Bottoms, MO	X						
Lower Hamburg Bend, MO							X
Nishnabotna, MO							X
Overton Bottoms – North, MO	X	X	X	X	X		
Overton Bottoms – South, MO		X	X		X		
Plowboy Bend, MO	X						
Rocheport Cave, MO						X	
Rush Bottom Bend, MO							X
Tate Island, MO	X	X			X		
Thurnau, MO							X
Worthwine Island, MO							X
Benedictine Bottoms, KS	X		X	X	X		

SW=Shallow Water, FR=Floodplain Reconnected, W=Wetland, P=Prairie, BH=Bottomland Hardwood, O=Other, U=Undeveloped

TABLE 14 (Continued)

Site Name	SW	FR	W	P	BH	O	U
Auldon Bar, IA							X
Blackbird Bend, IA							X
California Bend, IA	X		X		X		
Copeland Bend, IA							X
Louisville Bend, IA	X			X	X		
Middle Decatur Bend, IA	X			X	X		
Noodleman Island, IA							X
Upper Decatur Bend, IA	X			X	X		
Winnebago Bend, IA	X			X	X		
Hamburg Bend, NE	X		X	X			
Kansas Bend, NE							X
Langdon Bend, NE	X			X	X		
Middle Decatur Bend, NE	X			X	X		
Tieville Bend, NE	X			X	X		
Tobacco Island, NE	X			X	X		
Number of Sites	**17**	**5**	**6**	**12**	**14**	**1**	**12**

SW=Shallow Water, FR=Floodplain Reconnected, W=Wetland, P=Prairie, BH=Bottomland Hardwood, O=Other, U=Undeveloped

Columbia Bottom, Missouri

This mitigation site is 4,108 acres in size and is located just North of St. Louis at the confluence of the Missouri and Mississippi Rivers, RM 0 - 4. The site is on existing public land owned and operated by the Missouri Department of Conservation (MDC). The land at the Columbia Bottom mitigation site was previously farmed. The area is being improved so that wetlands, native grasses, and bottomland hardwood forest habitats can be restored to the area. Due to the size of the site, the mitigation will occur in several phases.

Columbia Bottom, MO
View looking south at the land now on the riverside of newly constructed levee setback.

Phase I, setback of an 8000 linear foot existing levee, was completed in Summer of 2002. The setback moved the existing levee approx. 800 feet from the Mississippi River bank to create an additional 145 acres of land on the riverside of the levee. In the future, this riverward area will be planted with bottomland hardwood trees and shore area may be evaluated for shallow water habitat potential.

Construction of Phase II, development of approx. 800 acres of wetlands, is currently underway and is scheduled to be complete Spring 2004. Phase II includes construction of 15 low dikes, a pump station, and a water delivery system. Once completed, Phase II will allow development of high quality migratory waterfowl habitat.

Tate Island, Missouri

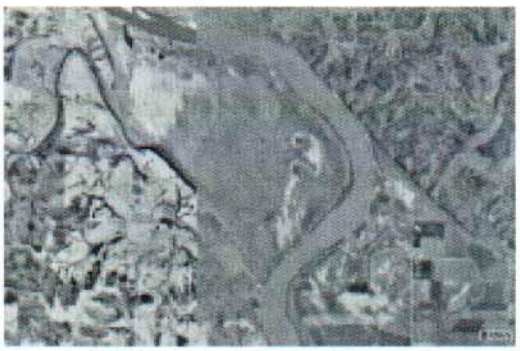
This mitigation site is located at river miles 110 to 113 on the left descending bank of the river near the Morrison Bend. The site contains 422 acres, but is situated in the middle of the river. Access to the site is limited to boat during most times of the year. The site is located two miles east of Portland, MO. The island is being preserved in it's heavily timbered state. No construction is planned for the site at this time, however opportunities to complete shoreline and/or within river improvements to increase and diversify the shallow water habitat at this site may be undertaken in the future.

Tate Island, MO
Outlet of chute, downstream end of timbered island

Marion Bottoms, Missouri

This mitigation site is located at river mile 158 to 164, on the right descending bank of the river, northwest of Jefferson City. Mitigation at this location was undertaken within the river channel along the banks of the Marion Bottoms Conservation Area, land owned and operated by MDC.

Work at this location consisted of modification to existing river structures so that shallow water habitat could be formed in the river channel. The work was completed in spring 2001.



Marion Bottoms, MO
USGS aerial photo fromMicrosoft Terraserver

Plowboy Bend, MO
Diverse and shallow water habitat created within river by structure modification

Plowboy Bend, Missouri

The Plowboy Bend mitigation site is one of several efforts to complete within river structural changes for fish habitat improvements. This site is located adjacent to the Plowboy Bend Conservation Area at river mile 169 to 172 on land which is owned and operated by the MDC.

The work Plowboy included notching an existing dike in several locations and reversing the direction of a second existing dike. The structural modifications were used to direct the natural force of the river against the adjacent riverbank. The eroded riverbank and area within the dike field have created an area of diverse shallow and deep water fish habitat.

Eagle Bluffs, Missouri

This mitigation site is located at river mile 170 to 174 on the left descending bank of the river. The site is on 571 acres of existing public land owned and operated by MDC. The area is bounded by the Missouri River to the west and Perche Creek to the East.

Eagle Bluffs, MO
One of two new wetland cells and backwater areas.

The area had been historically used for row crop production. The mitigation at this site included converting the farmed lands to seasonally flooded wetlands, and reconnecting the floodplain area to the river. Two wetland pools and additional riparian areas were constructed using new levees, berms, and water control structures.

The work also included installation of two "fish friendly" structures specifically designed to allow high flows during the spring to back up into the area to allow fish to spawn within the wetland area and then safely return to the Missouri River. The work at Eagle Bluffs was completed January, 2002.

Overton Bottoms South, Missouri

The Overton Bottoms – South (OBS) site is approximately 3,662 acres in size and is located just to the south of I-70 approximately 15 miles from Columbia, MO. The main project element for the mitigation at the OBS site is setback of an existing agricultural levee. The levee setback creates opportunities on the additional land on the river side of the levee in which future shallow water and/or bottomland hardwood forest habitats can be restored. The borrow area for the construction of the new levee was constructed so as to allow opportunistic wetlands to form. Additionally, the OBS site contains about 500 acres of bottom land forest areas that will be maintained along the river corridor. The construction of the levee setback was completed September, 2002. MDC has assumed operation and management of the area.

Overton Bottoms – South, MO
Opportunistic wetlands forming in borrow areas for new levee.

Rocheport Cave, MO
Biologists at the gated cave entrance

Rocheport Cave, Missouri

This mitigation site is 51 acres in size and is located up a side drainage at river mile 183. The mitigation at this site consisted of completing a cave gating across the entrance to an existing cave. The cave is a summer home to maternal colonies of endangered Gray bats. In the wintertime, the cave also serves as an important hibernaculum.

The gating project prevents human disturbance. The work was completed in July 2002 and has been turned over to MDC for their management.

Overton Bottoms North, Missouri

Overton Bottoms North (OBN) is approximately 1,687 acres in size. It is located at river miles 185 to 189, directly north of I-70 from the Overton Bottoms South site. OBN is made up of formerly farmed lands purchased from private willing sellers by both the Corps of Engineers and US Fish and Wildlife Service (USFWS).

The mitigation at this site included taking the agricultural lands out of production and planting native grasses and trees. In 2000, the Corps designed and constructed a river chute at the OBN site. The 3000 foot long chute is currently 40 feet wide. The chute has created opportunities for new aquatic habitat. The chute was constructed at higher elevations so that it is only inundated on a seasonal basis. The Corps plans to make adjustments to the chute in FY03. Also at OBN, an existing levee was breached. This allows high flows in the spring to spread out over the floodplain and introduce valuable organic nutrients to the river.

Overton Bottoms - North
View looking across habitat area inundated during high spring flows.

OBN has been turned over to the USFWS to manage as part of their Big Muddy Wildlife Refuge system. The USFWS has implemented low maintenance operation plans for the area and plans to let the land recover to pre-agricultural conditions on its own.

Grand Pass, Missouri

This mitigation site is located at the Grand Pass Conservation Area (GPCA) on land owned by MDC. The area is adjacent to the right descending bank of the Missouri River, at river miles 263 to 266.

At this site, the Corps of Engineers constructed shallow water habitat by re-opening a river chute. Restoration of the chute was completed in 1991. The work included modification of existing river structures, excavation and dredging of the chute, installation of submerged brush piles, and construction of rock hard points. The restored chute is now approximately 50 feet wide and has restored 10 acres of high quality shallow water habitat.

Grand Pass, MO
Upstream view of the restored chute

Benedictine Bottoms, KS
Wet prairie habitat during spring high water

Benedictine Bottoms, Kansas

This mitigation site is 2,111 acres in size and is located just north of Atchison, Kansas. The site is at river miles 424 to 429 on the right descending bank at the Rushville Bend of the river.

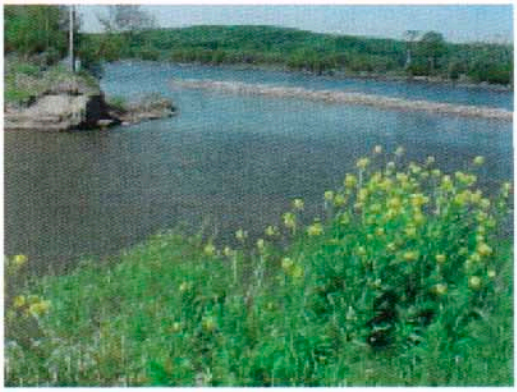
In 1998, the Corps completed installation of seasonal wetlands, planting of native hardwood trees and prairie grasses, and within river structural changes for shallow water habitat. There is a total of 550 acres of upland hardwood trees, 750 acres of grasslands, and 450 acres of wetlands.

Benedictine Bottoms has been turned over to the Kansas Department of Wildlife and Parks for their management as a wildlife refuge and conservation area. The site is highly utilized by the Biology Department of Benedictine University.

Deroin Bend, Missouri

This mitigation site is located at river mile 516 to 520, on the left descending bank of the river. The site contains 1,082 acres of land belonging to MDC.

At Deroin Bend, the Corps completed restoration of a side channel, planting of several hundred native hardwood trees and cover crop, and connected two existing scour holes to the river. The side channel is approx. three miles long with a 70 foot bottom width. The site has been turned over to MDC for their management as a fish and wildlife area.



Deroin Bend, MO
Inlet to the new side channel

Langdon Bend, NE
Wintertime view of the outlet of the backwater area to the Missouri River

Langdon Bend, Nebraska

The Langdon Bend mitigation site is located at river miles 529 to 532 on the right descending bank near the town of Nemaha, Nebraska. The site consists of 921 acres of formerly farmed lands purchased from willing sellers.

At this site, a 10-foot bottom width pilot channel and backwater area was constructed. The channel is connected to the river at the outlet, but stops before meeting the river at the upstream end. Flow into this area occurs by water from the Missouri River backing up the channel and will allow overland flow at the times when the Missouri River is at high water. This site was completed in 1998 and has been turned over to the Nebraska Game and Parks Commission (NGPC).

Hamburg Bend, Nebraska

The Hamburg Bend mitigation site is located at river miles 552 to 556 on the right descending bank, just south of Nebraska City, Nebraska. The site consists of 1,544 acres of side channels and backwater areas that mimics the historic meander belt of the floodplain. The increase in numbers and variety of fish at this location shows that excellent habitat has been created at this site.

The mitigation at Hamburg Bend was completed in 1996 and has been turned over to the NGPC to be managed as a wildlife area. Additional adjustments to the side channels and river structures are planned for this site.

Hamburg Bend
Aerial view of the meandering floodplain and chutes during high water event in 1997

Tobacco Island, NE
View of the inlet to the restored side channel

Tobacco Island, Nebraska

Tobacco Island is located south of Plattsmouth, Nebraska at river miles 586 to 590 on the right descending bank of the river. The site consists of 1,604 acres of former agricultural land that was purchased from willing sellers by the Corps for the mitigation project.

The mitigation at Tobacco Island included construction of a new side channel and planting native grasses and trees. The mitigation has created additional shallow water aquatic and floodplain habitats. The side channel is three miles long with a 10-foot bottom width and is designed to open up to a wider cross section as the area scours out during high flows. Construction of the site has just been completed and a dedication ceremony was held on Oct 02.

California Bend, Iowa

The California Bend mitigation site is located across the river from Blair, Nebraska at river miles 649 to 652 on the left descending bank. The site was established on 420 acres of land owned by the Iowa Department of Natural Resources (IDNR).

The mitigation at California Bend included opening a side channel and backwater area. This effort has restored connectivity to the river and created shallow water aquatic habitat. The area is directly connected to the Missouri River and is a fine backwater wetland area for lots of different waterfowl. The improvements have been turned over to be managed by IDNR.

California Bend, IA
Aerial view of the meandering floodplain and backwater areas

Louisville Bend, IA
View of backwater in the restored side channel

Louisville Bend, Iowa

The Louisville Bend mitigation site is 1,096 acres in size. It is located near Onawa, IA at river miles 682 to 685 on the left descending bank. This site was developed on lands owned by IDNR. This site was developed primarily as a wetland and backwater area.

Habitat development at Louisville Bend was completed in 1995. The work included installing controlled openings at the upstream and downstream end of a large side channel area. A pump was installed at the upstream end to pump water into the area as needed. The outflow at the downstream end can be regulated so as to hold water pumped into the area, or allow backwater to flow up into the area during high river stages. A 270 acre area of permanent open water has been created. This area has been turned over to IDNR for their management as a fish and wildlife area.

Tieville-Decatur Bends, Iowa and Nebraska

Mitigation at the Tieville and Decatur Bends of the river are currently being constructed under a single construction contract. The mitigation site is located west of Onawa, Iowa at river miles 686 to 694 on the left descending bank. The area is on lands that lie in both Iowa and Nebraska.

Construction at the Tieville-Decatur Bends site has begun. The planned mitigation will include development of backwater and wetland areas within an old oxbow of the Missouri River. At the upstream end of the site, river pumps will be used to keep the area inundated seasonally. The area will also be allowed to have backwater from the downstream end during periods of high river stages. This area will eventually restore floodplain connectivity to the river and create additional wetland habitat

Tieville-Decatur Bends, IA, NE
Existing oxbow lake area will have permanent water source from either pumps or backwater

Winnebago Bend, IA
View of the restored side channel

Winnebago Bend, Iowa

The Winnebago Bend mitigation site is located just south of Sioux City, Iowa at river miles 708 to 713 on the left descending bank. The site was established on 1,300 acres of land owned by the Corps of Engineers.

Using Project funds, habitat development at the Winnebago Bend site was completed in 2001. The mitigation features a reopened side channel with control structures at the inlet, outlet and middle of the site. At the upstream end of the site, river pumps are used to keep the area inundated seasonally for waterfowl. The area is also allowed to have backwater move up from the downstream end during periods of high river stages. This area has been turned over to IDNR for their management as a fish and wildlife area.

OPERATION AND MAINTENANCE (FY02 and Prior)

There are two types of Operation and Maintenance (O&M) activities for this Project. The first is "O&M During Construction". O&M During Construction takes place at sites that have not yet had habitat developed on them, yet require O&M activities such as weed control to be performed. Typically, these sites are either waiting for funds to be constructed, or additional lands to be acquired prior to habitat development. There are currently nine sites under O&M During Construction, but this number goes up or down.

Funding for sites which require O&M During Construction is made with Construction, General (CG) type funds and are accounted for against Project funding. The work is usually performed by contract or by the agency that is interested in managing the site once habitat development has occurred. If funds are needed by an agency other than the Corps of Engineers for O&M During Construction, the funds are requested and approved from the Corps on an annual basis via an Annual Management Plan process. Requests are usually made in the summer for work planned for the following fiscal year (Oct through Sep).

The second type of O&M is straight Operation and Maintenance. Sites are considered to be in an O&M phase once constructed features have been completed and are accepted as complete by all parties. Sites can also be considered in an O&M phase when areas have been planted and are in a healthy growing condition. The constructed features and habitat lands must be operated and maintained to assure that maximum habitat value is achieved. Therefore, O&M funds are provided for this purpose. O&M type funds are not a part of CG funding and do not count against the Project costs.

On a typical site, O&M requirements are estimated initially during the design phase. An O&M manual is then developed during the construction phase with the party responsible for administering the O&M at the particular site. An O&M manual will define the entity that will do the maintenance, the degree of Corps responsibility, schedule and procedure requirements, monitoring, etc. After construction of features or habitats at a site, a cooperative agreement will be executed between the Corps and the party responsible for administering the O&M. The cooperative agreement will document the O&M responsibilities. If funds are needed by an agency other than the Corps of Engineers for O&M, the funds are requested and approved from the Corps on an annual basis via an Annual Management Plan process.

To date, the Corps has funded 100 percent of the O&M of the mitigation features and habitat lands developed under this project, whether the sites are in O&M During Construction or straight O&M status. The funding of O&M at 100% Federal cost will continue for the life of the Project. For mitigation that has occurred on properties not owned by the Corps, O&M will only be conducted on those portions of the property in which mitigation occurred and only for those features that were constructed by the Project. In most instances, the funds are forwarded to the landowner for the work to be accomplished by their existing work force.

As of 30 Sep 02, there were thirty mitigation sites that have been established. Six of these sites have not had any O&M performed on them to date. There are nine sites that are undergoing land management using O&M During Construction funds. Also, there are fifteen sites which have had habitat developed or preserved and are now considered to be in an O&M phase. The status of the O&M of all mitigation sites is described in Table 15.

TABLE 15

STATUS OF OPERATION AND MAINTENANCE FOR MITIGATION SITES (FY02 and Prior)

Site	Current Funding	Description of O&M	Responsible Party
Berger Bend, MO	--	None (habitat preservation, weed control, food plots through ag-lease)	COE
Columbia Bottom, MO	--	None (to be started in FY04)	COE
Corning, MO	CG	Basic land management, weed control	MDC
Deroin Bend, MO	O&M	Management and surveillance of the constructed chute and tree plantings, access road improvements	MDC
Eagle Bluffs, MO	O&M	Management of wetland pool elevations, water control structures, weed control, mowing, food plots	MDC
Grand Pass, MO	O&M	Management and surveillance of the constructed chute (no cost to date due to ag leasing program)	MDC
Marion Bottoms, MO	O&M	Monitoring dike notching	COE
Lower Hamburg, MO	CG	Land management, tree planting, existing habitat preservation	MDC
Nishnabotna, MO	CG	Land management, existing habitat preservation	MDC

TABLE 15 Continued

Site	Current Funding	Description of O&M	Responsible Party
Overton Bottoms North, MO	CG	Native grass and tree plantings, weed control, surveillance of constructed chute, signage	USFWS
Overton Bottoms South, MO	CG	Basic land management and monitoring	MDC
Plowboy Bend, MO	O&M	Monitoring dike notching	COE
Rocheport Cave, MO	O&M	Monitoring, debris removal	MDC
Rush Bottom Bend, MO	CG	Land management, weed control	MDC
Tate Island, MO	O&M	Habitat preservation, signage	MDC
Thurnau, MO	CG	Land management, weed control	MDC
Worthwine Island, MO	--	None (to be started FY04)	MDC
Benedictine Bottoms, KS	O&M	Wetland management, infiltration control, tree planting, weed control	KDWP
Auldon Bar, IA	CG	Land management and habitat preservation	IDNR
Blackbird Bend, IA	--	None (to be started in FY04)	COE
California Bend, IA	O&M	Maintain all structures, fences, signs and roadways. Land management and habitat preservation.	IDNR
Copeland Bend, IA	CG	Land management and habitat preservation.	IDNR

TABLE 15 Continued

Site	Current Funding	Description of O&M	Responsible Party
Louisville Bend, IA	O&M	Maintain all structures, fences, signs and roadways. Provide law enforcement. Land management and habitat preservation. Pump maintenance.	IDNR
Noodleman Island, IA	CG	Land management and habitat preservation.	IDNR
Winnebago Bend, IA	O&M	Maintain all structures, fences, signs and roadways. Land management and habitat preservation. Pump maintenance.	IDNR
Tieville-Decatur Bends, IA - NE	--	None (to be started in FY04)	COE
Hamburg Bend, NE	O&M	Maintain all structures, fences, signs and roadways. Land management and habitat preservation.	NGPC
Kansas Bend, NE	--	None (to be started in FY05)	COE
Langdon Bend, NE	O&M	Maintain all structures, fences, signs and roadways. Land management and habitat preservation.	COE
Tobacco Island, NE	O&M	None (to be started in FY03)	COE

CG = Construction General Funding, O&M = O&M Funding, COE = Corps of Engineers, MDC = Missouri Department of Conservation, KDWP = Kansas Department of Wildlife and Parks, IDNR = Iowa Department of Natural Resources, NGPC = Nebraska Game and Parks Commission.

MONITORING AND EVALUATION (FY02 and Prior)

Because many of the mitigation features of this project will be constructed as opposed to created naturally over time, it is important to complete monitoring and evaluation (M&E). By monitoring the mitigation sites and collecting basic habitat data, the Agency Coordination Team can determine whether the mitigation sites are performing as expected.

Typically, during the design phase, specific goals and objectives are determined for each site and monitoring criteria for meeting these objectives are established. After construction, M&E will be conducted on the various aspects of each site in order to assess the degree of success of the habitat development. M&E will be performed by utilizing teams with representatives from the Agency Coordination Team, the USGS, contractors, and academic institutions. Monitoring results will be collected at some sites on an annual basis and at others at a less frequent interval, depending on the objectives of the specific site. Project performance will be reported in future Annual Implementation Reports.

As of 30 Sep 02, the only funds provided for this project were based upon the WRDA86 authorized 48,100 acres. A minimal amount, approx. $300,000 was included for M&E efforts. The M&E was envisioned to be a very low cost effort of annual inspection with no efforts to complete research efforts.

To that end, periodic and/or annual inspections have been conducted at the mitigation sites that have been placed in an O&M phase. Some site specific data has been collected. This includes a three-year fisheries study performed under contract with the State of Nebraska, limited funding of efforts at Benedictine Bottoms through the Benedictine University, pallid sturgeon micro model studies with the St. Louis District, and USFWS studies on songbirds and turtles at the Overton North site.

CURRENT MITIGATION EFFORTS
FY03

FUNDING (FY03)

As of the writing of this Annual Implementation Report, a Federal budget for the project has not been approved. The Federal government has started FY03 operating under a continuing resolution authority. Therefore, the FY03 budget for the project is uncertain. The following information assumes that the FY03 budget for the project will be the same as what is in the "President's Budget" which is $17.5 million for this fiscal year. Based upon this assumed budget amount, a breakdown of the FY03 funding is presented in Table 16.

TABLE 16

BREAKDOWN OF ESTIMATED FUNDING FOR FY03

Task	CENWK (1,000)	CENWO (1,000)	TOTAL (1,000)
Land Acquisition	$2,725	$2,230	$4,955
Planning, Engineering, and Design	1,800	600	2,400
Habitat Development	3,800	4,500	8,300
Construction Management	250	270	520
O&M During Construction	350	100	450
Monitoring and Evaluation	575	300	875
TOTAL	**$9,500**	**$8,000**	**$17,500**

REAL ESTATE (FY03)

As of September 30, 2002, there remains a total of 4,723 acres of non-public lands and 6,045 acres of existing public lands authorized under WRDA86. Also, during FY03 it is anticipated that the SEIS will be completed for the additional acres authorized by WRDA99. Once the Record of Decision for the SEIS is signed, the authorized amount of land remaining to be purchased is going to exceed 129,000 acres. These acres will be available in all four states and real estate efforts will be of primary interest during FY03.

During FY03, the Corps will undertake several efforts to purchase additional land from non-public owners. Willing seller efforts will take place in Iowa, Kansas, and Nebraska. Current ownership information will be updated and many landowners will be contacted to see if they are willing to sell their property. An amount of $4,955,000 is estimated to be available in FY03 for real estate activities (pended appropriation by Congress).

In Missouri, focused efforts will be placed on the Church Farms property near Jefferson City. If this acquisition falls through, then additional lands will be sought in Ray County, MO. Additional acquisitions adjacent to the existing sites at Berger Bend, Corning, Nishnabotna, and Lower Hamburg sites will be pursued. Additionally, the Corps will be seeking to obtain Federal prison farm land on the Missouri side of the river opposite Leavenworth, KS. The Corps will also be seeking to obtain more easements on existing public property at Columbia Bottom and Thurnau sites.

In Kansas, a willing seller effort will be undertaken on several locations in Doniphan and Atchison Counties. The Corps will continue to work with the Kansas Department of Wildlife and Parks and the USFWS to prioritize lands. Additional opportunities to expand the area at Benedictine Bottoms will be included.

In Iowa, additional non-public lands are being sought at Copeland Bend. The Corps will be working with NRCS and IDNR at this location. Additional efforts will be undertaken at Auldon Bar, Noddleman, and Blackbird Bends.

In Nebraska, the Corps will be attempting additional acquisitions at Hamburg Bend, Langdon Bend, Kansas Bend, and Tobacco Island. The Corps will also pursue real estate agreements with the Omaha Tribe at Hole in the Rock and the Winnebago Tribe at Glovers Point to complete projects on their lands.

HABITAT DEVELOPMENT (FY03)

In FY03, an amount of $11,220,000 is estimated to be available for habitat development (pending appropriation by Congress). This includes $2,400,000 for engineering and management activities and $8,820,000 for construction. The following is a summary of habitat development activities to be completed by site, if Congress appropriates full funding for FY03.

Columbia Bottom, MO – Phase II construction to install water management system for wetlands will continue. The plans and specifications for installation of one or more river pumps will be completed in FY03. Pending receipt of FY03 funding, a construction contract for installation of the river pump(s) will be awarded in Spring 03 with the construction extending into FY04.

Berger Bend, MO – Funding in FY03 will be used to begin habitat improvements at this site. A habitat development plan will be completed with MDC and USFWS. The installation of hardwood trees and planting of a cover crop will be completed as much as possible through an agricultural lease of the property over a three year planting cycle. Goal is to turn the property over to MDC by Dec 05.

Overton Bottoms South, MO – A construction contract to set back an existing levee at this site was awarded in FY01 and will be completed in FY03. The set back will be made operational this year and turned over to the Overton-Woolridge levee district for O&M beginning in FY03. Also at this site, the Corps of Engineers will continue efforts to fund and construct a maintenance building including site improvements and fencing. The boundary of this mitigation site will be surveyed and marked in FY03.

Overton Bottoms North, MO – The Corps will continue to work on the chute at this site. Deeping the chute to accommodate shallow water habitat will be completed as funding and weather permit during FY03. A new inlet will be constructed so as to improve debris flow through the chute. The boundary of this mitigation site will be surveyed and marked in FY03.

Benedictine Bottoms, KS – During FY03, the Corps will be working with KDWP to improve the water holding at the wetlands at this site. This will be accomplished by blending soda ash with the natural soil and compacting the mixture in place at the wetland areas. Also, additional trees will be planted at this location to augment the trees already there.

Worthwine Island, MO – The design to re-open a chute at this site will continue. Plans and specifications will be completed during FY03. Depending on available funds, a construction contract for this project may be awarded very late in FY03. The current working estimate for the project is $3.5M.

Langdon Bend, NE – The plans for the improved access road and parking area are complete. However, an additional easement across private land is necessary prior to installation. If negotiation of the easement is successful, this project will be completed as funding and weather permit during FY03.

Kansas Bend, NE – Plans and specifications for installation of a side channel at this mitigation site will be completed in FY03. A construction contract will be advertised and awarded pending receipt of FY03 funds. The construction will extend into FY04.

Lower Hamburg, MO - Plans and Specifications for construction of a chute at this site will be updated to reflect lessons learned from the Overton and Deroin Bend chutes. Pending receipt of FY03 funding, a construction contract will be awarded in Spring 03. The construction of the project is will continue into FY04. The current working estimate for the project is $3.5M.

Hamburg Bend, NE – The Corps will be undertaking additional improvements along the river at this site during FY03. Existing river structures will be modified and some new dikes may be installed to establish additional shallow water habitat and floodplain connectivity.

Copeland Bend, IA – Acquisition at this site is not complete. However, on the lands already owned, the Corps and IDNR will continue to work at creation of depressional wetlands through excavation of material. The completion of proper environmental documentation and awarding of a contract will be completed in FY03.

Noodleman Island, IA – Acquisition at this site is not complete. However, on the lands already owned, the Corps and IDNR will continue to work at creation of depressional wetlands through excavation of material. The completion of proper environmental documentation and awarding of a contract will be completed in FY03.

Louisville Bend, IA – During FY03, the Corps will award a construction contract to modify the inlet structure and build a dike across the middle of the site to improve control of flows through the area.

Tieville-Decatur Bends, IA and NE – A construction contract to install backwater and side channel areas at this site was awarded in FY02. This construction is continuing through FY03. Depending on receipt of funds and weather, this project is scheduled to be completed in early FY04.

Shallow Water Habitat, IA, NE, KS, MO – A construction contract to modify existing river structures will be awarded during FY03. Work started during FY02 using O&M funds will be funded during FY03 using mitigation project funds. These type of river structure modifications are anticipated to continue for many years.

SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (FY03)

An Environmental Impact Statement for the Fish and Wildlife Mitigation project was filed with US EPA on December 23, 1982. This effort was completed for the original 48,100 acres authorized under WRDA86. In the Water Resources Development Act of 1999, the Missouri River Fish and Wildlife Mitigation Project was reauthorized to include an additional 118,650 acres of land to be purchased from willing sellers on which to develop, restore or enhance fish and wildlife mitigation sites. A Supplemental Environmental Impact Statement (SEIS) will be completed prior to project purchase or habitat development on the additional acres.

The SEIS process was started in August 2001 and will continue during FY03. The public involvement and review of the draft document will take place during October 2002. The Final SEIS will be available for public review starting in February, 2003. As with the Draft document, a pre-final SEIS document will be produced for Agency Coordination Team review prior to issuing the final document for public comment. The Record of Decision document will be completed by March, 2003. The Corps of Engineers is utilizing an AE firm to complete the SEIS effort.

OPERATION AND MAINTENANCE (FY03)

In FY03, an amount of $450,000 of Construction, General (CG) funds is estimated to be available for O&M During Construction (pending appropriation by Congress). If Congress appropriates full funding for FY03, the following is a summary of how the CG funds will be spent.

At sites that have not been placed in an O&M status, O&M During Construction funds will be provided for basic land management, habitat preservation, tree plantings, weed control, and signage. This will occur at the following mitigation sites: Berger Bend, MO; Overton Bottoms South, MO; Overton Bottoms North, MO; Rush Bottom Bend, MO; Thurnau, MO; Corning, MO: Nishnabotna, MO; Lower Hamburg, MO; Auldon Bar, IA; Copeland Bend, IA; Auldon Bar, IA; and Noddleman Island, IA.

For those sites that have been placed in an "Operations" status, CG funds will not be used. The Corps must provide O&M type funds for these mitigation sites and the funding for this does not get counted toward overall project costs. The types of work that this would include is maintaining constructed structures, pumps, fences, signs and roadways. Also covered are land management activities such as habitat preservation, wetland and infiltration control, habitat preservation, tree planting, and weed control. O&M will continue during FY03 at the following mitigation sites: Tate Island, MO; Marion Bottoms, MO; Plowboy Bend, MO; Eagle Bluffs, MO; Rocheport Cave, MO; Grand Pass, MO; Benedictine Bottoms, KS; Deroin Bend, MO; Langdon Bend, NE; Hamburg Bend, NE; Tobacco Island, NE; California Bend, IA; Louisville Bend, IA; and Winnebago Bend, IA.

MONITORING AND EVALUATION (FY03)

In FY03, an amount of $875,000 of Construction, General (CG) funds is estimated to be available for Monitoring and Evaluation (M&E) (pending appropriation by Congress). If Congress appropriates full funding for FY03, M&E funds will be spent on periodic and/or annual inspections at the mitigation sites that have been placed in an Operation phase. Some site specific data will be collected to support baseline conditions for shallow water habitat. Participation with MDC on conducting a public use survey will be started. USFWS studies on song birds, turtles, and native fish will be funded at the Overton North site. Additionally, an M&E plan for the project will be drafted for review and acceptance by the Agency Coordination Team.

FUTURE MITIGATION EFFORTS
FY04 TO COMPLETION

FUNDING (FY04 to completion)

In FY2001, the Corps of Engineers worked with the Agency Coordination Team to develop a Cost Report to Congress. The Cost Report gave a cost estimate of the amount of funds needed to complete mitigation of the additional 118,650 acres authorized by WRDA99. The cost to complete the project was estimated to be $740 million (includes 7,000 acres of shallow water habitat) to $1.33 billion dollars (includes 20,000 acres of shallow water habitat). These costs were at October, 2001 price levels. The Corps is currently creating budgets based upon the $1.33 billion in anticipation that pressures from resource agencies will continue to focus mitigation efforts on shallow water habitat. Note that all future work is subject to annual appropriation. The life of the project is currently projected to last until the year 2042.

REAL ESTATE (FY04 to completion)

At the conclusion of FY03, the SEIS process will be completed and the amount of non-public and existing public lands authorized for the project will be in excess of 120,000 acres. Authority to purchase additional lands will be available in all four states. It is hoped that the concerted effort to inform the public of the project and the update of the willing seller surveys that take place during FY03 may produce additional willing sellers. Also, during FY04 and beyond, the Corps will continue to work with the Agency Coordination Team to identify existing public in which mitigation projects can be implemented.

As willing sellers, both private and public, come forward, acquisitions of their properties will be of top priority. Real estate acquisitions will take priority over awarding all construction contracts for habitat development. If funds are provided, it is estimated that the acquisition effort will last for at least 20 years before enough willing sellers are found.

HABITAT DEVELOPMENT (FY04 to completion)

If funds are provided in FY04, the habitat development that had been started in FY03 will continue to completion. This will be at the Columbia Bottom, MO; Kansas Bend, NE; Lower Hamburg Bend, MO; and Tieville-Decatur Bends, IA & NE mitigation sites. The Corps will

continue to adaptively manage the constructed chute at Overton Bottoms North. Additionally, it is anticipated that funds will be provided to begin habitat development at the Worthwine Island, MO mitigation site.

For all future years, if funds are provided, continued modifications to the river structures will be a priority for habitat development. Additional opportunities for reconnecting he floodplain with the river will be undertaken at all possible locations. Set back and breaching of existing levees will be undertaken. Vegetative plantings and other land management practices will also continue.

OPERATION AND MAINTENANCE (FY04 to completion)

If funds are provided in FY04 to completion of the project, the Corps of Engineers will be establishing many new mitigation sites. As is current practice, the States will be asked to provide annual management plans in order to receive Federal funds for maintenance of constructed features of this project. O&M of the mitigation sites will remain 100% Federal funded.

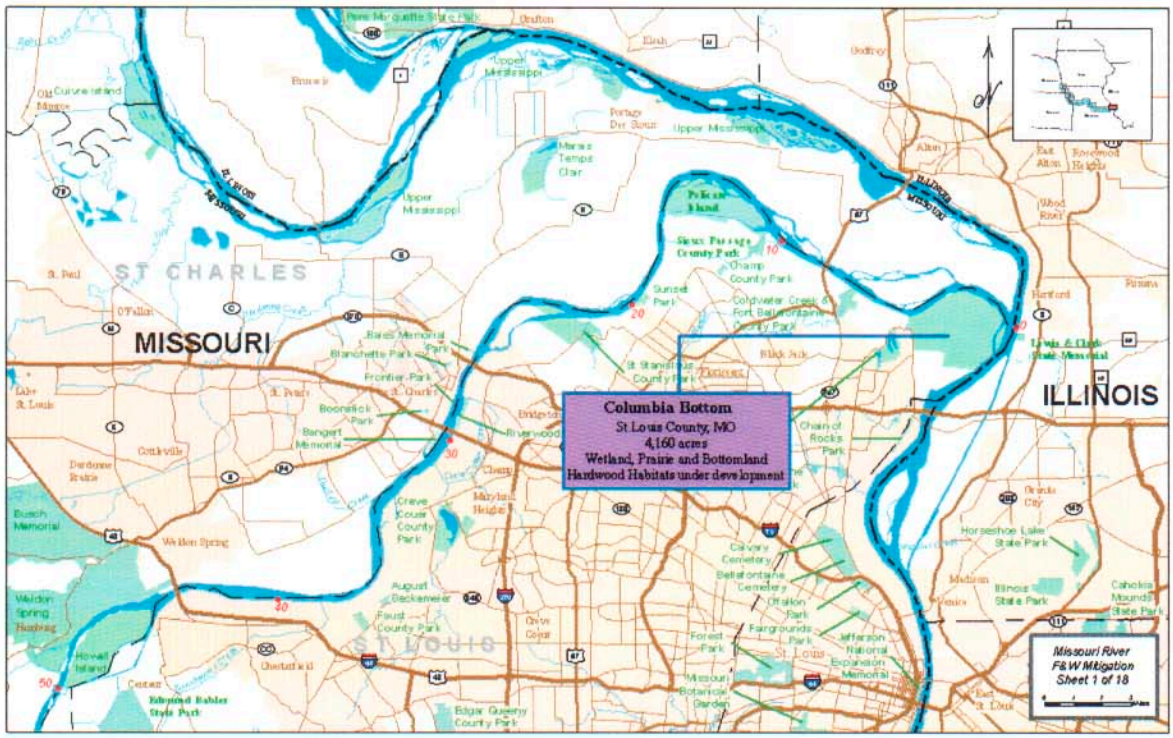
It was estimated in the Cost Report to Congress that the O&M requirements would incrementally increase over time to reach an amount estimated to be $5 million per year by the time the project was fully constructed. This amount was estimated based on only passive, self sustaining habitat areas being constructed by this project.

MONITORING AND EVALUATION (FY04 to completion)

It is anticipated that the SEIS will call for a detailed Monitoring and Evaluation (M&E) effort to be funded by the mitigation project. The M&E effort will be used to support adaptive management of established mitigation sites. Participation of the Agency Coordination Team is considered essential to understanding and agreeing upon adaptive management needed to keep established mitigation sites healthy and productive.

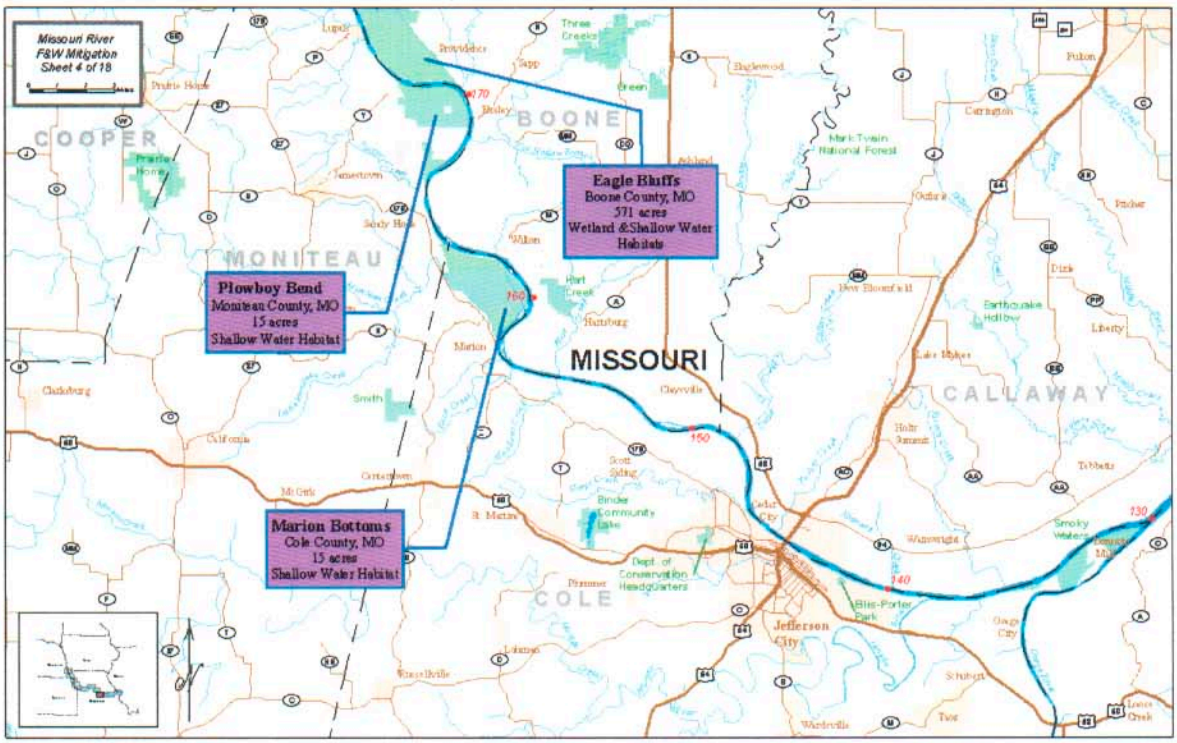
If funds are provided in FY04 to completion, M&E efforts will be based on the entire Missouri River floodplain ecosystem. No one species will be concentrated upon. Rather, a holistic approach must be taken to assure the form and function of the river is restored. It was estimated in the Cost Report to Congress that an amount of 5% of each annual appropriation will be budgeted for M&E activities.

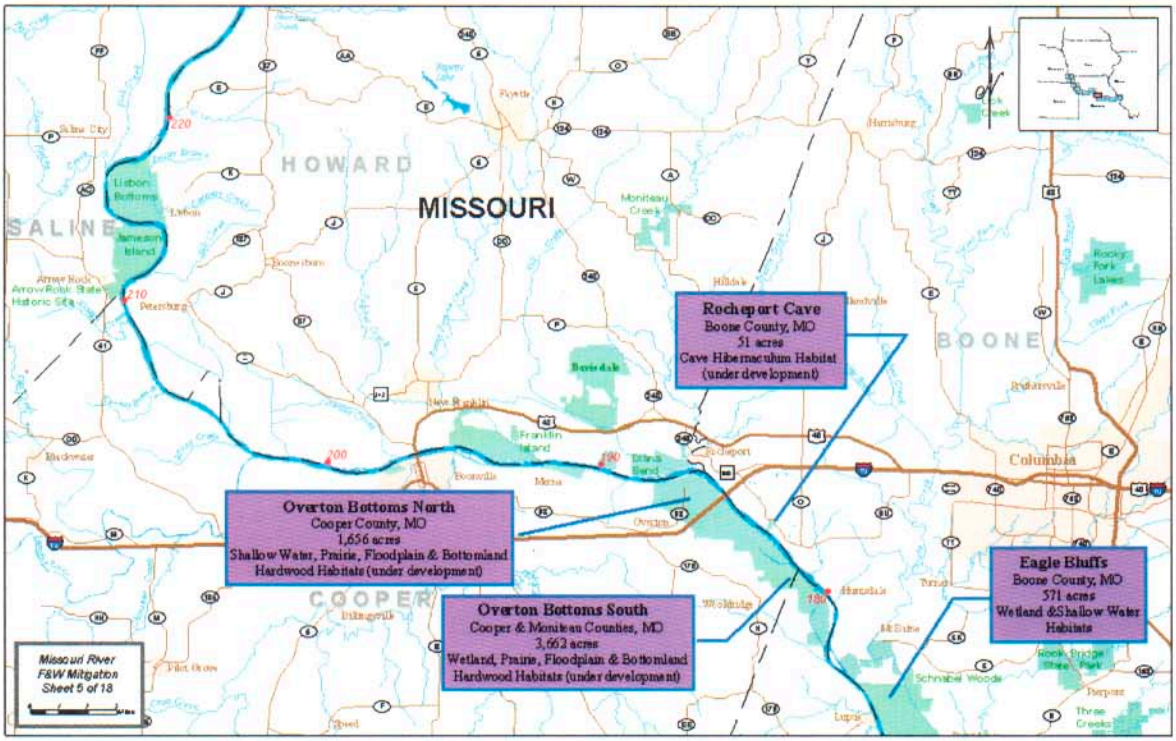
APPENDIX 1
SITE LOCATION MAPS

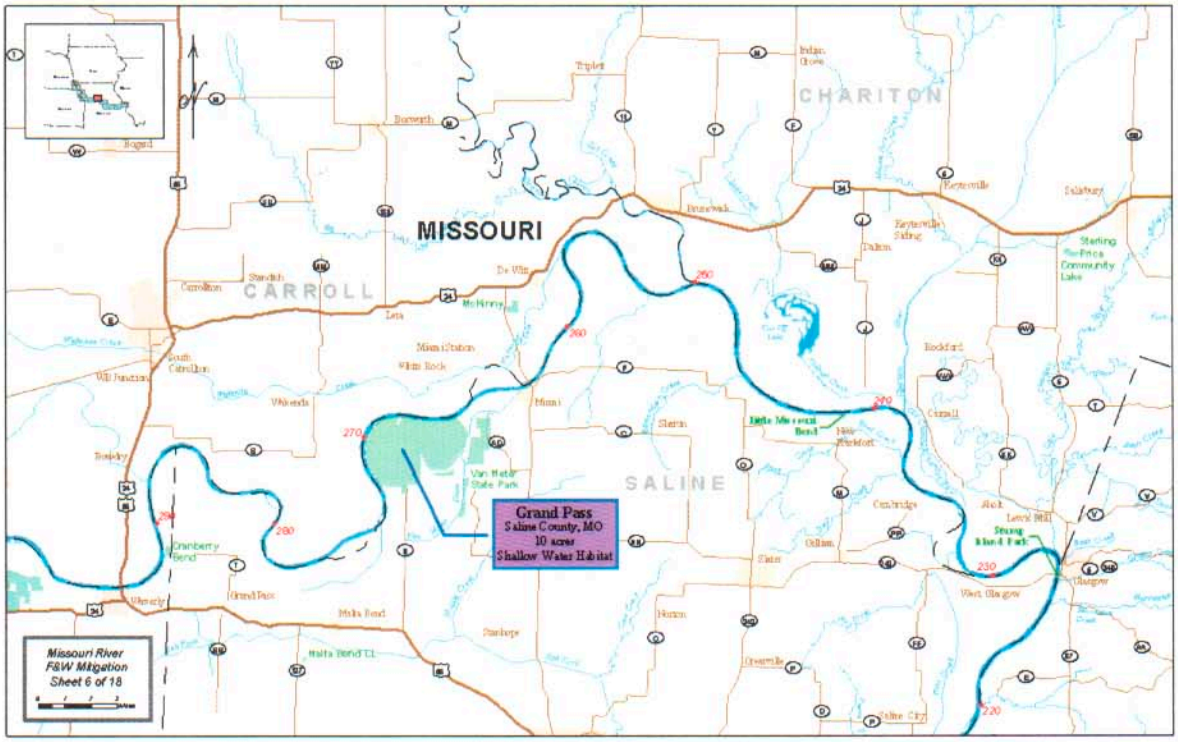

Columbia Bottom
St Louis County, MO
4,160 acres
Wetland, Prairie and Bottomland
Hardwood Habitats under development
MISSOURI
ILLINOIS
ST CHARLES
ST LOUIS
Missouri River
F&W Mitigation
Sheet 1 of 18


Berger Bend
Franklin County, MO
474 acres
undeveloped
MISSOURI
WARREN
ST CHARLES
GASCONADE
FRANKLIN
Missouri River
F&W Mitigation
Sheet 2 of 18


Missouri River
F&W Mitigation
Sheet 3 of 18
Tate Island
Callaway County, MO
423 acres
Shallow Water, Island
Sandbar & Bottom Land
Hardwood Habitats
MONTGOMERY
CALLAWAY
MISSOURI
OSAGE
GASCONADE
Jefferson City


Missouri River
F&W Mitigation
Sheet 4 of 18
Eagle Bluffs
Boone County, MO
571 acres
Wetland &Shallow Water
Habitats
Plowboy Bend
Moniteau County, MO
15 acres
Shallow Water Habitat
Marion Bottoms
Cole County, MO
15 acres
Shallow Water Habitat
COOPER
BOONE
MONITEAU
COLE
CALLAWAY
MISSOURI
Jefferson City

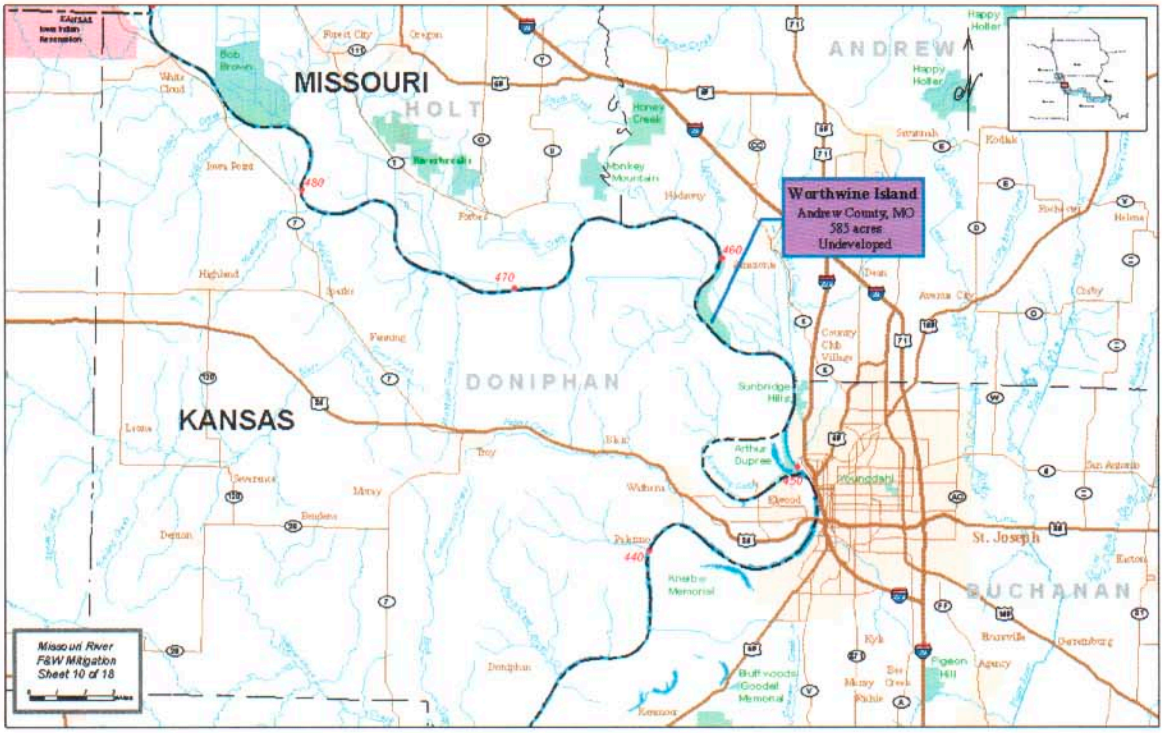

MISSOURI
HOWARD
SALINE
COOPER
BOONE
Columbia
Rocheport Cave
Boone County, MO
51 acres
Cave Hibernaculum Habitat
(under development)
Overton Bottoms North
Cooper County, MO
1,656 acres
Shallow Water, Prairie, Floodplain & Bottomland
Hardwood Habitats (under development)
Overton Bottoms South
Cooper & Moniteau Counties, MO
3,662 acres
Wetland, Prairie, Floodplain & Bottomland
Hardwood Habitats (under development)
Eagle Bluffs
Boone County, MO
571 acres
Wetland &Shallow Water
Habitats
Missouri River
F&W Mitigation
Sheet 5 of 18

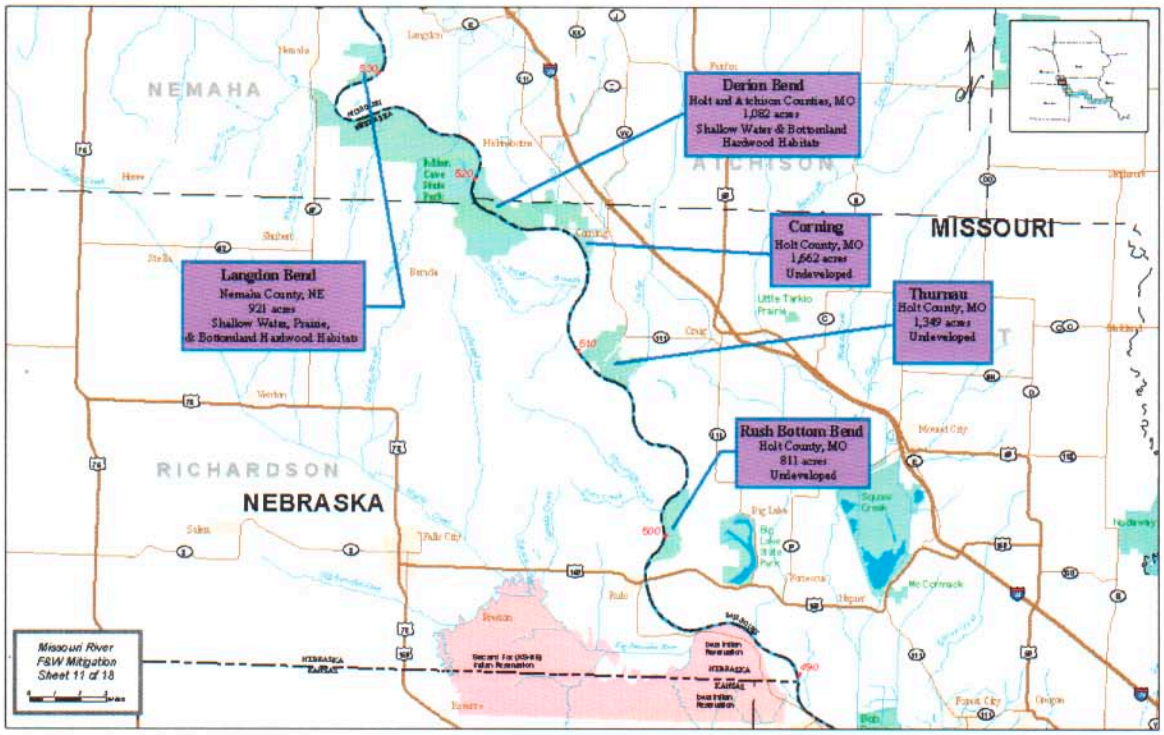

MISSOURI
CHARITON
CARROLL
SALINE
Grand Pass
Saline County, MO
10 acres
Shallow Water Habitat
Missouri River
F&W Mitigation
Sheet 6 of 18

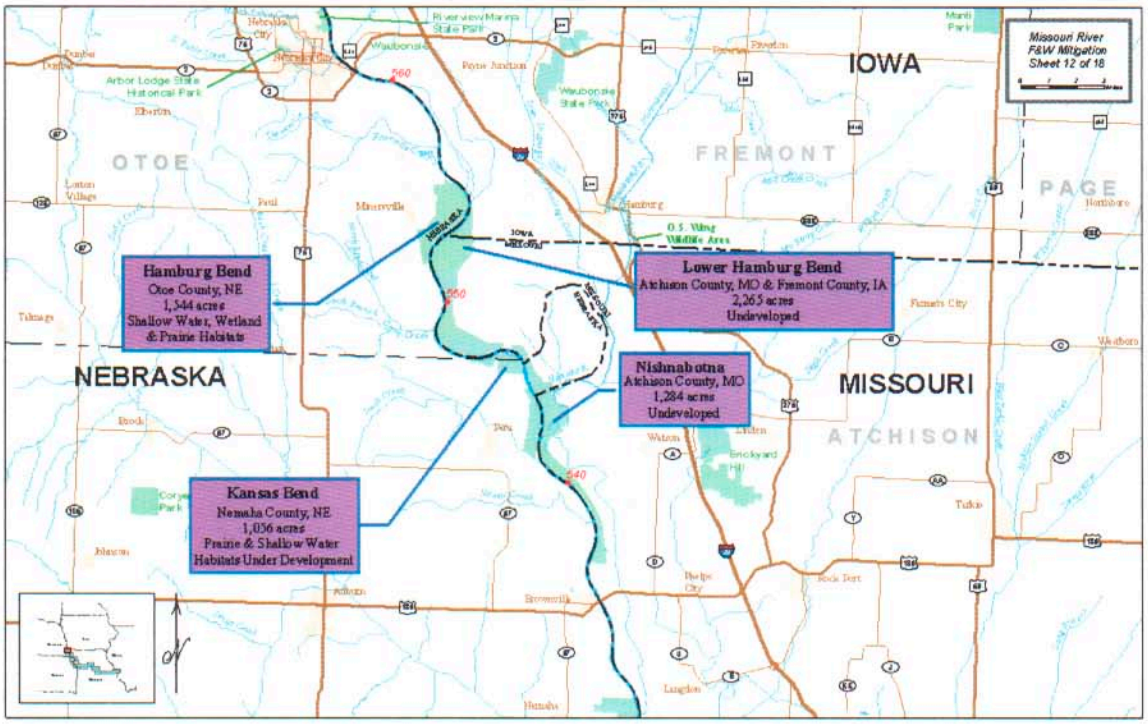

Missouri River
F&W Mitigation
Sheet 7 of 18
CLAY
RAY
CARROLL
JACKSON
LAFAYETTE
MISSOURI
340
330
320
310
300

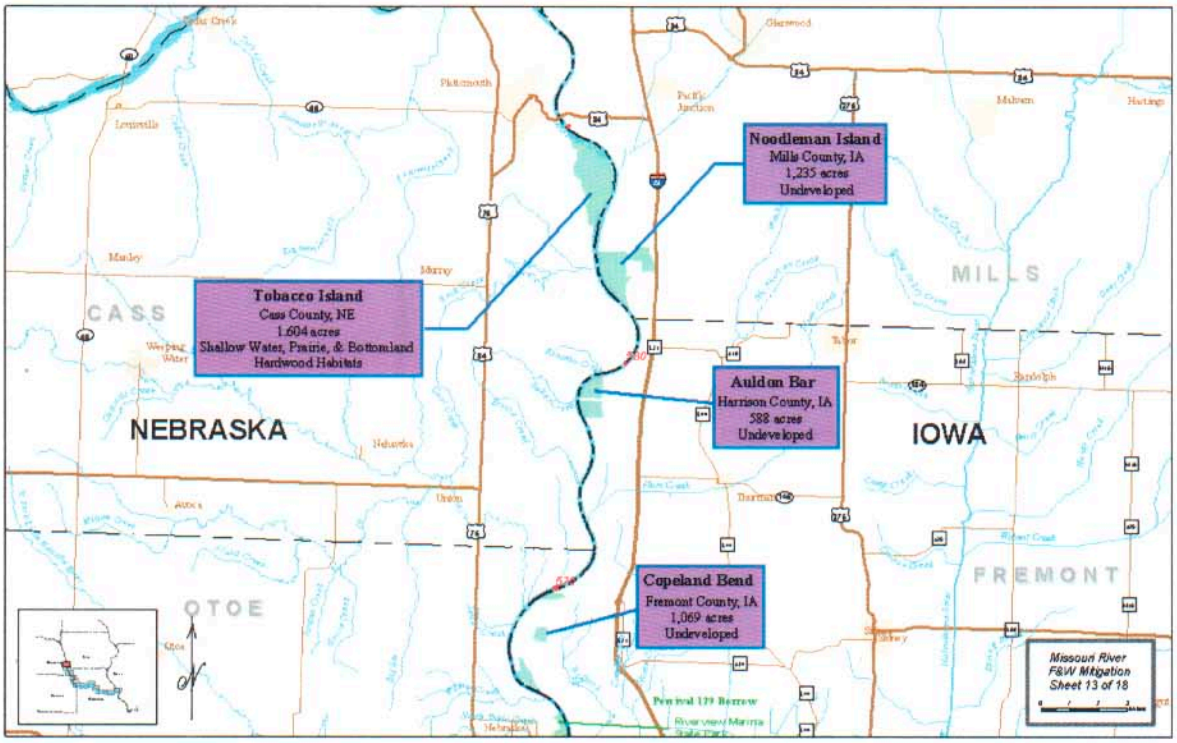

Missouri River
F&W Mitigation
Sheet 8 of 18
Fort Leavenworth Boundary
MISSOURI
CLAY
LEAVENWORTH
KANSAS
WYANDOTTE
Kansas City, KS
Kansas City, MO
Kansas City Airport
400
390
380
370
360
350

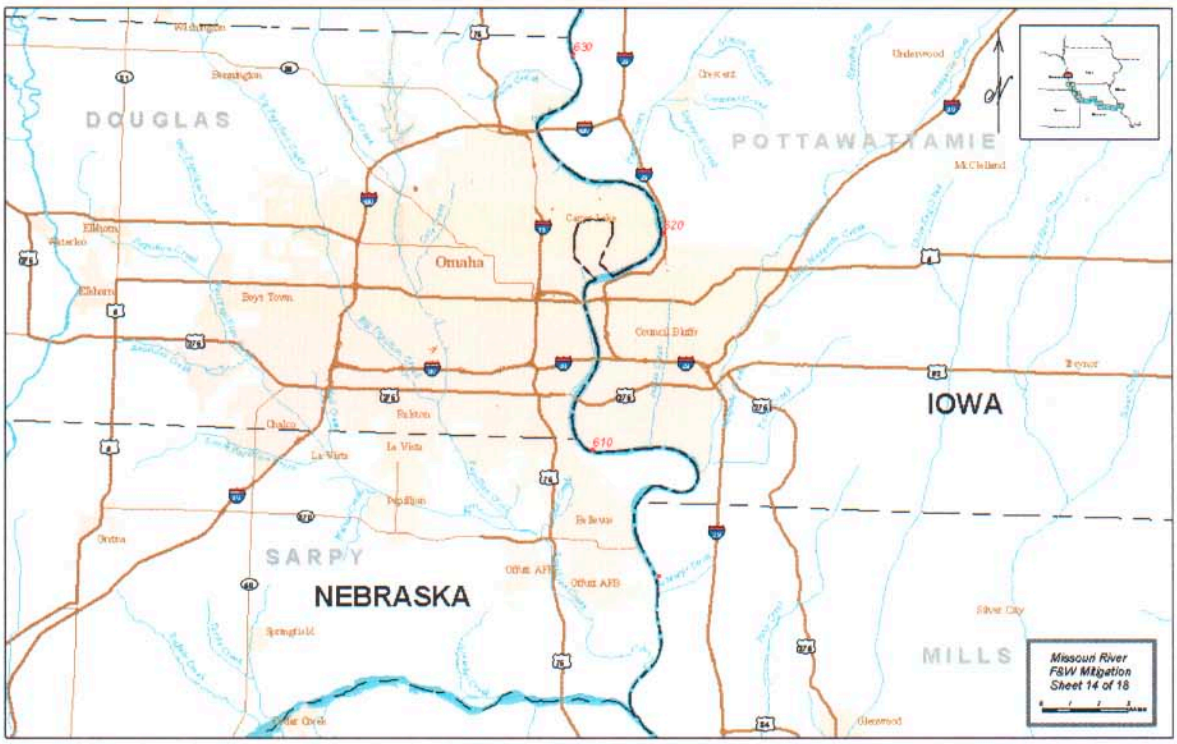

Benedictine Bottoms
Atchison County, KS
2,112 acres
Wetland, Prairie, Shallow Water &
Bottomland Hardwood Habitats
MISSOURI
KANSAS
ATCHISON
LEAVENWORTH
BUCHANAN
CLINTON
PLATTE
CLAY
Fort Leavenworth Boundary
Missouri River
F&W Mitigation
Sheet 9 of 18

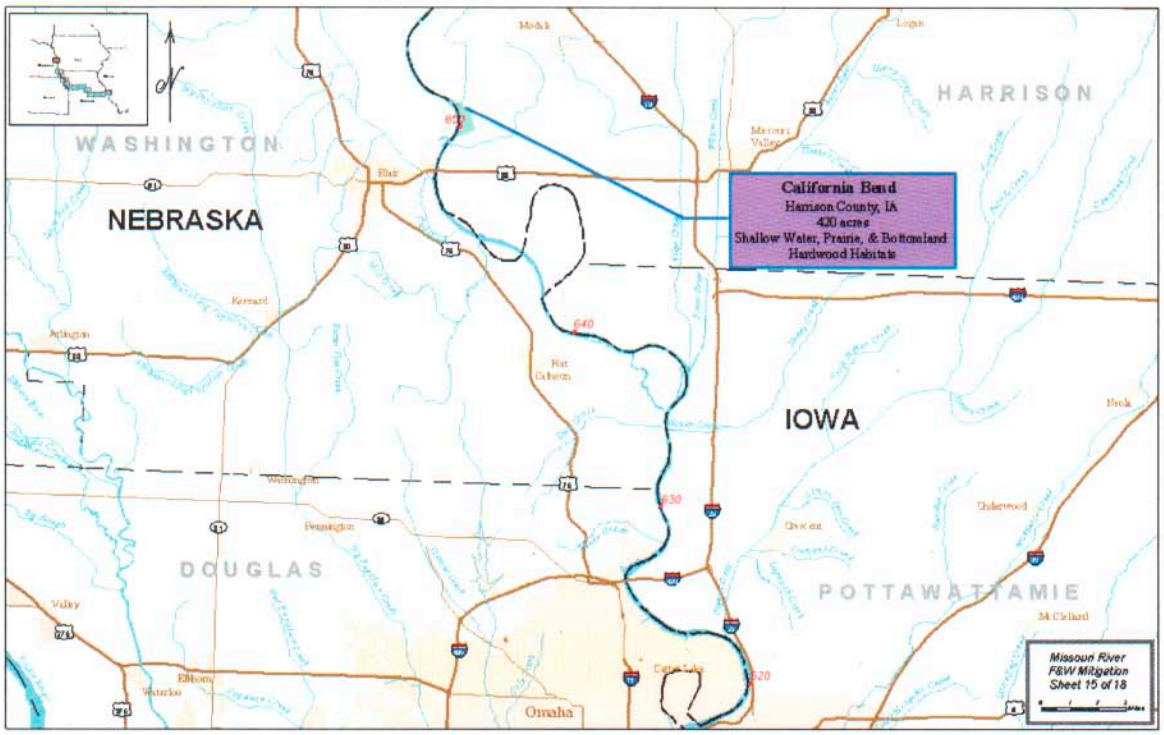

MISSOURI
KANSAS
HOLT
DONIPHAN
ANDREW
BUCHANAN
Worthwine Island
Andrew County, MO
585 acres
Undeveloped
St. Joseph
Missouri River
F&W Mitigation
Sheet 10 of 18

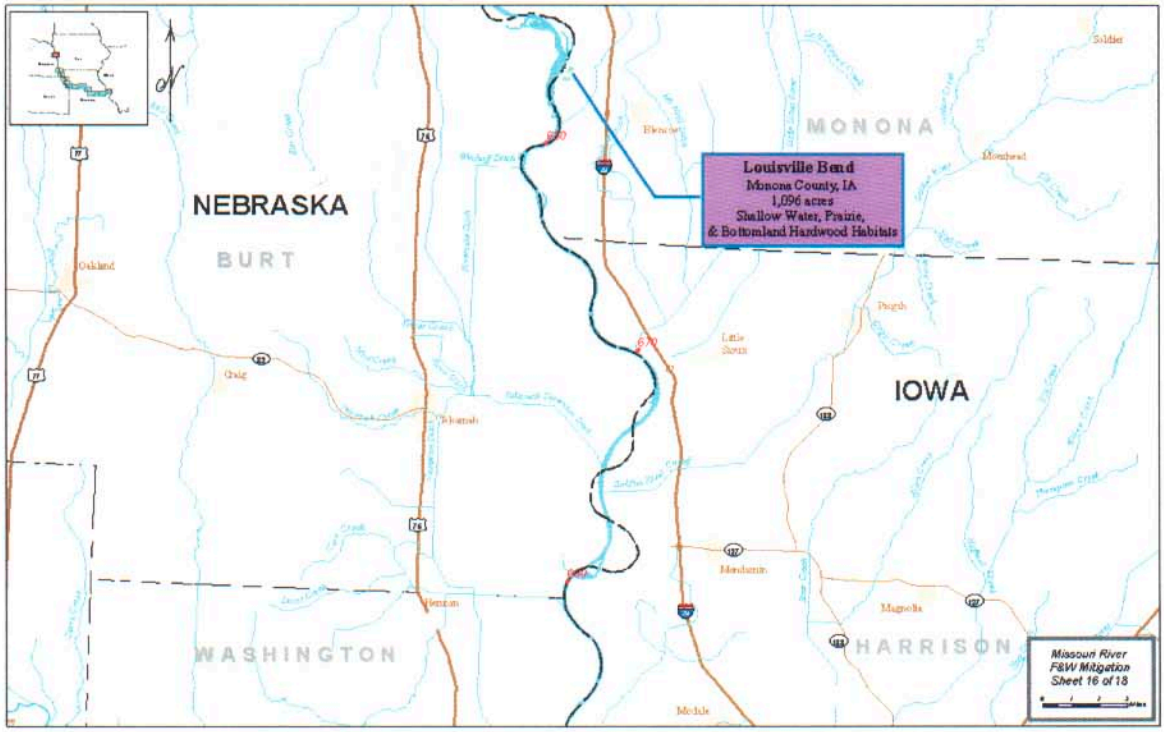

Derion Bend
Holt and Atchison Counties, MO
1,082 acres
Shallow Water & Bottomland Hardwood Habitats
Corning
Holt County, MO
1,662 acres
Undeveloped
Langdon Bend
Nemaha County, NE
921 acres
Shallow Water, Prairie, & Bottomland Hardwood Habitats
Thurnau
Holt County, MO
1,349 acres
Undeveloped
Rush Bottom Bend
Holt County, MO
811 acres
Undeveloped
NEMAHA
ATCHISON
MISSOURI
RICHARDSON
NEBRASKA
Missouri River
F&W Mitigation
Sheet 11 of 18

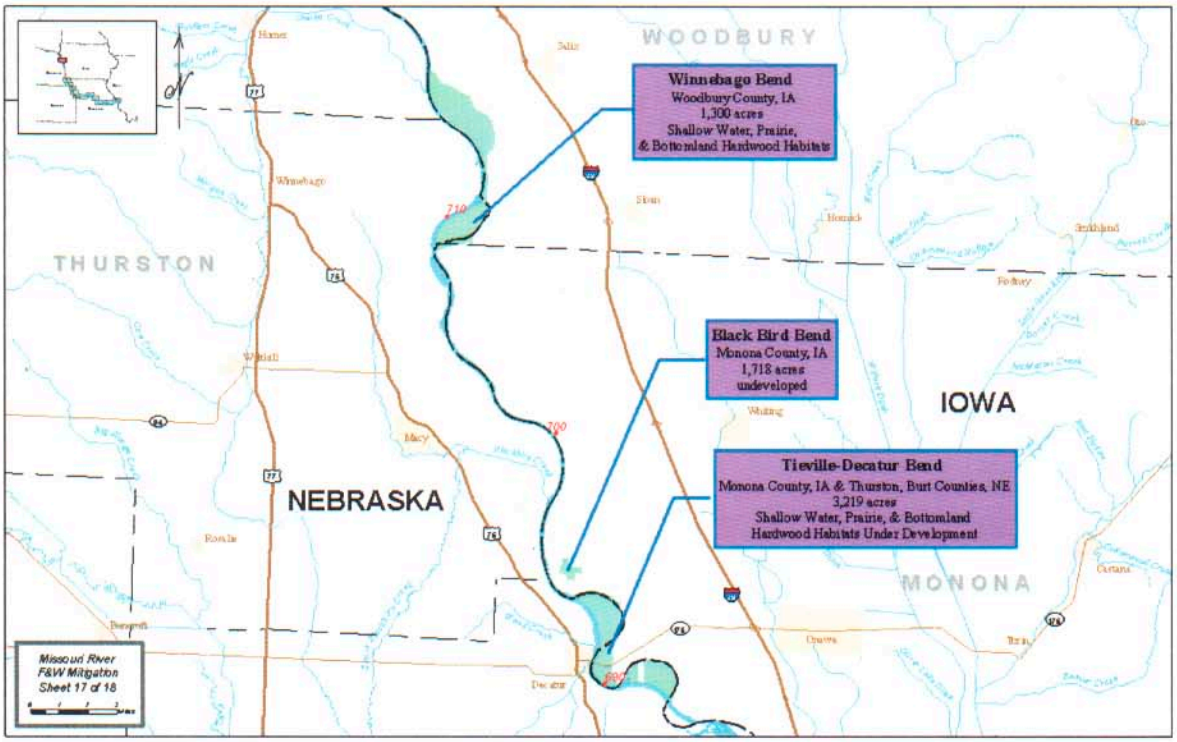

Hamburg Bend
Otoe County, NE
1,544 acres
Shallow Water, Wetland & Prairie Habitats
Lower Hamburg Bend
Atchison County, MO & Fremont County, IA
2,265 acres
Undeveloped
Nishnabotna
Atchison County, MO
1,284 acres
Undeveloped
Kansas Bend
Nemaha County, NE
1,036 acres
Prairie & Shallow Water
Habitats Under Development
IOWA
NEBRASKA
MISSOURI
OTOE
FREMONT
PAGE
ATCHISON
Missouri River
F&W Mitigation
Sheet 12 of 18

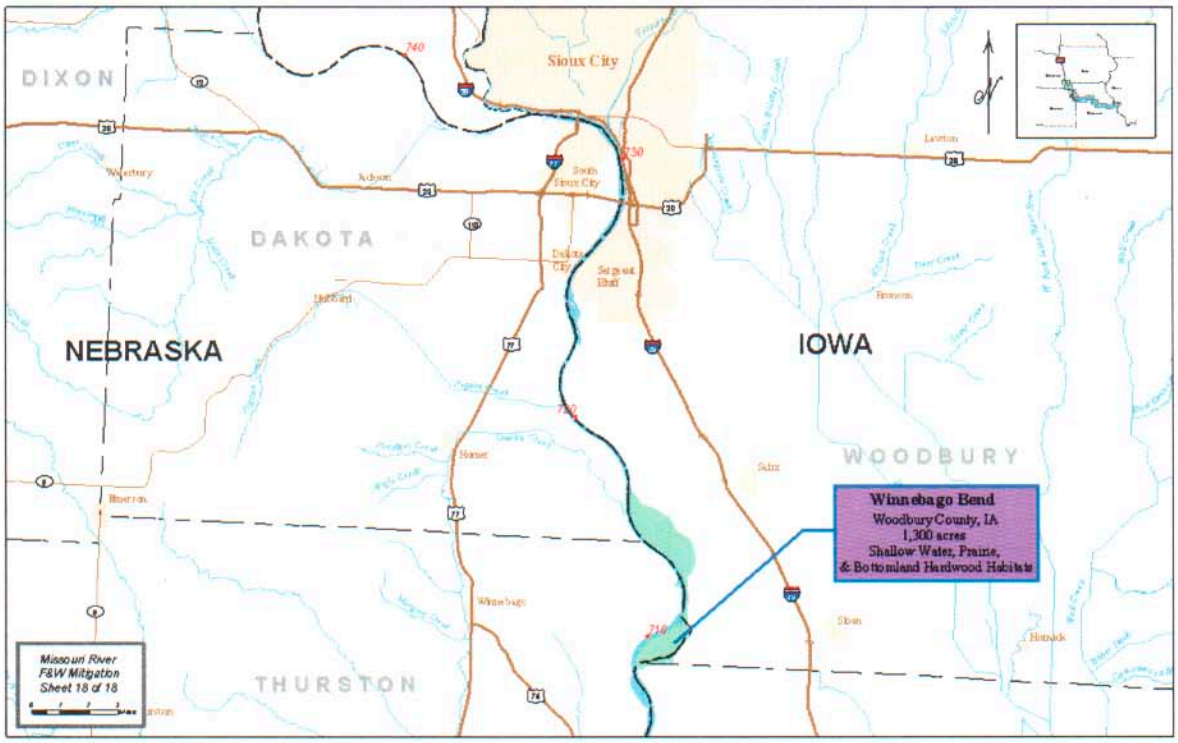

Noodleman Island
Mills County, IA
1,235 acres
Undeveloped
Tobacco Island
Cass County, NE
1,604 acres
Shallow Water, Prairie, & Bottomland Hardwood Habitats
Auldon Bar
Harrison County, IA
588 acres
Undeveloped
Copeland Bend
Fremont County, IA
1,069 acres
Undeveloped
CASS
MILLS
NEBRASKA
IOWA
OTOE
FREMONT
Missouri River F&W Mitigation Sheet 13 of 18


DOUGLAS
POTTAWATTAMIE
Omaha
IOWA
NEBRASKA
SARPY
MILLS
Missouri River F&W Mitigation Sheet 14 of 18


California Bend
Harrison County, IA
420 acres
Shallow Water, Prairie, & Bottomland
Hardwood Habitats
WASHINGTON
NEBRASKA
HARRISON
IOWA
DOUGLAS
POTTAWATTAMIE
Omaha
Missouri River
F&W Mitigation
Sheet 15 of 18


Louisville Bend
Monona County, IA
1,096 acres
Shallow Water, Prairie,
& Bottomland Hardwood Habitats
NEBRASKA
BURT
MONONA
IOWA
WASHINGTON
HARRISON
Missouri River
F&W Mitigation
Sheet 16 of 18


WOODBURY
Winnebago Bend
Woodbury County, IA
1,300 acres
Shallow Water, Prairie,
& Bottomland Hardwood Habitats
THURSTON
Black Bird Bend
Monona County, IA
1,718 acres
undeveloped
IOWA
NEBRASKA
Tieville-Decatur Bend
Monona County, IA & Thurston, Burt Counties, NE
3,219 acres
Shallow Water, Prairie, & Bottomland
Hardwood Habitats Under Development
MONONA
Missouri River
F&W Mitigation
Sheet 17 of 18


DIXON
Sioux City
DAKOTA
NEBRASKA
IOWA
WOODBURY
Winnebago Bend
Woodbury County, IA
1,300 acres
Shallow Water, Prairie,
& Bottomland Hardwood Habitats
THURSTON
Missouri River
F&W Mitigation
Sheet 18 of 18

US Army Corps of Engineers
Kansas City District
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Appendix B: Missouri River Streambank Stabilization and Navigation Project Action Plan for Creating 2000 acres of Shallow Water Habitat by 2005

Missouri River Streambank Stabilization and Navigation Project
Action Plan For Creating 2000 acres of Shallow Water Habitat by 2005

March 20, 2002

1. Introduction: The plan outlined below describes a process by which the Corps will modify the existing Missouri River Streambank Stabilization and Navigation Project (BSNP) in an attempt to meet the Missouri River Biological Opinion goal of 2000 acres of shallow water habitat by the year 2005. The plan also includes M&E so that knowledge gained through this initial effort can be applied toward the long-range vision of a more diverse and dynamic river environment that includes 20-30 acres of SWH per mile from Sioux City, Iowa to the mouth. The plan also describes assumptions, constraints and investment requirements necessary to meet future goals of the Biological Opinion. Further, it must be understood that there will be a lag time between modification of the river structures and development of habitat.

2. Objective: The objective of the shallow water development outlined below is to create the required habitat acreage, and develop the design tools necessary to continue habitat development into the future while maintaining the authorized project purposes. Goals of the habitat creation are to allow for more dynamic alluvial processes and increased depth/velocity distribution within the wider top width.

3. Assumptions and Definitions:

3.a. Effective Discharge. Habitat parameters (depth and velocity) are a function of discharge. In order to measure the effectiveness of the proposed project modifications; an effective or design discharge must be defined. For the purposes of assessing habitat creation, it was decided to use the 50 percent excedance discharge from the August flow duration curve(s) as the effective discharge. Although the accounting system will be based on the effective discharge, data will be gathered and analyzed for a range of flows. These data will be used to develop habitat (duration) availability curves at representative sites, as shown in Figure 1 below.

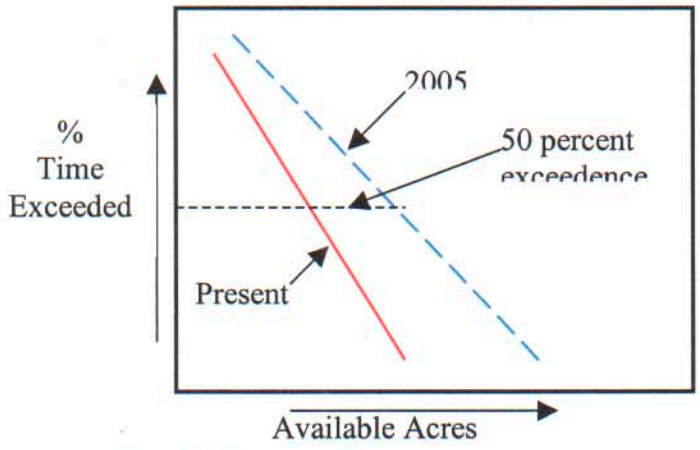


Figure 1. Conceptual Habitat Availability Curves.

3.b. Habitat Parameters. The habitat parameters defined in the Biological Opinion will be used. These are depths less than 5 feet (1.5M) and velocities less than 2 fps (0.6 m/s).

3.c. Depth Diversity. Although the Biological Opinion calls for a finite number of acres of shallow water habitat, biologist for the USFWS and state agencies have expressed a need for a more diverse depth distribution within the main channel of the river. Creation of shallow water habitat will increase the depth diversity; however, no one has expressed a desire to eliminate any particular depth class. Designer must keep this in mind when developing modification plans.

3.d. Maintenance of Existing Project Purposes. All authorized project purposes must be maintained. The authorized 300-foot wide by 9-foot deep navigation channel must be maintained along a reliable sailing line. The authorized streambank stabilization function must be maintained to the point that general channel meandering and channel avulsions are prevented.

3.e. Private Property. No modifications will be placed so that erosion of, or damage to private property will result. All modification will be placed adjacent to Corps owned land, land owned by the USFWS or state owned land. Memorandums of Agreement may need to be obtained from the USFWS and states before any modifications are placed adjacent to these properties.

3.f. Flood Control. No modifications will be implemented that will result in diminished capacity of, or damage to existing flood control projects. This may require levee setbacks and/or purchasing of easements.

4. Modifications: Following is a brief description of the types of modifications that are planned as part of shallow water habitat development.

4.a. Chutes and Backwater Areas. These types of modifications consist of rehabilitation of historic side channels and re-connection of backwaters that were cut-off from the main channel as a result of construction of the BSNP. Review of the Project Management Plan (PMP) for Implementation of the Biological Opinion indicates that approximately 400 acres will be created using these techniques by 2005. This habitat will be created by the existing Missouri River Mitigation Project and by Section 1135 projects that are at least in the feasibility stage.

4.b. Dike Lowering/Notching/Removal. Dikes adjacent to publicly owned land will be targeted for modification in an attempt the increase the top width of the main channel of the Missouri River. By increasing the top width, the river is more free to erode and deposit sediments in response to changes in the hydrograph. The length of dike to be modified will vary depending on the location. However, in general, dikes in the lower river will have the potential for longer modification lengths. Model studies and field observations indicate that an increase in top width does not necessarily lead to a

corresponding increase in shallow water habitat. Based on these studies and observations, for the purposes of this report, it is assumed that a minimum of 100 linear feet of dike would have to modified to produce a substantial change in depth distribution and that only 50 percent of the modified length would actually product acceptable shallow water habitat. In addition, modification lengths and elevations will vary through a bend to produce a more dynamic river response.

4.c. Placement of New Structures. As stated 4.b., simple dike modifications will likely not be sufficient to create the require amount of habitat, while remaining within the assumptions stated in Section 3. The width of the main channel varies from 600 feet at Sioux City, Iowa to approximately 1100 feet at the mouth. The navigation channel occupies 300 feet of this width. Most of the remainder of the main channel is generally deep (well over 9 feet) and fast (>5 fps). The area outside the navigation channel provides a factor of safety for commercial navigators and is used by recreational boaters; however, there is no evidence that this area is at all productive from a biological point of view. For this plan the portion of the main channel outside the authorized navigation a channel will be referred to as the Under Utilized Zone (UUZ). New structures will be placed in the UUZ to promote the deposition of sediments at a higher elevation than is presently happening. These structures may include chevrons, vane dikes, rootless dikes, etc. and will be constructed to varying elevations and locations within the UUZ to provide for a more dynamic river response. A conceptual plan view of the dike modifications/new structure placement is shown in Plate 1.

4.d. Combination Dike Modification and New Structures. The most likely scenario to produce the required acres of habitat will be a combination of dike modifications and new structures. The short term goal is to develop a situation where, on average, 200 feet of the cross section width is considered shallow water habitat while maintaining all authorized project purposes. This width may produce up to approximately 24 acres per river mile of shallow water habitat. To produce the remaining 1600 acres needed to meet the 2000 acre goal, a total of 66 river miles will need to be modified.

5. Location: Initially dike modifications will be concentrated at existing mitigation sites, state, and USFWS property.

6. Monitoring: The monitoring plan described below consists of data collection and analysis aimed at determining; (1) the quantity and quality of various modification schemes, (2) impacts of the modification schemes on authorized project purposes, and (3) development of the design tools necessary to extend habitat creation beyond the short-range goal. This monitoring does not specifically include any biological monitoring. Biological monitoring plans are being developed under a separate task. However, all monitoring efforts will be fully coordinated, and wherever possible, coincidental with other monitoring efforts.

6.a. Data. The data collection effort will include both a velocity and geometry component. Channel geometry data will be collected using standard hydrographic and land survey techniques. Velocity data will be collected using an Acoustic Doppler

Current Profiler (ADCP). The ADCP will provide 3-dimensional velocity profiles that will be useful in assessment in the macro changes (impacts to the existing project) as well as micro changes (habitat values). All data will be referenced to a common spatial coordinate system and stored in a GIS format. The coordinate system and GIS format will be compatible with other data collection efforts (i.e. biological and water quality data).

6.b. Data Collection. The collection and processing of the data will be accomplished primarily through contracts. Government hired labor forces will be used for small short-suspense work efforts, interim/reconnaissance data collection, and QA/QC of contract efforts. Project engineers and scientists will work with both Kansas City District and Omaha GIS/survey personnel and the contractor to develop the protocol, data layer schemes, etc. This work will also be coordinated with other data collection efforts along the river. This includes U.S. Geological Survey and state agencies engaged in river research.

6.c. Data Analysis. To create the required 2000 acres of habitat by the year 2005, nearly 66 miles of river will have to be modified over the next 3 years. It is not practical, from a cost or logistical point of view, to conduct detailed data collection over the entire 66 miles of the river. Therefore, it is proposed to conduct detailed data collection at selected sites in order to determine the average number of habitat acres created by each type of modification. Detailed data collection sites will be classified by type of modification, relative size of modification, and river reach. Enough sites within each classification will be monitored to establish both habitat creation trends as well as project impacts. The detailed data collection process will also identify indicator parameters that will be measured at the remaining sites. The indicator parameters will be used to total the number of acres created as well as track project impacts.

7. Costs: The costs listed below are based on the schedule outlined in the Implementation Plan PMP, construction history, and recent contract cost for data collection. These costs are for the 1600 acres needed beyond those planned for construction through the Missouri River Mitigation Project and the CAP programs. A breakdown of the costs per river reach and fiscal year is shown in Table 1.

Table 1 Design, Construction and Monitoring Costs Estimate For Development of 2000 Acres of SWH by 2005						
River Reach	Estimated Developable SWH[1] (acres)	Required Funding ($000)				
		FY 02	FY 03	FY 04	FY 05	Total Funds Required
Sioux City to Omaha	100-220	0	400	1000	1000	2400
Omaha to Neb City	50-120	0	400	500	500	1400
Neb City to Rulo	185-440	20	1850	1000	1000	3870
Rulo to Kansas City	180-325	200	350	350	150	1050
Kansas City to the Osage River	570-740	855	750	500	250	2455
Osage River to the Mouth	250-325	445	400	150	100	1095
Total Est. Number of Acres[4]	1335-2170					
Total Estimated Const. Cost		1520	4150	3500	3000	12170
Monitoring Costs[2]		120	480	710	875	2185
Engineering and Design/Const. Admin. Cost[3]		305	600	500 [5]	450 [5]	1855 [5]
Total Cost Per Year		1945	5230	4710	4325	16210

Notes:
Estimated developable SWH acres are based on publicly owned land that has been offered to the Corps by the owner for creation of shallow water habitat.
The monitoring costs are for measuring the change in the physical environment (channel geometry, velocity, etc.), not for biological monitoring, which is being developed under a separate plan. The details of the plan are being developed through coordination with the USFWS, Corps Biologist, etc. These costs may change as the plan is finalized.
These costs include development of the plans and specifications for the current and proceeding year, construction contract administration costs, and development and application of design tools.

Additional acres, if any, to be applied toward the long-range goal of 20-30 acres per mile.
To meet the long-range goal, additional investment will be necessary in this area.

8. Unresolved Issues/Stumbling Blocks/Logistical Considerations: The following are issues that need to be addressed.

8.a. Reconciliation of habitat development with requirements in the Biological Opinion. The plan outlined above includes development of habitat in the lower river where the current habitat approaches 20 acres per mile. This work may result in habitat in excess of 30 acres per mile. The Corps and the USFWS need to reach an agreement as to the credits given in areas where habitat exceeds the Biological Opinion requirements

8.b. Coordination of physical and biological monitoring. The above plan does not include any specific biological monitoring, however, the physical monitoring must be coordinated with biological monitoring to ensure that all data is accessible to all users, consistent protocols are followed, and effort are not duplicated. The PDT will ensure that this coordination is taking place.

8.c. Real Estate limitations beyond 2005. There does not appear to be a real estate limitation on the short-term goal of 2000 acres by year 2005, provided the Corps and USFWS can reach an agreement on crediting acres (see issue 8a). However, real estate will become a limiting factor after 2005 if additional right-of-way is not secured. The Corps should prioritize real estate efforts to ensure continued opportunities. This may require innovative real estate instruments such as sloughing/conservation easements, collaborating with NRCS/Nature Conservancy, etc. This is a critical path element for the long-term goal.

8.d. Impacts on infrastructure (flood control). Development of the shallow water habitat has the potential to affect other infrastructure, primarily private levees. The Corps should develop a clear and consistent approach to addressing these issues. The SEIS should go a long way in addressing this issue, but additional clarification would increase the likelihood of success in securing the needed real estate.

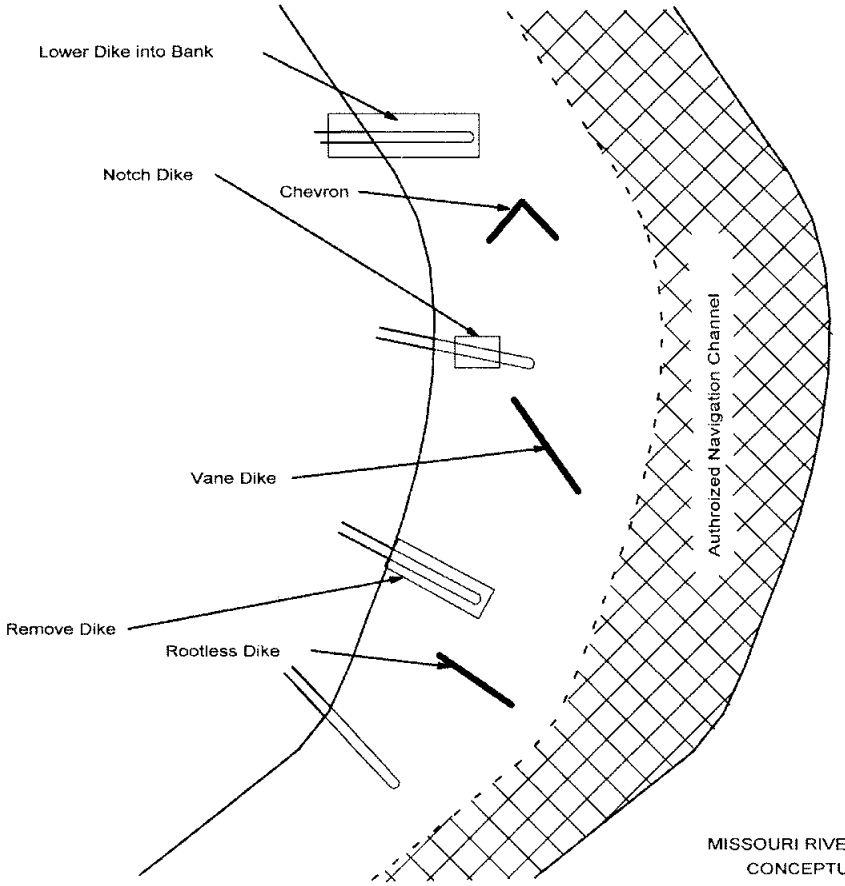
8.e. Long-term maintenance and Operation and Maintenance logistics. Construction of these features will be relatively straightforward. Standard floating plant and excavating equipment are all that is needed. However, once the shallow water habitat has been created, maintenance of the project will be more difficult and costly. Land access and/or shallower draft floating plant may be required. All efforts will be made to minimize maintenance requirements, but is it safe to say that Operation and Maintenance Standard Office Procedures will change.

8.f. Long-term viability. Although the Corps will monitor the development areas and develop models to project future conditions, this technology can not predict habitat value or usage. This biological information must be developed in parallel with the river monitoring/models to ensure sustained value.

9. FY 2002 Work Plan. Both the Omaha and Kansas City District have developed plans to begin the habitat development process. Funds have been provided for pre-construction monitoring, development of models, and design efforts (see Table 1). In addition, both Districts are proceeding with construction activities using operations and maintenance funds. The Omaha District is in the process of obtaining Section 10/404 permits for modification of a 13 mile reach of the river in the Nebraska City the Rulo reach, and will begin a modest construction effort in FY 2002 using hired labor forces. The Kansas City District's FY 2002 work plan is far more robust and is outlined in Attachment A.

10. FY 2003 Work Plan. Both District's plan to continue design, construction, M&E effort in FY 2003 as outlined in Table 1. This is subject to available funding and will require close coordination with the USFWS and researcher.

11. QA/QC Plan. Most of this work is cutting edge and will require extensive over sight from senior level engineers/scientist and technical specialist in order to maintain an acceptable level of risk to the existing project, ensure that state of the art tools are being used/developed, to verify that lessons learned have been incorporated, and to verify that the long-term objectives are being met in terms of biological response. Further, these technical experts, and senior level engineers and scientist will provide input and oversight for development of data collection protocol, monitoring plans and data base development. Table 2 provides a list of key personnel as well as their area of expertise and responsibilities. Annual QA/QC plans will be developed that outline specific tasks, roles and responsibilities.



MISSOURI RIVER - SIOUX CITY TO THE MOUTH
CONCEPTUAL DIKE MODIFICATION PLAN

Plate 1

Table 2 Key Personnel		
Name	Expertise	Responsibilities
Allen Tool- CENWK-EC-HH	Senior Hydraulic Engineer: Sediment Transport, Numeric Modeling, Alluvial Geomorphology	SWH development program over sight, Technical Review Of Project Design, Technical Over Sight of Modeling QA/QC
Mike Chapman – CENWK-EC-HH	Senior Operations Engineer: River Operations, Structure Design/Modification, Channel Design	Technical Project Designs, Design Coordination, Scope Preparation, Contract Admin
Ken Stark- CENWK-EC-HH	Senior Hydraulic Engineer: Sedimentation Transport, Numerical Modeling, Stream Rehabilitation Design	Conducting and Technical Over Sight of Numeric Model Design, Technical Project Design
Dereck Wansing- CENWK-EC-HH	Engineering Technician: Data Base Development, Data Collection,	Data base development and design, data collection method and protocol
John Remus – CENWO-ED-HF	Senior Hydraulic Engineer: Sedimentation Transport, Alluvial Geomorphology, Channel Restoration Design.	SWH development program over sight, development of monitoring plan and protocols, technical review of project designs, scope preparation and contract administration, QA/QC.
Dan Pridal - CENWO-ED-HD	Hydraulic Engineer Technical Specialist: Numerical Modeling, Channel Design, Data Base Development.	Conducting and technical over sight of multi-dimensional numerical modeling, data base design, monitoring plan and protocol development.
Jon Kragt - CENWO-IM-P	GIS Expert: Development of Data Bases and Development/ Application of Geo-spatial Analysis Techniques.	Development and Maintenance of Data Bases.

Table 2 (continued) Key Personnel		
Name	Expertise	Responsibilities
Doug Latka – CENWD-CM-W-M	Fisheries Biologist CENWD Missouri River	Regional over sight of biological monitoring and interface with USFWS
Mike George – CENWO-PM-C	Project Manager for the Biological Opinion Implementation	Over sight of the implementation plan for the Biological Opinion
Mike Barnes – CENWO-PM-C	Study Manager for the Missouri River Mitigation Project – Omaha District	Project Management activities for the Missouri River Mitigation Project in the States of Iowa and Nebraska
Kelly Ryan – CENWK-PM-CJ	Project Manger for the Missouri Mitigation Project.	Project Management activities for the Missouri River Mitigation Project

Appendix C: A Scoping Study of Water Quality Conditions in the Missouri National Recreational River Reach from near Gavins Point Dam to Ponca State Park, Nebraska

U.S. Army Corps of Engineers
Omaha District

A SCOPING STUDY OF WATER QUALITY CONDITIONS IN THE MISSOURI NATIONAL RECREATIONAL RIVER REACH FROM NEAR GAVINS POINT DAM TO PONCA STATE PARK, NEBRASKA

MISSOURI NATIONAL
RECREATIONAL RIVER

March 2002

A SCOPING STUDY OF WATER QUALITY CONDITIONS IN THE MISSOURI NATIONAL RECREATIONAL RIVER REACH FROM NEAR GAVINS POINT DAM TO PONCA STATE PARK, NEBRASKA

Prepared by:

Water Quality Unit
Water Control and Water Quality Section
Hydrologic Engineering Branch
Engineering Division
Omaha District
U.S. Army Corps of Engineers

March 2002

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1. INTRODUCTION

The unchannelized reach of the Missouri River below Gavins Point Dam has several ongoing water resource management issues that involve and affect the U.S. Army Corps of Engineers (Corps). Water quality management considerations are of particular importance to three issues: 1) management of a portion of the reach as a recreational river under the Federal Wild and Scenic Rivers Act, 2) the reach is included in an action area identified by the U.S. Fish and Wildlife Service (USFWS) under the Federal Endangered Species Act (ESA) for three species (pallid sturgeon, least tern, and piping plover) identified as being in jeopardy, and 3) the State of Nebraska has given the reach Tier 3 protection under the antidegradation provisions of the state's water quality standards and Federal Clean Water Act (CWA). To facilitate identification of water quality management concerns and information needs regarding these issues, the Omaha District's Water Quality Unit (ODWQU) conducted a scoping study of water quality conditions on the portion of the reach from Gavins Point Dam to Ponca State Park, Nebraska.

1.1. BACKGROUND

1.1.1. Wild and Scenic Rivers Act Provisions

The approximate 57-mile reach of the Missouri River from about one-mile below Gavins Point Dam to Ponca State Park, Nebraska has been classified as a recreational river under the Federal Wild and Scenic Rivers Act. All the rivers in the Wild and Scenic System must be free-flowing and the related adjacent land must possess outstanding remarkable characteristics for at least one of the following: scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. The justification that supported that this reach of the Missouri River be protected as a recreational river identified its outstanding remarkable recreational, fish and wildlife, aesthetic, historical, and cultural values. The Secretary of the U.S. Department of Interior is mandated to administer the river in a manner that will protect and enhance these values for the benefit and enjoyment of present and future generations. Therefore, the recreational, fish and wildlife, aesthetic, historical, and cultural values that qualified the segment for designation are to be protected and enhanced. Plate 1 shows the location of the Missouri National Recreational River (MNRR) reach within the Omaha District.

The National Park Service (NPS) is designated as the overall administrator of the MNRR. In 1999, the Corps and the NPS jointly finalized an updated version of the General Management Plan (GMP) for the MNRR. The existing GMP, which was developed in 1980, was updated because of the identification of additional federally-designated threatened and endangered species that inhabited the reach. The new GMP provides a management strategy to protect and enhance the values for which the reach was designated as a recreational river, which includes "fish and wildlife" values. The NPS and the Corps manage the MNRR through a cooperative agreement with the NPS generally administering land-related resources and the Corps generally managing water-related resources. Bank stabilization is still a project component, primarily to protect the MNRR values.

1.1.2. Endangered Species Act and Biological Opinion Provisions

The Corps, in early 2000, requested that formal Section 7 consultation under the ESA begin with the USFWS on Corps projects affecting the Missouri River. An ESA Section 7 consultation addresses the effects of a Federal action on listed species and the ecosystem upon which they depend. An ecosystem-based consultation was conducted that addressed three

listed bird species – bald eagle (threatened), Interior population of the least tern (endangered), and Northern Great Plains population of the piping plover (threatened); and one fish species – pallid sturgeon (endangered). A Biological Opinion (BiOp) regarding the four evaluated species was issued concerning the continuing operation and maintenance of the following Missouri River Basin Corps projects:

- Missouri River Main Stem Reservoir System,
- Kansas River Tributary Reservoir System, and
- Maintenance of the Missouri River Bank Stabilization and Navigation Project.

The BiOp stated that the continuing operation of these projects is likely to jeopardize the continued existence of the least tern, piping plover, and pallid sturgeon, but is not likely to jeopardize the continued existence of the bald eagle.

Of the three species identified to be in jeopardy, water quality conditions have the most direct impact on the pallid sturgeon. Pallid sturgeon historically occupied warm, turbid river systems. Current research indicates that pallid sturgeon spawning is directly linked to water temperature – as water temperature increases to 16.7° to 18.3°C (62° to 65°F) pallid sturgeon initiate spawning activity (USFWS, 2000). Current operation of the Fort Peck, Garrison, and Fort Randall Dams with hypolimnetic hydropower releases, provides unsuitable colder water temperatures that negatively impact spawning by native river fishes, including the pallid sturgeon, and production at all trophic levels (USFWS, 2000). More suitable water temperatures for native fish spawning and invertebrate production exist in the free-flowing river below Gavins Point Dam. Pallid sturgeon avoid areas without turbidity and current (Bailey and Cross, 1954 and Erickson, 1992). Turbidity levels below all the Missouri River mainstem reservoirs have been significantly reduced from pre-impoundment conditions due to sediment trapping in the impounded reservoirs. Due to the long potential life span of pallid sturgeon (i.e., greater than 50 years), the fish is particularly susceptible to the bioaccumulation of pollutants that may contribute to early mortality and reduced reproductive viability. The BiOp stated the Corps was to consider the Missouri River reaches from Fort Peck Dam to Lake Sakakawea and from Gavins Point Dam to the Mississippi River as high priority segments for pallid sturgeon management efforts (USFWS, 2000). The reach from Gavins Point Dam to the Mississippi River was also one of four recovery priority management areas on the Missouri River identified by the Pallid Sturgeon Recovery Plan (USFWS, 1993) for priority implementation of recovery actions.

The BiOp stated that the Corps should adopt adaptive management as one tool to preclude jeopardy to least terns, piping plovers, and pallid sturgeon. The BiOp requested that the Corps: 1) evaluate the cumulative effects of bank stabilization, as permitted by the Corps, to determine to what extent continued stabilization is reducing sedimentation, turbidity, import of organic matter, and elimination of cut-bank habitat on the Missouri River; 2) evaluate the capability and practicality of increasing water temperature of the Missouri River in priority reaches during critical periods for native warm-water fish though adjustment of water discharge requirements for power plants and other industries; 3) research and develop a way to restore the dynamic equilibrium of sediment transport and associated turbidity in river reaches downstream of Fort Peck, Garrison, Fort Randall, and Gavins Point Dams; and 4) restore turbidity to functional levels downstream of Fort Peck, Fort Randall, and Gavins Point Dams. Given the water quality issues raised by the BiOp, the collection of targeted water quality data could greatly facilitate implementation of an adaptive management approach by the Corps.

1.1.3. Nebraska Water Quality Standards Provisions

The MNRR reach has been designated by the State of Nebraska as a State Resource Water – Class A in its water quality standards (NDEQ, 2000). By Nebraska's definition, Class A State Resource Waters constitute an outstanding State or National resource, such as waters within national or state parks, national forests or wildlife refuges, and waters of exceptional recreational or ecological significance. These include waters that provide a unique habitat for federally designated endangered or threatened species and rivers designated under the Wild and Scenic Rivers Act. Designation of a waterbody as a Class A State Resource Water in Nebraska's water quality standards identifies that waterbody for Tier 3 protection under the state's antidegradation policy. Tier 3 protection as an Outstanding National Resource Water is also inferred to the MNRR reach under the Federal CWA's antidegradation provisions. The water quality implication of Tier 3 protection is that the existing water quality within the MNRR reach must be maintained and protected.

The CWA requires water quality to be maintained and protected in Tier 3 waters. The U.S. Environmental Protection Agency (EPA) has interpreted this provision to mean no new or increased discharges to Tier 3 waters and no new or increased discharge to tributaries of Tier 3 waters that would result in lower water quality in the Tier 3 waterbody. The only exception to this prohibition, as discussed in the preamble to the Water Quality Standards Regulation (48 F.R. 51402), permits States to allow some limited activities that result in temporary and short-term changes in the water quality of Tier 3 waters. Such activities must not permanently degrade water quality or result in water quality lower than that necessary to protect the existing uses in the Tier 3 waterbody. The intent of EPA's provision clearly is to limit water quality degradation to the shortest time possible (USEPA, 1994).

1.2. WATER QUALITY CONSIDERATIONS

1.2.1. Need for Water Quality Data in the MNRR Reach

Water quality data is needed by the Corps in the MNRR reach to facilitate current and future efforts regarding: 1) the management of the reach as a recreational river, 2) enhancing riverine habitat in the reach for jeopardized species, and 3) management of water quality in the reach pursuant to the antidegradation provisions of the State of Nebraska's water quality standards and the CWA. Water quality conditions are intrinsic to the values for which the reach was designated a recreational river under the Wild and Scenic Rivers Act. Knowing baseline water quality conditions and how water quality may be changing due to anthropogenic influences is paramount to managing the water resource aspects of the recreational river. Water temperature, turbidity, nutrient cycling, and sediment transport are water quality factors that have been identified as concerns regarding the jeopardization of pallid sturgeon, least terns, and piping plovers in the Missouri River. Documenting existing water quality conditions in the MNRR will facilitate the evaluation of any implemented actions to enhance water quality conditions for jeopardized species in the reach. Gaining insights into whether pollutants could be impacting the pallid sturgeon population in this reach of the Missouri River is also important. Knowing existing water quality conditions for pertinent parameters is also needed to facilitate implementation of the Tier 3 antidegradation provisions applicable to the reach.

1.2.2. Water Quality Scoping Study

A preliminary review of water quality monitoring activities along the MNRR reach found limited historic and ongoing water quality sampling. The Corps is collecting water quality data at

the Gavins Point Dam discharge. Although this sampling has occurred over a fairly lengthy time, the water quality parameters monitored are limited to water temperature, dissolved oxygen, pH, and conductivity. The Nebraska Department of Environmental Quality (NDEQ) has sampled the Missouri River at Ponca State Park on a periodic basis (i.e., every 5 years) as part of its rotating river basin monitoring network. The City of Yankton utilizes the Missouri River as a drinking water source, and regularly monitors the "raw" river water for numerous water quality parameters. Water quality data to define temporal and spatial water quality conditions throughout the MNRR reach are generally lacking.

In an initial effort to begin addressing the water quality information needs for the MNRR reach, the ODWQU conducted a scoping study of water quality conditions within the reach. The monitoring objectives established for the scoping study were:

1) Define "baseline" water quality conditions for the period of the study.
2) Assess longitudinal variation in selected parameters from the upstream to downstream boundaries of the MNRR reach.
3) Assess "horizontal" (i.e. thalweg versus backwater) and "vertical" (i.e., near-surface versus near-bottom) variation of selected water quality parameters.
4) Assess the impact, if any, that the inflows of the James and Vermillion Rivers have on turbidity levels in the Missouri River. Estimate the suspended solids load being delivered by these tributary rivers to associate with measured turbidity levels in the Missouri River above and below the tributary inflows.

Monitoring for of the scoping study occurred over a 6-week period from late August through September 2001, and included the collection of water quality samples at 9 locations.

2. DESCRIPTION OF STUDY AREA

2.1. SURFACE WATER HYDROLOGY

The MNRR reach starts about one mile below Gavins Point dam and extends downstream to Ponca State Park in Nebraska; a distance of approximately 57 miles. Two major tributaries, the James and Vermillion Rivers, flow into the reach from South Dakota (Plate 2). Several small tributaries (Beaver Creek, Antelope Creek, Bow Creek, Ames Creek, Lime Creek, Deer Creek, Walnut Creek, Turkey Creek, and Gibbs Creek) flow into the reach from Nebraska.

2.2. WATERSHED CHARACTERISTICS

The 8-digit Hydrologic Units (HUCs) that make up the watershed of the MNRR reach below Gavins Point Dam are shown in Plate 2 and described in Table 1. The size of the watershed contributing runoff to the MNRR reach below Gavins Point Dam is approximately 25,120 square miles. Of the total 25,120 square mile watershed, approximately 21,590 square miles is in the James River watershed and approximately 2,650 square miles is in the Vermillion River watershed. Approximately 880 square miles is in the watersheds of the other tributaries discharging directly to the MNRR reach (mainly from tributaries in Nebraska). The coteau region, HUCs 10160007, 10160010, and 10170103 (2,530 square miles), are largely internally drained and generally non-contributing to surface water runoff within the watershed.

The predominate land use within the watershed is agricultural, with both cropland and livestock operations present. There are numerous industries in the James River basin, most which are related to agriculture (SDDENR, 1998). Major towns in the watershed include

Vermillion, South Dakota (population 11,970), Yankton, South Dakota (14,330), Mitchell, South Dakota (14,390), Huron, South Dakota (17,180), Aberdeen, South Dakota (24,870) and Jamestown, North Dakota (15,570). All of these towns, except Vermillion, are in the James River basin.

2.3. WATER QUALITY CONDITIONS AND CONCERNS IDENTIFIED IN STATE 305(B) REPORTS

2.3.1. Missouri River (MNRR Reach)

Assessment of water quality conditions in the MNRR reach of the Missouri River in state 305(b) reports is limited. The State of Nebraska's 2000 305(b) report indicates that water quality in the MNRR reach was relatively good for the assessed period. This was based on water quality samples collected in 1995 from the Missouri River at Ponca State Park (i.e., lower end of MNRR reach). The 1995 sampling indicated that fecal coliform bacteria concentrations were supportive of the designated recreational use, and concentrations of the herbicides atrazine and alachlor met acute and chronic water quality standards criteria.

2.3.1.1. James River Basin (South Dakota)

[Note: The following discussion on the James River basin is taken directly from the State of South Dakota's 1998 305(b) Water Quality Assessment Report.]

Water quality in the James River basin has shown steady improvement over the past 10 years. Better water quality may have resulted in a large part due to completed and ongoing projects for construction and rehabilitation of wastewater treatment facilities for small municipalities and the City of Huron. Completion of an upgrade of the Huron wastewater facility should prevent further emergency discharges which in the past have been responsible for fish kills in the James River. However, river turbidity (cloudy or muddy water) may remain a persistent problem in the James River due to the considerable silt and sediment periodically brought in by its many small tributaries and the large amount of previously accumulated material on the river bottom.

Most of the lower James River basin fully supported its beneficial uses during the assessment period of 1992-97. Moderate impairment was caused by elevated total suspended solids (TSS) in the lowest reach. Minor impacts over the entire lower half of the river course were mainly elevated TSS, fecal coliform, total dissolved solids, pH, and low dissolved oxygen. Oxygen levels in the lower river appeared to have improved since previous assessments whereas instances of elevated TSS (>90 mg/l) increased in 1993 and were particularly high from 1993 to 1995. More rainfall and greater river flows in the area may have further increased stream turbidity at that time.

2.3.1.2. Vermillion River Basin

[Note: The following discussion on the Vermillion River basin is taken directly form the State of South Dakota's 1998 305(b) Water Quality Assessment Report.]

The water quality in the Vermillion River basin is usually marginal for the designated beneficial uses – most often the result of elevated total suspended solids (TSS). During the previous two reporting periods (1991-1995) the warmwater fishery use continued to be impacted by excessive TSS which represented the sole cause of non-support for the entire drainage. Moderate increases in TSS were noted during 1995-1997 which was a similarly wet period in

the watershed. Total dissolved solids showed a moderate decline although there was little change in water pH between reporting cycles. A moderate impairment for secondary contact was noted in the upper and lower reach of the river due to elevated fecal coliform numbers.

Overall water quality in the basin has remained relatively stable since 1986 with moderate fluctuations in TSS during most years and a decline in fecal coliform concentrations from the levels reported in 1986. The present evaluation of the lower quarter of the river course covered 5.75 years of accumulated data and resulted in a rating of non-support due to excessive TSS and moderate impairment owing to elevated fecal coliform bacteria concentrations.

3. METHODS

3.1. MONITORING LOCATIONS AND SAMPLING SITES

3.1.1. Location of Monitoring Sites Along the MNRR Reach

A total of nine monitoring locations were established on the Missouri, James, and Vermillion Rivers as part of the scoping study (Plate 3). Location 1 was on the Missouri River approximately 1 mile below Gavins point Dam at Missouri River Mile (RM) 810 and consisted of a thalweg site only (Plate 4). Location 2 was on the Missouri River, approximately 0.5 miles above the confluence of the James River at RM 801, and had both a thalweg and backwater site (Plate 5). Location 3 was on the James River approximately 0.5 miles upstream from the Missouri River, and water quality samples were collected at a single mid-channel site (Plate 5). Location 3T was located on a side channel of the Missouri River that received the inflow of the James River, and four sites (3T1, 3T2, 3T3, and 3T4) were sampled along an approximate 2 mile distance of the side channel downstream from the mouth of the James River (Plate 5). Location 4 was on the Missouri River, approximately 1 mile below where the side channel receiving the James River flow enters the main channel flow of the Missouri River at RM 797, and consisted of both a thalweg and backwater site (Plate 5). Location 5 was on the Missouri River approximately 1 mile upstream from the confluence of the Vermillion River at RM 774, and consisted of both a thalweg and backwater site (Plate 6). Location 6 was on the Vermillion River approximately 0.5 miles upstream of its confluence with the Missouri River and water quality samples were collected at a single mid-channel site (Plate 6). Location 7 was on the Missouri River, approximately 0.5 miles below the confluence of the Vermillion River at RM 771, and consisted of both a thalweg and backwater site (Plate 6). Location 8 was on the Missouri River at Ponca State Park, Nebraska at RM 753 and consisted of both a thalweg and backwater site (Plate 7).

3.1.2. Sampling Sites

Sampling sites consisted of four types: 1) thalweg, 2) backwater, 3) special turbidity, and 4) tributary. Thalweg sites were defined as locations on the Missouri River where the current was fast (> 2 ft/sec) and the water was deep (> 5 ft). Thalweg sites were sampled at all Missouri River monitoring locations (i.e., Locations 1, 2, 4, 5, 7 and 8). Backwater sites were defined as locations on the Missouri River where the current was slow (< 2 ft/sec) and the water was shallow (< 5 ft). Backwater sites were sampled at all Missouri River locations except Location 1 (i.e., Locations 2, 4, 5, 7, and 8); no extensive backwater conditions existed at Location 1. Special turbidity sites were established on a side channel of the Missouri River into which the James River discharges (i.e., Locations 3T1, 3T2, 3T3, and 3T4). These sites were

established to further evaluate the effects of the James River on turbidity levels in the Missouri River. Tributary sites were located on the James and Vermillion Rivers (i.e., Locations 3 and 6).

3.2. DETERMINATION OF WATER QUALITY CONDITIONS

3.2.1. Field Measurements

Field measurements were obtained using a Hydrolab, Secchi disc, and GPS receiver. A Hydrolab DataSonde 4 was used to take measurements of water quality conditions within one-meter of the surface at all monitoring locations. The water quality conditions measured were water temperature, dissolved oxygen, pH, and conductivity. A Secchi disc was used to measure visual water clarity. A black-and-white Secchi disc was bolted to the end of a pole with a tape measure attached. The pole was used to maintain the Secchi disc parallel to the water surface in the current. The Secchi disc was lowered into the water until the image was judged to just disappear from view. This depth, in inches, was determined from the tape measure and recorded as the Secchi depth. Geo-locational data were obtained at each site when a water quality sample was collected. A Garmin, GPSmap 76, hand-held GPS receiver was used to obtain geo-positional data. This GPS unit has a minimum accuracy of 15 meters. All field measurement were taken weekly during the six-week sampling period.

3.2.2. Sample Collection

All water samples for laboratory analysis were collected from a boat anchored at the site being sampled. Near-surface and near-bottom water quality samples were collected weekly at the appropriate sampling sites.

3.2.2.1. Near-Surface Samples

Near-surface water quality samples were collected at all the monitoring locations and sampling sites (i.e., 1T, 2B, 2T, 3, 3T1, 3T2, 3T3, 3T4, 4B, 4T, 5B, 5T, 6, 7B, 7T, 8B, and 8T). Near-surface water samples were collected by dipping a plastic bucket, equipped with a churn, below the water surface and filling the bucket. The bucket was rinsed with site water prior to collecting the sample. Two plastic one-liter bottles were filled from the bucket as it was churned. One bottle was preserved with 5 ml of concentrated sulfuric acid and the other was left unpreserved. When herbicides were to be analyzed a third one-quart glass, amber bottle was also filled.

3.2.2.2. Near-Bottom Samples

Near-bottom water samples were collected at all the thalweg sampling sites (i.e., 1T, 2T, 4T, 5T, 7T, and 8T). Near-bottom water samples were collected by lowering a weighted Kermmerer sampler to the bottom and triggering the device. The triggered sampler was retrieved to the surface and the contents emptied into the plastic bucket equipped with a churn. A single one-liter plastic bottle was filled from the bucket as it was churned.

3.2.3. Laboratory Analysis and Sample Preservation

The collected water samples were delivered to the Corps Waterways Experiment Station (WES) laboratory in Omaha, Nebraska for analysis within 24 hours of their collection. Laboratory analysis of the samples consisted of turbidity; total suspended solids, total organic carbon, total phosphorus, total Kjeldahl nitrogen, total ammonia, nitrate/nitrite nitrogen,

chlorophyll *a*, atrazine, alachlor, and metolachlor. Table 2 gives the method, method detection limit, and reporting limit for each of the parameters analyzed. Values greater than the method detection limit and less the reporting limit were qualified as estimated values. Near-surface thalweg and tributary samples were analyzed for all of the above parameters with the exception that the three herbicides (alachlor, atrazine, and metolachlor) were analyzed for every other week. Near-bottom thalweg samples were analyzed for turbidity and suspended solids. Backwater samples were analyzed for turbidity, suspended solids, and chlorophyll *a*. Special turbidity sites were analyzed for turbidity only. Samples for nutrient analyses were preserved with 5 ml of concentrated sulfuric acid when collected. All samples were placed on ice as soon as possible after collection.

3.3. FLOW ESTIMATION

Accounting for discharge is a primary consideration in any riverine water quality study. Generally, a great deal of the variance in water quality variables in a riverine setting is a function of discharge. This is a result of two different kinds of physical phenomena: dilution and wash off (Hirsch et. al, 1991). If a constituent is being delivered to a river or stream at a reasonably consistent rate (e.g., a point source or ground water discharge), as river flows increase these constituents will tend to be diluted and their concentrations reduced. Wash off from the watershed due to overland flow and streambank erosion can transport a solute, sediment, or a constituent attached to sediment into a river or stream. Under these runoff situations, the concentrations of nonpoint source pollutants tend to rise with increasing discharge. When the flow in a river or stream is regulated by dam releases, water quality in the river below will be highly dependent upon the water quality in the reservoir behind the dam and the discharge rate. Water quality conditions in a regulated river can be a reflection of all of these situations occurring at the same time. Knowing river flows when water quality constituents are measured can go a long way in helping to explain the variability in water quality conditions.

Flows through the MNRR reach were estimated from existing stream gaging stations. Plate 8 shows the location and type of permanent flow gaging stations on the MNRR reach and on tributaries in close proximity to the reach. Mean daily discharge values for the period August 17 through September 26, 2001 were calculated for the five gages capable of recording discharge (i.e., Gavins Point Dam, Scotland Gage, Vermillion Gage, Akron Gage, and Sioux City Gage). Flow in the Missouri River from Gavins Point Dam down to the James River was defined as the discharge from Gavins Point Dam. Flow in the Missouri River from the James River to the Vermillion River was defined as the discharge from Gavins Point Dam plus the flow measured in the James River at the Scotland gage. Flow in the Missouri River below the Vermillion River was taken to be the discharge from Gavins Point Dam plus the James River flow measured at the Scotland gage plus the Vermillion River flow measured at the Vermillion gage. This process discounted the flows contributed to the James and Vermillion Rivers below the Scotland and Vermillion gage sites and the flow contributed by the other tributaries discharging directly to the Missouri River. It is noted that the flow at the downstream boundary of the MNRR reach could also be estimated as the flow recorded at the Sioux City gage minus the flow recorded at the Akron gage. This discounts flow contributed to the Big Sioux River below the Akron gage and flow contributed by tributaries discharging to the Missouri River downstream from the lower boundary of the MNRR reach (e.g., Aowa Creek in Nebraska). Table 3 gives the mean daily discharge values for the five gages determined for the period August 17 through September 26, 2001.

To verify flows through the MNRR reach, a water balance was constructed that compared the estimated flow at the end of the MNRR reach as determined by the addition of the

upstream gages (i.e., Gavins Point Dam, Scotland gage, and Vermillion gage) and as determined by the subtraction of the Akron gage from the Sioux City gage. Table 4 gives the estimated mean daily flows out of the MNRR reach based on these two methods. The average daily flow for the period of August 17 through September 26 determined by adding the upstream gages was 27,565 cfs, while the average daily flow determined from the downstream gages was 27,985 cfs; a difference of 420 cfs (1.52%). The relative percent difference (RPD) between the same day mean daily flows determined from the two methods was calculated (Table 4). The mean RPD value based on 41 pairings was 2.16%. It is noted that the Corps has determined the channel velocity of the Missouri River through the MNRR reach ranges from about 2 to 5 ft/sec. Using an average velocity of 3.5 ft/sec (2.4 mph) an estimated time-of-travel through the 57-mile reach would be about 24 hours. Based on the estimated time-of travel, RPD values were also determined by pairing a 1-day delay in the downstream estimate (i.e., the downstream estimate was paired with the previous day upstream estimate). This resulted in a mean RPD value based on 40 pairings of 1.60%. The RPD values indicate that the two estimation methods yielded very similar results – the addition of the upstream gages (i.e., Gavins Point Dam, Scotland, and Vermillion) account for about 98% of the flow occurring through the MNRR reach as estimated by the downstream gages.

3.4. ASSESSMENT OF WATER QUALITY DATA

The water quality data collected during the scoping study were assessed in the following ways: 1) descriptive statistics (i.e., mean, median, minimum, and maximum) were calculated for all measured parameters, 2) box plots were constructed to visually display the distribution of the measurements for each parameter, and 3) a simple two-tailed, paired t-test was used to test for significant differences between selected monitoring locations and sampling sites. It was assumed that the collected data met the requirements for application of parametric statistics (i.e., normality, homogenous variance, and independence of observations). This assumption was believed valid since no major runoff events occurred during the scoping period. Episodic runoff events tend to skew water quality data and cause the assumptions for use of parametric statistics to be violated. It is also noted that the calculated mean and median values for most measured parameters were quite similar (Table 5).

3.5. DATA QUALITY INDICATORS

Quality assurance/quality control (QA/QC) samples, a field blank and duplicate, were created on each sampling trip to evaluate the quality of the data generated by the scoping study. These QA/QC samples were in addition to the internal QA/QC samples utilized by the WES Laboratory as part of the Laboratory's QA/QC program. The six field blank samples were used to generate a data quality indicator for accuracy. De-ionized water was used to fill a set of sample containers at a random monitoring location. The field blanks were handled identically as the site samples. The measurement quality objective that was established for accuracy was that the field blanks should be below detection limits for all parameters analyzed for in the laboratory. The six collocated field duplicate samples were used to generate a data quality indicator for precision. A collocated sample was collected at random from a near-surface thalweg sampling site on each of the six sampling trips. The measurement quality objective established for precision was that the collocated samples should not deviate by more than 25%, as measured by their relative percent difference.

4. RESULTS AND DISCUSSION

4.1. GENERAL WATER QUALITY CONDITIONS

A statistical summary of the water quality conditions monitored at the surface thalweg and tributary sites during the scoping study is given in Table 5. Monitored dissolved oxygen, pH, and total ammonia values were supportive of state water quality standards at all times. Of the three herbicides measures, only atrazine was present in levels above the detection limit of 0.05 µg/l. The only site where the measured atrazine levels were above the reporting limit of 0.1 µg/l was Site 6 (i.e., Vermillion River) where the measured values ranged from 0.07 to 0.28 µg/l. Measured conductivity, turbidity, total organic carbon, total phosphorus, and total kjeldahl nitrogen levels were noticeable higher and the measured secchi depths noticeable lower at the tributary sites on the James and Vermillion Rivers. All measured total suspended solids concentrations were at or below 100 mg/l and all measured nitrate-nitrite nitrogen concentrations were below 0.2 mg/l. Chlorophyll *a* concentrations were highly variable at all sites.

4.2. LONGITUDINAL VARIATION IN WATER QUALITY

Longitudinal variation in water quality through the MNRR reach was evaluated by assessing the water quality conditions monitored at "completely-mixed" near-surface thalweg sampling sites. Of the six near-surface thalweg monitoring sites along the Missouri River (i.e., Sites 1Ts, 2Ts, 4Ts, 5Ts, 7Ts, and 8Ts), two sites, 4Ts and 7Ts, did not represent completely-mixed conditions. Site 4Ts, although located below the mouth of the James River, did not represent water quality conditions in the Missouri River resulting from complete mixing of the James River inflow. The James River flows into the Missouri River from the north and enters a side channel of the Missouri River that is separated from the main channel of the river by a large island. Site 4Ts was located near the south bank of the Missouri River just downstream from the large island and was above the "plume" formed in the Missouri River from the James River inflow. Site 4Ts represented conditions very similar to Site 2Ts. Site 7Ts was located approximately one-half mile downstream from the mouth of the Vermillion River. The Vermillion River enters the Missouri River from the north and Site 7Ts was near the north bank of the Missouri River. In reviewing the water quality results it was determined that Site 7Ts did not represent the conditions of the Vermillion River inflow being completely-mixed with the Missouri River. Based on conductivity measurements, a slight plume of "Vermillion River water" was still noticeable at Site 7Ts. Longitudinal variation in water quality along the MNRR reach was assessed by comparing conditions at Sites 1Ts, 2Ts, 5Ts, and 8Ts.

Monitoring results were used to construct box plots for each parameter measured, except alachlor and metolachlor, at Sites 1Ts, 2Ts, 5Ts, and 8Ts during the scoping study. As noted previously, all samples analyzed for alachlor and metolachlor were below method detection limits. The constructed parameter box plots were plotted, by site, on a graph where the x-axis represented Missouri River mileage points (Plate 9). Based on this graphical representation it was determined that water temperature, pH, total organic carbon, total Kjeldahl nitrogen, total ammonia, nitrate-nitrite, chlorophyll *a*, and atrazine exhibited no noticeable longitudinal variation through the MNRR reach; while, dissolved oxygen, conductivity, Secchi depth, turbidity, total suspended solids, and total phosphorus did. For the six parameters that exhibited longitudinal variation it was concluded that no noticeable difference existed between Sites 1Ts and 2Ts; however, there was a noticeable difference between Sites 2Ts and 5Ts for all six parameters and Sites 5Ts and 8Ts for all the parameters except conductivity. Statistical assessment (two-tailed, paired t-test) of the measured values obtained at Sites 2Ts and 5Ts

where there was a noticeable difference observed in Plate 9, found the following significance levels (rounded to two significant digits): conductivity ($p = 0.02$), dissolved oxygen ($p = 0.05$), Secchi depth ($p = 0.03$), turbidity ($p < 0.01$), total suspended solids ($p < 0.01$), and total phosphorus ($p < 0.01$). A similar assessment of the measured values obtained at Sites 5Ts and 8Ts found the following significance levels: dissolved oxygen ($p = 0.04$), Secchi depth ($p = 0.05$), turbidity ($p = 0.02$), total suspended solids ($p = 0.01$), and total phosphorus ($p < 0.01$).

The differences between Sites 2Ts and 5Ts and Sites 5Ts and 8Ts for all the noted parameters except possibly dissolved oxygen are believed due to the respective inflows of the James and Vermillion Rivers. The differences in dissolved oxygen may be due to other factors. It is noted that the Sites 1Ts and 2Ts were sampled in the early morning, Site 5Ts was sampled around noon, and Site 8Ts was sampled in the late afternoon. The dissolved oxygen percent saturation levels measured at Sites 1Ts and 2Ts were in the low 90's, at Site 5Ts it was in the high 90's, and at Site 8Ts it was above 100%. This downstream pattern of increasing dissolved oxygen concentrations and percent saturations could be reflective of the "normal" diurnal changes in dissolved oxygen due to photosynthesis and respiration. It is also noted that the pattern could be the result of reoxygenation of lower oxygenated water discharged from the reservoir through Gavins Point Dam or a possible bias introduced into the measurements from meter drift.

4.3. LOCALIZED VARIATION IN WATER QUALITY

4.3.1. Near-Surface Versus Near-Bottom Thalweg Sites

Near-surface and near-bottom thalweg turbidity and total suspended solids levels were compared for each of the Missouri River monitoring locations (i.e., Locations 1, 2, 4, 5, 7, and 8). Side-by-side box plots of the near-surface and near-bottom samples for turbidity and total suspended solids are shown in Plates 10 through 15. A statistical assessment (two-tailed, paired t-test) of the turbidity results revealed that no significant difference ($\alpha = 0.10$) existed between the near-surface and near-bottom sites at any of the six assessed monitoring locations. Significant differences ($\alpha = 0.10$) in suspended solids levels did exist between the near-surface and near-bottom samples at monitoring locations 1 ($p = 0.08$), 2 ($p = 0.04$), and 7 ($p = 0.08$) -- in all cases, the total suspended solids concentrations were higher in the near-bottom samples (Plates 10, 11, and 14). The higher suspended solids levels in the near-bottom samples were attributed to the "bed load" material being transported near the bottom of the river. However, the magnitude of the difference between the near-surface and near-bottom suspended solids levels was small, and it did not result in significantly different turbidity levels.

4.3.2. Thalweg Versus Backwater Sites

Measured turbidity, total suspended solids, and chlorophyll *a* levels were compared for near-surface thalweg and backwater samples collected at monitoring locations 2, 4, 5, 7, and 8. Side-by-side box plots displaying the distribution of the measured levels at the five monitoring locations is presented in Plates 11 through 15. The statistical assessment (two-tailed, paired t-test) of the chlorophyll *a* results revealed that no significant difference ($\alpha = 0.20$) existed between the backwater and near-surface thalweg sites at any of the five monitoring locations. Significant differences ($\alpha = 0.05$) in the turbidity and total suspended solids levels existed between the backwater and near-surface thalweg sites at monitoring locations 4 and 7. The significant difference between the backwater and near-surface thalweg sites at monitoring location 4 is attributed to the effects of the James River inflow. The backwater site at this

location, which was in the plume formed below the James River inflow, had higher turbidity and total suspended levels than the near-surface thalweg site that was above the plume (Plate 12). The significant difference between the two sites at monitoring location 7 is believed due to the influence of the Vermillion River inflow. The near-surface thalweg site at this location, which was in the plume formed below the Vermillion River inflow, had higher turbidity and suspended solids levels than the backwater site that was above the plume (Plate 14). The only significant difference between the backwater and near-surface thalweg sites at monitoring locations 5 and 8, which represented completely-mixed conditions, was the difference in turbidity levels (α = 0.05) at monitoring location 5. Turbidity levels were higher at the backwater site, but the magnitude of the difference was quite small (Plate 13).

4.4. Effects Of The James And Vermillion Rivers On Turbidity In The Missouri River

The inflow of the James River appears to have a significant influence on turbidity levels in the Missouri River (Plate 9). During the scoping study a turbidity plume was observed below the mouth of the James River in the side channel of the Missouri River into which it enters. This turbidity plume can visually be seen in the 1997 orthophoto of the area (Plate 16). Mean turbidity, Secchi depth, and conductivity values calculated from the data collected at Sites 2Ts, 3, 3T1, 3T2, 3T3, 3T4, 4B and 5Ts are given in Table 6. The plume formed below the James River stays relatively intact throughout the entire length of the side-channel of the Missouri River into which it flows. As seen in the data collected at Site 4B, the plume still exists within the Missouri River one-half mile below where the side-channel rejoins the main river, but is dissipating (Table 6).

Based on the average of the estimated mean daily flows for Sites 2Ts (26,286 cfs) and 3 (1,144 cfs) the dilution factor of the Missouri River to the James River inflow is approximately 23:1. This dilution factor was used to project when the James River inflow would be completely-mixed with the Missouri River based on conductivity levels. The mean conductivity levels measured at Sites 2Ts and 3 were respectively 833 and 1,256 μmhos (Table 6). Applying a 23:1 dilution factor to these mean values, a completely-mixed situation would be present when conductivity levels in the Missouri River reached approximately 851 μmhos. The mean conductivity determined for Site 5Ts was 853 μmhos (Table 6). It was therefore concluded that the James River inflow has completely-mixed with the Missouri River by the time the flows have reached Site 5Ts, which is approximately 28 river miles downstream from the mouth of the James River.

It is noted that the turbidity levels measured at Sites 2Ts, 3, and 5Ts do not conform to the 23:1 dilution factor, as does conductivity. This can possibly be attributed to two factors. First, conductivity is a "quantitative measurement" of a physicochemical property of water that conforms to a simple dilution analysis. Turbidity, on the other hand, is a "relative measurement" of an optical property of the water (i.e., "cloudiness" of water caused by the light scattering of suspended particles). The important attributes of suspended particles regarding their optical character and other important aspects of environmental behavior, notably settling velocity, are their particle size, shape and composition (Davies-Colley and Smith, 2001). Thus simple dilution is a lesser factor in determining turbidity levels than the particle size, shape, and composition of the suspended material. Second, streambed degradation and streambank erosion may be contributing to turbidity levels as the river flows downstream between the sites.

Turbidity levels significantly increased between the two sites, 5Ts and 8Ts, where the Vermillion River enters the Missouri River (Plate 9). Mean turbidity, Secchi depth, and

conductivity values calculated from the data collected at Sites 5Ts, 6, 7Ts, and 8Ts are given in Table 6. As seen in the mean conductivity value for Site 7Ts, a limited plume did occur below the inflow of the Vermillion River. Site 7Ts was located approximately one-half mile downstream from the mouth of the Vermillion River near the north bank (Plate 6).

Based on the average of the estimated mean daily flows for Sites 5Ts (27,430 cfs) and 6 (135 cfs) the dilution factor of the Missouri River to the Vermillion River inflow is approximately 203:1. This dilution factor was used to project when the Vermillion River inflow would be completely-mixed with the Missouri River based on conductivity levels. The mean conductivity levels measured at Sites 5Ts and 6 were respectively 853 and 1,385 μmhos (Table 6). Applying a 203:1 dilution factor to these mean values, a completely-mixed situation would be present when conductivity levels in the Missouri River reached approximately 856 μmhos. The mean conductivity determined for Sites 7Ts and 8Ts was, respectively, 864 and 851μmhos (Table 6). It was therefore concluded that the Vermillion River inflow has completely-mixed with the Missouri River by the time the flows have reached Site 8Ts, which is approximately 19 river miles downstream from the mouth of the Vermillion River.

As was seen in conditions above and below the James River, the mean turbidity levels above and below the Vermillion River (Sites 5Ts and 8Ts) do not conform to a simple dilution analysis, as does conductivity. However, the magnitude of the nonconformity below the Vermillion River is much more apparent given the dilution factor of 203:1. Streambed degradation and streambank erosion may be influencing turbidity levels to a greater degree in the reach between Sites 5Ts and 8Ts.

The daily load of total suspended solids (TSS) delivered by the inflows of the James and Vermillion Rivers was estimated for each of the days (TSS) was measured. The estimate was based on the average daily flows recorded at the Scotland and Vermillion gages and the total suspended solids concentration measured on that day. Table 7 gives the daily total suspended solids loads estimated for each of the 6 days water quality samples were collected during the scoping study. The average daily load of total suspended solids delivered by the James and Vermillion Rivers was estimated to be, respectively, 169.8 and 14.5 tons.

4.5. DATA QUALITY INDICATORS

4.5.1. Accuracy

A review of the analysis results obtained for the six field blank samples found only one occurrence of a reported value greater than a detection limit. The one occurrence was an estimated value of 2 μg/l for chlorophyll *a*. The detection limit for chlorophyll *a* is 1 μg/l and the reporting limit is 3 μg/l. Given that this one occurrence was an estimated value near the detection limit, it was not considered significant.

4.5.2. Precision

Table 8 gives the analytical results of the collocated samples and the relative percent difference (RPD) for the analyzed parameter. The RPD was calculated only when the analytical results for a parameter were above the reporting limit. Of the total 36 RPD values calculated for all parameters, 4 were at or above 25%. Two of the 4 RPD values calculated for chlorophyll *a* were at or above 25%, while 1 of 6 were for total phosphorus and turbidity. The RPD values calculated for the 4 chlorophyll *a* paired samples ranged from 10.5 to 93.3%, and raise a

concern on the precision of the chlorophyll *a* results. It is noted that the 8 reported chlorophyll *a* values were relatively low (i.e., all less than 15 μg/l). From a water quality standpoint these are low values, and although poor precision is a concern, it is not considered environmentally significant. The reported turbidity values for one pair of collocated samples were 39 and 19 NTUs (RPD = 69.0%). The other 5 paired turbidity values were within 2 NTUs of each other (RPD values of 0.0, 0.0, 4.7, 4.9, and 10.0). Although the RPD of the one pair of turbidity measurements is a concern, the overall precision of the turbidity measurements for the scoping study is considered good based on the other 5 collocated samples. The one high RPD value may represent an outlier situation. The one RPD value for total phosphorus above 25% was 28.6%, and resulted from paired values of 0.04 and 0.03 mg/l. These values are near the detection and reporting limit for total phosphorus and are very low from a water quality standpoint. The "high" RPD value is a reflection of the low magnitude of the paired results and is not considered significant. Overall, the precision of the analyzed parameters is considered good, with some concern regarding the measured chlorophyll *a* values.

5. SUMMARY

The overall water quality of the MNRR reach appears to be good. All the water quality parameters monitored in the MNRR reach during the scoping study met the appropriate state water quality standards adopted pursuant to the Federal Clean Water Act. Significant longitudinal variation through the reach was observed for the monitored parameters of conductivity, dissolved oxygen, Secchi depth, turbidity, total suspended solids, and total phosphorus. The longitudinal variation of all these parameters except dissolved oxygen, appears to be largely attributed to the inflows of the James and Vermillion Rivers. Little difference was observed between near-surface and near-bottom thalweg water quality conditions and near-surface thalweg and backwater water quality conditions. It is noted that these observations are based on a limited sampling period (i.e., late August through September) of a single year and are probably seasonally biased.

6. RECOMMENDATIONS

6.1. ADDITIONAL WATER QUALITY MONITORING

It is recommended that the ODWQU implement a 2 to 3 year monitoring project to define the water quality conditions that exist in the MNRR reach. The scoping study established that there is longitudinal variation in water quality along the MNRR reach, and it appears that the inflows of the James and Vermillion Rivers play a significant role in this variation. The scoping study was limited in its temporal coverage and additional monitoring is needed to account for seasonal variation in water quality. The monitoring project should include near-surface thalweg sampling at 3 Missouri River sites (immediately below Gavins Point Dam, near Maskell, NE, and at Ponca State Park, NE). These sampling points along the Missouri River will represent completely-mixed conditions that bracket the inflows of the James and Vermillion Rivers. Two additional sites, one on the James River and one on the Vermillion River near their mouths, should also be collected. The sampling sites on the James and Vermillion Rivers could be at the South Dakota state highway 50 bridge crossings. Ongoing South Dakota Department of Natural Resources water quality monitoring activities on the James and Vermillion Rivers should be reviewed for possible partnering and data-sharing opportunities. The recommended sampling period is April through October. During this sampling period it is recommended that systematic monthly grab samples be collected. In addition to the systematic monthly samples, 4 additional spring season grab samples and up to 4 additional runoff grab samples should be collected. Parameters coverage should include field measurements of water temperature,

dissolved oxygen, conductivity, pH, and turbidity; and analytical measurements of nutrients, suspended solids, selected herbicides and priority pollutants. The Nebraska Department of Environmental Quality should be consulted as to the parameters they deemed important regarding implementation of their Tier 3 antidegradation provisions.

6.2. WATER QUALITY MANAGEMENT CONCERNS

A water quality management concern is the seemingly contradictory water quality management goals identified for the MNRR reach under the Federal Endangered Species Act (ESA), Clean Water Act (CWA), and Wild and Scenic Rivers Act (WSRA). The BiOp, developed pursuant to the ESA, directs the Corps to increase turbidity and suspended solids in the MNRR. The BiOp states that sediment transport and turbidity need to be restored to functional levels in the MNRR reach to improve habitat conditions for the jeopardized species inhabiting the reach. State water quality standards (i.e., South Dakota and Nebraska) adopted pursuant to the CWA require that suspended solids and turbidity levels be maintained at "reduced" levels in the MNRR reach, and imply that increasing turbidity and suspended solids levels in the reach could represent a degradation of water quality conditions and a possible impairment of a designated beneficial use. South Dakota has specifically adopted water quality standards criteria to manage total suspended solids levels in the MNRR reach. One of the beneficial uses South Dakota designates on the MNRR reach is "warmwater permanent fish life propagation". Protection of this use requires that total suspended solids levels are to be $\leq$ 158 mg/l as a daily maximum, and $\leq$ 90 mg/l as a 30-day average. Management of the MNRR reach as a recreational river under the WSRA requires that the values for which it was designated as a recreational river (i.e., its outstanding remarkable recreational, fish and wildlife, aesthetic, historical, and cultural values) be protected and enhanced. Increasing suspended solids and turbidity levels in the MNRR reach may degrade the habitat for recreationally important fish species that were present in the reach when it was designated as a recreational river. The existing water quality literature suggests that elevated levels of turbidity adversely impact the recreational and aesthetic values of a waterbody. The U.S. Environmental Protection Agency's "Red Book" states; "Turbid water interferes with recreational use and aesthetic enjoyment of water" (USEPA, 1976). The USFWS should enter consultation with EPA Regions VII and VIII, and possibly the NPS, to discuss coordinating the water quality aspects of the BiOp, CWA, and WSRA to ensure that there are consistent water quality management goals on the MNRR reach.

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Table 1. 8-Digit Hydrologic Units (HUCs) that make up the watershed, below Gavins Point Dam, of the MNRR Reach.

HUC Number	HUC Name	Approximate Area (sq. miles)
10160001	James River Headwaters	1760
10160002	Pipestem Reservoir	1040
10160003	Upper James River	4250
10160004	Elm Creek	1600
10160005	Mud Creek	650
10160006	Middle James River	3640
10160007	East Missouri Coteau	890
10160008	Snake Creek	1520
10160009	Turtle Creek	1480
10160010	North Big Sioux Coteau	1230
10160011	Lower James	3530
10170101	Lewis and Clark Lake*	3240
10170102	Vermillion River	2240
10170103	South Big Sioux Coteau	410
10170101*	(MNRR Reach)	880
10170101*	(Above and Below MNRR Reach)	2360

Table 2. Analytical method, method detection limit, and reporting limit for parameters analyzed in the WES Laboratory.

Parameter	Analytical Method	Method Detection Limit	Reporting Limit
Turbidity (NTU)	EPA180.1	1 NTU	3 NTU
Total Suspended Solids (mg/l)	EPA160.2	4 mg/l	10 mg/l
Total Organic Carbon (mg/l)	EPA9060	0.05 mg/l	0.25 mg/l
Total Phosphorus (mg/l)	EPA365.4	0.01 mg/l	0.02 mg/l
Total Kjeldahl Nitrogen (mg/l)	EPA351.2	0.1 mg/l	0.2 mg/l
Total Ammonia (mg/l)	EPA350.1	0.01 mg/l	0.1 mg/l
Nitrate/Nitrate as N (mg/l)	EPA353.2	0.02 mg/l	0.1 mg/l
Chlorphyll *a* (µg/l)	SM10200H2	1 µg/l	3 µg/l
Atrazine (µg/l)	EPA507	0.05 µg/l	0.1 µg/l
Alachlor (µg/l)	EPA507	0.05 µg/l	0.1 µg/l
Metholachlor (µg/l)	EPA507	0.05 µg/l	0.1 µg/l

Table 3. Mean daily discharge calculated for 5 gaging sites in proximity to the MNRR reach for the period August 17 through September 26, 2001. (Note: The calculated mean daily discharges are based on provisional discharge measurements.)

	Mean Daily Discharge (cfs)				
Date	Gavins Point Dam	Scotland Gage	Vermillion Gage	Akron Gage	Sioux City Gage
17-Aug-2001	25,003	1,259	137	1,603	29,239
18-Aug2001	25,478	1,272	137	1,539	28,012
19-Aug2001	25,499	1,276	133	1,502	28,246
20-Aug2001	25,494	1,263	127	1,466	28,296
21-Aug2001	25,970	1,239	128	1,397	28,413
22-Aug2001	25,993	1,229	120	1,364	28,919
23-Aug2001	26,208	1,227	141	1,281	28,838
24-Aug2001	25,997	1,235	143	1,270	28,832
25-Aug2001	26,005	1,219	147	1,250	28,820
26-Aug2001	26,003	1,220	145	1,213	28,669
27-Aug2001	25,997	1,208	142	1,189	28,585
28-Aug2001	26,000	1,196	138	1,148	28,578
29-Aug2001	26,000	1,181	133	1,123	28,655
30-Aug2001	26,000	1,172	133	1,070	28,917
31-Aug2001	26,000	1,156	132	1,040	28,418
1-Sep2001	25,996	1,131	132	1,255	28,122
2-Sep2001	25,998	1,110	140	1,111	28,551
3-Sep2001	25,999	1,103	134	978	28,441
4-Sep2001	26,796	1,091	123	918	28,148
5-Sep2001	27,504	1,066	120	894	29,012
6-Sep2001	27,957	1,054	121	608	29,660
7-Sep2001	27,994	1,092	121	592	30,171
8-Sep2001	28,005	1,119	119	566	30,760
9-Sep2001	27,998	1,124	118	566	30,663
10-Sep2001	28,002	1,144	123	583	30,318
11-Sep2001	27,998	1,125	130	576	30,190
12-Sep2001	27,753	1,110	126	554	30,303
13-Sep2001	27,501	1,032	122	529	30,371
14-Sep2001	27,504	1,088	129	549	31,169
15-Sep2001	27,991	1,110	139	571	31,668
16-Sep2001	27,081	1,135	144	641	31,049
17-Sep2001	25,480	1,157	148	796	30,532
18-Sep2001	25,005	1,171	153	845	28,352
19-Sep2001	24,999	1,161	158	819	27,627
20-Sep2001	25,001	1,144	155	717	27,503
21-Sep2001	25,010	1,119	151	665	27,400
22-Sep2001	25,002	1,087	146	649	27,457
23-Sep2001	25,007	1,061	141	669	27,365
24-Sep2001	25,004	1,029	136	621	27,158
25-Sep2001	25,499	997	133	579	26,731
26-Sep2001	25,998	974	132	558	27,067
Mean	**26,286**	**1,144**	**135**	**924**	**28,908**

Table 4. Water balance based on the mean daily discharges calculated at the 5 gage sites for the period August 17 through September 26, 2001.

Date	GPT + SCT + VER* (cfs)	SC ! AKR* (cfs)	RPD** (Same Day)	RPD** (1-Day Delay)
17-Aug-2001	26,399	27,636	4.58	
18-Aug-2001	26,887	26,473	1.55	0.28
19-Aug-2001	26,908	26,744	0.61	0.53
20-Aug-2001	26,884	26,830	0.20	0.29
21-Aug-2001	27,337	27,016	1.18	0.49
22-Aug-2001	27,342	27,555	0.78	0.79
23-Aug-2001	27,576	27,557	0.07	0.78
24-Aug-2001	27,375	27,562	0.68	0.05
25-Aug-2001	27,371	27,570	0.72	0.71
26-Aug-2001	27,368	27,456	0.32	0.31
27-Aug-2001	27,347	27,396	0.18	0.10
28-Aug-2001	27,334	27,430	0.35	0.30
29-Aug-2001	27,314	27,532	0.79	0.72
30-Aug-2001	27,305	27,847	1.97	1.93
31-Aug-2001	27,288	27,378	0.33	0.27
1-Sep-2001	27,259	26,867	1.45	1.55
2-Sep-2001	27,248	27,440	0.70	0.66
3-Sep-2001	27,236	27,463	0.83	0.79
4-Sep-2001	28,010	27,230	2.82	0.02
5-Sep-2001	28,690	28,118	2.01	0.38
6-Sep-2001	29,132	29,052	0.27	1.25
7-Sep-2001	29,207	29,579	1.27	1.52
8-Sep-2001	29,243	30,194	3.20	3.32
9-Sep-2001	29,240	30,097	2.89	2.88
10-Sep-2001	29,269	29,735	1.58	1.68
11-Sep-2001	29,253	29,614	1.23	1.17
12-Sep-2001	28,989	29,749	2.59	1.68
13-Sep-2001	28,655	29,842	4.06	2.90
14-Sep-2001	28,721	30,620	6.40	6.63
15-Sep-2001	29,240	31,097	6.16	7.94
16-Sep-2001	28,360	30,408	6.97	3.92
17-Sep-2001	26,785	29,736	10.44	4.74
18-Sep-2001	26,329	27,507	4.38	2.66
19-Sep-2001	26,318	26,808	1.84	1.80
20-Sep-2001	26,300	26,786	1.83	1.76
21-Sep-2001	26,280	26,735	1.72	1.64
22-Sep-2001	26,235	26,808	2.16	1.99
23-Sep-2001	26,209	26,696	1.84	1.74
24-Sep-2001	26,169	26,537	1.40	1.24
25-Sep-2001	26,629	26,152	1.81	0.06
26-Sep-2001	27,104	26,509	2.22	0.45
Mean	**27,565**	**27,985**	**2.16**	**1.60**
		Minimum	0.07	0.02
		25th Percentile	0.72	0.43
		Median	1.58	1.21
		75th Percentile	2.59	1.84
		Maximum	10.44	7.94

* GPT = Gavins Point Dam Discharge, SCT = Scotland gage discharge, VER = Vermillion gage discharge, SC = Sioux City gage discharge, and AKR = Akron gage discharge.

** RPD = [$|X_1 ! X_2| / ((X_1 + X_2)/2)$] x 100%; where X_1 = (GPT + SCT + VER), and X_2 = (SC ! AKR).

Table 5. Summary statistics of water quality conditions monitored at the near-surface thalweg and tributary sites during the scoping study.

Parameter	Site 1Ts					Site 2Ts					Site 3					Site 4Ts				
	Mean	Med.	Min.	Max.	Obs.	Mean	Med.	Min.	Max.	Obs.	Mean	Med.	Min.	Max.	Obs.	Mean	Med.	Min.	Max.	Obs.
Water Temperature (°C)	21.7	22.5	18.3	24.6	6	21.5	22.3	18.0	24.5	6	21.4	22.7	16.2	25.3	6	21.6	22.3	17.9	24.7	6
Dissolved Oxygen (mg/l)	7.9	7.9	7	8.8	6	8.0	8.0	7.4	8.8	6	7.5	7.5	6.6	8.6	6	7.9	8.0	7.4	8.6	6
pH (S.U.)	—	8.3	8.3	8.4	6	—	8.3	8.3	8.4	6	—	8.3	8.1	8.3	6	—	8.3	8.3	8.3	6
Conductivity (µmhos)	832	833	815	848	6	833	835	816	849	6	1256	1267	1180	1310	6	833	835	817	850	6
Secchi Depth (Inches)	25	26	23	28	5	25	24	21	30	6	10	10	10	11	5	25	24	22	28	5
Turbidity (NTU)	12	12	8	17	6	14	14	11	17	6	34	35	19	42	6	13	13	11	17	6
Total Suspended Solids (mg/l)	15	13	8	29	6	14	12	6	28	6	55	49	38	100	6	14	12	11	22	6
Total Organic Carbon (mg/l)	4.2	4.2	3.9	4.8	6	4.2	4.1	3.8	4.9	6	12.5	12.5	12.0	13.0	6	4.0	4.1	3.0	4.8	6
Total Phosphorus (mg/l)	0.03	0.03	0.03	0.04	6	0.03	0.04	0.02	0.04	6	0.47	0.48	0.38	0.53	6	0.03	0.03	0.02	0.04	6
Total Kjeldahl Nitrogen (mg/l)	0.3	0.1	<0.1	0.7	6	0.3	0.1	0.1	0.6	6	0.6	0.6	0.4	0.8	6	0.3	0.1	<0.1	0.7	6
Total Ammonia as N (mg/l)	0.08	0.02	<0.01	0.24	6	0.07	0.03	<0.01	0.22	6	0.08	0.03	<0.01	0.25	6	0.07	<0.01	<0.01	0.21	6
Nitrate-Nitrite as N (mg/l)	0.12	0.13	0.07	0.15	6	0.12	0.14	0.07	0.15	6	0.06	<0.02	<0.02	0.17	6	0.12	0.13	0.07	0.15	6
Chlorophyll *a* (µg/l)	13	7	2	48	6	22	9	4	85	6	21	21	11	38	6	10	10	4	16	6
Atrazine (µg/l)	0.06	0.06	<0.05	0.07	3	0.06	<0.05	<0.05	0.07	3	<0.05	<0.05	<0.05	<0.05	3	0.06	0.06	<0.05	0.06	3
Alachlor (µg/l)	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3
Metholachlor (µg/l)	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3

Parameter	Site 5Ts					Site 6					Site 7Ts					Site 8Ts				
	Mean	Med.	Min.	Max.	Obs.	Mean	Med.	Min.	Max.	Obs.	Mean	Med.	Min.	Max.	Obs.	Mean	Med.	Min.	Max.	Obs.
Water Temperature (°C)	21.7	22.6	17.0	24.5	6	20.3	21.4	14.0	24.3	6	21.2	21.8	17.0	24.2	5	22.2	23.5	17.4	25.0	6
Dissolved Oxygen (mg/l)	8.5	8.5	7.9	9.2	6	8.7	8.7	7.9	9.3	5	8.7	8.7	8.3	9.1	4	9.0	9.1	8.7	9.4	5
pH (S.U.)	—	8.3	8.3	8.4	6	—	8.2	8.0	8.3	6	—	8.4	8.3	8.4	5	—	8.4	8.3	8.4	6
Conductivity (µmhos)	853	853	836	865	6	1385	1385	1361	1408	6	864	869	847	874	5	851	854	834	865	6
Secchi Depth (Inches)	20	21	19	21	5	12	12	11	14	5	19	18	18	20	5	19	19	18	20	5
Turbidity (NTU)	18	18	16	22	6	30	27	25	37	6	21	22	18	23	6	22	21	19	29	6
Total Suspended Solids (mg/l)	29	24	21	54	6	41	39	30	62	6	37	31	25	70	6	40	33	30	80	6
Total Organic Carbon (mg/l)	4.8	4.4	4.1	6.4	6	11.2	11.0	11.0	12.0	6	4.8	4.8	4.5	5.5	6	4.4	4.4	4.1	5.2	6
Total Phosphorus (mg/l)	0.06	0.06	0.05	0.07	6	0.21	0.21	0.18	0.26	6	0.08	0.08	0.06	0.09	6	0.07	0.08	0.06	0.08	6
Total Kjeldahl Nitrogen (mg/l)	0.2	<0.1	<0.1	0.6	6	0.5	0.6	0.1	0.9	6	0.3	0.1	<0.1	0.7	6	0.3	0.1	<0.1	0.6	6
Total Ammonia as N (mg/l)	0.06	0.01	<0.01	0.19	6	0.07	0.03	<0.01	0.21	6	0.06	<0.01	<0.01	0.20	6	0.06	0.02	<0.01	0.19	6
Nitrate-Nitrite as N (mg/l)	0.13	0.14	0.08	0.17	6	0.05	<0.02	<0.02	0.13	6	0.12	0.14	0.05	0.16	6	0.09	0.10	<0.02	0.17	6
Chlorophyll *a* (µg/l)	19	9	<1	79	6	24	27	100	35	6	12	14	2	22	6	10	10	2	19	6
Atrazine (µg/l)	0.06	<0.05	<0.05	0.09	3	0.21	0.27	0.07	0.28	3	0.07	0.07	<0.05	0.08	3	<0.05	<0.05	<0.05	0.06	3
Alachlor (µg/l)	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3
Metholachlor (µg/l)	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3	<0.05	<0.05	<0.05	<0.05	3

Mean = Mean value of observations. (Values below detection limit were set at the detection limit when calculating mean values.)
Med. = Median value of observations.
Min. = Minimum value of observations.
Max. = Maximum value of observations.
Obs. = Number of observations on which the mean, median, minimum, and maximum are based.

Table 6. Mean turbidity, Secchi depth, and conductivity values determined from data collected at Sites 2Ts, 3, 3T1, 3T2, 3T3, 3T4, 4B, 5Ts, 6, 7Ts, and 8Ts during the scoping study.

Site	Turbidity (NTU)	Secchi Depth (inches)	Conductivity (μmhos)
2Ts	14	25	833
3	34	10	1,256
3T1	47	10	1,290
3T2	42	10	1,243
3T3	36	11	1,248
3T4	34	12	1,151
4B(1)*	32	13	1,050
4B(2)*	19	19	859
5Ts	18	20	853
6	30	12	1,385
7Ts	21	19	864
8Ts	22	19	851

* 4B(1) was located in a backwater area near the north bank of the Missouri River and was in a noticeable plume formed by the James River inflow. 4B(2) was in a backwater area away from the north bank and just on the edge of the James River plume. See Plate 5.

Table 7. Total suspended solids loading estimates for the James and Vermillion Rivers for selected days during the scoping study.

James River:

Date	Mean Daily Discharge (cfs)	TSS Concentration (mg/l)	TSS Flux Rate (lbs/sec)	Estimated TSS Load (tons/day)
22-Aug-2001	1,229	100	7.67	331.4
29-Aug-2001	1,181	38	2.80	121.0
5-Sep-2001	1,066	44	2.93	126.5
12-Sep-2001	1,110	52	3.60	155.7
19-Sep-2001	1,161	53	3.84	165.9
26-Sep-2001	974	45	2.74	118.2
Average	1,120	55	3.93	169.8

Vermillion River:

Date	Mean Daily Discharge (cfs)	TSS Concentration (mg/l)	TSS Flux Rate (lbs/sec)	Estimated TSS Load (tons/day)
22-Aug-2001	120	62	0.46	20.1
29-Aug-2001	133	32	0.27	11.5
5-Sep-2001	120	30	0.22	9.7
12-Sep-2001	126	45	0.35	15.3
19-Sep-2001	158	33	0.33	14.1
26-Sep-2001	132	46	0.38	16.4
Average	132	41	0.34	14.5

Table 8. Analysis results and percent relative difference (RPD) of collocated samples collected during the scoping study. RPD values calculated only if analysis results were above the reporting limit for that parameter.

	22-Aug-2001			29-Aug-2001			5-Sep-2001		
Parameter	**Duplicate**	**Site 3**	**RPD***	**Duplicate**	**Site 5Ts**	**RPD***	**Duplicate**	**Site 7Ts**	**RPD***
Alachlor (µg/l)	<0.05	<0.05	BRL				<0.05	<0.05	BRL
Atrazine (µg/l)	<0.05	<0.05	BRL				0.06	0.08	BRL
Chlorophyll *a* (µg/l)	4	11	93.3	9	7	25.0	---	16	---
Metolachlor (µg/l)	<0.05	<0.05	BRL				<0.05	<0.05	BRL
Nitrate/Nitrite as N (mg/l)	0.12	0.12	0.0	0.15	0.16	6.5	0.04	0.05	BRL
Total Ammonia as N (mg/l)	<0.01	<0.01	BRL	<0.01	<0.01	BRL	<0.01	<0.01	BRL
Total Kjedahl Nitrogen (mg/l)	0.84	0.73	14.0	0.15	<0.1	BRL	<0.1	<0.1	BRL
Total Organic Carbon (mg/l)	13	13	0.0	4.5	4.4	2.3	4.5	4.7	4.4
Total Phosphorus (mg/l)	0.56	0.53	5.5	0.08	0.07	13.3	0.08	0.09	11.8
Total Suspended Solids (mg/l)	104	100	3.9	27	26	3.8	32	37	14.5
Turbidity (NTU)	39	19	69.0	21	22	4.7	20	21	4.9

	12-Sep-2001			19-Sep-2001			26-Sep-2001		
Parameter	**Duplicate**	**Site 1Ts**	**RPD***	**Duplicate**	**Site 8Ts**	**RPD***	**Duplicate**	**Site 8Ts**	**RPD***
Alachlor (µg/l)				<0.05	<0.05	BRL			
Atrazine (µg/l)				<0.05	<0.05	BRL			
Chlorophyll *a* (µg/l)	2	6	BRL	14	12	15.4	9	10	10.5
Metolachlor (µg/l)				<0.05	<0.05	BRL			
Nitrate/Nitrite as N (mg/l)	0.07	0.07	BRL	0.17	0.17	0.0	0.07	0.09	BRL
Total Ammonia as N (mg/l)	0.02	<0.01	BRL	0.19	0.19	0.0	0.14	0.13	7.4
Total Kjedahl Nitrogen (mg/l)	0.12	<0.1	BRL	0.48	0.54	11.8	0.58	0.56	3.5
Total Organic Carbon (mg/l)	3.4	3.9	13.7	4.0	4.1	2.5	4.5	4.4	2.3
Total Phosphorus (mg/l)	0.04	0.03	28.6	0.07	0.08	13.3	0.07	0.06	15.4
Total Suspended Solids (mg/l)	11	13	16.7	27	34	23.0	27	30	10.5
Turbidity (NTU)	14	14	0.0	21	19	10.0	19	19	0.0

	RPD Summary Statistics						
Parameter	**Mean**	**Minimum**	**25th Percentile**	**Median**	**75th Percentile**	**Maximum**	**No. of Obs.****
Alachlor (µg/l)	---	---	---	---	---	---	0
Atrazine (µg/l)	---	---	---	---	---	---	0
Chlorophyll *a* (µg/l)	36.1	10.5	14.2	20.2	42.1	93.3	4
Metolachlor (µg/l)	---	---	---	---	---	---	0
Nitrate/Nitrite as N (mg/l)	2.2	0.0	0.0	0.0	3.2	6.5	3
Total Ammonia as N (mg/l)	3.7	0.0	1.9	3.7	5.6	7.4	2
Total Kjedahl Nitrogen (mg/l)	9.8	3.5	7.6	11.8	12.9	14.0	3
Total Organic Carbon (mg/l)	4.2	0.0	2.3	2.4	3.9	13.7	6
Total Phosphorus (mg/l)	14.7	5.5	12.2	13.3	14.9	28.6	6
Total Suspended Solids (mg/l)	12.1	3.8	5.6	12.5	16.1	23.0	6
Turbidity (NTU)	14.8	0.0	1.2	4.8	8.7	69.0	6

* BRL = Analysis results for one or both of the collocated samples were below the reporting limit for that parameter.
** No. of Obs. = Number of observations on which the RPD summary statistics are based.

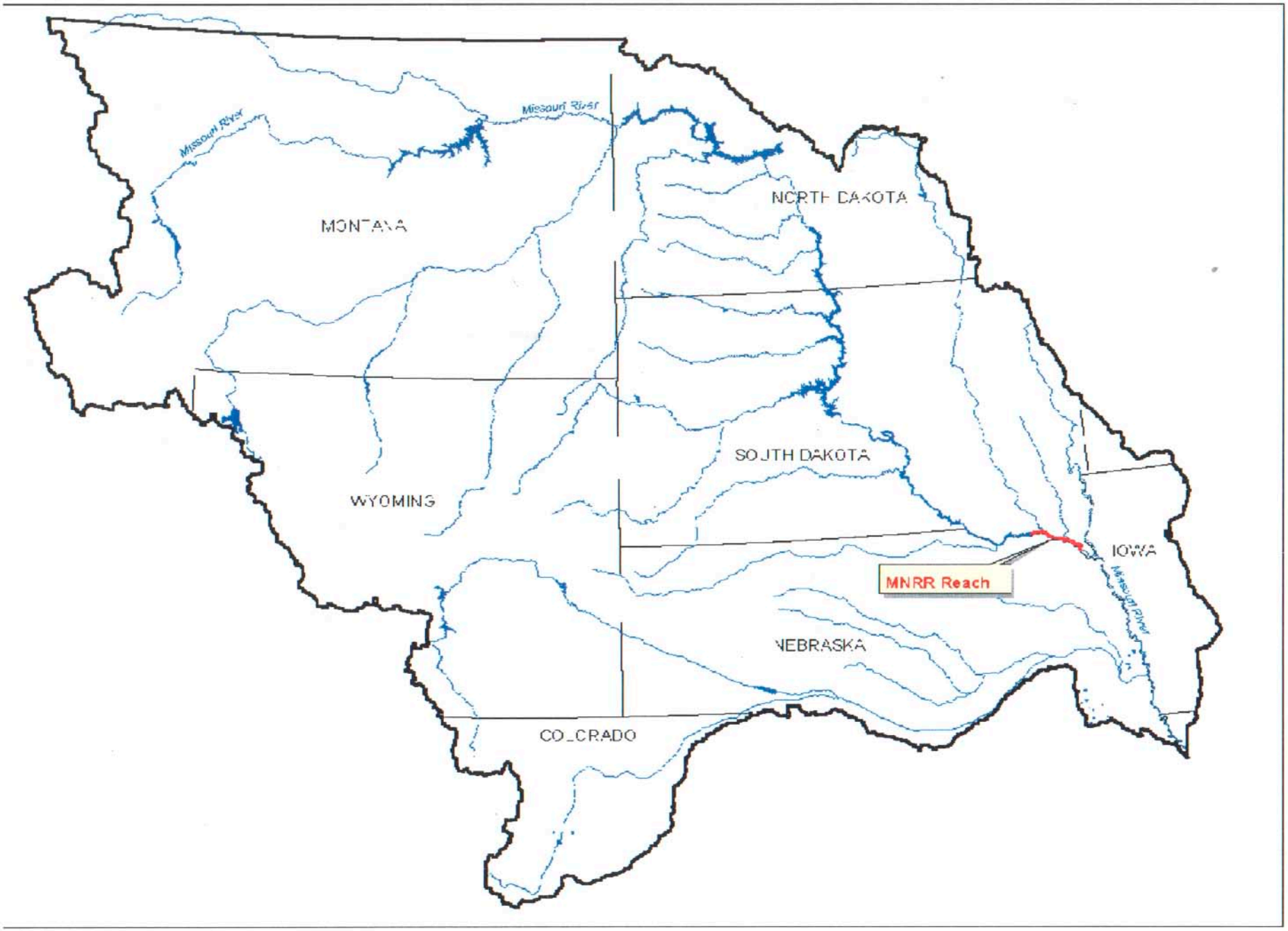


Plate 1. Location of the Missouri National Recreational River (MNRR) reach within the Omaha District.

Plate 2. Watershed area draining to the MNRR reach below Gavins Point Dam as delineated by 8-digit Hydrologic Units (HUCs). Note: The "shaded" area of HUC 10170101 is the area above Gavins Point Dam and below Ponca, Nebraska that does not contribute runoff to the MNRR reach.

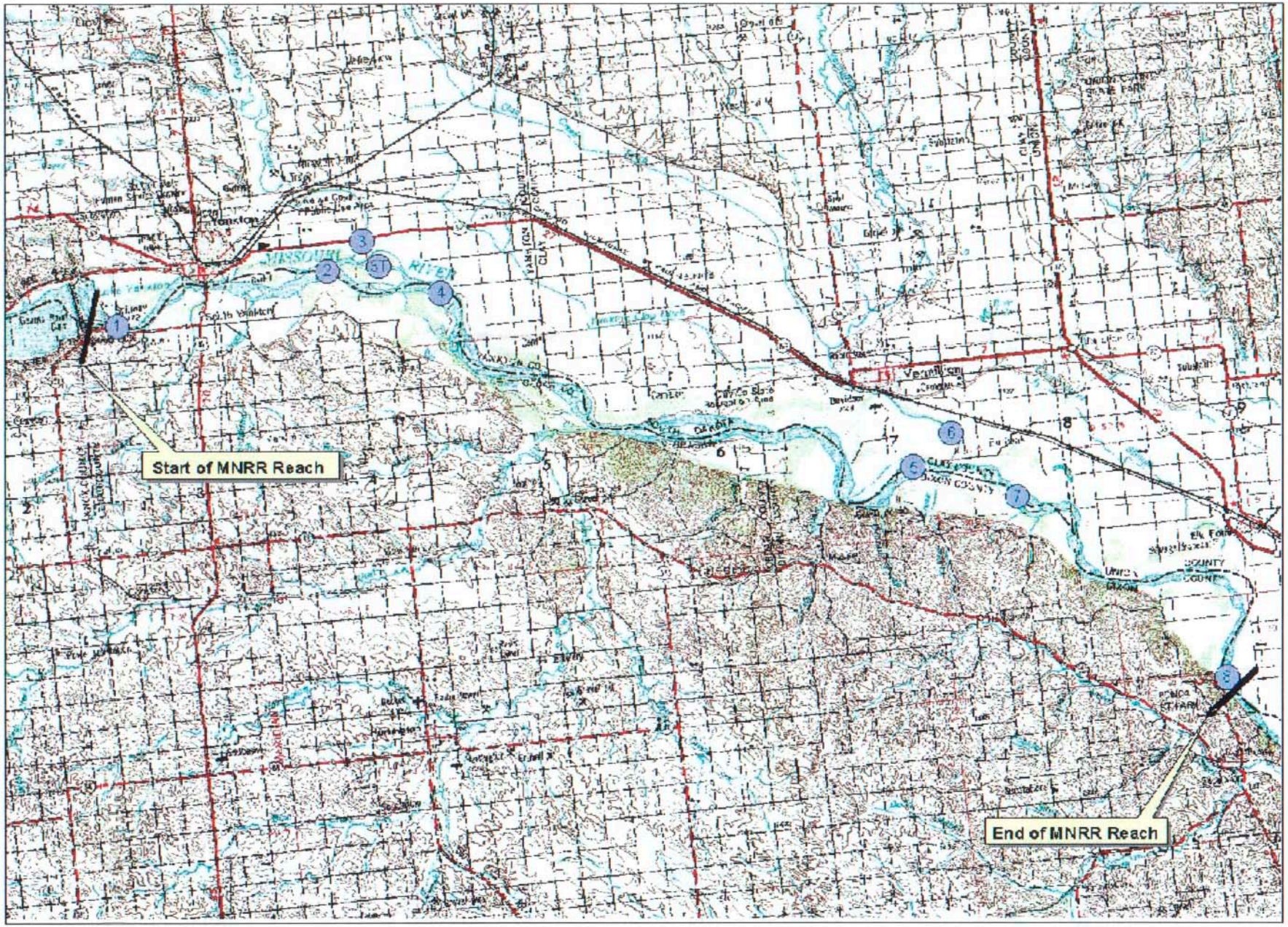


Plate 3. Location of monitoring sites along the MNRR reach where water quality samples were collected as part of the scoping study

Plate 4. Location of Site 1 based on the average of the acquired GPS coordinates and projected on a 1997 orthophoto of the area.

Plate 5. Location of Sites 2B, 2T, 3, 3T1, 3T2, 3T3, 3T4, 4B and 4T based on the average of the obtained GPS coordinates and projected on a 1997 orthophoto of the area.

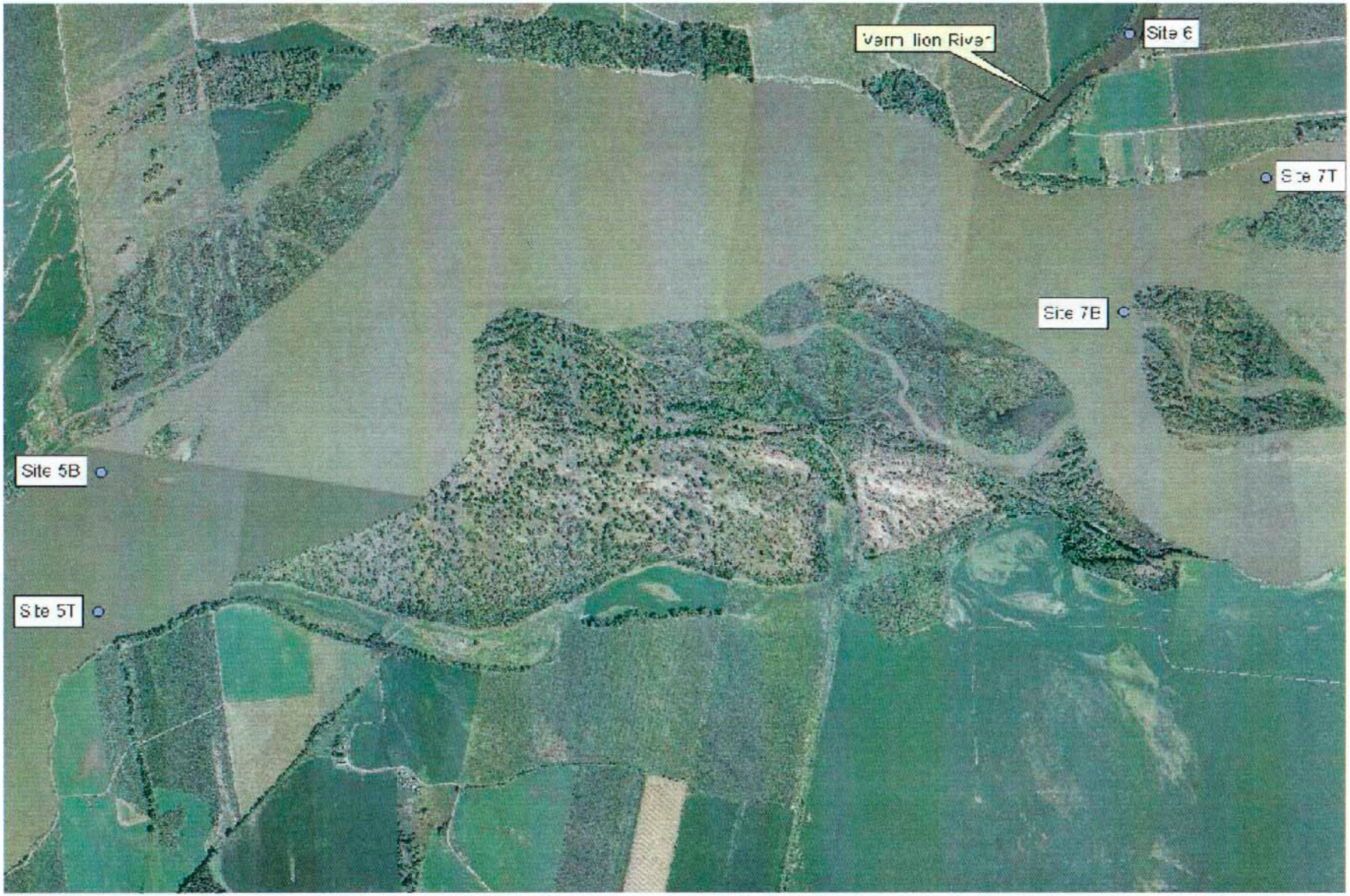


Plate 6. Location of Sites 5B, 5T, 6, 7B and 7T based on the average of the obtained GPS coordinates and projected on a 1997 orthophoto of the area.

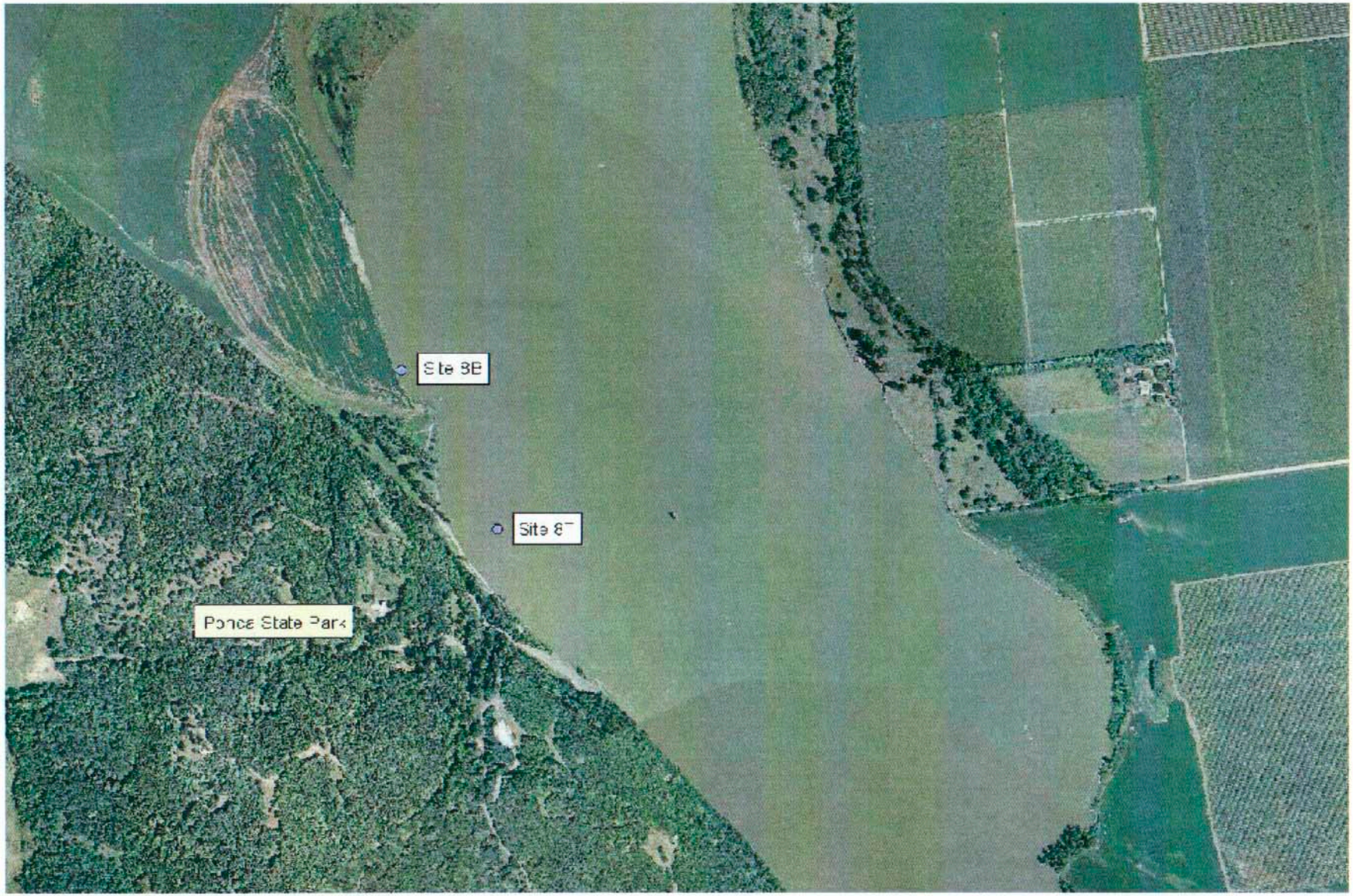


Plate 7. Location of Sites 8B and 8T based on the average of the obtained GPS coordinates and projected on a 1997 orthophoto of the area.

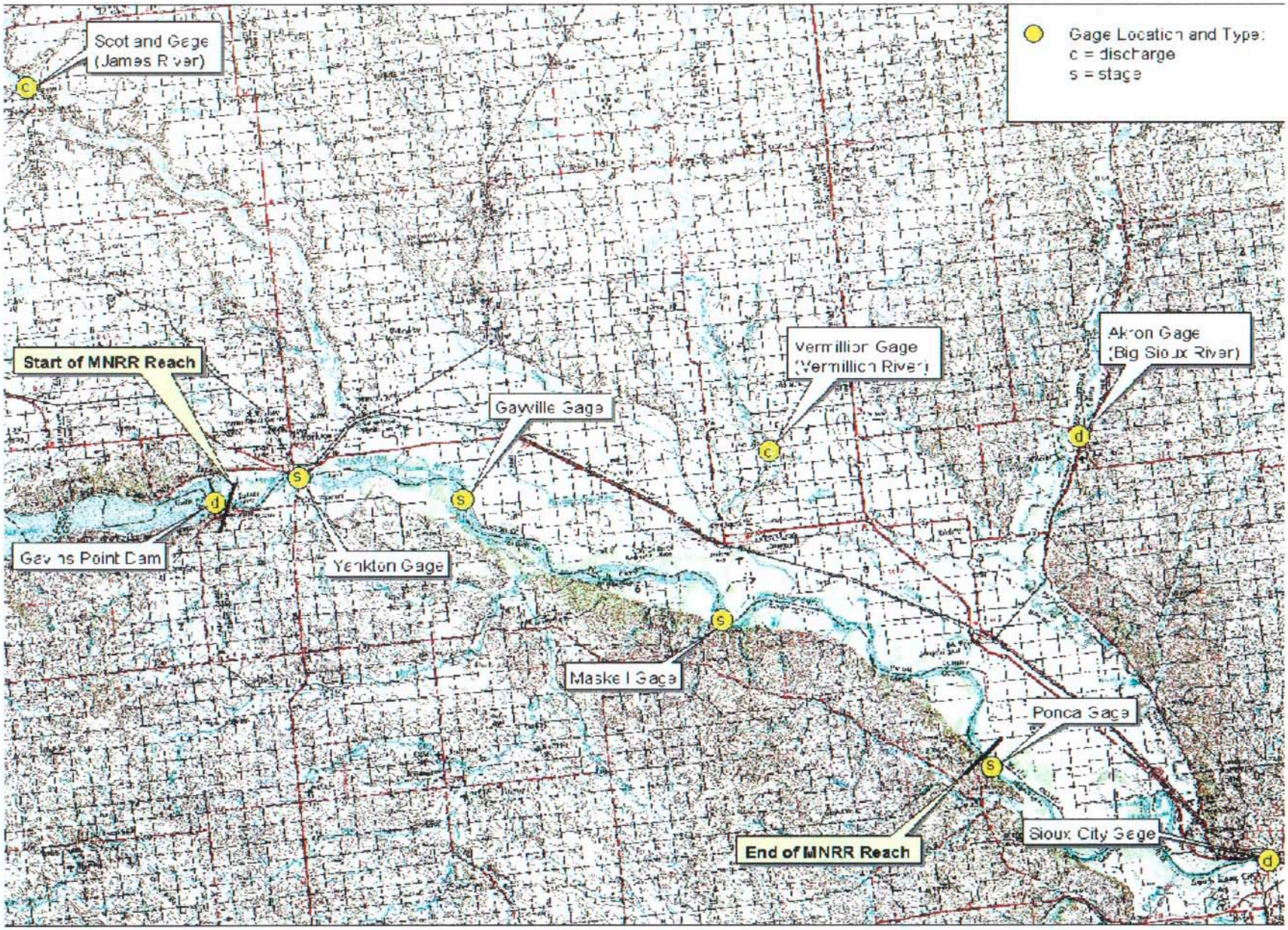
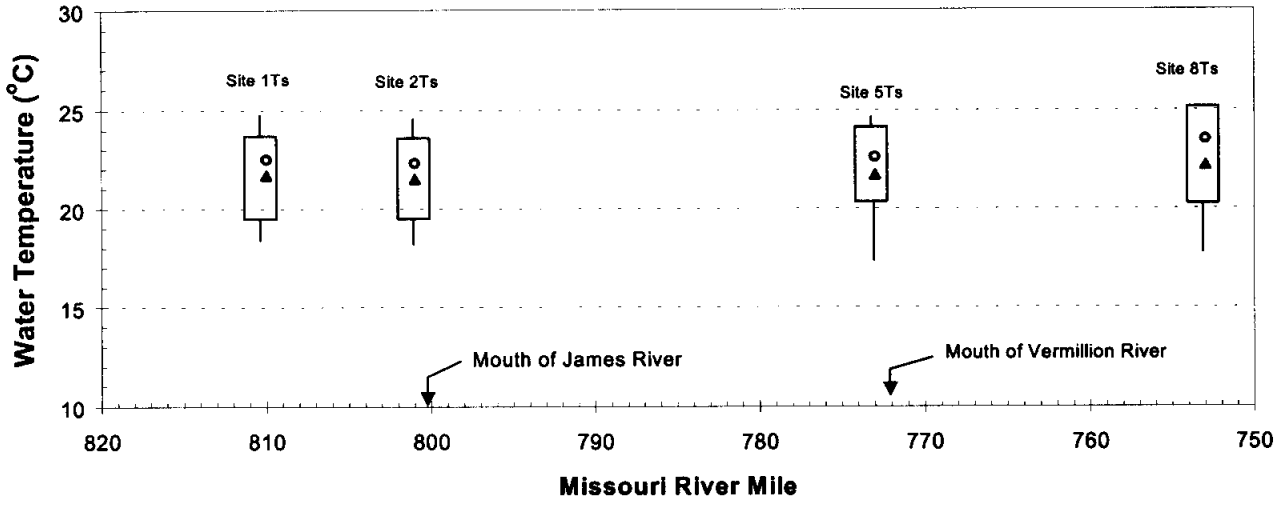
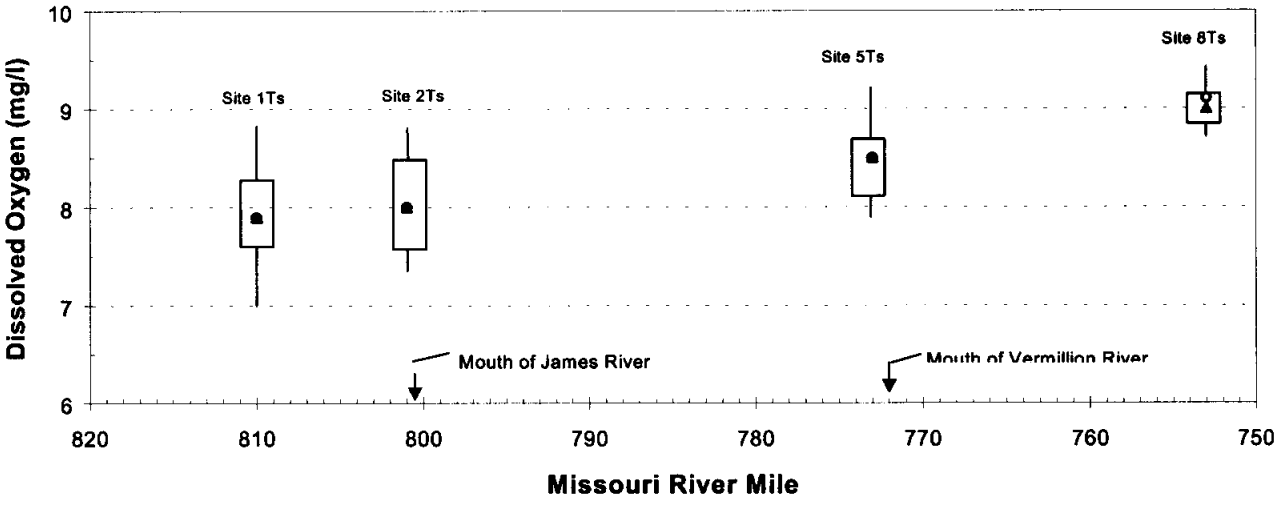


Plate 8. Location of gaging stations along and in proximity to the MNRR reach.





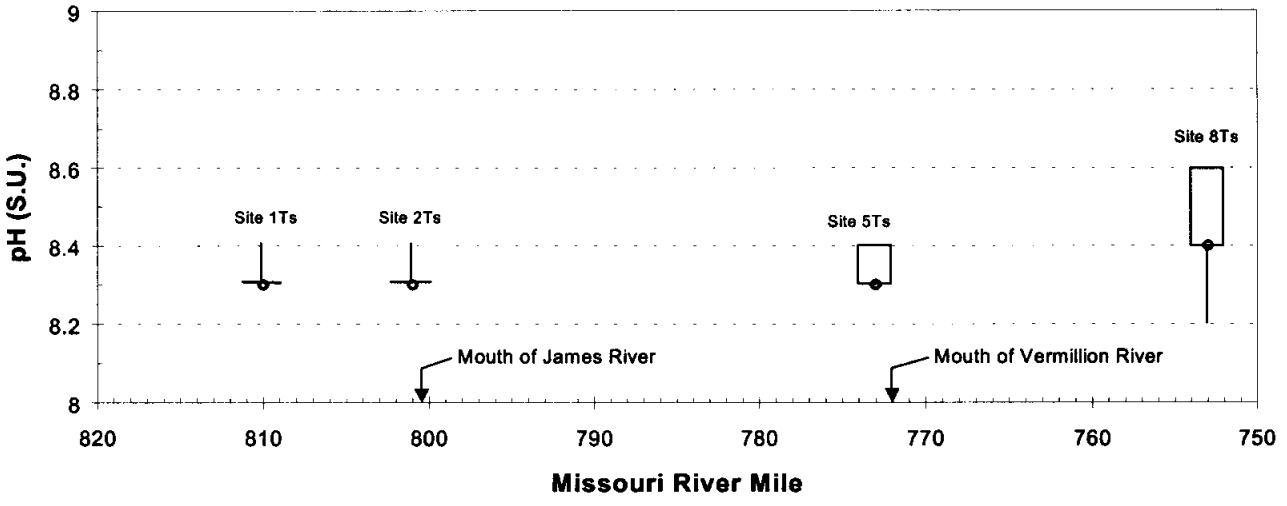
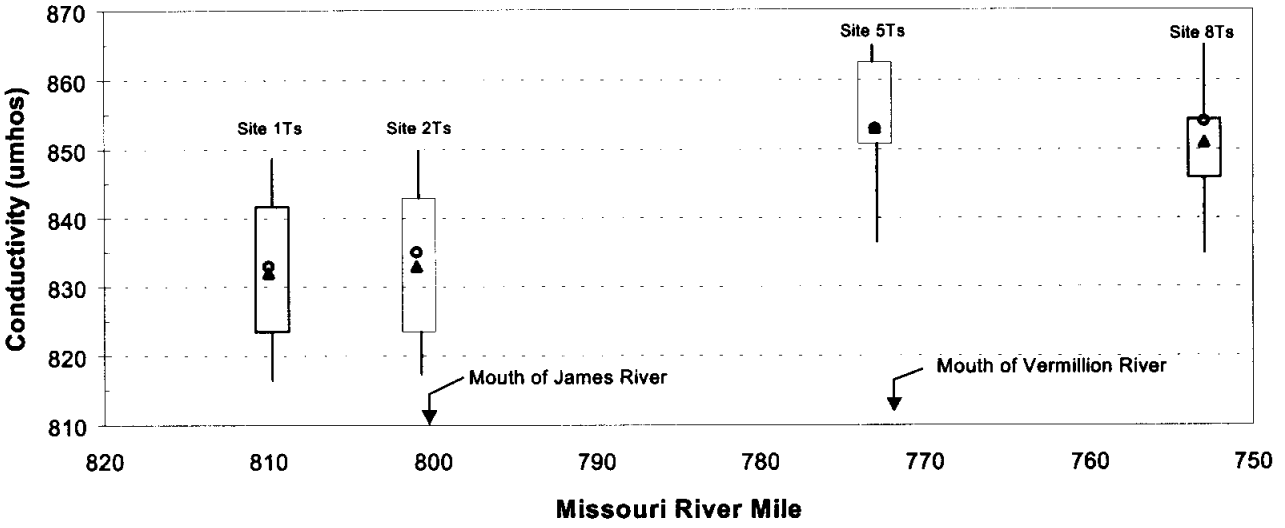
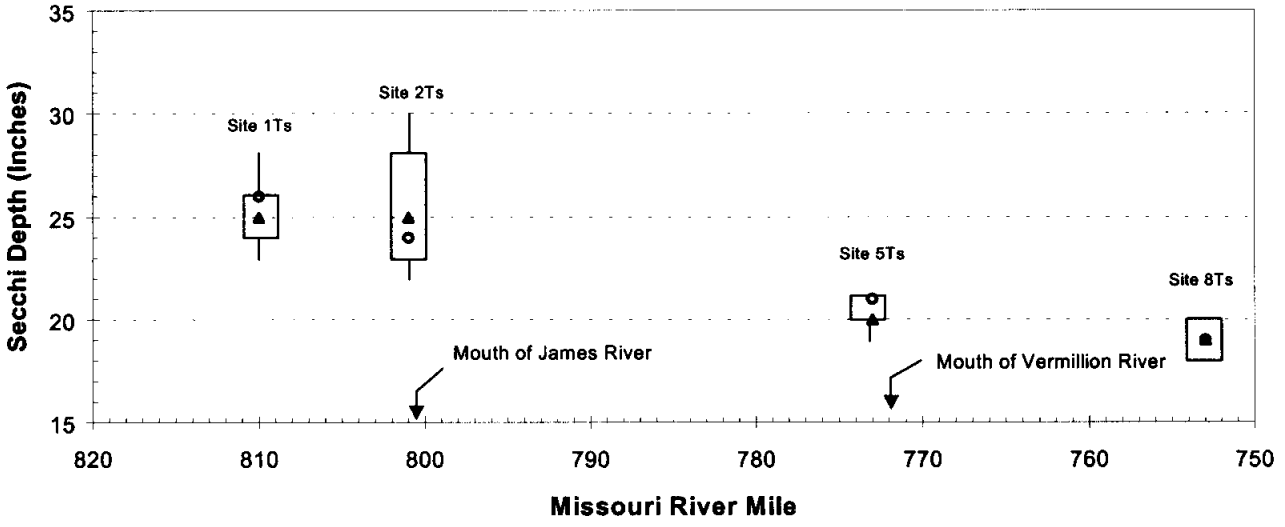


Figure 9. Box plots of water quality parameters monitored at Sites 1Ts, 2Ts, 5Ts, and 8Ts during the scoping study.





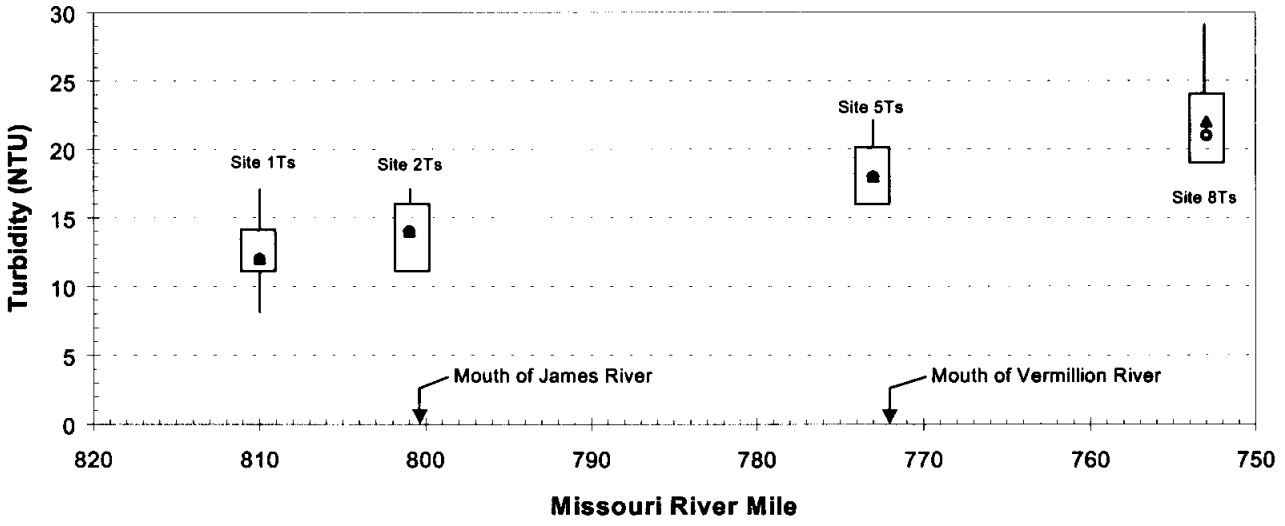
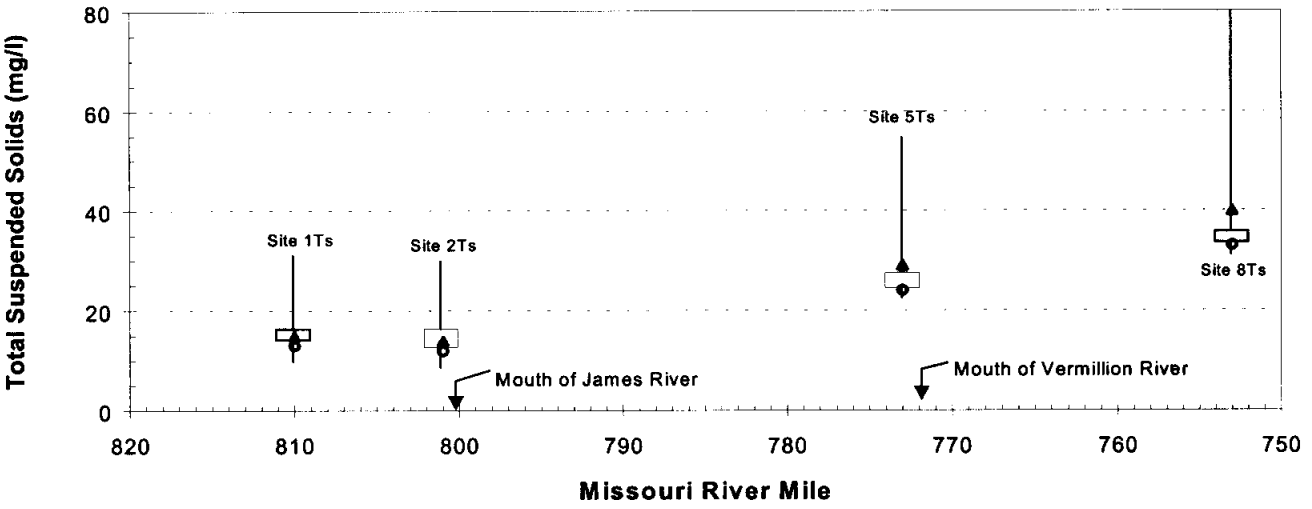
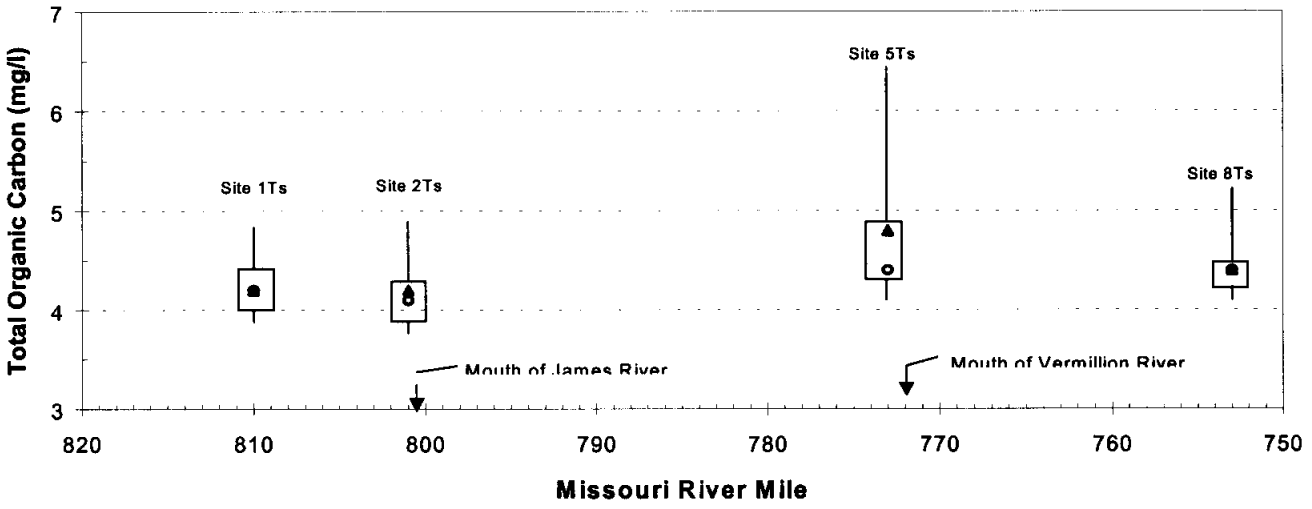
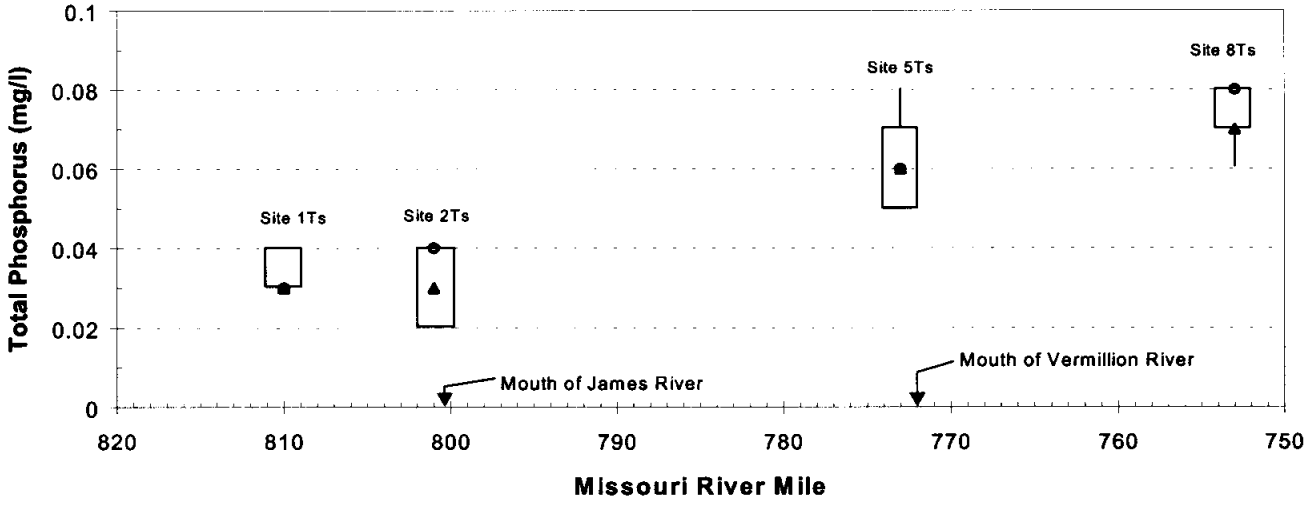


Figure 9. (Continued.)







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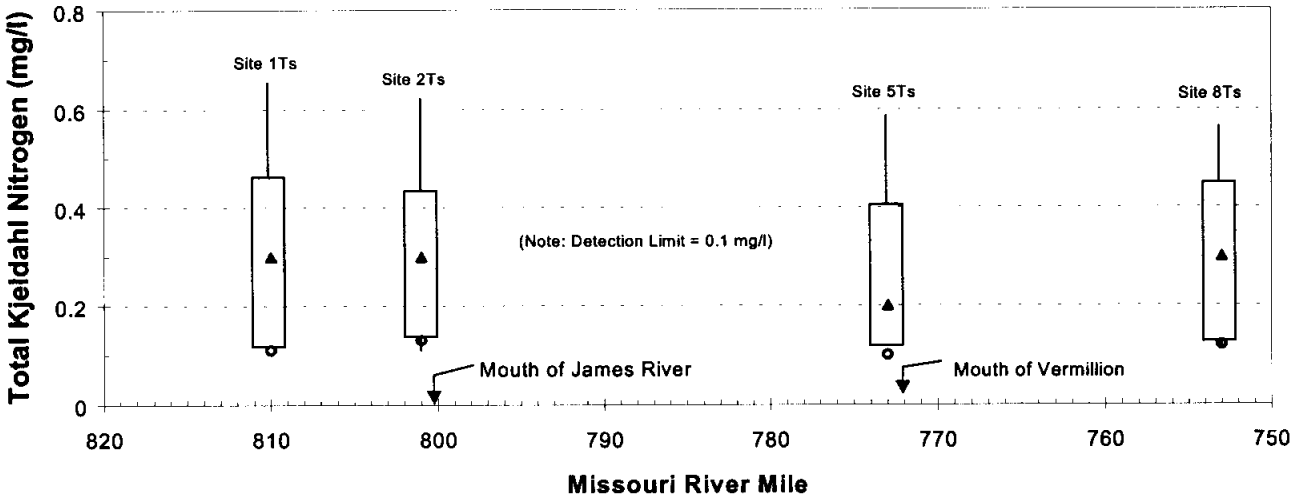

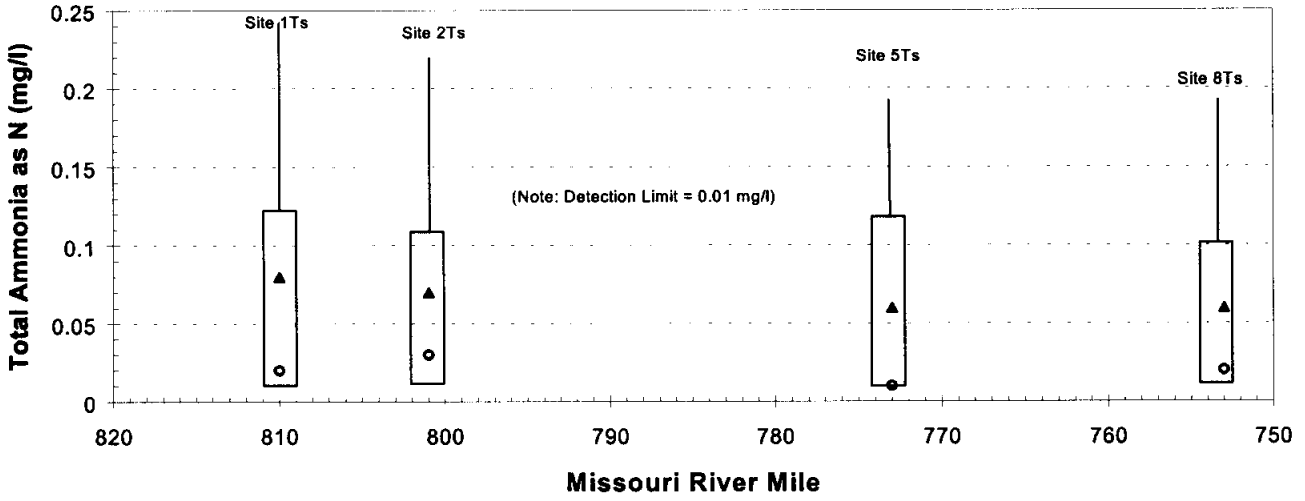

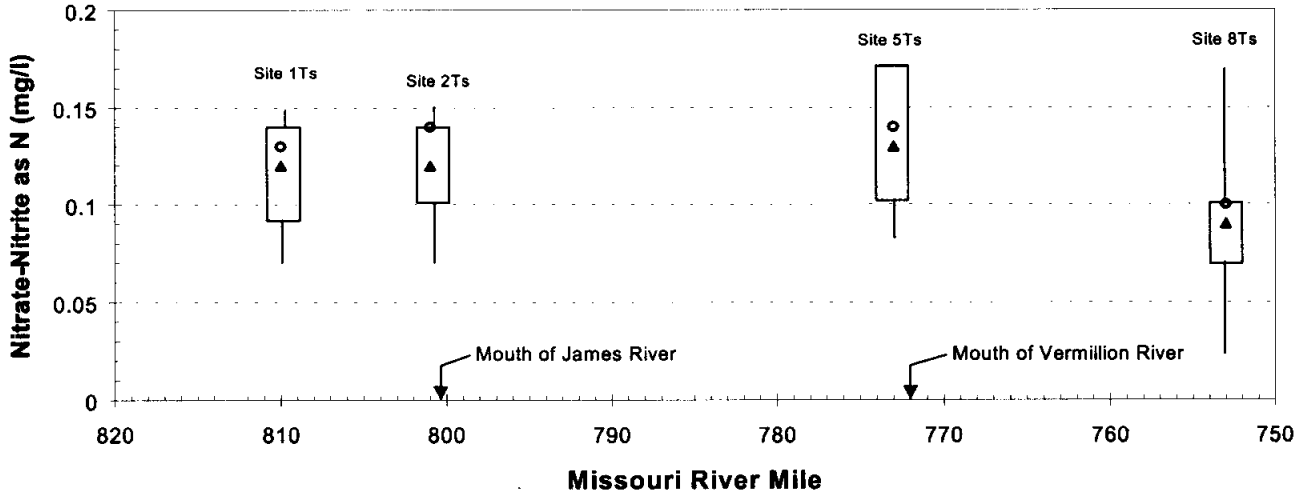

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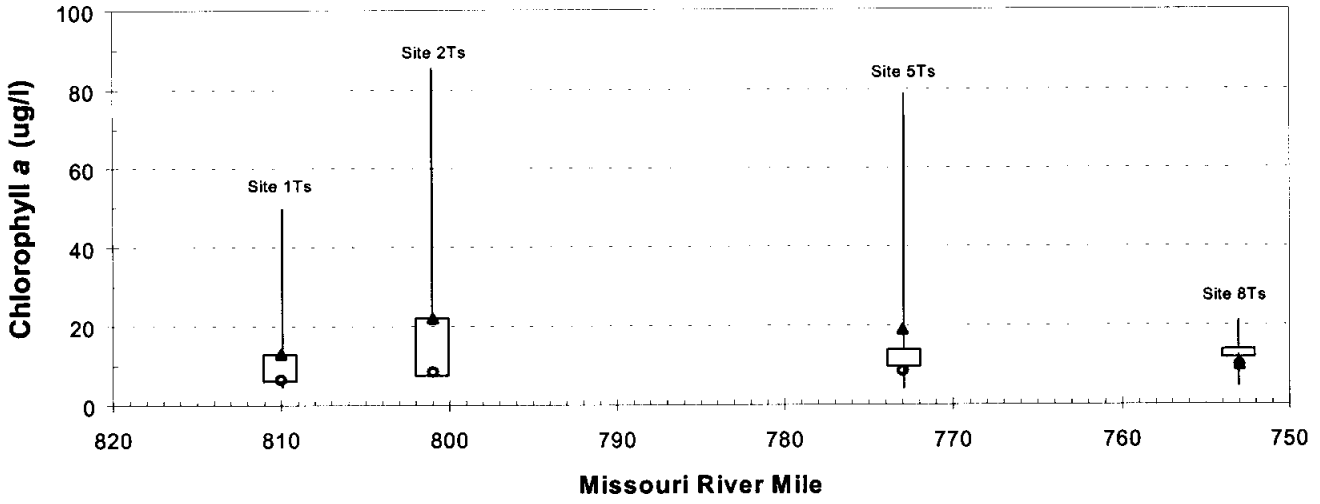

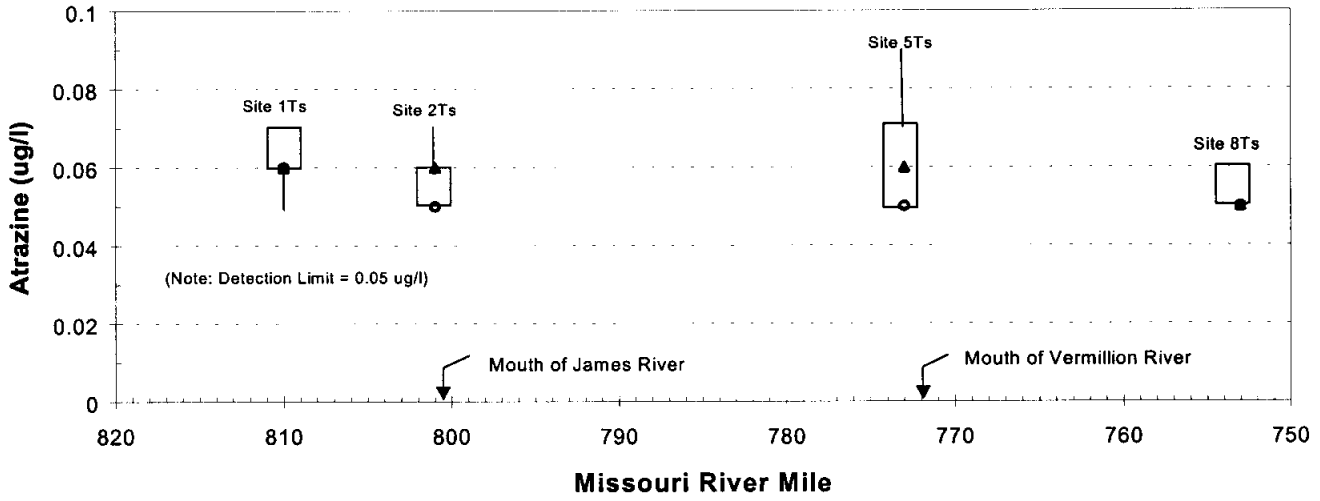

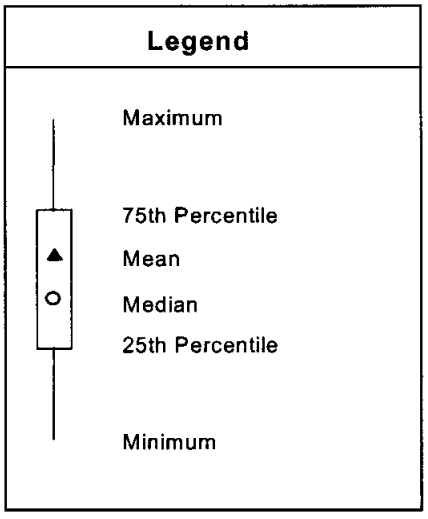

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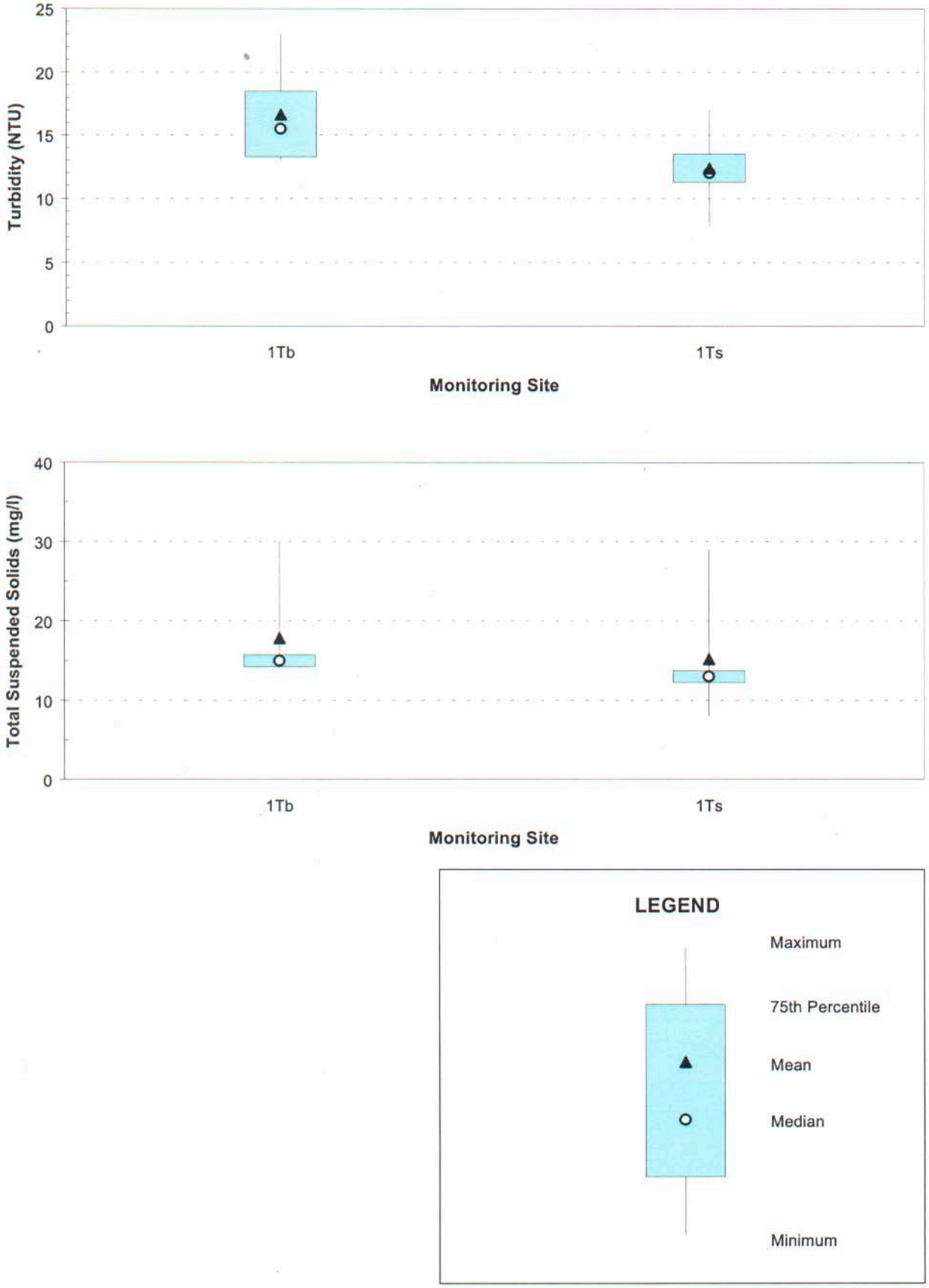

Figure 10. Boxplots of turbidity and total suspended solids levels for the near-bottom and near-surface thalweg samples collected at monitoring location 1.

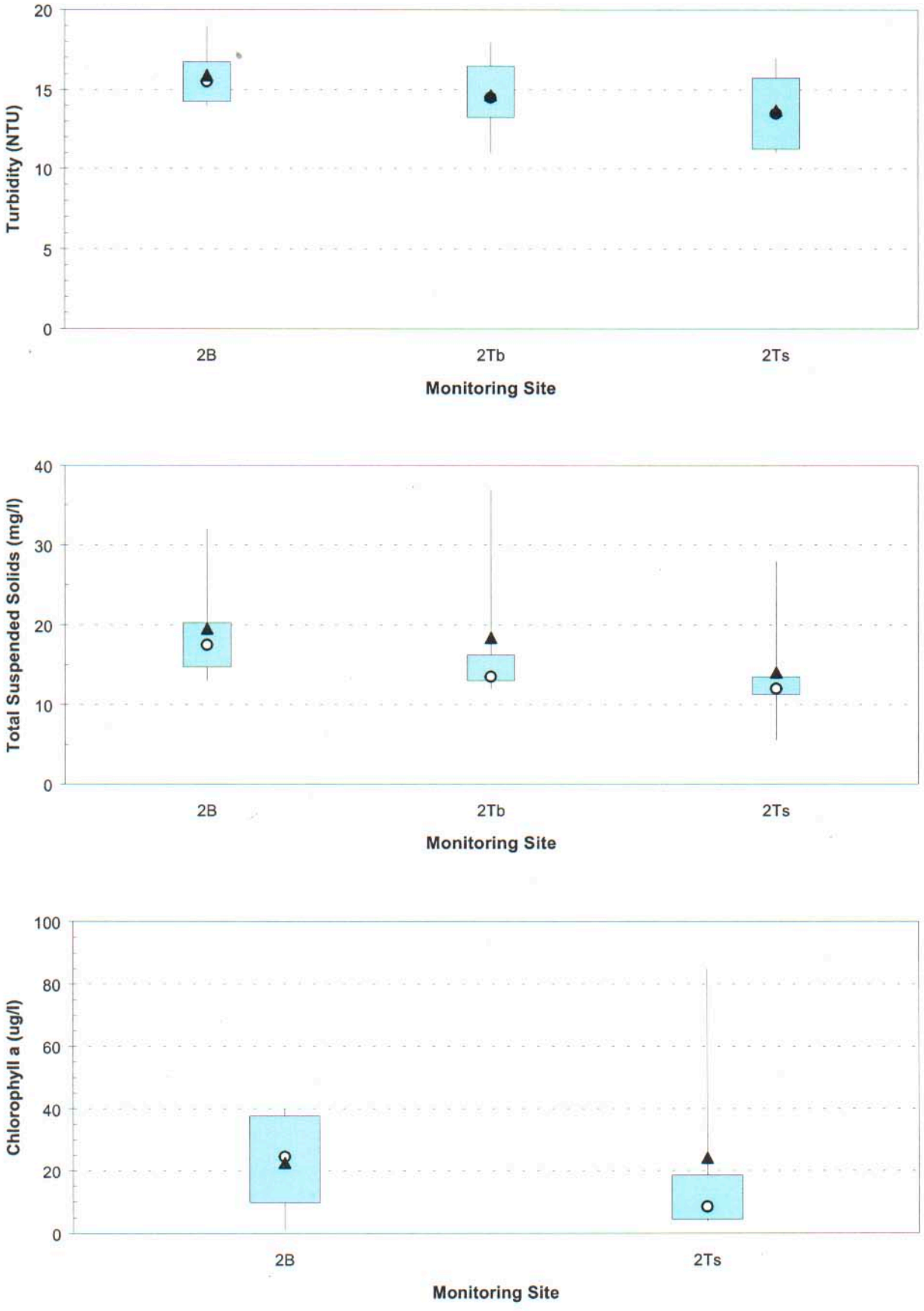

Figure 11. Boxplots of turbidity, total suspended solids, and chlorophyll *a* levels for the backwater and near-bottom and near-surface thalweg samples collected at monitoring location 2.

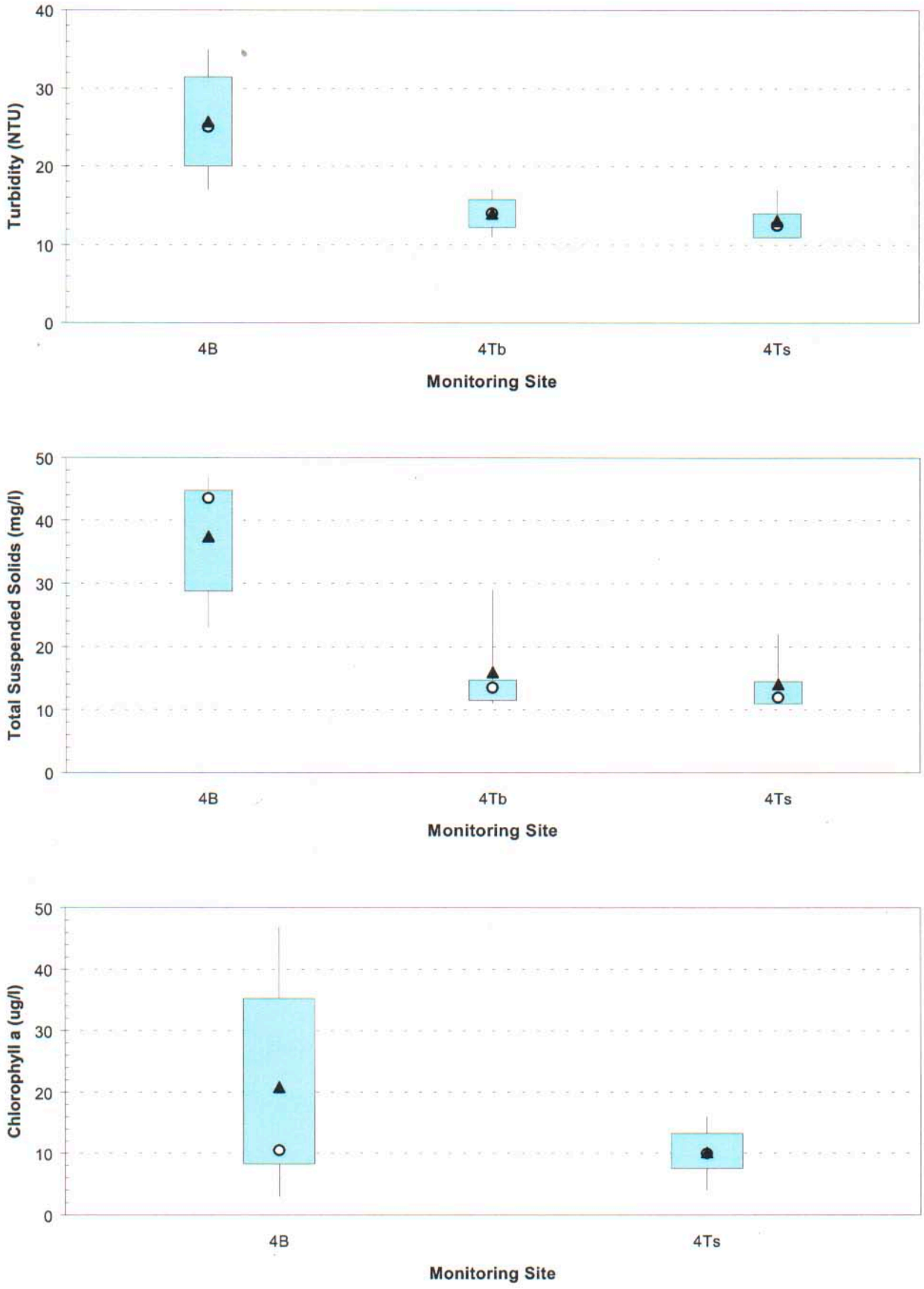

Figure 12. Boxplots of turbidity, total suspended solids, and chlorophyll *a* levels for the backwater and near-bottom and near-surface thalweg samples collected at monitoring location 4.

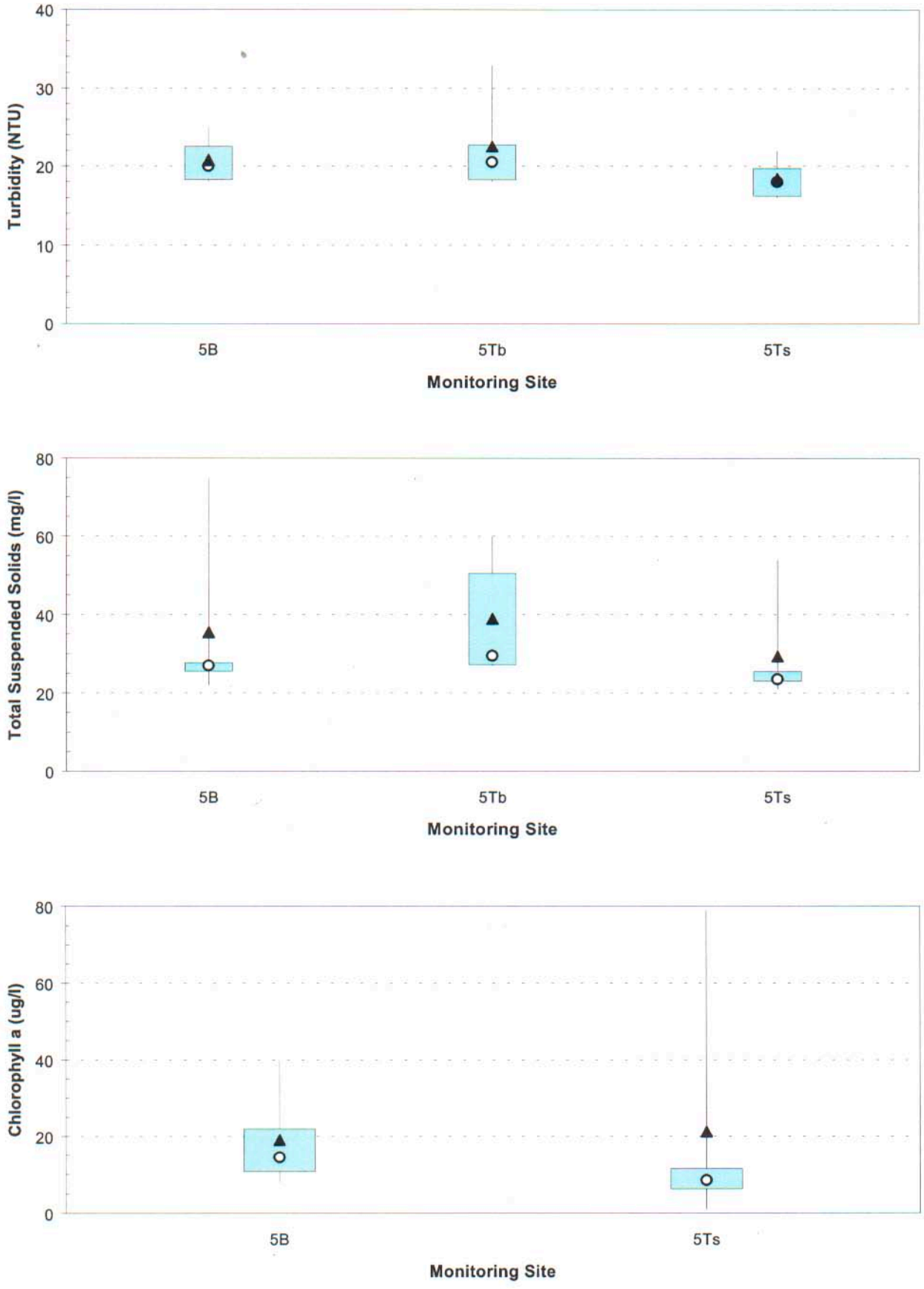

Figure 13. Boxplots of turbidity, total suspended solids, and chlorophyll *a* levels for the backwater and near-bottom and near-surface thalweg samples collected at monitoring location 5.

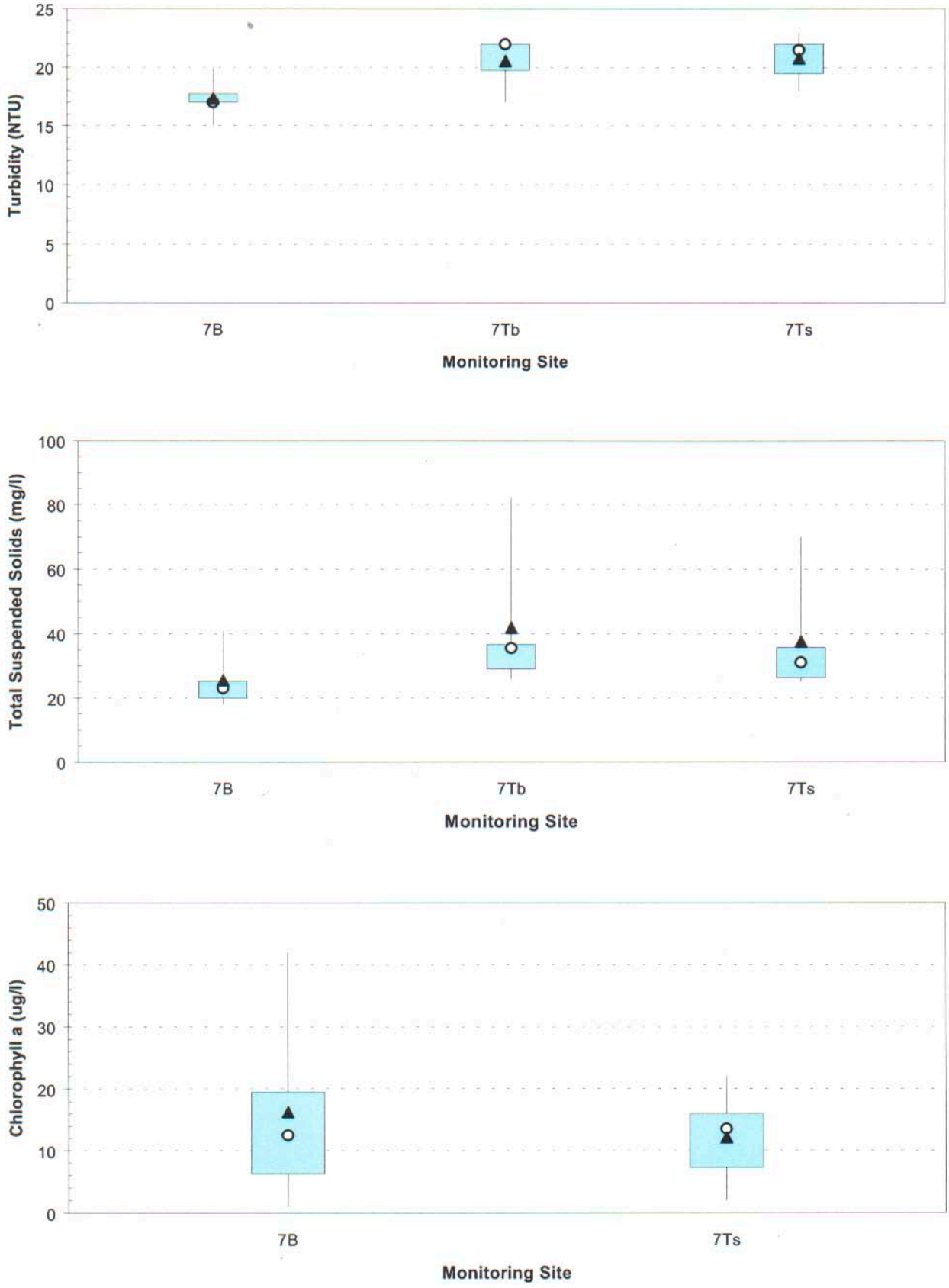

Figure 14. Boxplots of turbidity, total suspended solids, and chlorophyll a levels for the backwater and near-bottom and near-surface thalweg samples collected at monitoring location 7.

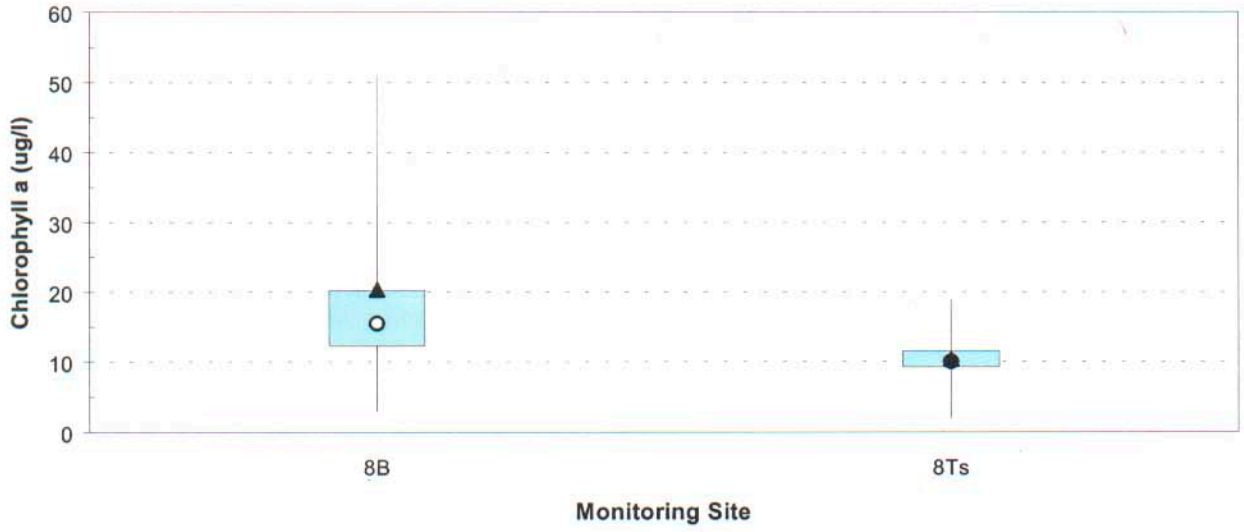

Figure 15. Boxplots of turbidity, total suspended solids, and chlorophyll *a* levels for the backwater and near-bottom and near-surface thalweg samples collected at monitoring location 8.

Plate 16. Area near the mouth of the James River as it enters a side channel of the Missouri River as depicted in a 1997 orthophoto of the area

Appendix D: List of Biological Opinion Requirements (Table 24)

Reasonable and Prudent Alternative	Implementation Objective
Actions Applicable for Multiple Listed Species in Ecosystem	
I. Adaptive Management	
A) Establish an Agency Coordination Team (ACT)	March 2001
1) Coordination Meetings	Twice a year
B) Develop Endangered Species Monitoring Plan	Within 1 Year
C) Annual Report	Annually
II. Flow Enhancement	
A) Gavins Point Dam:	
1) Spring Rise: 17.5 Kcfs above full service for 30 days between 1 May – 15 Jun	Once every 3 years/start 2003
Summer Low: flows stepped down to 25 Kcfs by June 21 held until July 15 July 15 flows stepped down to 21 Kcfs and held until August 15 August 15 flows stepped up to 25 Kcfs and held until September 1.	
B) Fort Peck Dam	
1) Implement mini-test	2001
2) Implement full test	2002
3) Implement full enhancement flows, modified based on test	2003, once every 3 years
C) Other Segments	
Investigate the applicability of flow enhancement at Garrison Dam, implement if applicable	2005
III. Unbalanced Intrasystem Regulation	2001
IV. Habitat Restoration/Creation/Acquisition	
A) Restoration of Submerged Shallow Water Habitat (Goal: restoration of 19,565 total acres)	
1) Ensure no-net-loss of existing shallow water habitat from O&M in lower river.	
2) Develop habitat restoration plans and strategies in segments 10 through 16	2001
3) Implement habitat restoration plans and strategies	2002
4) Continue implementation of habitat restoration plans and strategies	2003
4) Reached 8% (1,700 acres) aquatic shallow water habitat goal	2004
5) Reached 10% (2,000 acres) aquatic shallow water habitat goal	2005
6) Reached 30% (5,870 acres) aquatic shallow water habitat goal	2010
7) Reached 60% (11,739acres) aquatic shallow water habitat goal	2015
8) Reached 100% (19,565 acres) aquatic shallow water habitat goal	2020

B) Restoration of Emergent Sandbar Habitat

1) Provide natural sandbar habitat complexes.

a) Minimum emergent interchannel sandbar habitat acres per river mile:

Garrison (25 acres) Fort Randall (10 acres) L&C Lake (40 acres) Gavins Point (40 acres)	2005
Garrison (50 acres) Fort Randall (20 acres) L&C Lake (80 acres) Gavins Point (80 acres)	2015
b) Complete 1998 baseline habitat evaluations on Fort Peck River (Segment 2)	2003
c) Meet minimum baseline acres on Fort Peck River (Segment 2)	2015

2) Provide Reservoir beach and island habitat.

a) Maintain reservoir habitats through intra-system regulation	2001
b) Identify all potential habitat enhancement on reservoir segments (Segments 1,3, 5)	2005
c) Complete 25% of reservoir projects identified above	2010
d) Complete 50% of reservoir projects identified above	2015
e) Complete 100% of reservoir projects identified above	2020

3) Atificial or Mechanically Created Habitat

a) Provide created sandbar habitat on Segments 2, 4, 8, 9, 10 to supplement B1 above	Years B1a, B1c are deficient

C) Initiate studies of the lack of sediment transport and impacts on habitat regeneration and turbidity	2003
D) Monitoring of tern and plover nesting habitat	Once every 3 years

Elements Applicable to Specific Species

V. Least Tern and Piping Plover

A) Operate the Kansas river to provide overall benefits to conservation of least terns and piping plovers	2001
1) Develop a Study Plan	2002
2) Gather data and evaluate whether Kansas River provides source or sink.	2005
B) Provide habitat to meet or exceed fledge ratio goals of 0.70 for least terns and 1.13 for piping plovers	2001 (3 year average)
C) Initiate and conduct a piping plover foraging ecology study on the Missouri River.	2005

VI. Pallid Sturgeon

A) Support, assist, and increase pallid sturgeon propagation and augmentation efforts.	2001 - 2011
1) Collect and spawn female broodstock	2003 - Evaluation
2) Goal – produce 4,700 juvenile to 1 – year olds (Corps responsibility 2,973)	
3) Production, rearing and release of juvenile fish	
4) Monitor stocked juvenile pallid sturgeon	
5) Meet annually through ACT	

B) Conduct pallid sturgeon population assessment including habitat parameters.	2001
1) Identify the causes for the lack of reproduction and recruitment, causes for hybridization, and identify restoration actions.	begin 2001
2) Identify and map spawning habitat.	Implement strategy by 2001 to conduct mapping by 2002.
3) Channel training structure maintenance.	Coordinate construction activities with the Service and affected State agencies
4) Prioritize research needs.	

Reasonable and Prudent Measures to Minimize Take	Terms and Conditions
Bald Eagle	
Measure 1 Map and evaluate current health of cottonwood forests on Missouri River. a. Identify stands with periodic flooding b. Determine baseline mortality and tree vigor	Complete within 2 years of final BO. Monitor every 2 years for first 4 years, then every 5 years after that.
Measure 2 Develop management plan for cottonwood regeneration	Complete & implement within 2 years of completion of measure 1 above.
Measure 3 Implement actions to ensure no more than 10% eagle habitat is lost.	
Terns and Plovers	
Measure 1 Monitor all tern and plover nesting sites on Missouri and Kansas Rivers 1. Population survey information a. total # of colonies b. total # of birds c. map nest site locations 2. Monitoring information a. total # of nests and nest fates b. total # of fledged chicks/pair and other chick fates c. elevation of nests above water level.	Conduct population surveys and productivity monitoring annually. Report survey and monitoring information in the Annual Report.
Measure 2 Compile and evaluate the previous impacts to take from: 1. Daily and hourly release fluctuations below dams 2. Changes in releases due to maintenance or other isolated causes 3. Changes in releases to prevent downstream flood impacts	Submit report by Jan 2002 of the impacts to take resulting from historic operational changes (1986-2000). To include protocols to prevent historic cases of take from reoccurring.
Measure 3 The Corps shall continue to evaluate operational changes to avoid take.	Avoid operational caused flooding and spiked releases. Report all documented incidental take immediately to Service. Coordinate regularly through ACT to ensure proposed operations will avoid take. If take is unavoidable- take shall be consistent with incidental take statement. The Corps will re consult with the Service if the Corps develops new operational

		scenarios not considered during initial consultation.
Measure 4	The Corps shall follow the "Contingency Plan for Protection of Least Tern and Piping Plover Nests and Chicks" and the "Captive Rearing Protocol". 1. Continue captive rearing program, coordinate with Service 2. Initiate a peer review on Captive Rearing Protocol. 3. Continue research into the effectiveness of the captive rearing program	Any changes to Protocol will be coordinated with and approved by the Service. Peer review every 5 years start in 2001. Finish the captive reared plover study. Through the adaptive management process identify if additional research necessary or if captive rearing should continue. Report all captive rearing activities in the Annual Report.
Measure 5	The Corps shall implement public information and educational programs to increase public awareness and reduce disturbance to nesting sites.	Produce and update public service announcements. Engage in intensive public relations efforts for tern and plover conservation. Post all tern and plover nesting areas off limits to human disturbance.
Measure 6	The Corps shall implement aversive action to reduce predation on least tern.	Apply all available predator management techniques including, cages, strobe lights, and trapping.

Pallid Sturgeon

Measure 1	The Corps shall evaluate and modify operational changes and maintenance activities to avoid take.	Avoid operational changes that may affect spawning. Report all documented incidental take immediately to Service. Coordinate regularly through the ACT to ensure proposed operations will avoid take. The Corps will re consult with the Service if the Corps develops new operational scenerios not considered during initial consultation.

Measure 2 The Corps shall increase awareness of the pallid sturgeon on the Missouri River and develop support for recovery and conservation measures.

Produce and distribute public service announcements for use in states bordering the Missouri River.

Project Offices shall incorporate pallid sturgeon conservation into public education efforts.

Within 1 year of the final BO, develop and implement an outreach program for pallid sturgeon.

Implement workshops every 3 years starting in 2001 to educate reseachers and continue developing of handling protocols.

Conservation Recommendations

Recommendations Applicable to Multiple Species

1. Develop a Recovery and Implementation Program.
2. Documant current and future water depletions

Recommendations Applicable to Single Species

Bald Eagle

Pursue the recovery tasks assigned in the implementation schedules.

1. Conduct or participate in wintering and nesting bald eagle surveys.
2. Determine population dynamic characteristics of wintering and nesting birds.
3. Protect and manage habitat.
4. Conduct public outreach on the value of river habitat to the bald eagles.
5. Protect, maintain and enhance riparian forest usable by bald eagles through the Section 10/404 permit authorities.

Least Tern and Piping Plover

1. Research connectivity or interchange between Missouri River least terns and least terns nesting on tributaries and other rivers.
2. Research connectivity or interchange between Missouri River piping plovers and plovers nesting in the Northern Great Plains.
3. Investigate the response of invertebrate production to operations as it applies to tern and plover survival, growth, and energetics.
4. Modify/eliminate development activities that negatively impact reproductive success or lead to habitat destruction.
5. Assess the feasibility of intensively managing a limited number of tern and plover breeding areas for high reproductive output.
6. Develop a population model of terns and plovers on the Missouri that predicts survival and long term population trends.
7. Investigate the role of sandbar complexes to migration, staging, and pre-wintering conditioning of terns and plovers.
8. Work with the Service and other partners to research and examine what impacts wintering ground activities have on long term survival.

Pallid Sturgeon

1. Complete a feasibility study to identify and evaluate the effects of tributary dams and other structures on spawning migrations .
2. Implement Basin wide education and outreach programs for anglers.
3. Assist the Service and State with identifying impacts and extent of commercial harvest in the basin on pallid sturgeon.
4. Provide funding to continue development and conduct sturgeon genetic techniques to ensure genetic variation.
5. Provide funding to conduct Population Viability Analysis to determine appropriate recovery numbers.
6. Evaluate standard recommendations on placement and design of municipal and industrial intakes.
7. Evaluate standard recommendations on practices for channel dredging and sand and gravel mining.
8. Evaluate the cumulative effects of bank stabilization.
9. Evaluate capability and practicality of increasing water temperature in priority reaches during critical periods for native warm-water fish.
10. Participate as a partner in regional pallid sturgeon recovery work groups.
11. Provide funding to develop and validate a sturgeon aging technique.
12. Evaluate effects of severe rapid flow reductions or complete flow reductions on native fish below Ft Randall Dam.
13. Assist the Service and other partners with fish health issues as they relate to pallid sturgeon.
14. Assist the Service and other partners with cyropreservation banking of pallid sturgeon sperm.