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REPLY TO
ATTENTION OF:

CEMVD-MD-PM (1105-2-10c)

26 NOV 2003

MEMORANDUM FOR Commander, St. Paul District, ATTN: CEMVP-PM-A

SUBJECT: Spring Lake Islands Habitat Rehabilitation and Enhancement Project (HREP)

1. Reference memorandum, CEMVP-PM-A, 7 Apr 03, subject as above.

2. The revised final Detailed Project Report provided on 21 Aug 03 satisfactorily incorporates the comments of this office and is approved. Future HREP reports should include an assessment of the impacts of the alternatives and not just the recommended plan in the Environmental Assessment.

STEPHEN P. COBB
Chief, Planning and Programs
Management Divison

US Army Corps
Of Engineers
St. Paul District

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM

DEFINITE PROJECT REPORT AND INTEGRATED ENVIRONMENTAL ASSESSMENT (SP-25)

Volume 1

SPRING LAKE ISLANDS HABITAT REHABILITATION AND ENHANCEMENT PROJECT

Pool 5
Upper Mississippi River
Buffalo County, Wisconsin

August 2003

EXECUTIVE SUMMARY

The Spring Lake Island Habitat Rehabilitation and Enhancement Project (Spring Lake Island Project) is located on the Wisconsin side of the Mississippi River in lower pool 5. The site lies within the Upper Mississippi River National Wildlife and Fish Refuge near Buffalo City, Wisconsin. This 500-acre backwater area lake is triangular in shape, and a natural peninsula partially separates it from the river at the northwest boundary. The lake was previously a quiet, protected area with much diversity, making it a valuable area for fish and wildlife. The habitat concerns in the study area center around the conversion of backwater habitat to more open riverine habitat. This has come about through the loss of islands and a peninsula breach protecting Spring Lake, which in turn has allowed flows and sediments into the lake contributing to the decline in aquatic vegetation and the exacerbation of conditions adversely affecting winter fish habitat, such as increased current velocities and lower water temperatures.

Since 1939, over 90 percent of the island acreage in the Spring Lake complex have been lost to erosion. Excessive current velocities and low water temperatures make the Spring Lake area uninhabitable during the winter by Centrarchids, the primary component of the backwater fish community.

The plan formulation process established project goals and objectives, and considered a number of alternatives for meeting these goals and objectives. The ultimate goal of the current project is to improve winter and summer centrarchid habitat and improve waterfowl habitat in Spring Lake. The alternatives for the Spring Lake area involved protecting existing islands/natural peninsula habitat from further erosion, reconstruction of islands to replace the island habitat lost to erosion, to reduce flows in the area, and to protect the area from effects of wind and wave action. It was also desirable to create additional deep-water fish habitat.

The Spring Lake Islands Project is a continuation of the original plan formulation process, begun as far back as 1987. The original plan considered several alternatives for addressing the same project objectives listed above including closing the peninsula breach, creating barrier islands, and dredging. The original report completed in 1991 determined that the breach closure in the natural peninsula was a minimum requirement to address some of the project objectives and would be a component of any plan. The Spring Lake Peninsula Project was approved and construction completed in May 1995 at a cost of $260,000. This 550-foot-long closure was constructed using a combination of pervious fill and fine material.

The overall recommended plan for the Spring Lake Islands Project is to protect a couple of the existing small barrier islands/peninsula with rock mounds, construct 4 islands in a configuration to reduce flows into the Spring Lake area and to protect the area from wind and wave action. In addition a single low rock sill would be constructed between a small opening in the existing natural peninsula to allow only low flows into the upper area of Spring Lake during the winter. The sill would be designed low enough to allow spring and summer high flow events to pass through the area, maintaining the scouring action of these high flows. The islands would be constructed at various elevations to provide topographic diversity, and would be planted with grasses, forbs, vines, shrubs, and/or trees, depending on management objectives for a particular island.

Total direct construction costs for the recommended plan are estimated to be $2,738,800. Costs for plans and specifications and construction management bring the total estimated implementation costs to $3,403,000 (These costs are "fully indexed", i.e., indexed for inflation). Project construction is scheduled to begin in the spring of 2004 and be completed in summer 2005.

Because the project is located entirely within the Upper Mississippi River National Wildlife and Fish Refuge, the construction cost of the project would be 100 percent Federal, in accordance with Section 906(e) of the Water Resources Development Act of 1986. Average annual operation and maintenance costs are estimated to be $9,425. The annual operation and maintenance would be the responsibility of the U.S. Fish and Wildlife Service.

DEFINITE PROJECT REPORT

SPRING LAKE ISLANDS
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 5 UPPER MISSISSIPPI RIVER
BUFFALO CITY, WISCONSIN

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Introduction

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DEFINITE PROJECT REPORT AND INTEGRATED ENVIRONMENTAL ASSESSMENT

SPRING LAKE ISLANDS HABITAT REHABILITATION AND ENHANCEMENT PROJECT POOL 5, UPPER MISSISSIPPI RIVER BUFFALO COUNTY, WISCONSIN

INTRODUCTION

1.1 AUTHORITY

The authority for this report is provided by Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The proposed project would be funded and constructed under this authorization. Section 1103 is summarized as follows:

Section 1103. UPPER MISSISSIPPI RIVER PLAN

(a)(1) This section may be cited as the Upper Mississippi River Management Act of 1986.

(2) To ensure the coordinated development and enhancement of the Upper Mississippi River system, it is hereby declared to be the intent of the Congress to recognize that system as a nationally significant ecosystem and a nationally significant commercial navigation system....The system shall be administered and regulated in recognition of its several purposes.

(e) PROGRAM AUTHORITY

(1) AUTHORITY

(A) IN GENEAL. The Secretary, in consultation with the Secretary of the Interior and the states of Illinois, Iowa, Minnesota, Missouri, and Wisconsin, is authorized to undertake, as identified in the Master Plan -

(i) a program for the planning, construction, and evaluation of measures for fish and wildlife habitat rehabilitation and enhancement....

1.2 PARTICIPANTS AND COORDINATION

Participants in the planning process for the Spring Lake Islands project include the Upper Mississippi River Wildlife and Fish Refuge Office and the Region 3 Offices of the U.S. Fish and Wildlife Service (USFWS), the Wisconsin and Minnesota Departments of Natural Resources (WDNR and MDNR), and the St. Paul District, U.S. Army Corps of Engineers (COE).

The USFWS and the Wisconsin DNR were most heavily involved in project planning because the study area is located within the Upper Mississippi River National Wildlife and Fish Refuge and is located within the state of Wisconsin. The USFWS would be considered a cooperating agency under Federal regulations governing the implementation of the National Environmental Policy Act of 1969.

The following individuals played an active role in the planning and design of the Spring Lake project. For St. Paul District personnel, the discipline and contribution of the individual planning team members is listed. For resource agency personnel, the individual's position title is listed.

ST. PAUL DISTRICT, CORPS OF ENGINEERS

Name	Discipline	Contribution
Tom Novak	Architect	Project Manager
Steve Clark	Fisheries Biologist	Environmental Analysis/NEPA/404
Kari Layman	Hydraulic Engineer	Hydraulic analysis
Jon Hendrickson	Hydraulic Engineer	Hydraulic analysis
Joel Face	Civil Engineer	Geotechnical analysis
Tim Grundhoffer	Civil Engineer	Design Layout
Lori Taylor	Technician	Design Layout
Jeff Hansen	Civil Engineering	Cost Estimating
Byron Williams	Cartographic Technician	GIS analysis

U.S. FISH AND WILDLIFE SERVICE

Keith Beseke	EMP Coordinator
Bob Drieslein	Refuge District Manager
Gary Wege	Ecological Services

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Jeff Janvrin	Mississippi River Habitat Specialist
Michelle Marron	Fisheries Technician

Brian Brecka	Fisheries Biologist
Mark Andersen	Area Wildlife Manager
Ron Benjamin	Mississippi River Fisheries Supervisor
John Sullivan	Mississippi River Water Quality Specialist

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

Scot Johnson	Habitat Projects Coordinator
Dan Dieterman	Fisheries Biologist

1.3 PROJECT PURPOSE

1.3.1 RESOURCE PROBLEM/OPPORTUNITIES

The purpose of this Definite Project Report is to document existing and predict future habitat conditions and deficiencies, define habitat goals and objectives, identify and evaluate alternative measures that would address the goals and objectives, and recommend a selected plan for habitat restoration and enhancement.

1.3.2 PROJECT BOUNDARIES

The Spring Lake project area is located in Lower Pool 5 of the Mississippi River, approximately 1.2 miles downstream of Buffalo City, Wisconsin (Plates 1 and 2). The Spring Lake project area is triangular in shape, bounded by Belvidere Slough on the west, a peninsula on the north, the Wisconsin shore on the east, and the dam 5 dike on the south.

The project area is owned by the Corps of Engineers and cooperatively managed and administered by the USFWS as part of the Upper Mississippi River Wildlife and Fish Refuge. The area was originally acquired for the development and operation of the navigation system.

General Project Selection Process

2

GENERAL PROJECT SELECTION PROCESS

2.1 ELIGIBILITY CRITERIA

A design memorandum (or implementation document) did not exist at the time of the enactment of Section 1103. Therefore, the North Central Division, U.S. Army Corps of Engineers, completed a "General Plan" for implementation of the Upper Mississippi River System Environmental Management Program (UMRS-EMP) in January 1986. The USFWS, Region 3, and the five affected States (Illinois, Iowa, Minnesota, Missouri, and Wisconsin) participated through the Upper Mississippi River Basin Association. Programmatic updates of the General Plan for budget planning and policy development are accomplished through Annual Addendums or the Corps budget process.

Coordination with the States and the USFWS during the preparation of the General Plan and Annual Addendums led to an examination of the Comprehensive Master Plan for the Management of the Upper Mississippi River System. The Master Plan, completed by the Upper Mississippi River Basin Commission in 1981, was the basis of the recommendations enacted into law in Section 1103. The Master Plan report and the General Plan identified examples of potential habitat rehabilitation and enhancement techniques. Consideration of the Federal interest and Federal policies has resulted in the conclusions below:

a. (First Annual Addendum). The Master Plan report...and the authorizing legislation do not pose explicit constraints on the kinds of projects to be implemented under the UMRS-EMP. For habitat projects, the main eligibility criterion should be that a direct relationship should exist between the project and the central problem as defined by the Master Plan; i.e., the sedimentation of backwaters and side channels of the Upper Mississippi River System (UMRS). Other criteria include geographic proximity to the river (for erosion control), other agency missions, and whether the condition is the result of deferred maintenance....

b. (Second Annual Addendum).

(1) The types of projects that are definitely within the realm of Corps of Engineers implementation authorities include the following:

- backwater dredging
- dike and levee construction
- island construction
- bank stabilization
- side channel openings/closures
- wing and closing dam modifications
- aeration and water control systems
- waterfowl nesting cover (as a complement to one of the other project types)
- acquisition of wildlife lands

(2) A number of innovative structural and nonstructural solutions that address human-induced impacts, particularly those related to navigation traffic and operation and maintenance of the navigation system, could result in significant long-term protection of UMRS habitat. Therefore, proposed projects including such measures will not be categorically excluded from consideration, but the policy and technical feasibility of each of these measures will be investigated on a case-by-case basis and the measures will be recommended only after consideration of system-wide effects.

2.2 PROJECT SELECTION

Projects are nominated for inclusion in the District's habitat program by the respective State natural resource agency and the USFWS based on agency management objectives. The States and USFWS have agreed to utilize the expertise of the Fish and Wildlife Work Group (FWWG) of the River Resources Forum (RRF) to assist the District in the project selection process. The FWWG consists of field level biologists responsible for managing the river for their respective agency. The FWWG considers the critical habitat needs along the Mississippi River and prioritizes nominated projects on a biological basis.

The projects proposed by the various Federal and State agencies were ranked within each pool according to the prioritized resource problems that the individual projects addressed and other ranking factors. The resource problems identified in a pool included (in order of importance): backwater sedimentation; water quality; shoreline erosion; lack of important habitat; lack of habitat protection; and lack of public land base. The other ranking factors included anticipated fishery benefits, wildlife benefits, habitat diversity, ease of implementation, the potential for innovative or experimental construction techniques, project longevity, maintenance, and socioeconomic benefits. A prioritized list of projects was developed based on the following factors: results of numerical ranking; the desire to implement and evaluate a variety of habitat rehabilitation and enhancement techniques; the application of the Long Term Resource Management component to habitat project development; and the evaluation of existing habitat projects and those under construction. This biological ranking was forwarded to the RRF for consideration of the broader policy perspectives and river management objectives of the agencies involved. The RRF submitted the coordinated ranking to the District and each agency officially notified the District of its views on the ranking. The District then formulated and submitted a program consistent with the overall program guidance as described in the UMRS-EMP General Plan, Annual Addenda, and additional guidance provided by the North Central Division, Corps of Engineers.

Projects consequently have been screened by biologists closely acquainted with the river. Resource needs and deficiencies have been considered on a pool-by-pool basis to ensure that regional needs are being met and that the best expertise available is being used to optimize the habitat benefits created at the most suitable locations. Through this process the Spring Lake Islands project was recommended and supported as capable of providing significant habitat benefits.

The Spring Lake project was submitted in December 1986 by the WDNR to the FWWG for ranking with all the other originally proposed habitat projects. In the FWWG initial evaluation process, the Spring Lake project scored the highest of all projects evaluated and was ranked number one on the list recommended for implementation. A Definite Project Report for the Spring Lake Peninsula Project was completed in August 1991 recommending immediate closure of the peninsula on the north side of the project area.

Construction of two barrier islands was also found to be incrementally beneficial and could provide significant habitat benefits, but because of public and agency priorities and budget constraints, only the breach closure was selected for implementation. The Spring Lake Peninsula Project (breach closure) construction was completed in May 1995 at a cost of $260,000. This 550-foot-long closure was constructed using a combination of pervious fill and fine material.

The Spring Lake Islands Project having already been selected as a high priority project was programmed by the St. Paul District for study initiation in fiscal year 1997. After having competed again with other EMP projects for limited funds, the design effort finally began in FY 2000.

Assessment of Existing Resources

3

ASSESSMENT OF EXISTING RESOURCES

3.1 PHYSICAL SETTING

Spring Lake is part of the Upper Mississippi River system and was created by lock and dam 5. The lake is located about 1.25 miles below the center of Buffalo City, Wisconsin. The river valley in this area is about 3.1 miles wide from bluff to bluff with a 1.25 mile-wide low terrace on the Wisconsin side. A natural peninsula extends from the Wisconsin shore at the upper end of Spring Lake, and a series of barrier islands forms the west side of the upper half of the lake. In the past the peninsula had been breached by floods, allowing flow into the upper end of the lake. The Spring Lake Peninsula habitat project closed the breach and provided rockfill protection for the remaining peninsula and for 450 feet of existing barrier island. The west side of the lower half of the lake is open to Belvidere Slough and the open pool 5. The Wisconsin shoreline forms the east boundary of the lake and the lock and dam 5 dike forms the lower boundary.

3.2 WATER RESOURCES

3.2.1 UPPER MISSISSIPPI RIVER

Mississippi River discharge through the Spring Lake area (Table 3-1) is similar to the discharge gauged at Winona, Minnesota. The watershed upstream of Winona is 59,200 square miles. Average annual runoff from the watershed is 6.42 inches producing an average annual discharge of 27,980 cfs (Gunard et al. 1988). River discharge is usually greatest during spring runoff. Heavy rain can cause significant increases in discharge. Winter river discharge is normally about 10,000 cfs. There are no tributary streams to the project area. Since the project area is only about 1.3 miles long, normally only a few tenths of a foot of head differential exists between the upstream and downstream ends of the lake.

Flow through Spring Lake is from Belvidere Slough, entering through several channels between islands at the upper end. Water exits the project area along a wide shallow connection with the main channel at the lower end, and through the borrow trench along the dike. Culverts in the dam 5 dike release about 300 cfs from the lower end of Spring Lake into Fountain City Bay. These culverts were installed to improve water quality in the Fountain City Bay backwater area. Release of water through the culverts induces an increased flow rate into the lower end of Spring Lake, most pronounced during low flow periods. Wind-induced water movement in the lower end of pool 5 can be significant, and there may be considerable exchange of water between the Spring Lake area and the main channel during strong wind events. Conditions dampening wave action are the remaining islands and shallow areas along the west side, and extensive stands of emergent and submergent macrophytes during the growing season.

The Wisconsin DNR measured water velocities in Spring Lake during the winters of 1988 (Lucchesi and Benjamin 1988), 1992 (Dukerschein and Sullivan 1992), 1995 (Dukerschein 1995), and 2001 (Sullivan 2001, Personal Communication). Because the breach closure was constructed in the summer of 1995, measurements taken in winter of 1994-1995 and 2001 better represent current conditions in Spring Lake than those taken in 1988 and 1992. During the 1995 study, velocities ranged from 0 to 0.23 ft/sec within Spring Lake. The lower velocities were measured in areas protected from flow, specifically the area immediately downstream from the remaining peninsula at the upper end of Spring Lake. Velocities in the remainder of Spring Lake approached 0.066 and 0.098 ft/sec. Measurements taken in the same general area of Spring Lake on 31 January 2001 ranged from 0.059 to 0.12 ft/sec. The winter modification of the bluegill habitat suitability model (Palesh and Anderson 1990) shows that velocities greater than 0.098 ft/sec are nearly unsuitable for bluegills and those greater than 0.033 ft/sec severely limit habitat suitability. Because the bluegill is a representative of a backwater fish community, it is likely that most of Spring Lake has winter water velocities too high to be suitable for a backwater fish community.

Table 3-1
Discharge Frequencies at Spring Lake

Time of Return (Years)	Discharge (cfs)
2	82,000
5	125,000
10	150,000
50	210,000
100	240,000
500	310,000

3.3 GEOLOGY AND SOIL/SUBSTRATE

The Mississippi River lies in a broad, bedrock gorge or trench that probably existed in some form as long as 180 million years ago. The primary geologic event that created the valley existing today occurred approximately 10,000 years ago, near the end of the Pleistocene glaciation. During this glacial period the Mississippi gorge was filled with glacial outwash sand and gravel deposits. After deposition of the outwash sediments, large volumes of meltwater from the southward outflow of glacial Lake Agassiz eroded the sands and gravels while simultaneously scouring and deepening the bedrock valley. As the meltwaters diminished, the deeply eroded gorge filled with up to 200 feet of river sands, gravels, clays, and silts. The large supply of sediment from the Mississippi headwaters and it's tributary streams, coupled with a diminished water supply at the end of glacial melting, led to the development of a braided stream environment. River conditions were characterized by numerous channels, swampy depressions, natural levees, islands, and shallow lakes. The completion of Lock and Dam 5 in 1935 flooded the area and obscured the braided stream characteristics. Lake-type sediments now form a relatively thin, stratified, veneer of organics, silts, sands, and clays over most of the present river bottom. Side channels, meanders, and sloughs that typify low gradient conditions are conspicuous at the project location. The depth of sedimentation is generally greater in the slow moving backwater areas than in the main channel portions of pool 5.

Suspended solids concentration in the Spring Lake area varies seasonally and with river discharge. Average annual values for Total Suspended Solids(TSS) data collected in Spring Lake from 1985-1992 generally ranged from 8 – 22 ppm (USFWS 1998). The average concentration of suspended solids in the main channel of the river at Winona is 24 ppm (Tornes 1986). Average TSS concentrations from 1977-1988 were 28 ppm at Lock and Dam 3, 13 ppm at Lock and Dam 4, 20 ppm at Lock and Dam 5, and 30 ppm at Lock and Dam 9 (Ahearn et al. 1989). The average annual suspended sediment yield at Winona is estimated to be about 300,000 tons. Bedload inflow to pool 5 from the Mississippi and Zumbro Rivers averages 486,000 tons per year. Bedload outflow through lock and dam 5 is 230,000 tons per year. An average of 168,000 tons per year has historically been dredged from pool 5. Since the estimates were made, modifications to the river around Weaver Bottoms have improved sediment transport competency of the navigation channel to some extent. Bedload transport through lock and dam 5 is probably now in the range of 200,000 to 300,000 tons per year.

Belvidere Slough is the primary source of water for the upper Spring Lake area, and transports a considerable amount of sand. The Spring Lake area is removed from the channel of Belvidere Slough by a line of natural river levee islands and submerged ridges which serve to route most sand carried by Belvidere Slough downstream to the west of Spring Lake. An extensive sand flat has developed at the downstream end of Belvidere Slough. There appears to be some influx of sand into the upper end of Spring Lake. Vertical accretion of fine sediment occurs throughout most of Spring Lake. Probing with a steel rod indicated about 1 meter of fine sediment overlying most of Spring Lake.

A detailed analysis of riverbed elevation changes in the Spring Lake area cannot be made because of a lack of accurate and complete hydrographic surveys over time. It does not appear that there has been excessive influx of sediment into the area. The changes in area of islands and in bottom configuration appear to be primarily due to wave erosion and redistribution of material during floods. Ice forms over the entire Spring Lake area during most winters, reaching a thickness of up to 2 feet. Wind-driven ice can also erode the shoreline and islands.

A survey of substrate type in the Spring Lake area was conducted in the winter of 1986-1987 by the COE as part of the Weaver Bottoms rehabilitation project. Approximately nine locations within Spring Lake were sampled, and substrate material was analyzed for particle size composition and organic matter content. A substrate type map of the Spring Lake area has not been prepared. Additional sampling would be required to prepare a useful substrate type map. Most of the area has silt substrate with organic sediments probably occurring in the older macrophyte beds. There is a sand flat in the upper end of Spring Lake where the incurrent channels have created a delta. Because much of Spring Lake was bottomland forest before inundation, stumps and woody debris are common in the shallower areas.

There is much historical data on main channel sediment in pool 5. A limited amount of surficial backwater sediment quality data is available for pool 5, but no depth-stratified data are available. Contaminants of concern were found to be comparable to those of other backwater sediments in pool 5. No PCB's or chlorinated hydrocarbons were detected in Spring Lake. Most metal concentrations were within acceptable levels in Spring Lake.

3.4 WATER QUALITY

Water temperature in the main channel correlates with air temperature. Maximum water temperature occurs in mid-summer, and remains close to 32^{o}F during the winter. In the Spring Lake project area during the summer, water in the shallow areas attains a slightly higher temperature than the main channel, cools faster in the evening, and results in greater swings in diel temperature than occur in other flowing areas of the river. The water is warmer in the shallow areas due to suspended solids, the dark bottom, and smaller volume. The shallow areas cool faster than deeper areas because of the smaller volume of water.

During winter, areas within Spring Lake that are protected from current tend to be warmed by the river bottom, and perhaps from influx of groundwater, to temperatures up to several degrees warmer than the near-freezing water in the flowing channels. However, these conditions currently exist in a relatively small area behind the repaired peninsula breach in upper Spring Lake. The Wisconsin DNR measured winter water temperatures in 1995 (Dukerschein 1995), and 2001 (Sullivan 2001, Personal Communication). In 1995 temperatures behind the peninsula generally ranged from 32.5 to 34.7 degrees F, whereas temperatures in the remainder of Spring Lake generally ranged from 32 to 32.9 degrees F. Water temperature measurements in 2001 generally ranged from 32.4 to 33.6 degrees F.

Dissolved oxygen in Spring Lake is normally above the 5-ppm concentrations necessary to sustain most forms of aquatic life. During the growing season, oxygen concentration is strongly influenced by algal and aquatic plant activity. Oxygen concentrations can exceed 15 ppm within aquatic plant beds in the afternoon and fall to 6 ppm at night. These diel swings in dissolved oxygen also occur in open water areas due to phytoplankton activity, but tend to be less dramatic than in aquatic plant beds (see Dahlgren 1988 for examples from Weaver Bottoms). During winter, ice and snow cover and rates of exchange primarily affect dissolved oxygen levels. Winter dissolved oxygen levels in Spring Lake are typically higher than 5 ppm due to the present high rate of exchange. However, it is still important to consider potential dissolved oxygen problems within Spring Lake that could occur by meeting the other project objective of decreased flow velocities.

Phytoplankton in the Mississippi River follows a seasonal progression of species composition typical of north-temperate eutrophic water bodies, a strong spring diatom bloom giving way to blue-green algae blooms dominated by Aphanizomenon. Plant nutrient concentrations during the open water season normally exceed levels that allow nuisance blooms of algae to develop. Inorganic nitrogen and available phosphorus concentrations occasionally fall below limiting concentrations during intense algal blooms. Physical conditions of light penetration, mixing, filtering by aquatic plant beds, wind, flow path, and dilution have a great effect on phytoplankton concentrations at any point in the river.

The photic zone depth in Spring Lake is controlled primarily by the amount of suspended mineral and organic material in the water column. Photic zone depth (depth with greater than 1 percent of photosynthetically-active radiation incident at the surface) in upper Weaver Bottoms, pool 5 declined from 5.9 feet in 1986 to 3 feet in 1990 (USFWS 1998). The aquatic plant beds in the upper end of Spring Lake may serve to filter some of the suspended material and algae from the inflowing water during the growing season. Wind-induced water movements into the lower end of Spring Lake could periodically decrease water clarity and photic zone depth. Chlorophyll a attenuates a considerable amount of light in the water column in dense algae blooms. In Spring Lake, phytoplankton, duckweed mats, non-algal suspended solids, and epiphyton all create shaded conditions that limit growth of aquatic macrophytes.

3.5 VEGETATION

The species composition and distribution of vegetation in the Weaver Bottoms-Belvidere Slough areas of pool 5 have been extensively documented (Fremling et al. 1976; Fremling et al. 1979; Nielsen et al. 1978; Olson and Meyer 1976; Lucchesi and Benjamin unpublished). The emergent vegetation beds in the Lost Island-Belvidere Slough area are evenly distributed throughout, although Spring Lake had a higher coverage than the other areas surveyed (Nielsen et al. 1978). Emergent species found in Spring Lake during this study were water lily, arrowhead, narrow-leaf arrowhead, burreed, cattail, and lotus. A total of 15 species of submergent aquatic plants were also identified within Spring Lake in this study including coontail, wild celery, river pondweed, curly-leaf pondweed, waterweed, and water stargrass. The Wisconsin side of lower pool 5 is characterized by a wide, even distribution of submergent beds, with most of them located within Spring Lake. The Minnesota side is characterized by much larger beds located mainly in the northern and western areas (Nielsen et al. 1978). Important emergent species in the area are arrowhead, water lily, narrow-leaf arrowhead, and burreed. Important submergent species in the area are coontail, wild celery, river pondweed, water stargrass, curly-leaf pondweed, and waterweed. The Wisconsin Department of Natural Resources LTRMP field station personnel conducted a vegetation survey of Spring Lake in 2001. The frequency species were recorded during this survey are as follows: wild celery, 32%; water stargrass, 32%; Eurasian watermilfoil, 19%; American lotus, 8%; short-stemmed burreed, 3%; coontail, 3%; longleaf pondweed, 3%; white waterlily, 3%; stiff arrowhead, 2%; pickerelweed, 2%; sago pondweed, 2%; Canadian waterweed, 2%.

Landcover maps for the project area for 1989 and 2001 (Plate 5.5) indicate that the amount of open water (lacking vegetation) in Spring Lake increased from 51 acres in 1989 to 324 acres in 2001. The 1989 data is somewhat suspect due to its classification of an 11-acre 20-foot-deep hole in southeastern Spring Lake as submergent vegetation; however, regardless of the exact magnitude, there has been a significant loss of vegetation in Spring Lake. Furthermore, staff of the Wisconsin Department of Natural Resources observed a drastic decline of vegetation in Spring Lake in 1990 and vegetation remained sparse throughout the 1990's; there was a slight increase in 2000 and 2001 (Janvrin, Personal Communication, 2002).

The terrestrial floodplain areas in the study area support silver maple, green ash, cottonwood, and black willow. Reed canary grass is common in open canopy areas. Few trees remain on the small islands due to erosion and wind- fall.

3.6 FISH AND WILDLIFE

3.6.1 FISH

The Upper Mississippi River (UMR) has a diverse fish assemblage, with both lotic and lentic species. Ninety species of fish are known to be present in pool 5. Different habitats are important for different fish species, depending on season and life stages. Maintaining a diversity of habitats is key to maintaining this diverse fish assemblage. Both lentic and lotic species use backwater vegetated lakes for spawning, nursery habitat, feeding, and resting areas. The more lotic species (i.e. bluegill and largemouth bass) depend extensively on these backwater areas, including use as winter refuge, a critical time for many fish species in the upper reaches of the UMR.

Backwater areas are important to a variety of fishes as general, spawning, or winter habitat, or combinations of these. Species that use the backwater as both general and spawning habitat include the largemouth and smallmouth bass, bowfin, black and white crappie, longnose gar, yellow perch, northern pike, bluegill, orangespotted sunfish, pumpkinseed, and rockbass. Species requiring more riverine conditions as general habitat but use the backwaters for spawning include the white bass, bigmouth and western sand darters, shortnose gar, logperch, tadpole madtom, sauger, gizzard shad, spotfin shiner, brook silverside, and walleye. Some species that live in the backwater, but spawn elsewhere include the quillback and spotted sucker. Certain backwater areas become very important as summer feeding and congregation areas to paddlefish.

The Wisconsin DNR conducted netting and electrofishing surveys of the Spring Lake fishery during the late-80s and mid-90s. Thirty-six species were sampled during the fall of 1987 and the spring of 1988 (Lucchesi and Benjamin 1988). During these surveys, the dominant species were bluegill (31.3% of the total catch), black crappie (12.9%), common carp (10.0%) and yellow perch (7.5%). During the fall of 1995 and the spring of 1996, thirty-one species were sampled (Brian Brecka, Wisconsin DNR, Alma, personal communication). Dominating the catch were freshwater drum (17.3%), white bass (17.3%), black crappie (16.5%) and gizzard shad (13.1%). Comparing the two sampling periods, panfish species (bluegill, black crappie and yellow perch) were a higher percent of the catch during the 80s (51.4%) than during the 90s (18.6%). This difference is likely due to changes in the aquatic vegetation along with other factors. Lucchesi and Benjamin (1988) reported large beds of aquatic macrophytes in the upper reaches of Spring Lake. They also warned that high flow rates and increased sedimentation due to a breached peninsula might further degrade this habitat. Although the peninsula was replaced in 1995, losses of vegetation and depth occurred and will not likely return without physical improvements.

3.6.2 WILDLIFE

Fremling et al. (1976) identified 98 species of birds in the vicinity of Spring Lake, 36 of which were represented by 5 or fewer sightings. Common species include the coot and a variety of waterfowl including the mallard, blue-winged teal and woodduck. The heaviest use of the area is during fall migration when mallards, canvasbacks, coot, tundra swans, Canada geese, and widgeon occur. The spotted sandpiper is the most common shorebird in the area. Other common species include the great blue heron, mourning dove, tree swallow, robin, grackle, and the red-winged blackbird.

There have been 40 species of mammals reported to occur in the project area by Fremling et al. (1973). Fremling et al. (1976) observed 15 species of mammals in Weaver Bottoms, with the white-footed mouse, short-tail shrew, and muskrat being the most abundant. Little information exists on the status of amphibians and reptiles, but some of the species observed include the leopard frog; American toad; spring peepers; painted, soft-shell, and snapping turtles; and the water snake.

3.6.3 AQUATIC INVERTEBRATES/MUSSELS

Mussel surveys were conducted in and near Spring Lake in 2000 and 2001. Twenty-two transects were conducted with a skimmer dredge. Mussels were identified, enumerated, and returned to the water.

Within the interior of Spring Lake, nine species of mussels were collected. Most were found in relatively small numbers. The most common species collected were threeridge (*Amblema plicata*), threehorn (*Obliquaria reflexa*), and pigtoe (*Fusconaia flava*). One round pigtoe (*Pleurobema coccineum*) was collected, a species listed as threatened in Minnesota. No Wisconsin or federally listed species was collected within the interior of Spring Lake. It is likely that although construction of islands within Spring Lake would destroy some mussels, the impact to the population would be small, and therefore outweighed by the environmental benefits gained by the project.

During project planning, an area southwest of Spring Lake was identified as a possible source of sand for island construction. Four mussel transects were conducted in this area in 2001. These transects produced 12 species and 465 individuals. Four state-listed species were collected: (1) black sandshell (*Ligumia recta*), (2) hickorynut (*Obovaria olivaria*), (3) monkeyface (*Quadrula metanevra*), and (1) round pigtoe (*Pleurobema coccineum*). Dredging in this area would destroy many mussels that may be part of a source population for pool 5. Therefore, borrow material will not be taken from this site.

Five transects were collected outside the proposed project area. Nine mussel species were collected, two of which are state-listed: (1) hickorynut, (2) monkeyface. Also, overall numbers of mussels collected in these transects were good. No project features are being proposed for this area.

3.6.4 THREATENED AND ENDANGERED SPECIES

Two federally protected species have historically been known to inhabit the general project area: the bald eagle (*Haliaetus leucocephalus*) and the Higgins' eye pearlymussel (*Lampsilis higginsii*). In 2000 and 2001, the Corps of Engineers conducted mussel surveys in and near the proposed project area (see attached mussel survey report). No Higgins' eye pearlymussels were collected during these efforts. Furthermore, *Lampsilis higginsii* has not been collected in pool 5 in recent years. Therefore, it is unlikely that the proposed project would affect this species. There are currently no active bald eagle nests in the general project vicinity, and use of the area by bald eagles for feeding and perching is not significant. Therefore, it is unlikely that the proposed project would affect this species. It is the St. Paul District's determination that there would be no project related impacts to the Higgins' eye pearly mussel or the bald eagle. Concurrence by the U.S. Fish and Wildlife Service would be obtained prior to project construction.

Four State-listed mussel species were collected in or near the project area during sampling in 2000 and 2001. One round pigtoe mussel (*Pleurobema coccineum*), listed as threatened in Minnesota, was collected within the project area. Six additional round pigtoe mussels were collected outside, but near the project area. Other State-listed species collected near but outside the project area were: one black sandshell mussel (*Ligumia recta*), listed as special concern in Minnesota; two hickorynut mussels (*Obovaria olivaria*), listed as special concern in Minnesota; and three monkeyface mussels (*Quadrula metanevra*), listed as threatened in Minnesota and Wisconsin. Because only one individual of a State-listed species was collected within the project area, it is unlikely that the proposed project would have a significant effect on any State-listed or non-listed mussel species.

3.7 HABITAT TYPES AND DISTRIBUTION

There are a total of 500 acres within the project area. Of this total, only about 14 acres of land remain; 2 of which are reconstructed peninsula. The land area consists of the peninsula extending from the Wisconsin shore at the upper end and the remaining islands. The eastern sides of the islands have gradual slopes with emergent aquatic vegetation.

The Wisconsin Department of Natural Resources LTRMP field station personnel conducted a vegetation survey of Spring Lake in 2001. A map of the landcover types resulting from this work and one from 1989 is presented in Plate 5.5. There was an increase in open-water habitat from 10 percent in 1989 to 65 percent in 2001. Deep aquatic habitat (greater than 4 feet) occurs along the Wisconsin shore and close to vegetated aquatic habitat (Plate 6). The interspersion of shallow open water, submergent, and emergent aquatic plant beds has not been quantified; however, it appears good although the overall coverage of some vegetation types is minimal (Plate 5.5). About 12,265 lineal feet of island shoreline remains.

3.8 CULTURAL RESOURCES

Interest in the archaeological record of the Upper Mississippi River valley, including the area around Spring Lake in pool 5, has been ongoing since the middle of the nineteenth century (e.g., Lapham 1855). By the later part of the twentieth century, several cultural resource investigations had been conducted within and around the proposed project area. Most of these investigations were on terraces and upland landforms. Nine precontact and 11 historic sites have been identified within 1 mile of the proposed project area (e.g., Penman 1981; Rusch and Penman 1982). As of 1990, there were no cultural resources determined eligible or listed on the National Register of Historic Places. Two cultural resource surveys have been conducted along the floodplain of pool 5 (Johnson and Hudak 1975; Pleger 1997). The pool 5 surveys mainly consisted of visual inspection of shorelines. No cultural resources have been identified within the limits of the Spring Lake Habitat Rehabilitation and Enhancement Project (HREP) area, and none of the previously identified sites will be affected by the proposed project.

A Phase I cultural resources survey was conducted in 1990 across land areas designated to be affected by the dike and closure structures according to plans proposed in the Definite Project Report/Environmental Assessment (SP-12) issued in August 1991 (Withrow 1990). The Phase I survey consisted of a literature review and subsurface testing. No cultural resources were identified.

Only a portion of the current Spring Lake HREP was examined in the 1990 cultural resource survey. Areas previously surveyed include the boat landing area at the far northern end of Spring Lake, the existing portion of the original peninsula upstream from sill 1, and the two existing islands proposed for protection by rock mounds 2 and 3 (Plate 9). The current Spring Lake HREP proposes to place island protection (rock mounds 1 and 4) along two island complexes that will require a cultural resource survey.

In September 2002, the Corps conducted a cultural resource reconnaissance survey across the Spring Lake HREP land areas not investigated during the 1990 survey. No cultural resources were detected from a surface survey. Results from informal soil cores indicate that the soil profiles on the islands adjacent to proposed Rock Mound 1 and Rock Mound 4 are similar to the solums identified on Islands A and B during the 1990 cultural resource survey (Withrow 1990:6) (Plate 7.1). No buried soil horizons were detected and no cultural resources were identified.

The results of the 2002 investigations were detailed in a letter to the Wisconsin State Historic Preservation Office (SHPO) with a recommendation that no historic properties will be affected by the project. However, the SHPO did not concur with the Corps findings. Specifically, the SHPO is concerned that submerged resources (e.g., shipwrecks) or inundated archaeological sites may be impacted by the project. The SHPO recommended that soil coring take place to determine if submerged in situ archaeological features will be impacted.

Most of the Spring Lake HREP project area is situated over areas that, prior to inundation from construction of Lock and Dam 5 during the late 1930s, consisted of floodplain, back channels and wetlands, it is unlikely that submerged resources in the form of shipwrecks exist in the project area. Further, a literature review indicates that no shipwrecks are identified in the project area. As there is a potential for archaeological sites, now inundated, to exist within the project area, a soil coring program was conducted in the spring of 2003.

The 2003 soil coring program focused on identifying cultural resources, now inundated, that may exist along the footprint of a proposed access channel in the southern portion of Spring Lake and the Project. No cultural resources were identified.

3.9 SOCIOECONOMIC/RECREATION

The project area is located in a rural area of west-central Wisconsin, just downstream of Buffalo, Wisconsin, which has a population of 915 (1990 census). The city of Cochrane (population 475) is located about 1.25 miles inland. Other major towns within 9 miles of the project area are Alma (population 790) and Fountain City (population 938). The major city of Winona, Minnesota, with a population of over 25,000, is about 19 miles away.

The upper half of the eastern shore of Spring Lake is lined with year-round residences. At the upper portion of this area, these residences (about 25) are separated from the lake by a blacktop road. There are about 20 residences between the roadway and the shore at the lower portion of the lake. The Lower Spring Lake boat landing is at the end of the road and the residential development along the lake. The remainder of the Spring Lake shoreline is owned by the COE for project operations (dam 5 dike) or managed for wildlife by the USFWS.

A boat landing at the lower end of Spring Lake near the tie-back of the dam 5 dike provides direct access to the lake. The landing is maintained by the Wisconsin Department of Natural Resources. Spring Lake receives light fishing use during the open water season. Spring Lake historically supported a popular winter fishery, but success has recently declined due to increased water flows through the area. Most summer angling in the area takes place on the downstream side of the dam 5 dike at the culverts. A boat landing located on the peninsula at the north end of Spring Lake is owned by the COE and maintained by the city of Buffalo, Wisconsin. Access to Spring Lake can be gained a short distance downstream via an historic small channel through the remaining barrier islands.

The St. Paul District, with assistance from Region 3 of the U.S. Fish and Wildlife Service and various regional, State, and local agencies that have an interest in the river, developed a land use allocation plan for the Upper Mississippi River. The purpose of the plan is to balance and enhance public recreational use and fish and wildlife management while maintaining the river navigation system. This plan shows a narrow strip of land located along the east shore of Spring Lake and the barrier island complex that are allocated for wildlife management, the levee along the lower part of the lake for navigation project operations, and a small area at the upstream end of the dam 5 dike for low-density recreation (Lower Spring Lake Landing).

Problem Identification

4

PROBLEM IDENTIFICATION

4.1 EXISTING HABITAT CONDITIONS

Existing habitat conditions in Spring Lake are deficient in meeting management goals. Winter water quality in Spring Lake greatly limits suitable fishery habitat and additional winter habitat in the area is needed. Current velocity greater than 0.098-ft/sec and water temperatures less than 33.8^{o}F severely limit wintering bluegill habitat, which is a species that is a major component of a backwater fishery in the project area. Of the 90 species of fish present within pool 5, most have very narrow tolerances for winter flow velocity, temperature, and dissolved oxygen levels. Prior to the breach in the peninsula, the loss of barrier islands, and increased flows, Spring Lake provided optimal wintering habitat (warmer winter water temperatures, little or no flow, and high dissolved oxygen levels). Most of the surrounding backwater is not suitable as overwintering habitat, either because of excessive flow, water temperatures below 4^{o}C, low dissolved oxygen levels, or other factors. Therefore, the project area likely served as an important winter fish refuge for the larger Belvidere Slough/Spring Lake backwater complex.

The completion of the Upper Peninsula breach repair project in 1995 did help stabilize the upper portion of Spring Lake. However, except for the limited wintering habitat available in a small area immediately downstream of the breach repair, winter habitat is practically non-existent in Spring Lake. This is likely due to the loss of protection that would have been provided by the islands once found in Spring Lake. Summer habitat conditions in the project area are fairly good for a backwater fish community, even though the lack of rock, gravel, and riffle habitat limits fish species diversity. Continued barrier island loss due to erosion has continued, and will not be halted unless the wind fetch is disrupted.

Wildlife habitat includes the open water areas, submergent vegetation, emergent vegetation, and the islands. The primary wildlife habitat deficiency is the increasing lack of aquatic vegetation and vegetation diversity due to wave action. Other deficiencies include the lack of visual barriers, loafing habitat, and thermal cover (protection from cold winds and storms).

4.2 HISTORICALLY DOCUMENTED CHANGES IN HABITAT

Flow into Spring Lake increased because the peninsula forming the head of the lake was breached during the period from 1964 to 1977. The flow continued to increase past 1977 due to the continued erosion of the other barrier islands. The loss of barrier islands, the breach in the peninsula, and the decline of aquatic vegetation changed flow conditions and wave action in the lake. Although quantitative data on declines in use by waterfowl and other wildlife are not available, local resource managers believe that the lake has a much greater potential for habitat use than currently exists. This reasoning is based on the fact that the area was more heavily used by fish and wildlife in the past and the physical changes are producing habitat conditions that are not as conducive to their use.

4.2.1 ISLAND LOSS

The loss of barrier islands in Spring Lake is well documented (Plates 4 and 5). Shortly after inundation, the ratio of aquatic to terrestrial habitat was 1.5 to 1. In 1964, the ratio was 3.2 to 1 and in 1989 it was 20.9 to 1. Island habitat rapidly disappeared, as did the aquatic vegetation it was protecting. Table 4-1 shows the loss of islands that has occurred in the Spring Lake area.

Table 4-1
Island Loss in the Spring Lake Area

Year	Acres	Acres Lost	Acres Lost/YR	Percent Remaining
1939	97	-	-	-
1989	11.4	85.6	1.7	12.0%
1994	9.2	2.2	.44	9.5%
1998	13.7	-4.5*	-1.1*	14.1%

source: UMESC, * the “negative loss” in island acreage is due to the construction of the breach closure.

During the period 1939-1989, over 88 percent of the islands in the Spring Lake area disappeared. The period 1989-1994 was again a period of continued erosion with 19% of the remaining acreage of islands lost. The period 1994-1998 was more stable, with the acreage of islands increasing by 50 percent due to the construction of the breach closure. In 1998, less than 15 percent of the island acreage remained from that which was present in 1939. The lower rate of island loss during the period 1989-94 as compared to the period 1939-89 may partially be attributable to the fact that there was less island mass available to be lost during the 1989-94 period, and the construction of the breach closure added about 2 acres of islands. In addition, as islands erode flatter more stable slopes may be formed, which in turn can reduce the rate of erosion.

4.2.2 BATHYMETRIC CHANGE

The analysis of bathymetric change is limited by the sparseness of historic data. Field observations by resource managers conclude that there has been a loss of bathymetric diversity as shallow areas have scoured and the deeper areas have filled in.

4.2.3 AQUATIC VEGETATION

Because of the lack of good historical vegetation data for Spring Lake, it is not possible to accurately quantify vegetative changes there. Existing data is limited and was collected by varying methods, thereby making it difficult to compare or account for natural temporal variability. However, it is possible to make some general qualitative observations of the vegetative changes in Spring Lake.

An aerial photograph taken in 1930, prior to the construction of lock and dam 5, shows Spring Lake as mostly bottomland forest with some open grass areas crossed by small flowing channels and cut-off oxbows. The only relatively large open water area at that time was a 20-acre backwater lake (Spring Lake proper) located along the northwest shore of present-day Spring Lake. After the construction of lock and dam 5, water levels were raised, thereby having a major impact on vegetation in Spring Lake. Many of the plant species intolerant of wet conditions would have been lost and then replaced by wetland-type species. After an initial period of stabilization, Spring Lake contained a variety of vegetative communities including bottomland hardwood, meadow, emergent wetland, rooted-floating aquatics, and submersed aquatics.

The gradual loss of islands in Spring Lake led to further vegetation changes. By the mid-1970's most of the bottomland hardwood communities found on the islands were gone. Shallow areas that were islands converted to emergent and rooted-floating aquatic communities. An aerial photograph from 1973 shows large expanses of emergent and rooted-floating aquatic vegetation. Although it is not discernable from the aerial photograph, it is likely that submersed aquatic vegetation could be found in much of the deeper water. Areas that had been protected from wave action by islands were becoming exposed to those forces as the islands eroded. This led to the loss of aquatic vegetation caused by uprooting and decreased light penetration. This trend continued until the present day and has led to a decrease in Spring Lake's aquatic plant community diversity and extent as compared to the condition of the lake shortly after inundation.

4.3 FACTORS INFLUENCING HABITAT CHANGE

A number of factors have been identified that are believed to be influencing habitat changes in the Spring Lake area post lock and dam construction and the consequent water level increase. Many of these factors are synergistic, combining to affect both the physical and biological environment. The following are the primary factors that have or are affecting habitat change in the Spring Lake area: flood events, flow conditions, wind generated waves, sedimentation, turbidity.

Flood events have the ability to erode and build islands and a flood event likely is the reason for the breach in the peninsula that was repaired in 1995. Wind-induced waves also have the ability to erode islands and are likely the cause of most island erosion in Spring Lake. Island erosion leads to changes in flow conditions and patterns that can cause further habitat change in the form of a decrease in flow pattern/velocity diversity.

The erosion of islands is related to increased sedimentation in depositional areas that can produce soft, unstable substrates. This increases the difficulty for aquatic plants to gain or retain a foothold. Aquatic plants that initiate growth are thus easily uprooted by wave action.

Sedimentation also causes changes in depths, producing a more uniform bottom that leads to decreased plant species diversity.

Average annual values for Total Suspended Solids (TSS) data collected in Spring Lake from 1985-1992 generally ranged from 8 – 22 ppm (USFWS 1998). Levels of TSS in Spring Lake are generally lower than those found above Lake Pepin (Sullivan 1995). Average TSS concentrations from 1977-1988 were 28 ppm at Lock and Dam 3, 13 ppm at Lock and Dam 4, 20 ppm at Lock and Dam 5, and 30 ppm at Lock and Dam 9 (Ahearn et al. 1989). However, TSS and the related turbidity are still factors to consider and may have localized effects. All the factors that increase erosion and sedimentation would likely increase suspended sediment related turbidity in Spring Lake. Restriction of light penetration is the greatest impact of turbid waters. Light transmission to the lake bottom is essential for the growth of submergent aquatic plants, especially early in the growing season. High turbidity indirectly affects fish and wildlife by depressing the growth of aquatic vegetation and directly affects fish community diversity by favoring rough fish over sport fish. It affects sport fish through diminished sight feeding ability, depression of planktonic food resources, and loss of shelter. An example of how changes in suspended sediment can affect vegetative growth is demonstrated by pool 8 data that showed a two-fold increase in ambient suspended sediment concentrations (increase from 20 ppm to 40 ppm) would decrease the 1-percent photic depth from 4.36 feet to 3.44 feet (a 27-percent decrease)(Korschgen et al. 1997).

4.4 ESTIMATED FUTURE HABITAT TYPES AND CONDITIONS

Habitat changes in the Spring Lake area can be expected to occur over the next 50 years that would result in a decrease in habitat value for fish and wildlife. Historic trends in geomorphology of the area can be expected to continue, resulting in significant physical changes to the area. These physical changes would affect sediment transport, water quality, vegetation, and backwater fisheries habitat. Wave action and flood events will continue to erode the islands that remain, further flattening the topographic relief of the area. The deep aquatic areas can be expected to gradually fill in. Wave action will level the bottom, eroding the high spots and filling in the deep areas. The area with islands and beds of emergent aquatic plants will become a large shallow flat.

A partial drawdown of pool 5 is scheduled for the summer of 2005 as another test of a management measure on a pool-scale basis for improving conditions for the growth of aquatic vegetation. A partial drawdown was conducted in pool 8 in the summers of 2001 and 2002. The pool 8 drawdown was successful in stimulating growth of emergent aquatic plants on exposed substrates. These periodic drawdowns may become part of the pool management in the future. However, lacking any unforeseen permanent changes in dam operation, the water level regime in the Spring Lake area will remain the same. The flow pattern through the project area will probably change, however, as the barrier islands continue to erode. Overall, flow through Spring Lake can be expected to increase. Current velocities through the area will increase somewhat.

As the barrier islands on the west side of Spring Lake erode, the area will become subject to increased wave energy. Wave action will resuspend bottom material and wind-induced currents will redistribute the material to a much greater extent than presently occurs. Increased flow into the area through the barrier islands may allow a greater influx of bed load, resulting in an expansion of the delta where the inflowing channels meet the backwater area.

Spring Lake water quality will become dominated by water inflow as the exchange rate through the area increases. Suspended solids concentration will increase due to the greater influence of inflowing water and increased resuspension of bottom sediment by wave action. Winter water temperature in Spring Lake will decrease because of increased flows.

Floodplain forest vegetation will decline as island erosion continues. As the islands on the west side of Spring Lake erode, the aquatic vegetation now protected by the islands will be subjected to increased wave action. Aquatic plant beds will become increasingly limited by light penetration and can be expected to decrease over time.

Future habitat conditions in Spring Lake will be characterized by increased shallow open water areas with higher flows and reduced island and aquatic plant bed areas. The area of desirable winter fishery habitat will be reduced as flow velocities increase, depths decrease, and water temperature decreases. Habitat variability will gradually decrease as the topographic relief and water temperature decline, and shallow open water area predominates.

Future fish habitat conditions will include areas with high flows deficient in aquatic vegetation and its interspersion with open water. The increase in suspended solids occurring from more flow and wave action will decrease fish habitat during the open water season.

The loss of wildlife habitat will continue due to increased water flow and wave action, and reduced light penetration caused by the resuspension of fine sediment. Wave action will have a greater effect on vegetation because of shallower depths. The decreases in aquatic vegetation, water:land interspersion, light penetration, and water depth diversity will cause a similar decrease in the fish and wildlife use of the area. The land to water ratio and aquatic vegetation acreage will need to be increased for wildlife habitat.

Project Goals And Objectives

5

PROJECT GOALS AND OBJECTIVES

5.1 INSTITUTIONAL FISH AND WILDLIFE MANAGEMENT GOALS

The USFWS, WDNR, and COE have direct management responsibilities for the Spring Lake area. The following describes the resource management goals of each agency for the project area.

The USFWS fish and wildlife management goals for the area are broadly defined in the Upper Mississippi River National Wildlife and Fish Refuge, and also those designated specifically in the Refuge Master Plan. The management goals listed in the Master Plan that most directly apply to the study area include:

Environmental Quality

* Reduce the adverse impacts of sedimentation and turbidity entering the river system.
* Eliminate or reduce adverse impacts of water quality degradation.
* Preserve unique and/or representative ecotypes.
* Restore species that are in critical condition and achieve the national population or distribution objectives.

Migratory Birds

* Maintain or improve habitat of migrating waterfowl using the UMR.
* Maintain or increase the populations and distribution of colonial nesting birds.
* Increase production of historically nesting waterfowl.
* Contribute to the achievement of the national population and distribution objectives identified in the North American Waterfowl Management Plan and flyway management plans.

Fisheries and Aquatic Resources

* Maintain and enhance, in cooperation with the States, the habitat of fish and other aquatic life on the UMR.

5.1.2 WISCONSIN DEPARTMENT OF NATURAL RESOURCES

The WDNR manages the fishery in the Spring Lake area in cooperation with the USFWS. WDNR conservation officers regulate hunting, fishing, and recreational boating on the Wisconsin portion of the Mississippi River. The WDNR manages water quality and regulates activities that affect waters of the State. WDNR management goals for the Spring Lake area include:

* Improve water quality.
* Improve fish and wildlife habitat conditions.
* Improve opportunity for all recreational uses of fish and wildlife (fishing, hunting, trapping, etc).
* Maintain access for recreational boating.
* Limit redistribution of in-place pollutants.
* Avoid increases in flood stages.

5.1.3 ST.PAUL DISTRICT, CORPS OF ENGINEERS

COE management goals for the Spring Lake area include:

* Manage resource capabilities wisely in relation to multiple-purpose resource demand.
* Reduce dredging requirements in lower pool 5.
* Minimize user conflicts and optimize public safety and access.
* Maximize COE management actions for the greatest economic, social, or environmental benefit to the public.
* Improve fish and wildlife habitat and water quality conditions.
* Conserve and enhance river-related natural resources.
* Maintain lock and dam 5 dike and culvert.

5.2 PROJECT GOALS AND OBJECTIVES

These management objectives, together with additional input from State and Federal agency natural resource managers, were used to guide the development of specific project objectives. The ultimate goal of the project is to restore and maintain backwater fisheries habitat and enhance aquatic plant bed development in Spring Lake for fish and wildlife. A secondary project goal would be to improve water quality. This could be accomplished by reducing wave induced erosion and resuspension of bottom sediments. For purposes of design and future evaluation, specific project objectives were developed. Specific goals are required for an engineered solution to the habitat problems. Current guidance on project evaluation indicates the prime focus should be on measurable chemical and physical parameters, with limited monitoring of biological features (i.e., vegetation studies only). Therefore, the stated project objectives were narrowly defined to reflect the aspects of the project that could be designed for future monitoring and evaluation. Meeting these objectives will not be the only end products resulting from construction of a project. Positive effects should also be experienced in other aspects and outside the project area. Discussions of specific project objectives for the 50-year future period follow.

<u>GOAL A:</u> Improve and maintain protected lacustrine habitat for backwater fish species.

The Spring Lake fishery traditionally supported backwater species such as bluegill, black crappie, yellow perch and largemouth bass. It is not uncommon to find local anglers that recollect an extremely popular winter fishery that received pressure from more than one hundred ice shanties. This quality winter fishery occurred as late as the mid-80s. However, fishery declines appeared to occur due to increased flow, decreased depth and loss of aquatic vegetation. Recent winters have brought only a few anglers to Spring Lake. Management goals for Spring Lake are to maintain year-round backwater fishery habitat and prevent future degradation of the aquatic plant community.

<u>OBJECTIVE A1:</u> Create and/or enhance overwintering (November-March) habitat for Centrarchids meeting the following criteria:

Backwater complexes such as the Spring Lake complex are often referred to as "Centrarchid habitat" due to the research emphasis on these species. However, many other species of fish use protected off-channel lacustrine habitat, either exclusively or for part of their life cycle. Therefore, the habitat objectives for Goal A were developed based on existing knowledge of backwater fisheries habitat as it pertains to Centrarchids with the assumption that other species will also benefit by providing quality Centrarchid habitat.

The specific criteria were developed based on the experiences of State and Federal fishery biologists as to what would be desirable to provide suitable overwintering habitat for backwater fish species.

A. A minimum of three discrete areas.

State and Federal biologists familiar with the Spring Lake study area believe, based on its size and other factors, that a minimum of three overwintering areas should be provided. One small area currently exists in the far upper end of Spring Lake; however, it is believed that this area is too small and shallow to provide good habitat throughout winter and likely does not have sufficient oxygen late in the season.

B. A minimum size of 20 acres per area.

Based on knowledge of know overwintering sites, State and Federal biologist believe 20 acres are preferred for a high quality overwintering site for Centrarchids and associated species.

C. Dissolved Oxygen levels ≥ 5 ppm.

The state water quality standard for dissolved oxygen is 5 ≥ ppm. While it is known that Centrarchids and associated species can survive over winter at lower dissolved oxygen levels, at least 5 ppm is considered optimal.

D. Current velocity < 0.01 ft/sec at mid-depth over 80% of the area.

Centrarchids prefer little or no current velocity during the winter, though they can tolerate some current if water temperatures and dissolved oxygen levels are in acceptable ranges. It is recognized in a riverine system that it is probably not practical to expect to be able to meet this criterion over 100% of an overwintering area.

E. Water temperatures at the following approximate distribution:

1) **39.2 degrees F over 35% of the area**
2) **35.6-39.2 degrees F over 30% of the area**
3) **32-35.6 degrees F over 35% of the area**

The optimum condition would be to have water temperature in the entire overwintering area as near 39.2 degrees F as possible. It is recognized that this does not occur naturally in river backwaters and would be very difficult to accomplish. The criteria shown are considered reasonable both for fish survivability and for what can be practically achieved.

F. Water depths should have the following approximate depth distribution.

1) **> 4 feet over > 40% of the wintering area**
2) **> 7 feet over 15% of the area***

This criterion is based on the observations of State and Federal biologists of water depth conditions in known high quality overwintering areas.

G. Connected to adjacent flowing water habitats*

*The combination of these two criteria will allow for the implementation of a variety of water level management strategies for Pool 5 without creating habitat that would always result in summer fish kills.

<u>OBJECTIVE A2:</u> Create and/or enhances summer habitat for Centrarchids meeting the following criteria:

The specific criteria were developed based on the experiences of State and Federal fishery biologists as to what is considered critical to providing suitable summer habitat for Centrarchids in Mississippi River backwaters.

A. A minimum of three discrete areas.

State and Federal biologists familiar with the Spring Lake study area believe, based on its size and other factors that a minimum of three areas should be provided.

B. A minimum size of 20 acres per area.

Based on knowledge of know sites, State and Federal biologist believe 20 acres is preferred for a high quality summer habitat areas for Centrarchids and associated species.

C. Dissolved Oxygen levels ≥ 5 ppm.

Maintaining adequate dissolved oxygen levels is critical for fish survival.

D. Water depths should have the following approximate depth distribution.

4) > 4 feet over > 40% of the area
5) > 7 feet over 15% of the area*

This criterion is based on the observations by State and Federal biologists of water depth conditions in known high quality summer habitat areas.

E. Connected to adjacent flowing water habitats*

*The combination of these two criteria will allow for the implementation of a variety of water level management strategies for Pool 5 without creating habitat that would always result in summer fish kills.

F. Aquatic vegetation cover in the range of 20-50%.

Aquatic vegetation is a significant habitat component because it provides food and cover for a wide variety of species. Habitat models indicate that providing aquatic vegetation cover in the range of 25-50 percent would create high quality habitat conditions for the Centrarchid species commonly found in backwater habitats, i.e. largemouth bass, bluegill, and crappie..

<u>OBJECTIVE A3:</u> Create and/or enhance spawning, rearing, and juvenile backwater habitat for Centrarchids in three locations, each approximately 5 acres in size and meeting the following criteria:

The specific criteria were based on the experiences of State and Federal fishery biologists as to what is required to provide suitable spawning, rearing and juvenile habitat for Centrarchids and other backwater fish species.

A. Dissolved Oxygen levels ≥ 5 ppm.

Maintaining adequate dissolved oxygen levels is critical for fish survival.

B. Current velocity < 0.017 ft/sec

Low or nonexistent current velocities are important for spawning of most Centrarchids. In addition, little or no current is important for the survival of most Centrarchids during early life stages.

C. Aquatic vegetation cover of approximately 80%

Relatively dense aquatic vegetation is important for the survival of young fish, primarily as protection from predators. Aquatic vegetation is also important as a substrate for food Organisms.

D. Substrates of sand and/or gravel available for spawning

Most Centrarchids are adaptable in their spawning habits, though they do prefer sand and/or gravel substrates. Providing preferred substrates would be expected to enhance spawning success.

<u>GOAL B:</u> Restore high quality puddle duck habitat and then maintain.

The study area formerly provided high quality puddle duck habitat throughout the entire annual cycle including spring and fall migration, nesting, brood rearing, and molting. The combination of island loss and reduction in acres of aquatic plant beds, particularly emergent plants, are factors in the decline of puddle duck use during fall migration and in low mallard duckling survival rates.

<u>OBJECTIVE B1:</u> Increase/maintain habitat meeting the following criteria.

These criteria were identified by Federal and State wildlife biologists as those needed to have high quality puddle duck habitat.

A. Provide/Maintain physical conditions considered important for the growth of emergent aquatic vegetation. These are:

(1) water depths less than 2 feet

(2) protected from dominant wind fetches

(3) current velocities generally less than 0.5 feet per second

Emergent aquatic vegetation is an important habitat component of high quality waterfowl habitat. Flooded, robust emergent species such as cattail, bulrush, and arrowhead provide shelter and food (seeds, tubers, browse, and aquatic invertebrates) for migrant and molting waterfowl, and broods. The value of an emergent plant community increases if beds of rooted floating plants and submersed aquatic plants are located nearby. Emergent vegetation has declined in the Spring Lake area and on the Upper Mississippi River in general. The criteria listed above are considered important to the growth of emergent vegetation and are those that can be modified through habitat restoration measures. There are other factors affecting the growth of emergent vegetation such as water level regulation that cannot be as easily modified on a site specific basis.

Though there may be exceptions for individual species, in general, water depths of less than 2 feet are considered necessary for the growth of emergent vegetation. Protection from large wind fetches is important as large wind-generated waves can make conditions physically inhospitable for the growth of emergent vegetation. Finally, it is recognized that excessive current velocity can also make conditions unsuitable for emergent vegetation. The amount of current velocity tolerated by emergent vegetation probably varies by species and time of year. Current velocities of less than 0.5 foot per second should be suitable for the majority of emergent species indigenous to the area.

OBJECTIVE B2: Provide/Maintain physical conditions considered important for the growth of submergent aquatic vegetation. These are:

(1) water depth less than 4 feet

(2) protected from dominant wind fetches

Submergent vegetation is also important to waterfowl, primarily as a food source. These parameters are considered important to the growth of submergent vegetation. While submergent vegetation can be found at depths greater than 4 feet on the Upper Mississippi, growth is most successful in water depths less than 4 feet. Protection from wind-generated waves is important, primarily due to the secondary effect of resuspended sediments reducing light penetration. Reduced light penetration can affect the growth and productivity of submerged vegetation.

OBJECTIVE B3: Restore Islands to meet puddle duck habitat needs.

Islands are used by puddle ducks to meet a number of habitat requirements. Islands are used for nesting (depending upon vegetative cover). Shoreline vegetation provides cover for broods. Certain species of puddle ducks may feed on insects and plants found on the islands. Island shoreline features such as snags, sand spits, and shallow shelves provide loafing sites for waterfowl. In addition, for puddle ducks, the island can provide a visual barrier to human disturbances. This is believed to be important for resting puddle ducks during the migration season.

OBJECTIVE B4: Provide sand/mudflats within the study area (areas with water depths less than 0.5 foot at normal summer pool elevation).

Shallow/flooded sand/mudflats are important to a wide variety of waterbirds. These flats may vegetate with aquatic plants, providing a food resource. Shallow water areas and/or exposed sand/mudflats support invertebrates that a variety of species feed upon. Without vegetation, the flats serve as important loafing sites used by migrant waterfowl or other waterbirds.

OBJECTIVE B5: Provide waterfowl loafing sites (10-20 per acre) at scattered locations throughout the study area.

Stumps, logs, muskrat houses and shallow flooded sand flats are used by waterfowl for loafing. Ten to twenty loafing sites per acre in preferred locations are considered the desired condition by Federal and State waterfowl biologists. The best loafing sites for broods and molting ducks are surrounded by water, have good visibility, and are near escape cover. For migrant waterfowl, visibility and access to water are important. In addition, it is important that some waterfowl loafing sites be located in areas where there is thermal protection from northwesterly winds.

GOAL C: Create habitat for migratory birds other than waterfowl (Neotropical migrants, marsh and water birds, and shorebirds); increase turtle nesting habitat; restore habitat for mammals, reptiles, and amphibians.

With the loss of islands and associated shallow water shoreline zones in the area, there has been a near total loss of habitat suitable for Neotropical migrants, marsh and water birds (grebes, white pelicans, double-crested cormorants, bitterns, herons, egrets, rails, and terns), and shorebirds.

With a loss of islands, there has been a loss of suitable nesting habitat for turtles in the area. In addition, there has been a near total loss of suitable habitat for aquatic or semi-aquatic mammals, many reptile species, and amphibians.

No numerical habitat goal for these particular species groups has been established for the Spring Lake area. For all these species groups, there are no specific thresholds identifying the amount of habitat required within the river corridor to meet the needs of these species. Any restoration of habitat for these species would benefit their overall population levels.

OBJECTIVE C1: When planning/designing habitat features for the Spring Lake area, the following habitat types or conditions should be provided:

A. For Neotropical migrants (grassland and woodland), provide islands seeded to grass an/or planted trees.

B. For marsh and water birds, provide habitat consisting of an interspersion of submersed, rooted floating aquatics, emergent plants, and open water, in proximity to islands.

C. For shorebirds provide gradual sloping beaches and/or shallow backwater lagoons.

D. For nesting turtles, provide isolated islands having gently sloping beaches with sparse vegetation and a substrate capable of maintaining soil moisture suitable for turle egg incubation.

E. For aquatic and semi-aquatic mammals, reptiles, and amphibians, provide wetland habitat consisting of an interspersion of submersed, rooted floating aquatics, emergents, and open water in proximity to islands.

These basic habitat conditions were identified by Federal and State wildlife biologists as those most limiting in the Spring Lake area for the various species groups. Their findings were based on a review of the habitat requirements of the wide variety of species that would be expected to use the area.

GOAL D: Enhance habitat for riverine fish species and mussels.

Prior to impoundment, the Spring Lake area had a number of well-defined channel systems. Following construction of the dam and impoundment of pool 5, portions of some of these channels were still definable by islands, but over time, many of the islands in this area have disappeared. Loss of bathymetric and topographic diversity has affected the habitat quality of the remnant channels that are still evident on bathymetric maps of the area.

The existing secondary and main channel border habitats in the project area are important areas for riverine fish species and mussels. There exists a lack of habitat diversity in the form of cover, velocity and shelter. Creation of more diverse substrate, bathymetric and cover conditions would enhance the area for riverine fish species and mussels. No numeric habitat goals for riverine fish species and mussels have been established for the Spring Lake area. There are no specific thresholds identifying the amount of habitat required within the river corridor to meet tha needs of these species. Any restoration of habitat would benefit their overall population levels.

OBJECTIVE D1: Enhance habitat for riverine fish species and mussels meeting the following criteria:

A. Continuous flowing channel (bordered by islands) of at least 2,000 feet.

Submerged flowing channels are still present within the study area. However, the loss of islands that bordered these channels has substantially reduced their habitat value. The presence of land bordering flowing channels increases the habitat value of the channel because of the variety of habitat niches provided in the shallow transition zones adjacent to the islands. In addition, there is usually structure in the form of fallen trees, snags, and other woody debris in areas adjacent to islands that provide important food and cover habitat for fish.

B. Areas of scour, eddies, and varying velocities.

Scour holes, eddies, and a variety of current velocities provide diverse habitat conditions for food organisms and fish themselves.

C. Variety of substrates (sand, silt, clay, cobble, etc.).

A variety of substrates provide diverse habitat conditions for food organisms.

D Connectivity with other channels.

Connectivity with other flowing channels provides avenues of passage for fish to use other habitats, which can be important depending on seasonal and river stage conditions.

5.3 DESIGN CONSIDERATIONS

A number of ideas were provided by river managers and engineers for consideration in the planning and design of project features.

5.3.1 NATURAL PROCESSES

Restoration of natural river processes disrupted by creation of the locks and dams is an overall goal for habitat restoration on the Upper Mississippi River. It is believed that restoration of these processes will generally result in improved habitat conditions for a wide variety of fish and wildlife. While restoration of natural river processes has merit from a systematic perspective, it is difficult to define this goal on a site-specific basis in a quantifiable manner. Also, the primary source of disruption of river processes, the navigation system with regulated pools, is part of the equation. Planning for habitat restoration measures must take into account that there is a navigation project in place, the operation of which is going to effect what can be accomplished with various restoration measures. As long as the navigation project is in place there will be limitations on the restoration of natural river processes. Therefore, the approach selected is to view restoration of natural river processes as a long-term systemic goal. Restoration of these processes will be incorporated into the development of the habitat restoration project where possible.

5.3.2 ISLANDS

A. Islands should be located in locations and configurations comparable to the natural islands that previously existed in the study area.

B. A mix of high and low elevation islands is preferred.

C. Use of rock should be minimized to allow for more aesthetic and natural looking conditions. Shorelines deemed critical to maintaining the integrity of an island or an overall island complex should be protected using bioengineering techniques, if possible. Non-critical shorelines should be vegetated with grass or left as sand.

D. Slopes of 10:1 extending from the toe of islands outward for 30' or more are desirable. This could be accomplished either through direct construction or providing sufficient material in an island berm for beach formation.

E. Do not plant willows on every portion of an island. Create dynamic shorelines with a transition zone (i.e., an above water beach) to provide more habitat that is suitable for shorebirds.

F. Locate islands to induce the maintenance and /or formation of channels to maintain/improve bathymetric diversity.

5.3.3 MUDFLATS

A. Mudflats located in proximity to islands are the optimum condition.

B. It is important to maintain and enhance microtopography within expanses of mudflats.

Alternatives

6

ALTERNATIVES

6.1 PLANNING OPPORTUNITIES

In the Spring Lake area, remnants of past-eroded islands still exist just beneath the surface of the water. These underwater remnants provide a solid base upon which to reconstruct islands. In addition, constructing new islands on top of these remnants reduces material requirements, thereby reducing costs.

6.2 PLANNING CONSTRAINTS

6.2.1 INSTITUTIONAL

The Spring Lake project area lies within the boundaries of the Upper Mississippi River National Wildlife and Fish Refuge. As such, Refuge management goals and objectives must be complied with, as well as the laws and regulations governing Refuge management.

6.2.2 ENGINEERING

Because of the shallow water depths, access for construction equipment would be difficult in many areas without dredging. Construction access had to be considered in the planning and design of habitat restoration features.

Project features should be designed with a minimum 50-year project life, with operation and maintenance requirements kept to a minimum. The latter is in recognition that the availability of operation and maintenance funds in the future may be limited

6.2.3 ENVIRONMENTAL

Potential sources of borrow material from the main channel may support healthy mussel populations. The selection of borrow areas need to avoid affecting productive mussel beds.

6.2.4 SOCIOECONOMIC/RECREATION

Boat access between Spring Lake and the main channel must be maintained.

6.2.5 CULTURAL

No specific cultural resource constraints have been identified for the study area. Compliance with cultural resource laws and regulations is required.

6.3 ALTERNATIVES IDENTIFIED

6.3.1 NO ACTION

The no action alternative is defined as no implementation of a project to modify habitat conditions in the study area. Water flows through the barrier islands would increase as erosion continued to increase the size of the openings.

6.3.2 ISLAND/BANK PROTECTION

Bank protection is a tool that can be used to control erosion. Generally, with habitat projects on the Upper Mississippi River, it is in the form of vanes, groins, a rock layer on the bank (traditional riprap design), or an off shore rock mound. The latter is used quite often in areas where access for construction equipment is a problem, or to avoid disturbing existing vegetation on the area targeted for protection. Bank protection was evaluated for all of the remnant natural islands in the study area.

6.3.3 ISLAND CREATION

Island creation was the primary habitat restoration feature evaluated for the Spring Lake backwater area. Restoration of islands protects shallow areas from wind and wave action. This in turn protects existing aquatic vegetation beds and improves conditions for the growth of aquatic vegetation in other shallow areas.

Islands provide terrestrial habitat, and their restoration increases habitat diversity and provides habitat niches that have been lost through the erosion of islands in this area. Islands can also be designed in a manner to channel flows to maintain bathymetric diversity.

Development & Evaluation of Alternatives

7

DEVELOPMENT AND EVALUATION OF ALTERNATIVES

The St. Paul District has completed island restoration projects in pool 5 (Weaver Bottoms-1986), pool 7 (Lake Onalaska-1989), pool 8 (Pool 8 Islands Phase I-1993 and Phase II-1999), pool 5A (Polander Lake-2000) and pool 9 (Pool 9 Islands). The lessons learned from the construction of these projects and the results of monitoring of physical and biological responses were applied to the development of alternative island restoration plans for the Spring Lake project area. How lessons learned were applied in the development of the island designs are discussed in more detail in the Hydraulic Appendix (attachment 5). The monitoring of past projects, especially the Lake Onalaska, Pool 8 Islands Phase I, and Pool 8 Islands Phase II projects, has shown that if the proper physical conditions are provided, such as shallow water (<4') protected from wind and currents, aquatic plants and the fish and wildlife that use them will respond.

7.1 NO ACTION

By definition, no action would entail no expenditure of Federal funds under UMRS-EMP HREP program to address habitat concerns in lower the Pool 5 Spring Lake project area. If the habitat concerns are not addressed under the UMR-EMP program, it is unlikely that any substantive habitat restoration measures would be undertaken by the U.S. Fish and Wildlife Service or the Wisconsin Department of Natural resources because of fiscal constraints.

The "no action" alternative would not satisfy any of the project objectives. Habitat conditions would change as described under an earlier section of this report, "estimated Future Habitat Conditions."

7.2 SPRING LAKE ISLAND ALTERNATIVES

7.2.1 ISLAND ALTERNATIVES

The Wisconsin Department of Natural Resources and the U.S. Fish and Wildlife Service prepared an initial island concept plan **(plate 7)** for the Spring Lake area using the islands present in 1939 as a guide. The District took that plan and after several iterations developed the preliminary island restoration plan as shown on **plate 7.1**. The plan shown on **plate 7.1** was designed to maximize meeting project objectives; to incorporate lessons learned from previous island restoration projects; and to take advantage of existing conditions to limit costs and minimize construction difficulties. For example, all of the islands were located on top of old island remnants or other shallow areas to minimize the amount of material needed to construct an island and the amount of rock required for stabilization. Also, borrow sites would be located in a manner to enhance habitat by increasing depths in areas protected from winter currents.

The plan shown on **plate 7.1** was used as the basis for defining alternatives and to serve as the basis for incremental analysis. Each alternative was evaluated in terms of meeting the key project objectives. Given the diverse nature of project objectives, it was not expected that any of the alternatives would fully meet all of the objectives.

The criteria contained in the project goals and objectives were established for planning purposes. These are the "targets" of the planning process, based on what habitat conditions resource managers would like to achieve, tempered by the reality of what actually may be practical to accomplish. Not fully achieving a planning goal and/or objective or not fully meeting a criterion does not mean that an alternative does not provide any habitat benefits. Partial achievement of a goal and/or objective may still produce habitat benefits warranting implementation of an alternative.

The first task was to identify the minimum plan that would achieve some measure of habitat objective such that it would warrant consideration as a stand-alone project. It was determined that it would be most important to protect the existing terrestrial habitat from further erosion. The construction/restoration of **rock sill 1 and rock mounds 1- 4** was determined to be the base or minimum plan, **Plan A.** The Spring Lake alternatives start with this base, and then incrementally add features (primarily islands) to this base plan.

Plan A	Rock Sill 1 and Rock Mound 1-4
Plan B	Island 1b, Rock Sill 1 & Rock Mound 1-4
Plan C	Islands 2, 1b, Rock Sill 1 & Rock Mound 1-4
Plan D	Islands 3, 2, 1b, Rock Sill 1 & Rock Mound 1-4
Plan E	Islands 4, 3, 2, 1b, Rock Sill 1 & Rock Mound 1-4
Plan F	Islands 5, 4, 3, 2, 1b and Rock Sill 1 & Rock Mound 1-4

Island designs were developed to the depth of detail necessary to obtain reasonable material quantity and cost estimates. This included development of typical cross-sections, shoreline stabilization designs, planting plans, and special features such as mudflats.

The construction of Rock Sill and Rock Mound 1 as a standalone alternative was eliminated because all of its features have been included in Plan A**.**

The Island 1a feature was eliminated from further consideration because the Island 1b feature would be more cost effective while still meeting most of the habitat objectives.

7.2.2 ALTERNATIVES EVALUATION

7.2.2.1 Costs

Table 7-1 summarizes the costs and quantifies benefits for the Spring Lake alternatives. As would be expected, the alternatives involving construction of a large number of islands would have greater costs.

Table 7-1
Summary of Costs and Quantifiable Benefits

Plan	Total Cost/ Cost	Avg. An. Cost	Inc. Cost	Incr. Ave. An. Costs	Gain	Inc AAHU Gain	Inc AAHU AAHU
A	$ 489,000	$ 30,484	$ 489,000	$30,484	39	39(BG) 30(DD)	$ 782
B	$ 724,000	$ 45,134	$ 235,000	$14,650	53	14(BG) 10(DD)	$ 1,017
C	$1,480,000	$ 92,263	$ 756,000	$47,129	79	26(DD) 0(BG)	$ 1,841
D	$2,666,000	$166,198	$1,186,000	$73,935	126	47(DD) 17(BG)	$ 1,564
E	$3,298,000	$205,597	$ 632,000	$39,399	147	21(DD) 0(BG)	$ 1,861
F	$3,841,000	$239,448	$ 543,000	$33,851	149	2(DD) 0(BG)	$17,027

BG – Bluegill
DD – Dabbling Duck

7.2.2.2 Quantifiable Habitat Benefits

Estimated habitat benefits were quantified using habitat evaluation procedures. The habitat evaluation is described in detail in **Attachment 4 – Habitat Evaluation Appendix**. Benefits were quantified using two models. The selection of the models was based on the primary habitat goals and objectives for Spring Lake. The fish community that would be expected to use Spring Lake is a backwater community characterized by a predominance of Centrarchids, i.e. largemouth bass, black crappie, and bluegill. After review of the available species models, the U.S. Fish and

Wildlife Service bluegill model (Stuber, et al., 1982) was selected because it has been modified by the St. Paul District (Palesh and Anderson, 1990) to include winter habitat variables. This was an important factor in model selection because a major project objective is to improve winter habitat conditions for Centrarchids and associated species.

Another important goal of the project would be to improve conditions for migratory waterfowl. The highest projected waterfowl use of the area is as migratory habitat for dabbling ducks. A dabbling duck migration model for the Upper Mississippi River developed by the St. Paul District (Devendorf, 2001) in cooperation with the U.S. Fish and Wildlife Service and Wisconsin Department of Natural Resources was used to quantify waterfowl habitat benefits.

7.2.2.2 Unquantifiable Benefits

There are other project benefits not quantifiable by the habitat models. Some of the more important habitats are provided by the islands themselves, accreation of sediments to form mudflats, the benefits to other wildlife from increases in aquatic vegetation growth, and fish habitat benefits to riverine species. Generally, the project would result in an increase in community diversity within the project area. Due to the size and location of the project area, it is anticipated there would be subtle, unmeasurable effects on the overall habitat quality of lower pool 5.

Numerous other wildlife benefits, not quantified by the habitat models used, would accrue with project construction. Some of these benefits are identified through the objectives identified under habitat goals C and D, which address creating habitat conditions for a variety of species through project design. These goals and design criteria were identified by Federal and State biologists as the most limiting habitat factors in the Spring Lake area. No numerical goals were established, but it was recognized that any restoration of these habitat components would benefit overall habitat conditions in lower pool 5.

Island construction would result in the creation of additional upland habitat. Vegetation on these islands would range from bottomland hardwoods, to shrub/scrub and grasslands, primarily along the shoreline. These conditions would provide habitat for neotropical migrant bird species and nesting habitat for turtles.

The establishment of islands and the associated shallow water and shoreline zones would provide habitat suitable for marsh and water birds such as grebes, white pelicans, double crested cormorants, bitterns, herons, egrets, terns and a variety of shorebirds. The increased aquatic vegetation and associated marsh conditions around the islands would provide habitat for aquatic and semi-aquatic mammals, such as muskrat, and many species of reptiles and amphibians.

The islands within this project have been designed such that they will enhance side channel habitat within, and on the perimeter of Spring Lake. Over the past decade, many islands and their associated protected side channel habitats have disappeared, resulting in large, unprotected open water areas. These conditions have contributed in some degree to the loss of large stands of aquatic vegetation, and resulted in the simplification of the mosaic of habitat types within the corridor. The result has been a gradual decline in the quality and integrity of wildlife habitat along the river. On a pool-wide basis, the restoration of islands and their associated side channel habitat may be considered as one of the key components in maintaining the integrity of the existing river corridor community.

7.3 PLAN SELECTION

There are no established guidelines for determining an acceptable level of cost effectiveness. However, for habitat projects on the Upper Mississippi River, projects with an average annual cost/average annual habitat unit of $2,000 or less have generally been considered acceptable. In some cases, up to $4,500/AAHU have been considered acceptable based on the uniqueness or value of the resource.

Because the Spring Lake alternatives are structured incrementally, the plan selection and justification process can follow an incremental process. The first decision to be made is whether or not the construction of **Alternative A** (Rock Sill1 and Rock Mounds 1-4) is acceptable.

Alternative A would provide an estimated 39 AAHU of quantifiable fish habitat benefits at an approximate cost of $782/AAHU and an estimated 30 AAHU of quantifiable dabbling duck habitat benefits at an approximate cost of $1,014/AAHU. This would be considered a reasonable cost for the benefits provided. In addition, this alternative would provide many of the additional unquantifiable fish and wildlife habitat benefits discussed earlier in section 7.2.2.2. The conclusion is that **Alternative A** would be acceptable by the quantifiable and unquantifiable fish and wildlife habitat benefits it would provide and the reasonableness of the costs.

The incremental analysis shows that **Alternative B** would provide an estimated 14 AAHU of quantifiable fish habitat benefits at an approximate cost of $1,017/AAHU. This does not take into account the 10 AAHU of quantifiable dabbling duck habitat benefits or the other unquantifiable fish and wildlife benefits that would be associated with construction of **Alternative B**. A cost of $1,017/AAHU would be considered a reasonable cost for the type of benefits provided. Therefore, the construction of **Alternative B** would be considered acceptable.

The addition of **Alternative C** would provide an estimated 26 AAHU of quantifiable dabbling duck habitat benefits at an estimated cost of $1,841/AAHU. This cost would be considered a reasonable cost for the type of benefits provided. In addition this alternative would provide many of the additional unquantifiable fish and wildlife habitat benefits. Therefore, the construction of **Alternative C** would be considered acceptable.

The addition of **Alternative D** would provide an estimated 47 AAHU of quantifiable dabbling duck habitat benefits at an estimated cost of $1,564/AAHU. This cost would be considered a reasonable cost for the type of habitat benefits provided. This does not take into account the 17 AAHU of quantifiable fish habitat benefits, or the other unquantifiable fish and wildlife habitat benefits associated with the addition of **Alternative D**. Also, the fishery benefits gained in the form deep water that would result from dredging the large amount of borrow material needed for this feature were not taken into account. Furthermore, the combined duck and bluegill benefits are greater for this alternative than for any other except **Alternative A**. Therefore, the construction of **Alternative D** would be considered acceptable.

The addition of **Alternative E** would provide an estimated 21 AAHU of quantifiable dabbling duck habitat benefits at an estimated cost of $1,861/AAHU. This cost would be considered a reasonable cost for the type of benefits provided. In addition, this alternative would provide many unquantifiable fish and wildlife habitat benefits. Therefore, the construction of **Alternative E** would be considered acceptable.

The final increment to consider is the construction of **Alternative F**. The addition of **Alternative F** would provide an estimated 2 AAHU of quantifiable dabbling duck habitat benefits at an estimated cost of $17,027/AAHU. This cost would be considered an unreasonable cost for the type of benefits provided. Therefore the construction of **Alternative F** would not be considered acceptable.

The conclusion of the plan selection process for Spring Lake is that **Alternative E** is acceptable and is therefore, the recommended plan (Plate 9).

Selected Plan with Detailed Description/Design/Construction Considerations

8

SELECTED PLAN WITH DETAILED DESCRIPTION/DESIGN AND CONSTRUCTION CONSIDERATIONS

8.1 SPRING LAKE

The selected features for the Spring Lake Islands project are listed in Table 8-1 and shown on plate 9.

Table 8-1
Summary of Selected Features

Feature Type	Primary Purpose(s)
Rock Sill 1	Reduce winter flows behind peninsula.
Rock Mound 1	Prevent erosion of the peninsula.
Rock Mound 2-4	Prevent the erosion of the small islands.
Island 1b	Reduce wind fetch and provide protection from winter flows.
Island 2	Reduce wind fetch to promote a diverse vegetation community.
Island 3	Reduce wind fetch and provide protection from winter flows.
Island 4	Reduce wind fetch to promote a diverse vegetation community.

8.1.1 ROCK SILL

Rock Sill 1 will extend between the openings in the natural peninsula. A typical cross section for the rock sill is shown on plate 11. (The rock sill would have a 1V: 3H upstream slope to minimize ice dislodgement of the stone).

The 10-foot top width of the rock sill would be considered adequate from a stability standpoint. Constructibility considerations also entered into the selection of the sill width. The preferred method of construction would be to have the contractor construct the rock sill from one or both ends, transporting rock along and working off the completed portions of the sill. This method of working off the top of sill would require a 12-foot minimum top width. However, because of limited accessibility by land, the rock will need to be barged in requiring an access channel. The access channel will need to be dredged 6 to 7 feet deep and 40 feet wide along the entire length of the rock sill and rock mounds features.

The rock sill would be constructed with a top elevation of 661.0. (average pool in this area is 660.0). The primary purpose of the rock sill is to reduce flow into the upper area of Spring Lake in the fall-winter period to meet the winter fishery objectives discussed earlier. An elevation of 661.0 was selected following an analysis of fall-winter high water events during the period 1981-01 (see attachment 5, Hydraulic Appendix, for more information).

A sill elevation higher than 661.0 was not selected because it is desirable to allow high water events to continue to flow through the Spring Lake complex. The purpose is to take advantage of the scouring action of high flows to remove accumulated fine sediments. This would reduce the long-term rate of sediment accumulation in the Spring Lake complex and help maintain bathymetric diversity.

A notch in the sill would be designed to limit flows into Spring Lake during the winter to 10 cfs. A flow of 10 cfs is considered adequate to meet winter dissolved oxygen requirements in Spring Lake, while at the same time providing sufficient flow to minimize the potential for adverse water quality effects during summer months. The notch would be 8 feet wide, 3 feet deep with a slope of 1V: 1.33H.

Geotextile would be placed in the rock sill to serve as a barrier to water seeping through the sill and to accelerate the natural plugging of the rock voids. Analysis indicates that there could be considerable flow passing through the voids in the rock before those spaces fill with sediment.

The rock for the rock sill (and the rock mounds, island groins and vanes) could come from quarries in either Wisconsin or Minnesota. If taken from a Wisconsin quarry, it would likely be loaded on barges for transport to the site either in the Spring Lake area or at the Alma Marina. If taken from a Minnesota quarry, the barge-loading site would likely be located in the Wabasha area. The St. Paul District has recently taken rehabilitation measures for the L/D 5 earthen embankment. The rehabilitation involved removal of some of the rock on the upstream face of the embankment. This rock has been stockpiled and would be available for use on the Spring Lake island project, reducing the need to acquire new rock. This potential opportunity to reduce costs would be explored during the preparation of construction plans and specifications.

As noted above, it is expected that the contractor would construct the rock sill from barges. This would require some access dredging. The material from this access dredging could be used in the construction of mudflats on island 2 and island 4. An access dredging volume of approximately 14,657 cubic yards (access channel 1 on plate 9) has been estimated and accounted for in the material requirements of island 2 thru 4.

8.1.2 ROCK MOUND PROTECTION

Rock Mound 1 would extend along the upstream side of the natural peninsula. The rock mound would prevent further erosion of the peninsula. Rock Mounds 2-4 would protect the smaller islands from further erosion (Rock mounds would be the traditional riprap design using an 18-inch layer placed on a 1.5H:1V slope). The rock mound design would be used to reduce or eliminate the costs and environmental impacts associated with additional access dredging to get floating plant and barges close to the islands for construction. In addition, this design eliminates the need for bank shaping further reducing costs and construction related environmental effects. A typical cross section for the rock mounds is shown on plate 11.

The rock mounds would be constructed with a top elevation of 662.0. (average pool in this area is 660.0). An elevation of 662.0 was selected following an analysis of fall-winter high water events during the period 1981-01 (see attachment 5, Hydraulic Appendix, for more information).

The rock for the rock mounds (and the island groins and vanes) could come from the same sources as the rock sill above.

As noted above it is expected that the contractor would construct the rock mounds from barges using the same access channel to construct the rock sill.

8.1.3 ISLANDS

The selected plan for the Spring Lake islands area involves the construction of four islands as shown on Plate 9. Plate 11 shows a typical cross section for the islands, while Plate 12 shows other features. Table 8-2 summarizes the design data for the islands.

Table 8-2
Summary of Design Data for Spring Lake Islands

Island	Length (ft)	Base Width (ft)	Top Width (ft)	Exterior Berm (ft)	Interior Berm (ft)	Top Elevation	Berm Elevation
IL1 (upper)	500	Varies	Varies	n.a.	n.a.	662.5	n.a.
IL1 (lower)	1300	Varies	Varies	n.a.	n.a.	662	n.a
IL 2 (upper)	100	125	40	30	45	663.0	662.0
IL 2 (middle)	1200	115	40	20	45	663.0	662.0
IL2 (lower)	1100	115	40	30	45	662.0	662.0
IL3 (upper)	2875	115	65	20	30	662.0	662.0
IL3 (lower)	825	125	65	30	30	662.0	662.0
IL4 (upper)	1600	115	40	20	45	662.0	662.0
IL4 (lower)	250	105	40	30	45	662.0	662.0

Island	End Protection	Exterior Protection	Interior Protection	Sand Fill (cy)	Random Fill (cy)	Fine Fill (cy)	Rock (cy)
IL1	Riprap	Groins	None	8,853	-	1,600	3,647
IL 1 mudflat	n.a.	n.a.	Groins			4,458	
IL2	Riprap	Groins/ Vanes	None	51,164	-	9,414	1,150
IL2 mudflat	n.a.	n.a.	Groins		9,250	944	
IL3	Riprap	Groins	None	100,389	-	12,854	1,534
IL3 mudflat	n.a.	n.a.	Groins		13,319		
IL4	Riprap	Groins/ Vanes	None	50,180	-	5,037	1,164
IL4 mudflat	n.a.	n.a.	Groins		10,093		
Total				210,586	32,662	34,307	7,495

8.1.3.1 Island 1b

Island 1b is located at the upper end of Spring Lake and is connected to the existing peninsula. Island 1b is primarily designed to train flows to the existing channel and to increase area of water greater than 4 feet deep sheltered from the river current. Island 1 will incorporate the existing island remnants and the recently constructed peninsula to reduce flow velocities in upper and mid Spring Lake. This design will maximize the area intended to serve as a winter fishery.

Two rows of willows/indigobush would be planted on the outer shoreline. A native grass/forb mix would be planted on the island, leaning heavily toward switchgrass and other tall, robust cool and warm season grasses. The vegetation will improve island stability and provide food sources/cover for fish and wildlife.

8.1.3.2 Islands 2 and 4

Islands 2 and 4 are designed to train flows to existing channel and reduce wave action. The upper portions of the islands are designed to reduce wind fetch in shallow areas, which will reduce wave action and allow establishment of aquatic vegetation. The lower portions of the islands are designed to train flows to existing channels to improve channel habitat.

The ends of the island would be protected with riprap, while the lower end of the island parallel to the channel would be protected with vanes. The upstream ends of the middle and upper portions of the island would be protected with groins.

Two rows of willows/indigobush would be planted on the outer shoreline. A native grass/forb mix would be planted on the island, leaning heavily toward switchgrass and other tall, robust cool and warm season grasses. The vegetation will improve island stability and provide food sources/cover for fish and wildlife.

8.1.3.3 Island 3

Island 3 is designed to reduce wave action and increase the area of water greater than 4 feet deep sheltered from river current. In addition, the island is located along one of he access channels to improve channel habitat. Island 3 would reduce water velocities in the southeastern portion of Spring Lake. The island also reduces wind fetch in shallow areas to allow establishment of aquatic vegetation.

The ends of the island would be protected with riprap. The upstream ends would be protected with groins.

Two rows of willows/indigobush would be planted on the outer shoreline. A native grass/forb mix would be planted on the island, leaning heavily toward switchgrass and other tall, robust cool and warm season grasses. The vegetation will improve island stability and provide food sources/cover for fish and wildlife.

8.1.4 Construction Methods

How islands are constructed is generally left to the discretion of the contractor. The contractor is responsible for providing the finished product (the islands as designed) in a manner best suited to his operation. Experience with construction of other island projects within the St. Paul District (17 islands in 5 different locations) has shown that there is a general pattern to cost effective construction of islands.

The sand base for an island is placed using hydraulic dredging equipment. Due to the quantities involved, it usually much more cost effective to use hydraulic dredging equipment than mechanical dredging equipment. The sand, as it is discharged from the pipeline, firms up quite rapidly and is capable of supporting bulldozers that are then used to shape the island.

The random fill sections of the island can be filled using either hydraulic or mechanical dredging equipment. If the contractor does not need the random fill sections to dispose of access dredging materials, the most cost effective approach is to fill these sections with sand as part of the sand placement process. If excess access dredging material is used, the method of placement will depend upon the type of equipment the contractor uses for access dredging.

Fine material is placed on islands by a variety of methods. Placement of fine material using mechanical equipment is slower and more costly in terms of actual placement. However, mechanically placed material dries quicker, so that it can be shaped and graded in a shorter time following placement. Initial placement of fine material using hydraulic dredging equipment is faster. However, hydraulically placed material must be contained and takes longer to dry before it can be shaped and graded. Meeting water quality limitations for the discharge of the dredge carriage water may affect the operation. These factors may negate the initial cost savings associated with the hydraulic placement.

New technologies are evolving which involve dredging of fine materials with a small hydraulic dredge and passing them through a mechanical dewatering process using flocculents and presses. The end product is dewatered fine material that can then be placed, shaped, and graded without an extensive drying period. This process was used on an island construction project in the St. Paul District in 2000 and holds promise in the future as a cost effective method of fine material placement.

Rock is barged to the islands and placed using hydraulic backhoes. The most limiting factor on rock placement is usually water depths for the rock barges and push boats. To limit the amount of access dredging or double handling of rock along the islands, contractors may place rock protection during periods of high water.

There is nothing in the design of the Spring Lake islands and other features to suggest that any innovative or unusual construction methods would be necessary.

8.1.5 Construction Restrictions

Construction restrictions can be applied for any number of reasons. Restrictions are generally applied in the construction of habitat projects to minimize the adverse effects of construction and to protect valuable habitats. The following are the basic construction restrictions that would likely be applied in the Spring Lake area.

a. Construction would not be allowed during the fall waterfowl migration season (October-November).

b. Access dredging would be limited to the minimum considered necessary to construct the project.

c. Water quality limitations would be imposed on the hydraulic placement of sand material for island bases. The criterion used in past island construction projects has generally been that a specified suspended solids concentration has to be met within a certain distance from the discharge point. These limits will be provided in the water quality certification.

d. Water quality limitations would be imposed on the hydraulic placement of fine material. The criterion used in past island construction projects has generally been that a specified suspended solids concentration has to be met at the discharge point for the dredge carriage water.

e. Contractors are usually allowed to propose alternative borrow sites. The contract documents will define areas where the Government will not approve alternative borrow sites in areas such as existing aquatic plant beds, mussel beds, or other environmentally sensitive areas.

8.2 ACCESS DREDGING

Access dredging would be required to construct the project. Generally, a balance must be struck to provide reasonable access for the contractor while minimizing the environmental disturbances associated with the dredging. In addition, being able to incorporate the access dredging material into the islands avoids the costs of having to transport this material elsewhere for disposal.

Plate 9 shows proposed access routes for construction of the islands that should provide adequate access for construction while minimizing secondary effects. It should be noted that these are routes where dredging could occur to obtain access. If a contractor can access other portions of the construction without dredging, he is generally free to do so. Contractors are allowed (and occasionally do) request alternate access routes. These would be evaluated on a case-by-case basis for approval.

8.3 MUDFLATS

Mudflats would be constructed in the bay formed by Islands 1, 2, and 4 and on the lower portion of Island 3 **(Plate 9)**. A low sand berm would be constructed along the outside edge of the designated mudflat areas. This sand berm would serve as the containment berm for the material used to create the mudflat. Material would most likely be placed within the mudflat area by a small hydraulic dredge. The design elevation of the mudflats is 659.6, however, a relatively wide tolerance will be allowed (such as $\pm$ 0.5 foot) to provide a diversity of elevations within the mudflat to promote a variety of vegetation species. The sand berm would be breached or allowed to erode naturally. That decision would be made after the mudflat is constructed and it can be determined how stable the material is.

8.4 SOURCES OF MATERIAL

Table 8-3 summarizes the expected sources of fill material for the Spring Lake area.

Table 8-3
Spring Lake Islands Material Sources

Feature	Sand Fill Required	Sand Fill Source	Random Required	Random Source	Fine Fill Required	Fine Fill Source	Rock
Island 1b	9,000	Spring Lake	-	n.a.	2,000	access and fine borrow dredging in Spring Lake	3,647
Island 2	51,000	Spring Lake	-	n.a.	9,000	access and fine borrow dredging in Spring Lake	1,150
Island 3	100,000	Spring Lake	-	n.a.	13,000	access and fine borrow dredging in Spring Lake	1,534
Island 4	50,000	Spring Lake	-	n.a.	5,000	access and fine borrow dredging in Spring Lake	1,164
Island1b Mudflat	-	n.a	-	n.a.	4,000	access and fine borrow dredging in Spring Lake	-
Island 2 Mudflat	-	n.a	9,000	access dredging	1,000	access and fine borrow dredging in Spring Lake	-
Island 3 Mudflat	-	n.a	13,000	access dredging	-	n.a.	-
Island 4 Mudflat	-	n.a	10,000	access dredging	-	n.a.	-
	210,000		32,000		34,000		7,495

8.4.1 Sand

A number of options for obtaining sand fill for the islands were evaluated and still may be considered during preparation of plans and specifications for project construction.

<u>Main Channel of the Mississippi River</u>

The main channel of the river is a known source of sand. This source is considered the fall back alternative, i.e., a known source if no better source can be found. The main channel is not considered a preferred source for sand because excavating in the main channel would provide limited secondary habitat benefits.

Off Channel Areas

Borrow dredging from off channel areas would be an option that depending on location, could provide substantial secondary fish habitat benefits. However there could be negative impacts associated with this activity that would require review prior to dredging. For example, one of the primary objectives of this project is to promote the growth of aquatic vegetation. It would be counter-productive to dredge such areas to the extent that they would become too deep to support aquatic vegetation. Another concern with dredging in off-channel areas is the possibility of destroying important mussel beds. Prior to dredging in such areas a mussel survey would be conducted if that area lacks sufficient available data.

During project planning, an area southwest of Spring Lake **(Plate 8)** was identified as a possible source of sand for island construction. Borings indicate there are some accessible sand deposits in this area. A mussel survey was conducted in this area in 2001 that produced 12 species and 465 individuals. Furthermore, four state-listed species were collected: (1) black sandshell (*Ligumia recta*), (1) hickorynut (*Obovaria olivaria*), (1) monkeyface (*Quadrula metanevra*), (2) round pigtoe (*Pleurobema coccineum*). The conclusion based upon the mussel survey data is that using material from this area to construct islands in the Spring Lake will not be considered.

Dredged Material Containment Sites

The St. Paul District maintains designated sites for the placement of material (sand) dredged to maintain the navigation channel. Two of these sites are located in proximity to the project area. The Fisher Island site is located 4 ½ miles from Spring Lake. This site has land access and is an active beneficial use removal site. The Lost Island site is located about 3 ½ miles from the center of the Spring Lake area. This site has land access and is an active beneficial use removal site.

Due to their distances from the project area, it would not be cost-effective to use material from either of these sites for construction of islands in the Spring Lake area solely under the UMRS-EMP. Use of these sites would cost more than obtaining sand material from the other sources discussed above, and would provide no habitat benefits commensurate with the increased cost.

Use of these sites could be considered cost effective if cost-shared with the St. Paul District's channel maintenance program for the 9-Foot Navigation Channel project. The benefit to he UMRS-EMP program is that sand can be obtained at a lower cost than from an alternative source. (The potential habitat benefits foregone at the alternative borrow site must also be considered.) The benefit to the District's channel maintenance is that the habitat project may offer a lower-cost dredged material placement alternative. Cooperative use of channel maintenance material has been successfully implemented in a limited manner with the Pool 8 Islands Phase I project, and more extensively with the Polander Lake Stage 2 project in pool 5A.

The potential for use of material from the two sites in a cost-shared manner was evaluated. At the present time, there is no financial incentive for the District's channel maintenance program to participate in removal of material from this site. Current beneficial use removal is sufficient to maintain capacity at the site.

The conclusion of these evaluations is that using material from either the Fisher or Lost Island sites to construct islands in the Spring Lake area is not a feasible option at this time.

Currently Proposed Source

The current proposed source of sand material for the proposed islands is from the Spring Lake backwater area **(Plate 8).** It is proposed to construct islands 1 thru 4 using sand located between islands 2 and 4. The amount of sand dredged from this area of Spring Lake would be maximized to the extent practical.

8.4.2 Random Fill

It is expected that most random fill will come from access dredging material that contains too much fine material to be used in the sand sections of the islands and too little fine material to be considered fine fill for topsoil. If the contractor does not need to use the random fill island sections for disposal of access dredging material, it is expected that it would be most cost effective for the contractor to use sand for the random fill.

8.4.3 Fine Fill

It is expected that the fine fill (island dressing/mudflat material) would come from both access dredging (cuts 1 and 2) and additional fine borrow dredging in the upper end (cuts 1 and 2) of Spring Lake.

8.4.4 Rock (island protection)

The rock for the rock groins and vanes would come from the same sources as the rock sill and rock mounds above.

8.5 CONSTRUCTION SCHEDULE

The scope of the project will require multi-year construction. Due to the location and nature of the construction, nearly all of the work will require use of marine equipment. Construction of this type is limited to the open water season on the Upper Mississippi River. Construction in certain years can begin in April, but May is more typical for beginning construction due to the constraints associated with spring high water. At the other end of the spectrum, late November is the end of the construction season due to winter freeze-up.

All of the Spring Lake project features are located within the Upper Mississippi River National Wildlife and Fish Refuge. As such, the U.S. Fish and Wildlife Service have indicated that construction will not be allowed in these areas during the fall migration season (essentially October and November).

The construction schedule for the project will be dependent upon the funds available for construction and other factors such as the potential for meshing construction with District operation and maintenance activities or the need to accommodate other habitat measures such as pool drawdown. Based on current and expected UMRS-EMP budgets, and project priorities within the St. Paul District, it is most likely that construction for the Spring Lake Islands project will begin in 2003.

Project construction is scheduled as one contract. **Table 8-4** shows a projected construction schedule for the project. The schedule assumes the availability of approximately $1,600,000 million/year in FY 04 and the remaining $500,000 in FY 05 for construction. Given the relatively short construction window (5 months) in any given year, the availability of additional funds would probably not appreciably accelerate the schedule.

Table 8-4
Construction Schedule
Spring Lake Island Project

May-Sep 2004	Initiate construction of islands - complete island construction, fine material placement and rock work
Oct-Nov 2004	No Work – Fall migration
Dec-Apr 2004/2005	No Work – Winter shutdown
May-Jun 2005	Complete construction – seeding and tree plantings

Environmental Assessment

9

ENVIRONMENTAL ASSESSMENT

An environmental assessment has been conducted for the proposed actions, and a discussion of the impacts follows. As specified by Section 122 of the 1970 Rivers and Harbors Act, the categories of impacts listed in table EA-1 were reviewed and considered in arriving at the final determination. In accordance with Corps of Engineers regulations (33 CFR 323.4(a)(2)), a Section 404(b)(1) evaluation has been prepared and is included in Attachment 3 of this DPR supplement. A Finding of No Significant Impact has been signed and is attached at the end of the report.

This environmental assessment discusses the effects of the following actions recommended for implementation:

1. Construct rock features to protect existing terrestrial and aquatic habitat in upper Spring Lake. The only alternative to these options evaluated was the “no action” alternative, which was not selected because it does not meet the project goals and objects.

2. Construct four island features in Spring Lake to protect/enhance wetland and aquatic habitat. Many alternatives were analyzed during the planning phase of this project. The chosen alternative provided the most benefits at an acceptable cost.

3. Construct four mud flats/shallow-water habitats to increase habitat diversity and provide suitable locations for dredged material placement. The “no action” alternative was not selected because it does not meet the project goals and objectives.

4. Dredge within Spring Lake to provide material for island construction and to allow construction equipment access to the project features.

9.1 APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

This assessment was prepared and the proposed work designed to comply with all applicable environmental laws and regulations, including the following: National Environmental Policy Act of 1969; Executive Order 11514, Protection and Enhancement of Environmental Quality (as amended in Executive Order 11991); Executive Order 11593, Protection and Enhancement of the Cultural Environment; Executive Order 11990, Protection of Wetlands; Clean Air Act of 1977; Clean Water Act of 1977; Endangered Species Act of 1973; Fish and Wildlife Coordination Act; National Historic Preservation Act; 40 CFR 1500-1508, Council on Environmental Quality, Regulations for Implementing Procedural Provisions of the National Environmental Policy Act of 1969.

Table EA-1. Environmental Assessment Matrix for the Spring Lake Islands Habitat Rehabilitation and Enhancement Project.

Section 122 of the River and Harbor and Flood Control Act of 1970 (Public Law 91-611)

	MAGNITUDE OF PROBABLE EFFECTS						
	BENEFICIAL				ADVERSE		
PARAMETER	SIGNIFICANT	SUBSTANTIAL	MINOR	NO EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT
A. SOCIAL EFFECTS							
1. Noise Levels					X		
2. Aesthetic Values			X				
3. Recreational Opportunities			X				
4. Transportation				X			
5. Public Health and Safety				X			
6. Community Cohesion (Sense of Unity)				X			
7. Community Growth and Development				X			
8. Business and Home Relocations				X			
9. Existing/Potential Land Use				X			
10. Controversy				X			
B. ECONOMIC EFFECTS							
1. Property Values				X			
2. Tax Revenue				X			
3. Public Facilities and Services				X			
4. Regional Growth				X			
5. Employment				X			
6. Business Activity			X				
7. Farmland/Food Supply				X			
8. Commercial Navigation				X			
9. Flooding Effects				X			
10. Energy Needs and Resources				X			
C. NATURAL RESOURCE EFFECTS							
1. Air Quality					X		
2. Terrestrial Habitat		X					
3. Wetlands			X				
4. Aquatic Habitat		X					
5. Habitat Diversity and Interspersion		X					
6. Biological Productivity		X					
7. Surface Water Quality			X				
8. Water Supply				X			
9. Groundwater				X			
10. Soils				X			
11. Threatened or Endangered Species				X			
D. CULTURAL RESOURCE EFFECTS							
1. Historic Architectural Values				X			
2. Prehistoric and Historic Archeological Values				X			

9.2 SOCIAL AND ECONOMIC EFFECTS

9.2.1 NOISE

During project construction, there would be noise generated by construction equipment. The noise generated in the project area could bother nearby residents.

9.2.2 AESTHETICS

The completed project would improve the aesthetics of the project area. The project features and the resulting aquatic vegetation would return the project area to a desirable condition similar to that found there in the past. However, rock features would generally be considered aesthetically displeasing.

9.2.3 RECREATION

Recreation in the project area would likely be negatively affected during construction. However, after completion, the project would likely have a positive effect on recreation. Improving overwintering habitat for backwater fish would increase ice-fishing opportunities. Improved vegetative conditions would likely attract migratory bird species that would provide recreational opportunities for viewing and hunting.

9.2.4 BUSINESS ACTIVITIES

The proposed project may increase the recreational use of Spring Lake, which would likely provide minor benefits to local businesses.

9.3 NATURAL RESOURCE EFFECTS

The significant natural resources of the project area are also described in the Existing Resources section of this DPR supplement.

9.3.1 AIR QUALITY

Emissions from construction equipment would have a minor negative impact on air quality in the project area during project construction.

9.3.2 TERRESTRIAL HABITAT

The proposed project would have a substantial positive effect on terrestrial habitat in Spring Lake. Constructing islands in Spring Lake would create about 27 acres of new terrestrial habitat, habitat that has been declining since the construction of lock and dam 5. Also, existing terrestrial habitat (the lower peninsula and small islands) would be protected from future erosion by the proposed rock features.

9.3.3 WETLAND HABITAT

The proposed project would have a minor positive effect on wetland habitat in Spring Lake. The construction of mud flats would create from 15 to 20 acres of new shallow-wetland habitat, and the improvement of vegetative conditions in Spring Lake would improve the existing wetland habitat in the project area.

9.3.4 AQUATIC HABITAT

The footprint of the proposed island, rock, and mud flat features would negatively affect about 52 acres of aquatic habitat. Aquatic habitat in these areas would be disturbed and converted to terrestrial habitat or made shallower.

The overall project would have a substantial positive effect on the aquatic habitat of Spring Lake. Island features would provide protection from wind; thereby decreasing sediment resuspension, increasing photic depth, increasing aquatic plant growth, and preventing uprooting. The proposed island features would also create areas of lower water velocity and decreased water exchange. This would provide better overwintering habitat in Spring Lake for backwater fish species by decreasing velocities and increasing water temperature. However, decreased water exchange in far upper Spring Lake could lead to dissolved oxygen depletion there during summer. This would be unlikely and would occur only if an unfavorable combination of factors coincided.

Dredging to provide borrow material and equipment access for construction of the proposed islands would disturb about 18 acres of aquatic habitat in Spring Lake. However, this disruption would be temporary, and the increased depths would improve aquatic habitat in Spring Lake for backwater species.

9.3.5 HABITAT DIVERSITY AND INTERSPERSION

Since the construction of lock and dam 5, the habitat in Spring Lake has become less diverse for a number of reasons: islands have eroded, deeper water has filled in, aquatic vegetation has declined, and flow characteristics have become more uniform. The proposed project would have a substantial positive effect on habitat diversity and interspersion in Spring Lake. Island construction would increase plan form, flow pattern, and aquatic vegetation diversity in Spring Lake. The proposed rock structures would provide a unique substrate in the project area and would therefore increase substrate diversity. Proposed dredging activities would increase depths in some areas and would therefore increase bathymetric diversity in the project area.

9.3.6 BIOLOGICAL PRODUCTIVITY

The proposed project would have a substantial positive effect on biological productivity in Spring Lake. Biological productivity would be most noticeably increased as more abundant aquatic vegetation in Spring Lake. This could lead to greater invertebrate production in Spring

Lake. This, coupled with other habitat improvements in the project area, could also lead to greater vertebrate productivity.

9.3.7 SURFACE WATER QUALITY

Detailed project effects on water quality can be found in the attached Section 404(b)(1) evaluation (Attachment 3). During construction, there would be a minor negative effect on water quality in the project area. Dredging activities and the placement of fill to construct the proposed features would result in localized increases in suspended sediment and turbidity. The coarseness of the material used to construct the island bases would reduce the amount of resuspension of this material. Also, the release of contaminants contained in this material would be minimal because of the low contaminant levels in sediment samples collected within Spring Lake. The increase in aquatic vegetation following completion of the project could lead to an increase in denitrifaction of surface water. However, the project would also reduce water exchange in Spring Lake which could lead to a decrease in denitrification. Because of these and other complications of the nitrogen cycle, it is difficult to predict whether or not the proposed project would have a measurable effect on the nitrogen budget of the project area. If there is a measurable effect, it would likely be minor.

9.3.8 AQUATIC AND TERRESTRIAL ORGANISMS

The placement of rock and sand to construct the channel features would cover substrate and the associated benthic organisms.

Increased activity and noise would disturb fish and wildlife in the immediate project area during construction. However, this disruption would be temporary, and no permanent effects would likely occur.

9.3.9 THREATENED AND ENDANGERED SPECIES

Two federally protected species have historically been known to inhabit the general project area: the bald eagle (*Haliaetus leucocephalus*) and the Higgins' eye pearlymussel (*Lampsilis higginsii*). In 2000 and 2001, the Corps of Engineers conducted mussel surveys in and near the proposed project area (see attached mussel survey report). No Higgins' eye pearlymussels were collected during these efforts. Furthermore, *Lampsilis higginsii* has not been collected in pool 5 in recent years. Therefore, it is unlikely that the proposed project would affect this species. There are currently no active bald eagle nests in the general project vicinity, and use of the area by bald eagles for feeding and perching is not significant. Therefore, it is unlikely that the proposed project would affect this species. It is the St. Paul District's determination that there would be no project related impacts to the Higgins' eye pearly mussel or the bald eagle. Concurrence by the U.S. Fish and Wildlife Service would be obtained prior to project construction.

Four State-listed mussel species were collected in or near the project area during sampling in 2000 and 2001. One round pigtoe mussel (*Pleurobema coccineum*), listed as threatened in Minnesota, was collected within the project area. Six additional round pigtoe mussels were collected outside, but near the project area. Other State-listed species collected near but outside the project area were: one black sandshell mussel (*Ligumia recta*), listed as special concern in Minnesota; two hickorynut mussels (*Obovaria olivaria*), listed as special concern in Minnesota; and three monkeyface mussels (*Quadrula metanevra*), listed as threatened in Minnesota and Wisconsin. Because only one individual of a State-listed species was collected within the project area, it is unlikely that the proposed project would have a significant effect on any State-listed or non-listed mussel species.

9.4 CULTURAL RESOURCE EFFECTS

Interest in the archaeological record of the Upper Mississippi River valley, including the area around Spring Lake in pool 5, has been ongoing since the middle of the nineteenth century (e.g., Lapham 1855). By the later part of the twentieth century, several cultural resource investigations had been conducted within and around the proposed project area. Most of these investigations were on terraces and upland landforms. Nine precontact and 11 historic sites have been identified within 1 mile of the proposed project area (e.g., Penman 1981; Rusch and Penman 1982). As of 1990, there were no cultural resources determined eligible or listed on the National Register of Historic Places. Two cultural resource surveys have been conducted along the floodplain of pool 5 (Johnson and Hudak 1975; Pleger 1997). The pool 5 surveys mainly consisted of visual inspection of shorelines. No cultural resources have been identified within the limits of the Spring Lake Habitat Rehabilitation and Enhancement Project (HREP) area, and none of the previously identified sites will be affected by the proposed project.

A Phase I cultural resources survey was conducted in 1990 across land areas designated to be affected by the dike and closure structures according to plans proposed in the Definite Project Report/Environmental Assessment (SP-12) issued in August 1991 (Withrow 1990). The Phase I survey consisted of a literature review and subsurface testing. No cultural resources were identified.

Only a portion of the current Spring Lake HREP was examined in the 1990 cultural resource survey. Areas previously surveyed include the boat landing area at the far northern end of Spring Lake, the existing portion of the original peninsula upstream from sill 1, and the two existing islands proposed for protection by rock mounds 2 and 3 (Plate 10). The current Spring Lake HREP proposes to place island protection (rock mounds 1 and 4) along two island complexes that will require a cultural resource survey.

In September 2002, the Corps conducted a cultural resource reconnaissance survey across the Spring Lake HREP land areas not investigated during the 1990 survey. No cultural resources were detected from a surface survey. Results from informal soil cores indicate that the soil profiles on the islands adjacent to proposed Rock Mound 1 and Rock Mound 4 are similar to the solums identified on Islands A and B during the 1990 cultural resource survey (Withrow 1990:6) (Plate 7.1). No buried soil horizons were detected and no cultural resources were identified.

The results of the 2002 investigations were detailed in a letter to the Wisconsin State Historic Preservation Office (SHPO) with a recommendation that no historic properties will be affected by the project. However, the SHPO did not concur with the Corps findings. Specifically, the SHPO is concerned that submerged resources (e.g., shipwrecks) or inundated archaeological sites may be impacted by the project. The SHPO recommended that soil coring take place to determine if submerged in situ archaeological features will be impacted.

Most of the Spring Lake HREP project area is situated over areas that, prior to inundation from construction of Lock and Dam 5 during the late 1930s, consisted of floodplain, back channels and wetlands, it is unlikely that submerged resources in the form of shipwrecks exist in the project area. Further, a literature review indicates that no shipwrecks are identified in the project area. As there is a potential for archaeological sites, now inundated, to exist within the project area, a soil coring program was conducted in the spring of 2003.

The 2003 soil coring program focused on identifying cultural resources, now inundated, that may exist along the footprint of a proposed access channel in the southern portion of Spring Lake and the Project. A total of eight (8) bore holes were drilled and the soils examined for cultural resources. No cultural resources were identified. Results of the boring program suggest that, overall, this portion of Spring Lake has been infilling with between 1.5 to 4 feet of sediments deposited since the installation of Lock and Dam 5 in 1935. Because of the depths of these recent deposits, it is believed it that most of the areas that will be excavated for the access channel will be confined to the recently deposited sediments or will penetrate into areas that may be experiencing erosion. Thus, it is unlikely that cultural resources will be impacted by access channel construction.

9.5 SUMMARY AND CUMULATIVE IMPACTS DISCUSSION

A number of factors will affect the future environment of the Upper Mississippi River (UMR). Some of those factors include the continued operation and maintenance of the navigation system, hydrologic and hydraulic processes in an altered environment, commercial traffic, public use, point and nonpoint source pollution, commercial and residential development, agricultural practices and watershed management, habitat restoration projects, and exotic species. The proposed project would likely have some minor beneficial cumulative effects on the UMR. In conjunction with other habitat restoration and island reconstruction projects, the UMR would likely experience an increase in habitat and aquatic vegetation diversity. Also, while there would likely be a negligible effect on the nitrogen budget within Spring Lake, the cumulative effect of the proposed project with other similar projects on the UMR could be a decrease in the export of nitrate to the Gulf of Mexico. This could lead to a reduction in the extent of the hypoxic zone. However, the majority of the nitrogen load to the UMR is derived from upland anthropogenic sources and the river itself primarily acts as a conduit for nitrogen, having a minor demnitrification effect on water released to the Gulf of Mexico.

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Summary of Plan Accomplishments

10

SUMMARY OF PLAN ACCOMPLISHMENTS

The selected plan will substantially improve habitat conditions over the entire Spring Lake area. The habitat improvements, while focusing on improving conditions for backwater fish species with an emphasis on overwintering habitat for centrarchids and wildlife habitat improvements for waterfowl within a critical component of the Upper Mississippi River National Wildlife and Fish Refuge, will also improve habitat for a variety of other fish and wildlife such as shorebirds, wading birds, aquatic mammals, terrestrial wildlife, turtles, lacustrine and lotic fish, and mussels.

The project would protect the existing small islands and natural peninsula while creating 32 acres of new islands, more than doubling the amount of existing island acreage.

The islands recommended for construction will protect about 500 acres of shallow aquatic habitat from large wind fetches, improving conditions for the growth of aquatic vegetation. Additional areas of deeper water will also be within the areas protected by the islands.

Habitat quality in the project area for migratory waterfowl is projected to improve. Substantial habitat benefits to shorebirds and wading birds are expected to accrue due to the creation of about 40,000 linear feet of sandy shoreline and four mudflats totaling about 11 acres. The sand berms of the islands will also provide a substantial amount of area available for turtle nesting.

The 32 acres of islands created will provide habitat for terrestrial and semi-aquatic species of wildlife. This type of habitat is nearly non-existent in the areas where the islands would be constructed.

The islands will help maintain about 2,000 linear feet of submerged channel, which will contribute to aquatic habitat diversity in this area, primarily for riverine fish species and mussels. Islands IL1 and IL 2 will create two protected deepwater areas about 20 acres in size, that would provide overwintering habitat for Centrarchids and other backwater fish species. This type of habitat is of critical importance in the project area where overwintering habitat is almost non-existent due to the loss of islands.

The project would contribute significantly to the cumulative long-term habitat restoration goals for lower pool 5 by supplementing the habitat gains already realized by the Spring Lake Peninsula (breach closure) project. When combined, these two phases will improve habitat over about a 500-acre portion of lower pool 5.

Plates 13 and 14 show the Pool 8 Islands Phase II habitat project. They illustrate the types of habitat changes/results that are expected with the Spring Lake Islands project. The 1961 photo shows habitat conditions in the Phase II project area in 1961. This is the general habitat condition the project was designed to achieve. The 1994 photo shows the Phase II project area prior to construction of the project. The 2000 photo shows the Phase II project area after completion of the project in 1999.

The Habitat Needs Assessment, Appendix Z (U.S. Army Corps of Engineers, 2000) identified pool 5 as having approximately 1,268 acres of contiguous floodplain shallow aquatic area that would be considered of acceptable quality. The desired future habitat condition for the year 2050 is to have 1,811 acres of acceptable quality habitat of these types in pool 5. The 500 acres of habitat improved by the Pool 5 project will contribute toward meeting this long-term goal.

Table 10-1 summarizes how the recommended project meets the planning goals and objectives established at the beginning of the study.

TABLE 10-1
Meeting Project Goals and Objectives

Goal	Project Objective	Met/Not Met	Discussion
Goal A - Improve lacustrine habitat for backwater fish species in Spring Lake.	A-1: Create overwintering habitat for centrarchids in three discrete areas with a minimum size of 20 acres each; D.O. $\geq$ 5 mg/l; current velocity < 0.3 cm/sec over 80% of the area; suitable water temperatures; and depths > 4 ft over 40% of area, >7 ft over 15% of the area protected from dominant wind fetches.	Partially Met	Overwintering habitat in excess of 30 acres in size created in two locations.
	A-2: Create summer habitat for centrarchids in three discrete areas with a minimum size of 20 acres each; D.O. $\geq$ 5 mg/l; depths > 4 ft over 40% of area, >7 ft over 15%; connected to adjacent flowing water habitats aquatic vegetation cover in the range of 20-50%.	Met	The island restoration project is expected to substantially improve growing conditions for aquatic vegetation. Dissolved oxygen levels are expecte to be > 5 mg/l.
	A-3: Create three discrete areas with a minimum size of 5 acres each in size that support spawning, rearing and juvenile backwater fish species; D.O. $\geq$ 5 mg/l; current velocity < 0.5 cm/sec; aquatic vegetation cover in the range of 20-50%; substrates of sand and/or gravel.	Met	The island shorelines, underwater slopes and protected areas will create substantial areas with conditions favored by spawning Centrarchids and preferred habitat for juvenile fish of a variety of species.
Goal B - Restore puddle duck habitat in Spring Lake	B-1: Provide conditions important for the growth of emergent vegetation with water depths less than 2 feet, protected from dominant wind fetches, and with current velocities less than 0.5 feet per second.	Met	32 acres of islands restored in a manner to improve growth conditions.
	B-2: Provide conditions important for the growth of submersed vegetation with water depths less than 4 feet, protected from dominant wind fetches.	Met	32 acres of islands restored in a manner to improve growth conditions.
	B-3: Restore islands to meet puddle duck habitat	Met	32 acres of islands restored in a manner to improve puddle duck habitat needs.
	B-4: Provide 11 acres of sand/mudflats.	Met	11 acres provided.
	B-5: Provide waterfowl loafing sites (10-20 per acres).	Met	40,000+ linear feet of island shoreline created that will be availble for waterfowl loafing.
Goal C: Create habitat for migratory birds, turtle nesting, mammals, reptiles, amphibians, and raptors.	C-1: Provide a diversity of habitat conditions suitable for a wide variety of species.	Met	Restoration of 32 acres of islands in the manner proposed should result in substanial improvements in habitat diversity and habitat quality for a wide variety of wildlife species.
Goal D: Enhance habitat for riverine fish species and mussels.	O-3: Enhance habitat by creating flowing channel bordered by islands at least 2,000 feet; provide areas of scour and eddies; a variety of substrates; and connectivevity with other channels.	Met	The project will create 40,000 linear feet of islands. A substantial portion of these islands border flowing channel or are configured in a manner to stimulate the formation of flowing channels.

Operations and Maintenance

11

OPERATION AND MAINTENANCE

11.1 GENERAL

Upon completion of construction, the U.S. Fish and Wildlife Service would accept responsibility for the project in accordance with Section 107(b) of the Water Resources Development Act of 1992. The operation and maintenance responsibilities of the U.S. Fish and Wildlife Service are addressed in the Memorandum of Agreement for the project (attachment 7).

Specific operation and maintenance requirements would be defined in project operation and maintenance (O&M) manuals, which would be prepared by the Corps of Engineers, and coordinated with the U.S. Fish and Wildlife Service.

11.2 OPERATION

There are no specific operational requirements associated with any of the project features that would be the responsibility of the U.S. Fish and Wildlife Service. The Service would be required to conduct periodic inspections of their portions of the project and submit reports of inspection activities and maintenance performed.

11.3 MAINTENANCE

The U.S. Fish and Wildlife Service will perform maintenance on the project as necessary for it to remain functional. The estimated average annual operation and maintenance costs for the U.S. Fish and Wildlife Service maintained portion of the project are shown in Table 11-1. The average annual costs are shown in May 2002 price levels.

Table 11-1
Average Annual Operation and Maintenance Costs - U.S. Fish and Wildlife Service

Feature	O&M Cycle	Average Annual Cost
a. Rock replacement	10-yr	$ 1,809
b. Period inspections	5-yr	$ 5,116
c. Annual inspections	1-yr	$ 2,500
Average annual amount		$ 9,425

Not all project features will require maintenance. Table 11-2 categorizes project features as to the expected level of maintenance. Critical features are those that must be maintained for structural integrity or for the feature to provide the majority of the habitat benefits for which it was designed. Non-critical features are those where minor change is acceptable and the need for maintenance will be considered on a case-by-case basis. Dynamic features are those where river forces will be allowed to shape the features with no future maintenance anticipated.

Table 11-2
Maintenance Categorization of Project Features

<u>Critical – Must Be Maintained or Repaired</u>

Rock sill tie-in points with islands
Rock end protection
Rock groin or vane tie-in points with islands
Major damage to rock sills

<u>Non-Critical – Maintained or Repaired if Determined Necessary</u>

Individual rock groins or vanes
Island shorelines
Minor damage to rock sills

<u>Dynamic – No Maintenance</u>

Mudflats
Sand tips on islands
Borrow sites
Access channels

Project Performance Evaluation

12

PROJECT PERFORMANCE EVALUATION

Project performance evaluation was designed to directly measure the degree of attainment of the project objectives. Table 12-1 summarizes the overall monitoring approach used for UMRS-EMP habitat projects. Table 12-2 summarizes the specific monitoring that would be conducted for the recommended features of the Spring Lake Islands project.

TABLE 12-1
UMRS-EMP Monitoring and Performance Evaluation Matrix

Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Remarks
Problem Analysis	System-wide problem definiti Evaluate planning assumptions.	USGS	USGS (UMESC)	LTRM	Lead into pre-project monitoring; define desired conditions for plan formulation.
Pre-project Monitoring	Identify and define problems at specific sites.	Sponsor	Sponsor	Sponsor	Should attempt to begin defining baseline.
Baseline Monitoring	Establish baselines for performance evaluation.	Corps	Field stations or sponsors thru Cooperative Agreements, or Corps.*	HREP	Should be over several years to reconcile perturbations.
Data Collection for Design	1. Identify project objectives. 2. Design of project. 3. Develop Performance Evaluation Plan.	Corps	Corps	HREP	After fact sheet. Data may aid in defining baseline.
Construction Monitoring	Assure permit conditions met.	Corps	Corps	HREP	
Performance Evaluation Monitoring	Determine success of projects	Corps	Field stations or sponsors thru Cooperative Agreements, sponsor thru O&M**, or Corps.*	HREP	After construction.
Analysis of Biological Responses to Projects	1. Determine critical impact levels, cause-effect relationships, and long-term losses of significant habitat. 2. Demonstrate success or response of biota.	USGS Corps	USGS (UMESC) Corps/USGS (UMESC)/Others	LTRM HREP	Biological Response Study tasks beyond scope of Performance Evaluation, Problem Analysis, and Trend Analysis.

*Choice depends on logistics. When done by the States under a Cooperative Agreement, the role of the EMTC will be to: (1) advise and assist in assuring QA/QC consistency, (2) review and comment on reasonableness of cost estimates, and (3) be the financial manager. If a private firm or State is funded by contract, coordination with the EMTC is required to assure QA/QC consistency.

**Some limited reporting of information for some projects (e.g., waterfowl management areas) could be furnished by on-site personnel as part of O&M.

TABLE 12-2
POST-CONSTRUCTION MONITORING- SPRING LAKE ISLANDS

Goal	Project Objective	Enhancement Feature	Unit of Measure	Measurement Plan	Monitoring Interval	Projected Cost/Effort
Goal A - Improve and maintain lacustrine habitat for backwater fish species.	A-1: Create overwintering habitat for Centrachids in three duscrete locations with a size of 20 acres; D.O. ≥ 5 mg/l: current velocity < 0.3 cm/sec; suitable water temperatures; depths > 4 ft over 40% of area and connected to flowing habitats.	Deep protected areas.	Acres, dissolved oxygen levels (mg/l), current velocities (cm/sec), water temperatures (degrees C), and depths (feet).	Dissolved oxygen, current velocity, water temperature, and depth during the winter.	Water depths would be monitored periodically as part of the LTRMP key pool monitoring program. The other parameters would be monitored 2, 5, 10, 20, 30, 40, and 50 years post-construction.	$4,000
	A-2: Create summer habitat for centrarchids in three discrete areas with a minimum size of 20 acres each; D.O. > 5 mg/l; depths > 4 ft over 40% of area, >7 ft over 15%; connected to adjacent flowing water habitats aquatic vegetation cover in the range of 20-50%.	Islands	Dissoved oxygen (mg/l), aquatic vegetation.	Dissoved oxygen (mg/l), aquatic vegetation.	5 year intervals post-construction.	Vegetation covered in the costs for B-1. Dissolved oxygen - $2,000
	A-3: Create three discrete areas with a minimum size of 5 acres each in size that support spawning, rearing and juvenile backwater fish species; D.O. > 5 mg/l; current velocity < 0.5 cm/sec; aquatic vegetation cover in the range of 20-50%; substrates of sand and/or gravel.	Islands	Dissoved oxygen (mg/l), aquatic vegetation.	Dissoved oxygen (mg/l), aquatic vegetation.	5 year intervals post-construction.	Covered in the costs for B-1.
Goal B - Restore puddle duck habitat in Spring Lake.	B-1: Provide conditions important for the growth of emergent vegetation with water depths less than 2 feet, protected from dominant wind fetches, and with current velocities less than 0.5 feet per second.	Islands	Emergent vegetation % cover and species; current velocities (ft/sec)	Emergent vegetation, and current velocities.	Emergent vegetation would be monitored at 5 year intervals. Current velocities would be measured 1 year post-construction.	$10,000

TABLE 12-2 Cont'd
POST-CONSTRUCTION MONITORING

Goal	Project Objective	Enhancement Feature	Unit of Measure	Measurement Plan	Monitoring Interval	Projected Cost/Effort
	B-2: Provide conditions important for the growth of submersed aquatic vegetation with water depths less than 4 feet and protected from dominant wind fetches.	Islands	Submersed vegetation % cover and species	Submersed vegetation % cover and species	Submersed vegetation would be monitored at 5 year intervals.	Covered in the cost for B-1.
	B-3: Restore islands to meet dabbling duck habitat needs.	Islands	Acres	Island area (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for B-1
	B-4: Provide 11 acres of sand/mudflats.	Mudflats.	Acres	Mudflat area (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for B-1
	B-5: Provide waterfowl loafing sites (10-20 per acres).	Mudflats and stumps.	Number	Presence or absence of features (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for B-1.
Goal C - Create habitat for migratory birds, turtle nesting, mammals, reptiles, amphibians, and raptors.	C-1: Create a diversity of habitat conditions suitable for a wide variety of species.	Islands	Islands (ac), beaches (lf), mudflats (ac).	Visual and aerial photos.	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for B-1.
Goal D - Enhance habitat for riverine fish species and mussels.	D-1: Enhance habitat by creating flowing channel at least 2,000 feet; provide areas of scour and eddies; a variety of substrates; and connectivitywith other channels	Islands	Acres	Island area (visual and aerial photos).	1, 5, 10, 20, 30, 40, and 50 years post-construction.	Covered in the cost for B-1.

* While the island complexes were designed to contribute to these desired habitat conditions as much as possible, no independent features are proposed for these objectives.

Cost Estimate

13

COST ESTIMATE

The total project cost for the selected plan is estimated to be $3,298,900 as summarized in Table 13-1. This cost does not include prior allocations of $200,000 for general design (planning). A detailed cost estimate is contained in Attachment 2. The fully funded cost of the project for budgeting purposes is estimated to be $3,403,000.

Table 13-1
Summary of the Selected Plan and Costs*

Mobilization	$ 295,100
Rock Sill 1	17,700
Rock Mound 1	84,800
Rock Mound 2	43,300
Rock Mound 3	41,600
Rock Mound 4	174,200
Island IL 1b	173,300
Island IL 2	560,900
Island IL 3	879,300
Island IL 4	468,600
Construction Subtotal	$ 2,738,800
Planning, Engineering, and Design	$ 396,500
Construction Management	$ 163,600
Total Cost	$ 3,298,900

*May 2002 price levels

Real Estate Requirements

14

REAL ESTATE REQUIREMENTS

This Environmental Management Program project is located in lower pool 5 of the Upper Mississippi River in Buffalo County, Wisconsin. This direct Federal project will be constructed entirely on lands owned by the United States of America. Additionally, the navigational servitude applies to any work performed within the river. The project is located on lands are administered by the U.S. Fish and Wildlife Service and are managed by the Service as part of the Upper Mississippi River National Wildlife and Fish Refuge. No additional interest in any lands will be necessary to complete this project.

Schedule for Design and Construction

15

SCHEDULE FOR DESIGN AND CONSTRUCTION

A schedule for review and approval, major work tasks, and project construction is shown below. This schedule assumes the availability of funds to prepare plans and specifications and undertake construction will not be limiting.

Requirement	Scheduled Date
Submit final Definite Project Report to Mississippi Valley Division (MVD), U.S. Army Corps of Engineers	May 2003
MVD approves project for construction*	Sep 2003
Complete plans and specifications	Dec 2003
Advertise for bids	Jan 2004
Award initial construction contract	Mar 2004
Complete construction	Jul 2005

Implementation Responsibilities

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IMPLEMENTATION RESPONSIBILITIES

The responsibility of plan implementation and construction fall to the Corps of Engineers as the lead Federal agency. After construction of the project, project operation and maintenance would be required for features of the project as outlined in the OPERATION AND MAINTENANCE section of this report. The U.S. Fish and Wildlife Service would be responsible for operation and maintenance of the project upon completion.

Should rehabilitation of those portions of the Spring Lake Islands project located on the Refuge be needed which exceeds the annual maintenance requirements (as a result of a specific storm or flood), a mutual decision between the participating agencies will be made whether or not to rehabilitate those portions of the project. Under conditions of Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, all construction costs of those fish and wildlife features for the Spring Lake Islands project are 100 percent Federal, and pursuant to Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580, all costs of operation and maintenance for the Spring Lake Islands project are 100 percent Federal.

Performance evaluation, which includes monitoring of physical/chemical conditions and some limited biological parameters, would be a Corps of Engineers responsibility.

Attachment 7 contains a draft of the formal agreement that would be entered into by the Corps of Engineers and the U.S. Fish and Wildlife Service. The Memorandum of Agreement formally establishes the relationships between the Department of the Army, represented by the Corps of Engineers, and the U.S. Fish and Wildlife Service in constructing, operating, and maintaining the project.

Coordination, Public Views, And Comments

17

COORDINATION, PUBLIC VIEWS, AND COMMENTS

The planning for the Spring Lake Islands project has been an interagency effort involving the St. Paul District, the U.S. Fish and Wildlife Service, and the Minnesota and the Wisconsin Departments of Natural Resources. Interagency coordination meetings and site visits were held on a periodic basis throughout the study phase. In additions to the meetings, informal coordination took place on an as-needed basis to address specific problems, issues, and ideas.

Initial public meetings were held in Buffalo City, Wisconsin on the 25 February 2002, to inform the public of the study and solicit input concerning fish and wildlife habitat conditions and problems within the project area. Over 60 private citizens attended the meeting.

Public support for this project is very strong. Most of those in attendance remembered fishing this area in the 1950's with their father and grandfather and commented on how the fishing has declined (quantity of fish and fish species) in the last 50 years. Additional comments were related to impacts from the Weaver Bottoms Project (sediment in Spring Lake is not due to the construction of islands in Weaver Bottoms) and the proposed Pool 5 drawdown scheduled for 2005.

A second public meeting was held in Buffalo City, Wisconsin on the 23 April 2003, to present the results of the study and the preliminary recommended plan. 13 private citizens attended the meeting. Public support remains strong and many in the audience had hoped construction would start this year. Many were concerned with future budget priorities and did not want to see this project delayed any longer.

The original Definite Project Report/Environmental Assessment was completed for the Spring Lake Peninsula Project (breach closure) in August 1991, which addressed the existing conditions and habitat problems in the project area, identified habitat goals and objectives, and identified alternatives to be studied in detail that would address the habitat goals and objectives.

The draft Definite Project Report/Environmental Assessment was sent to Congressional interests; Federal, State and local agencies; special interest groups; interested citizens; and other as listed in attachment 8.

Conclusions

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CONCLUSIONS

The Spring Lake Islands habitat rehabilitation and enhancement project provides the opportunity to restore habitat for fish, migratory birds, and other forms of fish and wildlife indigenous to the Upper Mississippi River. The loss of islands, decline in aquatic vegetation, and changes in bathymetry has significantly reduced the value of the project area to fish and wildlife. Similar changes have occurred throughout the lower reaches of pool 5.

A number of measures are aimed at correcting existing habitat problems and improving habitat conditions. Construction of the proposed islands will substantially improve conditions for the growth of aquatic plants and improve overall habitat diversity in the project area.

The islands will improve conditions for migratory waterfowl by increasing food resources, improved migratory resting areas, and by creating areas that will provide thermal protection during severe weather conditions.

The islands and associated habitats would provide improved habitat conditions for a wide variety of wildlife ranging from shorebirds to mammals to neotropical songbirds. The islands are designed to maintain and enhance flowing channels within the lake-like portion of lower pool 5 which in turn will improve conditions for lotic fish species and mussels. Some of the islands are designed to protect deep-water habitats from currents such that they would provide suitable overwintering habitat for Centrarchids and other lentic fish species. The lack of overwintering habitat has been identified by natural resource agencies as an important limiting factor to overall fish habitat quality in lower pool 5.

The habitat benefits that would be gained by the Upper Mississippi River System from implementation of the project justify expenditure of public funds for preparation of plans and specifications and for construction.

Recommendation

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RECOMMENDATION

I have weighed the accomplishments to be obtained from the Spring Lake Islands project against its cost and have considered the alternatives, impacts, and scope of the proposed project. The total estimated cost of the project at current price levels is \$3,298,000 (including sunk general design costs of \$200,000). As the project is located on national wildlife refuge lands, project costs would be 100-percent Federal in accordance with Section 906 (e) of Public Law. In my judgement, the cost of the project is a justified expenditure of Federal funds. Therefore, I recommend that the Spring Lake Islands Project for habitat restoration and enhancement in pool 5 of the Upper Mississippi River be approved for construction.

Robert L. Ball
Colonel, Corps of Engineers
District Engineer

Environmental and Economic Analysis Branch
Planning, Programs and Project Management Division

FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act of 1969, the St. Paul District, Corps of Engineers, has assessed the environmental impacts of the following project.

SPRING LAKE ISLANDS
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 5, UPPER MISSISSIPPI RIVER
BUFFALO COUNTY, WISCONSIN

The proposed actions for this Habitat Rehabilitation and Enhancement Project are: construct rock features to protect existing terrestrial and aquatic habitat in upper Spring Lake; construct four island features in Spring Lake to protect/enhance wetland and aquatic habitat; construct four mud flat/shallow-water habitats to increase habitat diversity and provide suitable locations for dredged material placement; dredge within Spring Lake to provide material for island construction and to allow construction equipment access to the project features. The goals of these actions are to improve habitat conditions for backwater fish, waterfowl, shorebirds, and to a limited extent, other organisms such as riverine fish, mussels, and turtles.

This Finding of No Significant Impact is based on the following factors: the proposed project would have minor long-term beneficial impacts on the aquatic environment and fishery resources; short-term minor adverse impacts to the aquatic and terrestrial environment from construction activities; and minor beneficial impacts on the economic and social environment.

The environmental review process indicates that the proposed action does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an environmental impact statement will not be prepared.

13 August 2003
Date

Robert L. Ball
Colonel, Corps of Engineers
District Engineer

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Bishop Henry Whipple Federal Building
1 Federal Drive
Fort Snelling, MN 55111-4056

IN REPLY REFER TO:

FWS/NWRS-VSO

MAR 25 2004

Colonel Robert L. Ball
District Engineer
Saint Paul District, U.S. Army Corps of Engineers
Army Corps of Engineers Center
190 Fifth Street East
Saint Paul, Minnesota 55101-1638

Dear Colonel Ball:

Enclosed is the signed Finding of No Significant Impact for the Spring Lake Islands Habitat Rehabilitation and Enhancement Project. Our Finding is based on your Definite Project Report/Environmental Documentation (SP-25) dated August 2003.

Also enclosed is the signed Memorandum of Agreement for the operation and maintenance of the Rehabilitation and Enhancement Project. The U.S. Fish and Wildlife Service will take responsibility for operation and maintenance as contained in the Definite Project Report. As you requested, we are returning two signed copies.

Sincerely,

Charlie Wooley

Charles M. Wooley
Acting Regional Director

Enclosure: FONSI, MOA in duplicate

FINDING OF NO SIGNIFICANT IMPACT

For the reasons presented below and based on an evaluation of the information contained in the supporting references, I have determined that the Environmental Management Program project, Spring Lake Islands Habitat Rehabilitation and Enhancement Project construction and maintenance, is not a major Federal action that would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969. An Environmental Impact Statement will, accordingly, not be prepared.

Reasons

This project by the U.S. Army Corps of Engineers, authorized under the Water Resources Development Act, would be located on Corps fee-title land managed as part of the Upper Mississippi River National Fish and Wildlife Refuge by the U.S. Fish and Wildlife Service under terms of a cooperative agreement, and is to be maintained by the FWS under terms of a memorandum of agreement.

The project would restore and protect 500 acres of former backwater in Pool 5 that through erosion is becoming more riverine and less backwater habitat by protecting existing small barrier islands and peninsula with rock mounds, constructing four islands, and constructing a low rock sill to reduce flows, wind, and wave action in Spring Lake.

The project area is within the range of two federally listed endangered and threatened species. The Corps has determined "that there will be no project related impacts to the Higgins' eye pearly mussel or the bald eagle. Concurrence by the U.S. Fish and Wildlife Service would be obtained prior to project construction."

The Corps has taken several steps to identify historic properties within the area of potential effect: "No cultural resources were identified."

Supporting References

1. Definite Project Report and Integrated Environmental Assessment (SP-25)
2. Memorandum of Agreement

Charlie Wooley

ACTING ~~Regional~~ Director

3/12/04

Date

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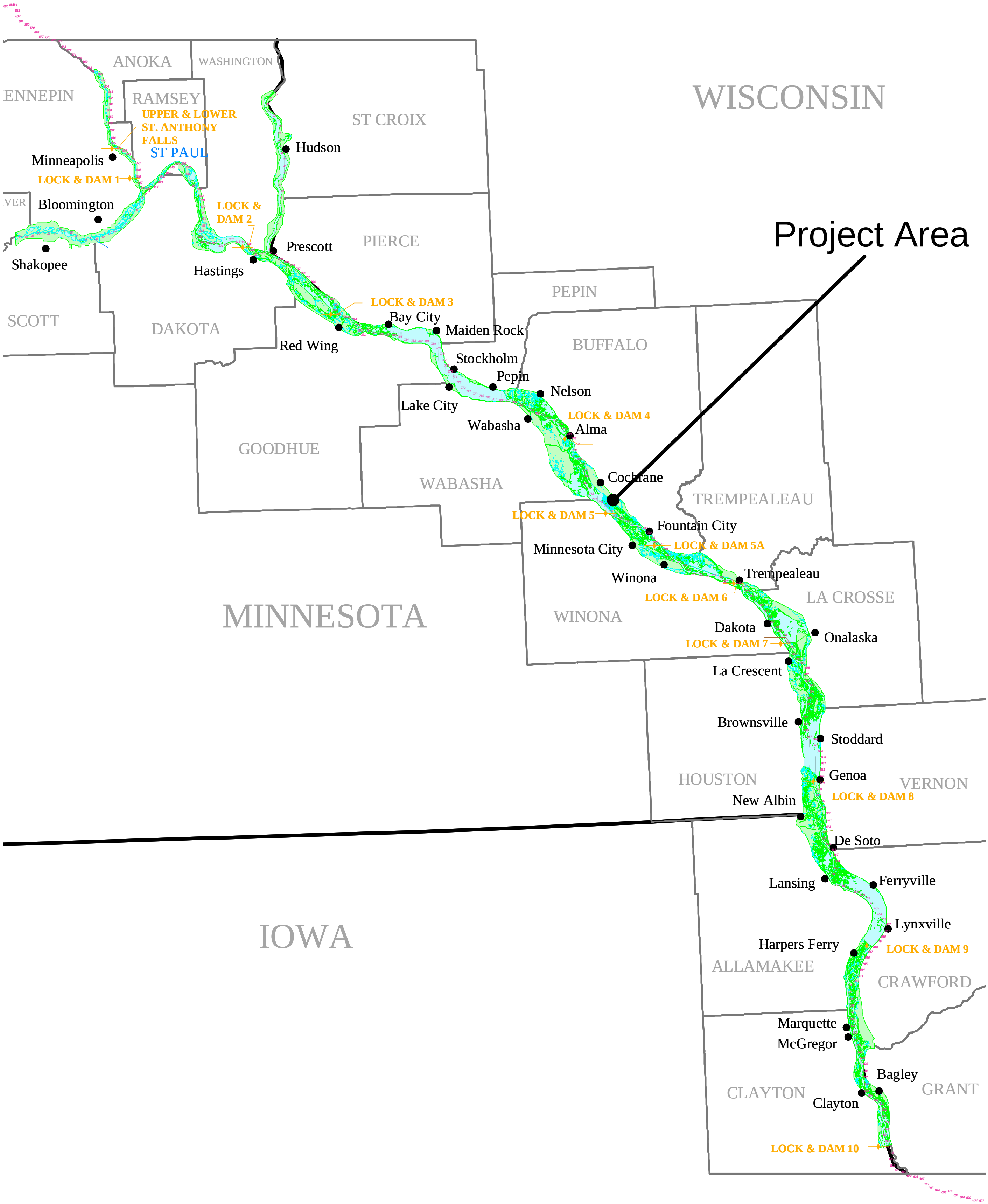
Plates

Attachment 1



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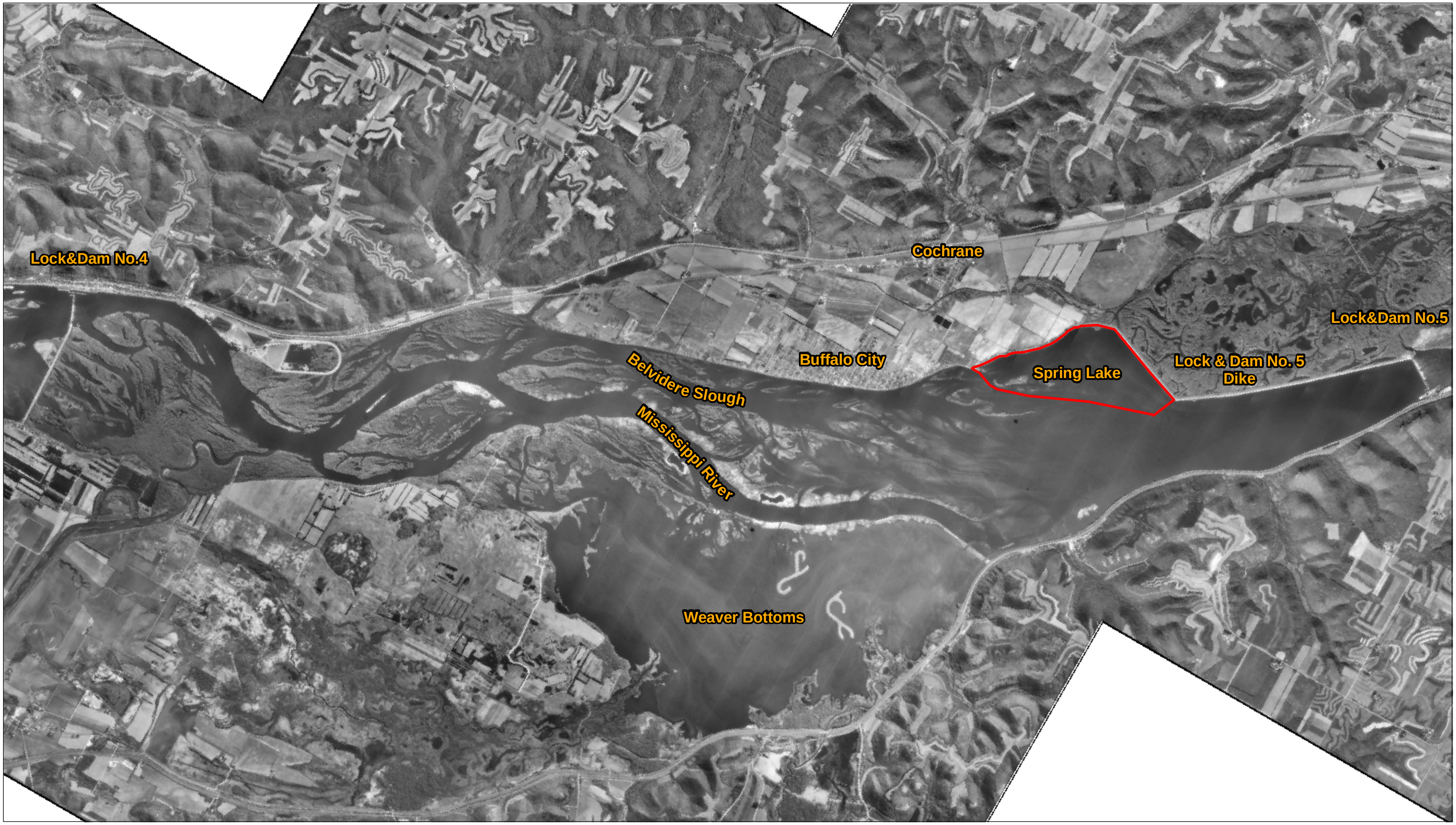
US Army Corps of Engineers

UPPER MISSISSIPPI RIVER SYSTEM

9 - Foot Navigation Channel Project Area

Plate 1

N



Mississippi River Pool 5

St. Paul District
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0 2,250 4,500 9,000 13,500 18,000
Feet

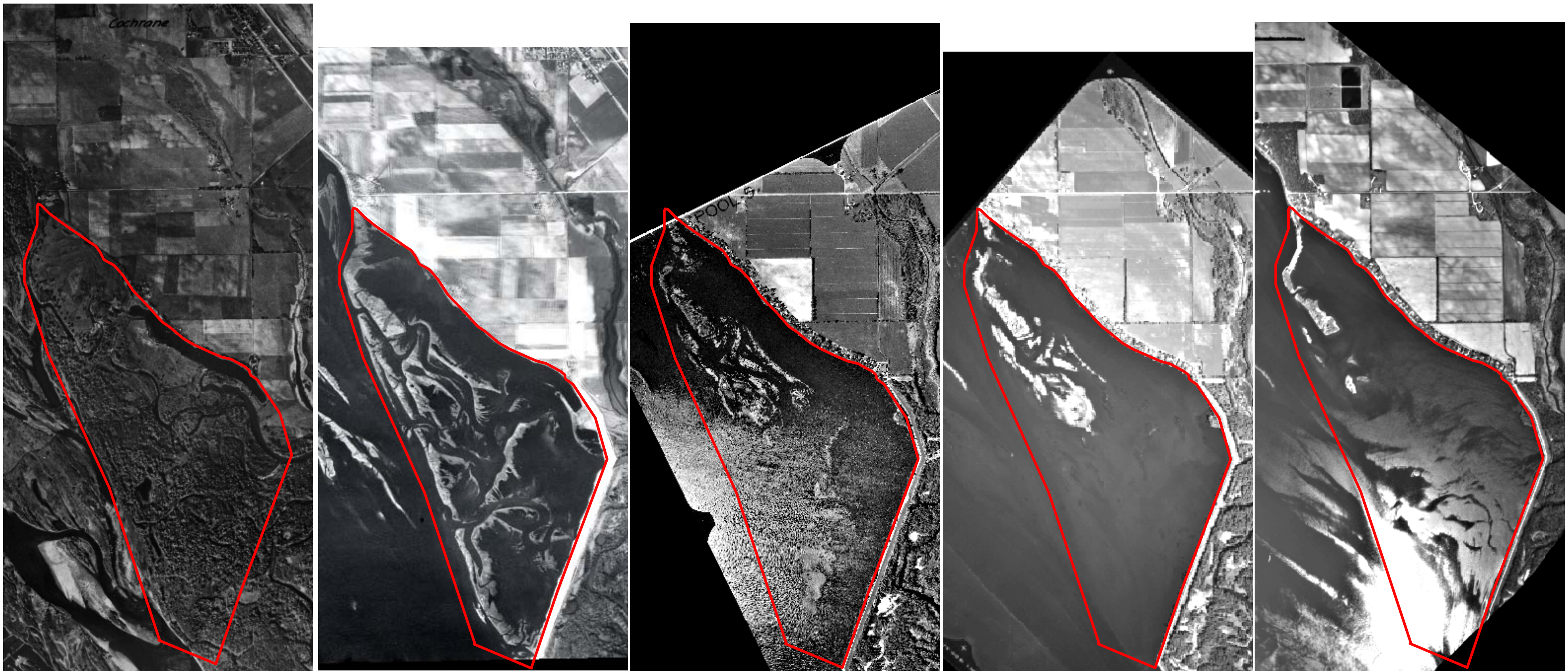
Spring Lake Islands Project Area

N

Plate 2

PME 62540 C:/BYRON/ARCMAP_PROJECTS/NOVAC_SPLK.MXD BGW 4/15

Plate 3



1930 1939 1989 1994 1998

Pool 5 Spring Lake Island

2,000 1,000 0 2,000 4,000 6,000 Feet

Project Area

St. Paul District
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US Army Corps of Engineers

Plate 4

N

0 350 700 1,400 2,100 2,800 Feet

1998
1994
1989
1939

St. Paul District
GIS CENTER
US Army Corps of Engineers

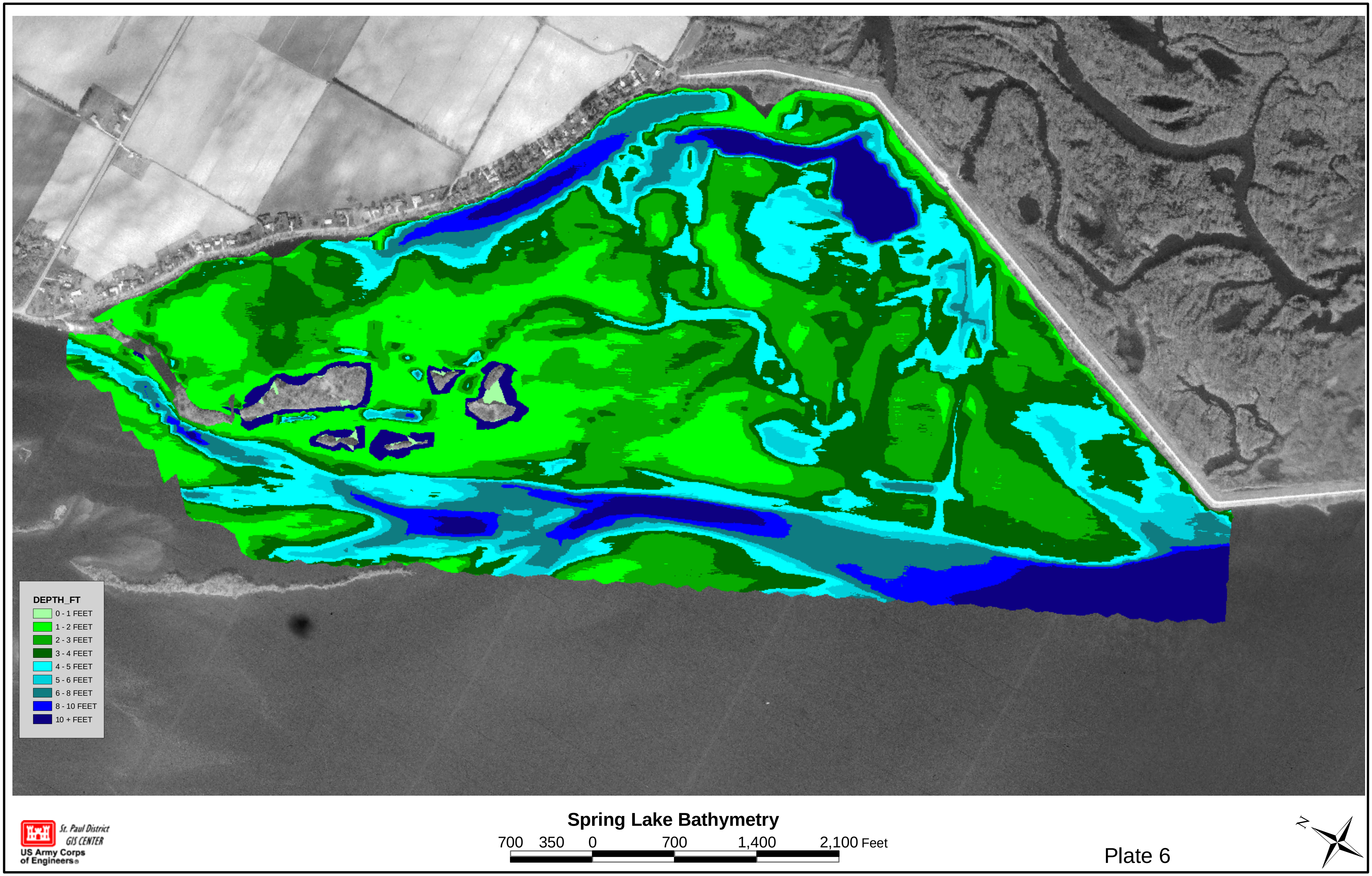
Spring Lake Islands Change Detection

Image Data:USGS Digtil Orthophoto 5 May 1992

PLATE 5

N

PME 62540 G;/PROJECT_DATA/NOVAK_SP_LK/ SPRINGLAKE.MXD BGW



Spring Lake Bathymetry

Plate 6

Label	Sum_Acres
A1	6.5150
A2	1.8100
ACCESS CHANNEL	16.1330
B	6.9170
BORROW NORTH	24.6080
BORROW SOUTH	5.2810
C	5.3770
D1	2.8050
D2	0.2130
D3	1.7490
D4	0.8970
E1	1.4320
E2	3.2140
F1	0.5580
F2	0.3630
IP1	0.1680
IP2	0.0840
IP3	0.0460
IP4	0.2890
IP5	1.1180
MF1	1.9110
MF2	3.8700
MF3	2.7110
MF4	2.7790
PENINSULA	2.6120
S1	0.0730
S2	0.3070
S3	1.7890
S4	0.1610

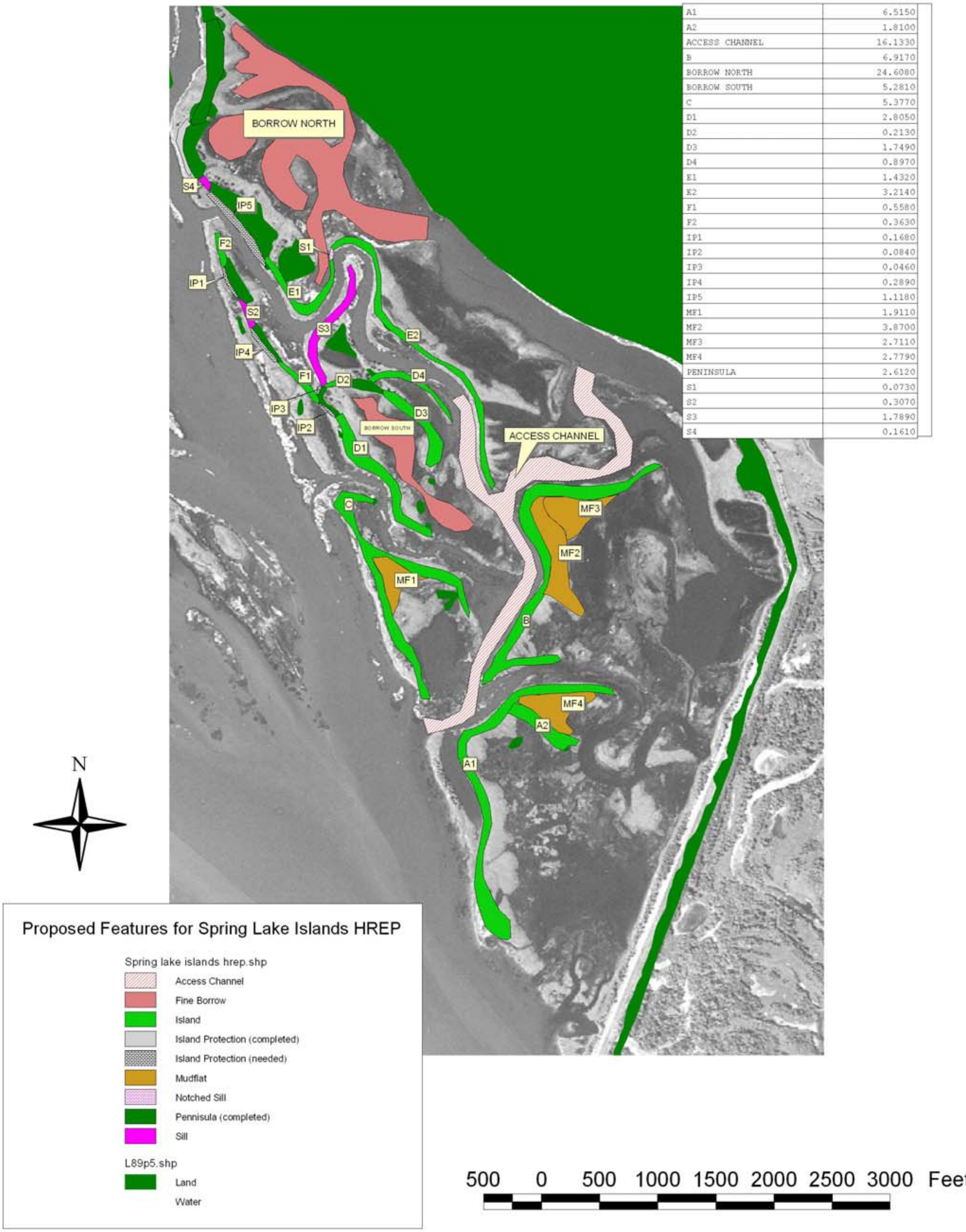


PLATE 7

Proposed Design Features - Corps Plan

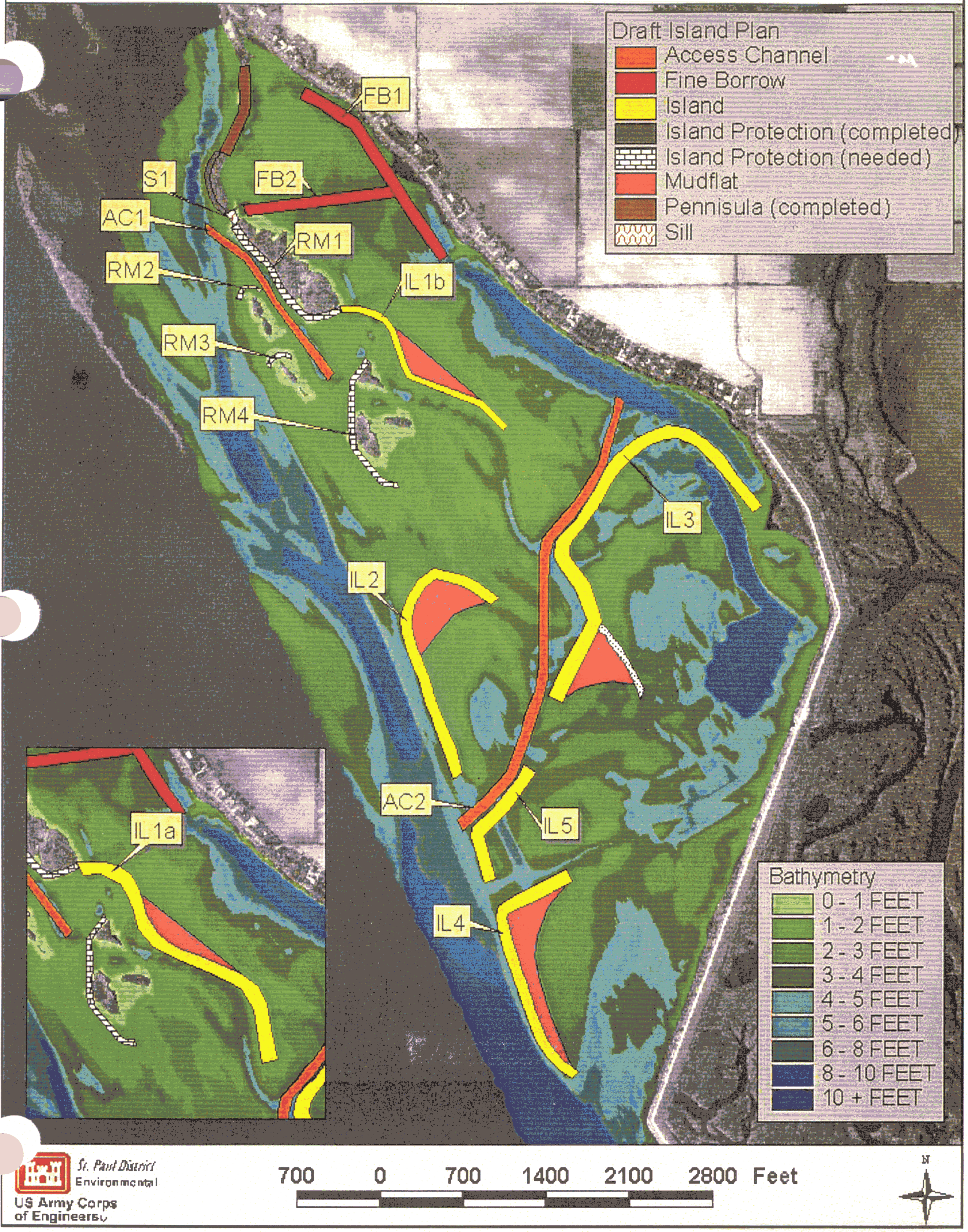
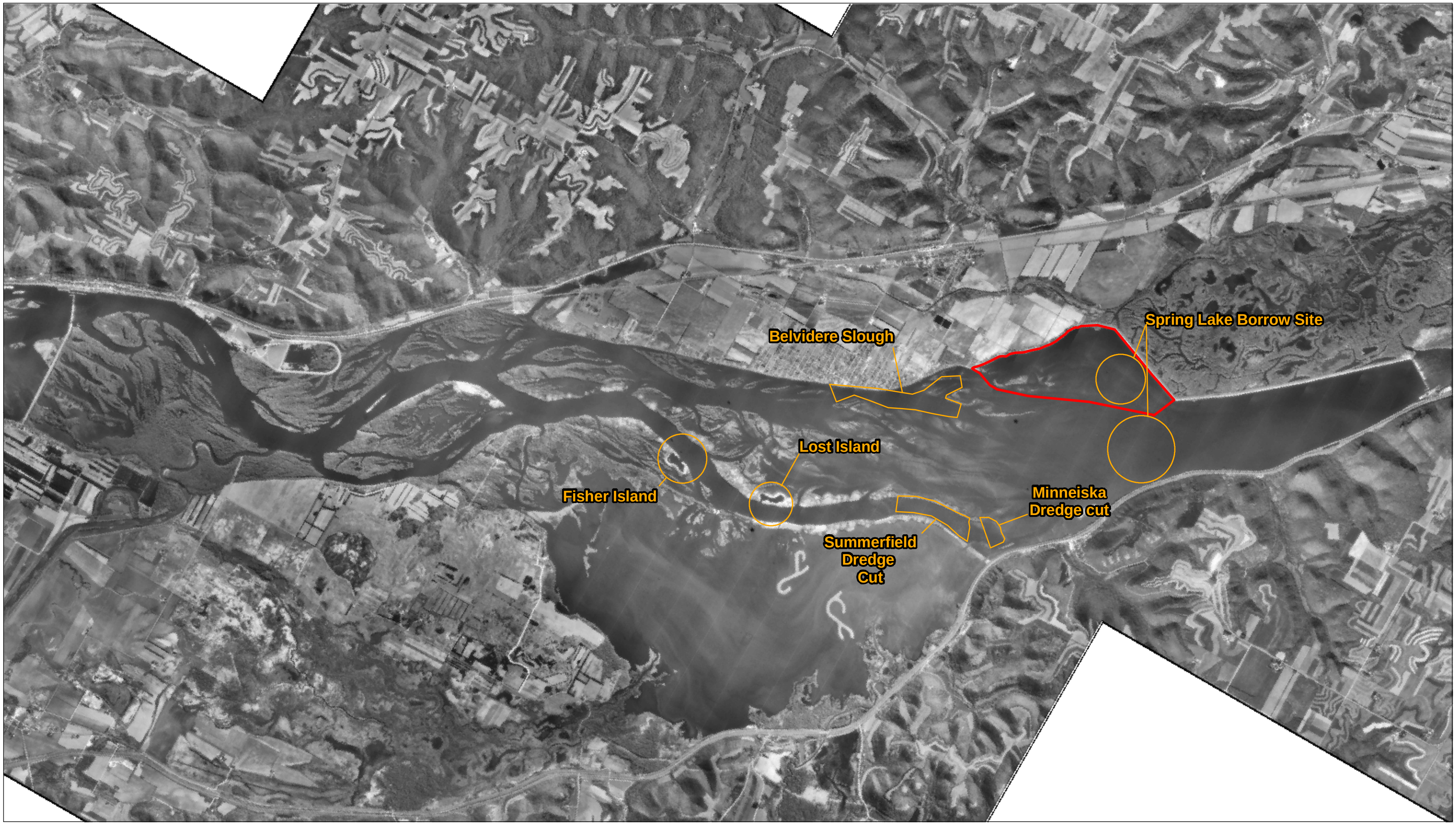


Plate 7.1



Borrow Material Sites

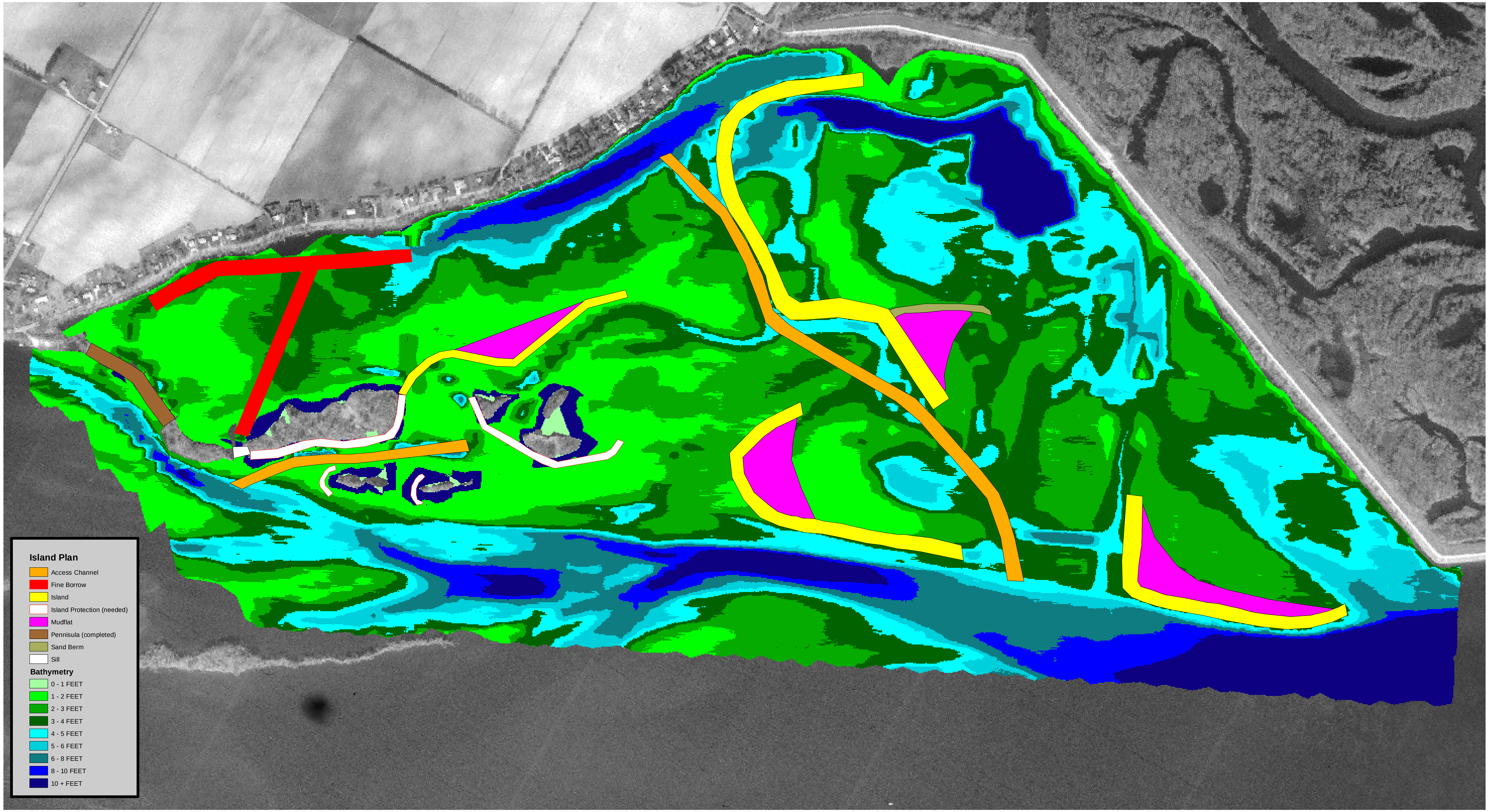
St. Paul District GIS CENTER
US Army Corps of Engineers

0 2,250 4,500 9,000 13,500 18,000 Feet

Spring Lake Islands Project Area

Plate 8

PME 62540 C:/BYRON/ARCMAP_PROJECTS/NOVAC_SPLK.MXD BGW 4/15



St. Paul District
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US Army Corps of Engineers®

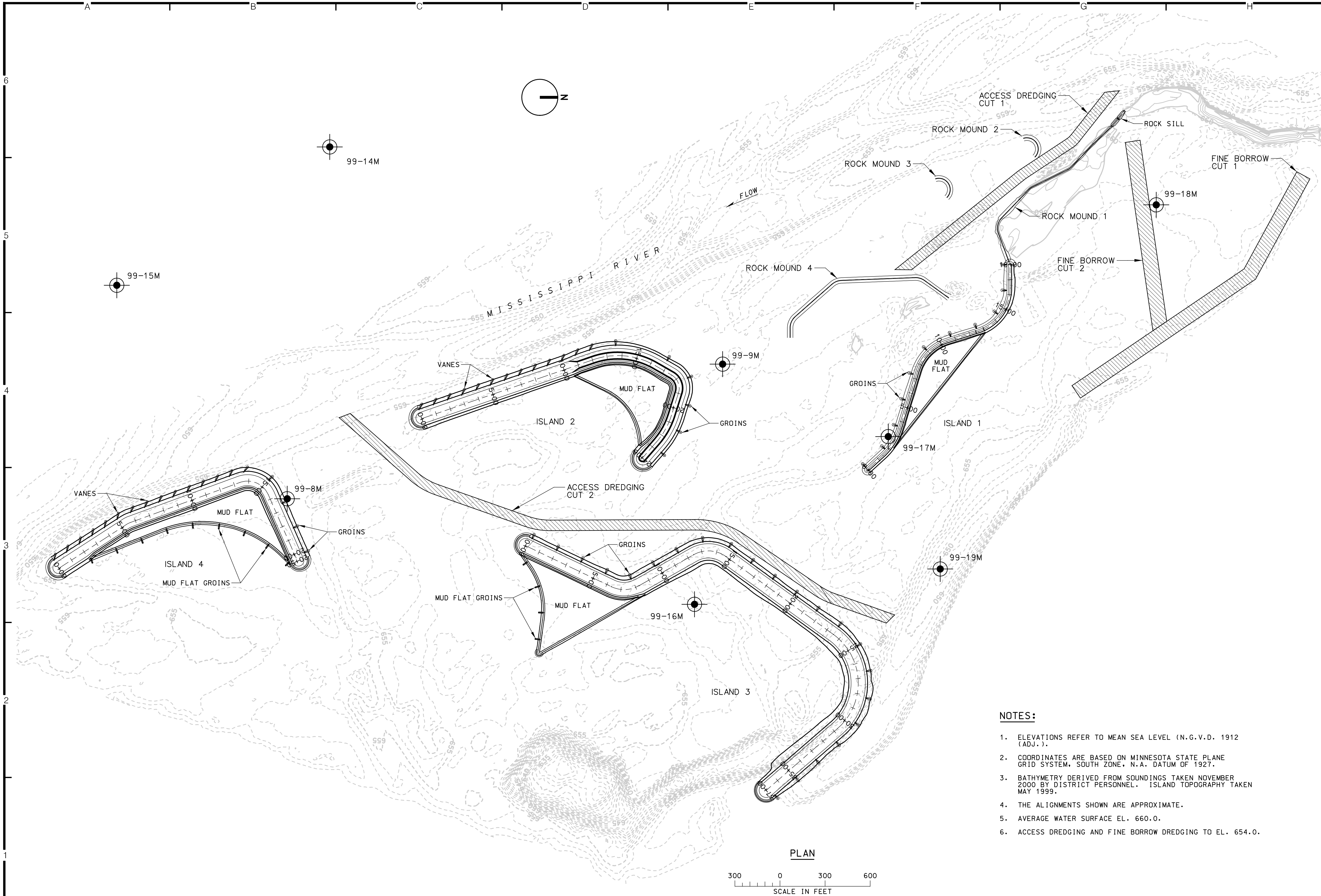
Spring Lake Island Selected Plan

0 350 700 1,400 2,100 2,800 Feet

N

Plate 9

Spring_lake.mxd BGW 3/4/03



NOTES:

1. ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 (ADJ.).
2. COORDINATES ARE BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1927.
3. BATHYMETRY DERIVED FROM SOUNDINGS TAKEN NOVEMBER 2000 BY DISTRICT PERSONNEL. ISLAND TOPOGRAPHY TAKEN MAY 1999.
4. THE ALIGNMENTS SHOWN ARE APPROXIMATE.
5. AVERAGE WATER SURFACE EL. 660.0.
6. ACCESS DREDGING AND FINE BORROW DREDGING TO EL. 654.0.

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

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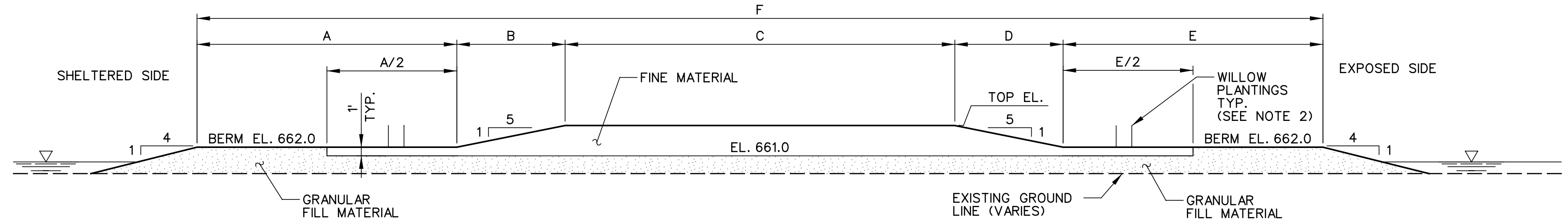
CHECKED: TMG
DRAWN: LKT
DESIGNED: KLL
CHECKED: JSH
ED-D
ED-H
SCALE: AS SHOWN
DATE: APR 2002
CADD FILE NAME: MSRC10401.DGN
SOL.NO:
AE APPROVING OFFICIAL:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

SPRING LAKE HREP
MISSISSIPPI RIVER - POOL 5
ENVIRONMENTAL
SITE LAYOUT

DRAWING NUMBER:
PLATE 10
SHT OF



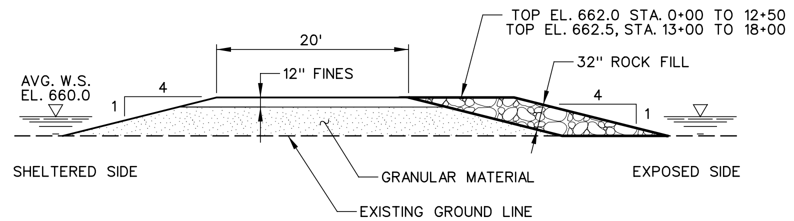
NOTE:

1. GROINS/VANES NOT SHOWN FOR CLARITY.
2. TWO ROWS OF WILLOW CUTTINGS SHALL BE PLANTED ALONG THE SHORELINES OF ALL ISLANDS WITH A 2 FT. SPACING BETWEEN STAGGERED ROWS AND WILLOWS.

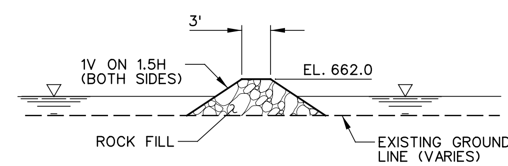
SECTION
ISLANDS 2, 3 & 4
SCALE: 1" = 10'-0"

10 0 10 20
SCALE IN FEET

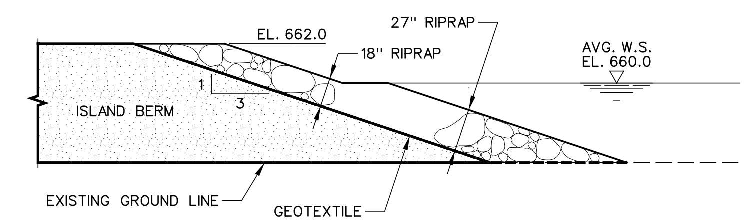
ISLAND DIMENSIONS (FEET)							
ISLAND NAME	A	B	C	D	E	F	TOP EL.
ISLAND 2 STA. 0+00 TO 10+50	45	0	40	0	30	115	662.0
ISLAND 2 STA. 11+00 TO 23+00	45	5	40	5	20	115	663.0
ISLAND 2 STA. 23+50 TO 24+00	45	5	40	5	30	125	663.0
ISLAND 3 STA. 0+00 TO 7+75	30	0	65	0	30	125	662.0
ISLAND 3 STA. 8+25 TO 37+00	30	0	65	0	20	115	662.0
ISLAND 4 STA. 0+00 TO 2+00	45	0	40	0	30	115	662.0
ISLAND 4 STA. 2+50 TO 18+50	45	0	40	0	20	105	662.0



TYPICAL SECTION
ISLAND 1
SCALE: 1" = 10'-0"



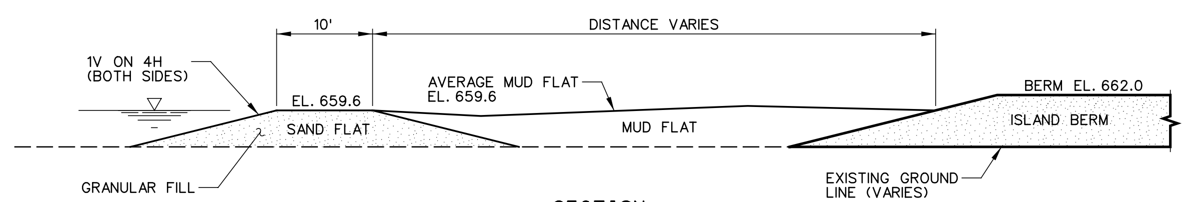
TYPICAL SECTION
ROCK MOUND ISLAND PROTECTION
SCALE: 1" = 10'-0"



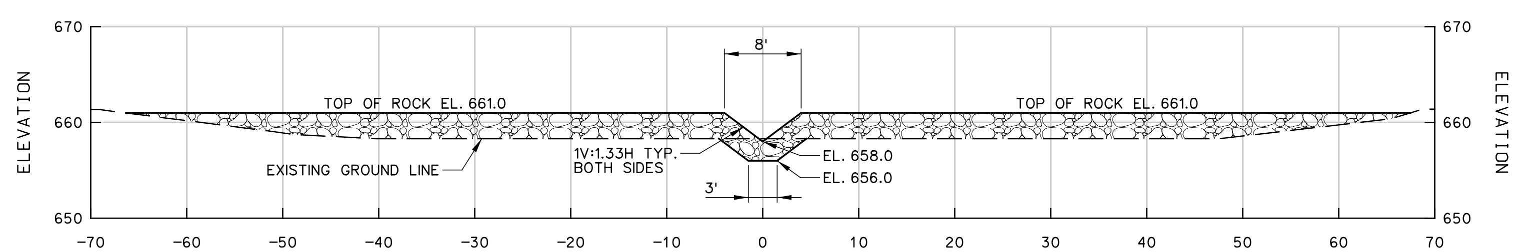
1. RIPRAP REQUIRED TO TOP OF ISLANDS 2, 3 & 4 AT EACH END.
2. STOP GEOTEXTILE 0.5 FT FROM TOP OF ISLAND.

DETAIL
ISLAND RIPRAP END PROTECTION
SCALE: 1" = 5'-0"

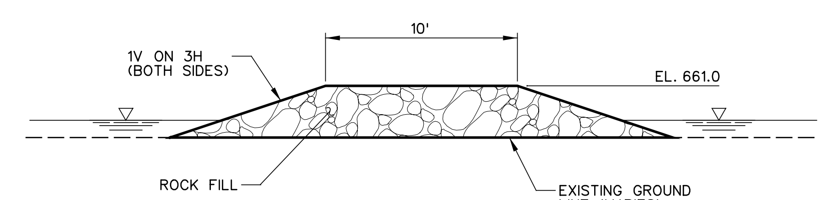
5 0 5 10
SCALE IN FEET



SECTION
TYPICAL MUD/SAND FLAT
SCALE: 1" = 10'-0"



LONGITUDINAL SECTION
ROCK SILL
SCALE: 1" = 10'-0"



TYPICAL CROSS SECTION
ROCK SILL
SCALE: 1" = 5'-0"

US Army Corps of Engineers
St. Paul District

Symbol | Description | Date | Appr.

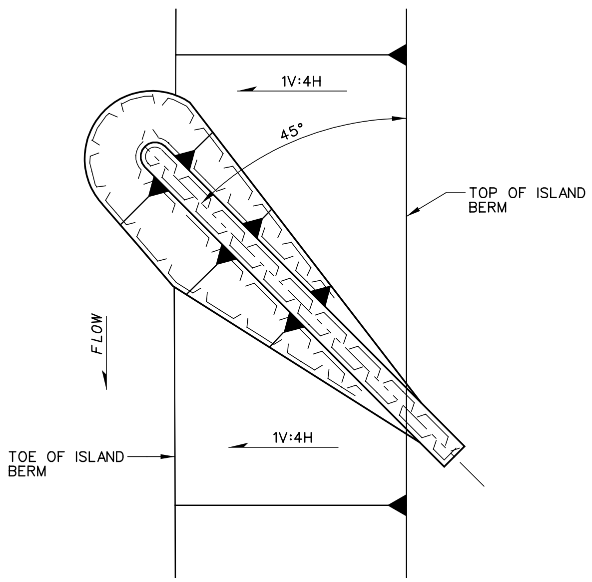
DESIGNED: ED-D | CHECKED: | DRAWN: | DESIGNED: | CHECKED: ED-H
SCALE: AS SHOWN | DATE: APR 2002
CADD FILE NAME: m0rc30402.DGN
SOL. NO.:
AE APPROVING OFFICIAL:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

SPRING LAKE HREP
MISSISSIPPI RIVER - POOL 5
ENVIRONMENTAL
ISLAND
TYPICAL SECTIONS & DETAILS

DRAWING NUMBER:
PLATE 11

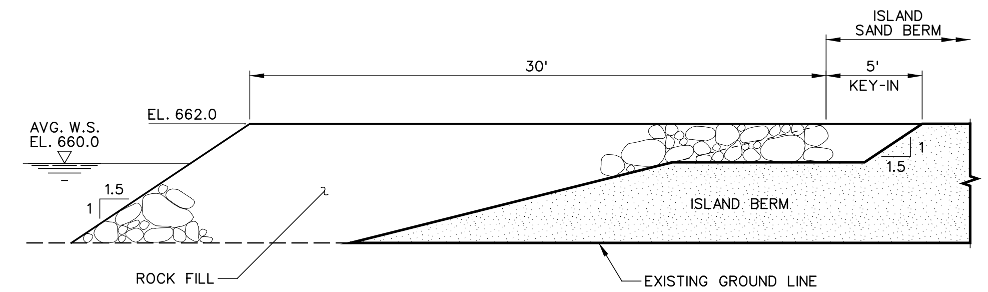
SHT OF



PLAN

TYPICAL ROCK VANE
SCALE: 1" = 10'-0"

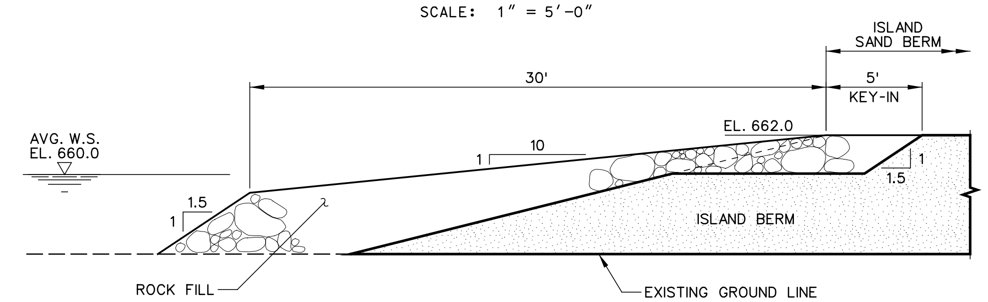
10 0 10 20
SCALE IN FEET



NOTES:
1. TOP OF MUD FLAT GROINS AT EL. 659.6.
2. ROCK GROINS SHALL BE PLACED PERPENDICULAR TO THE ISLAND.

LONGITUDINAL SECTION

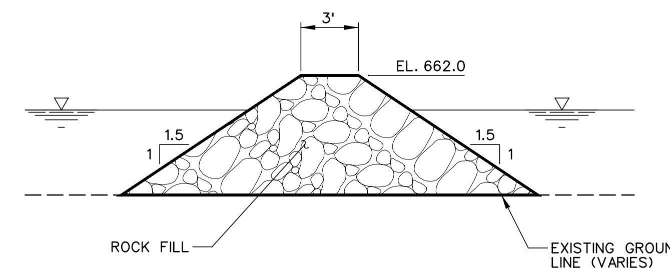
ROCK GROIN
SCALE: 1" = 5'-0"



LONGITUDINAL SECTION

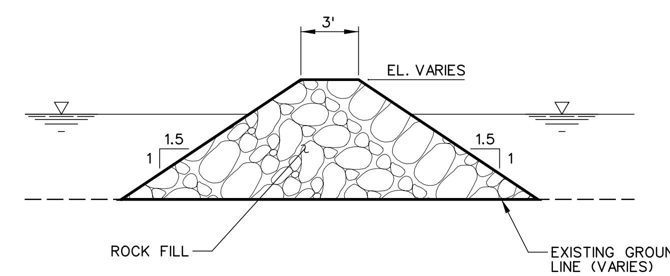
TYPICAL ISLAND ROCK VANE
SCALE: 1" = 5'-0"

5 0 5 10
SCALE IN FEET



CROSS SECTION

TYPICAL ISLAND ROCK GROIN
SCALE: 1" = 5'-0"



CROSS SECTION

TYPICAL ISLAND ROCK VANE
SCALE: 1" = 5'-0"

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

SCALE: AS SHOWN
DATE: APR 2002
CADD FILE NAME: MSRC3040.DGN
SOL. NO.:
AE APPROVING OFFICIAL:
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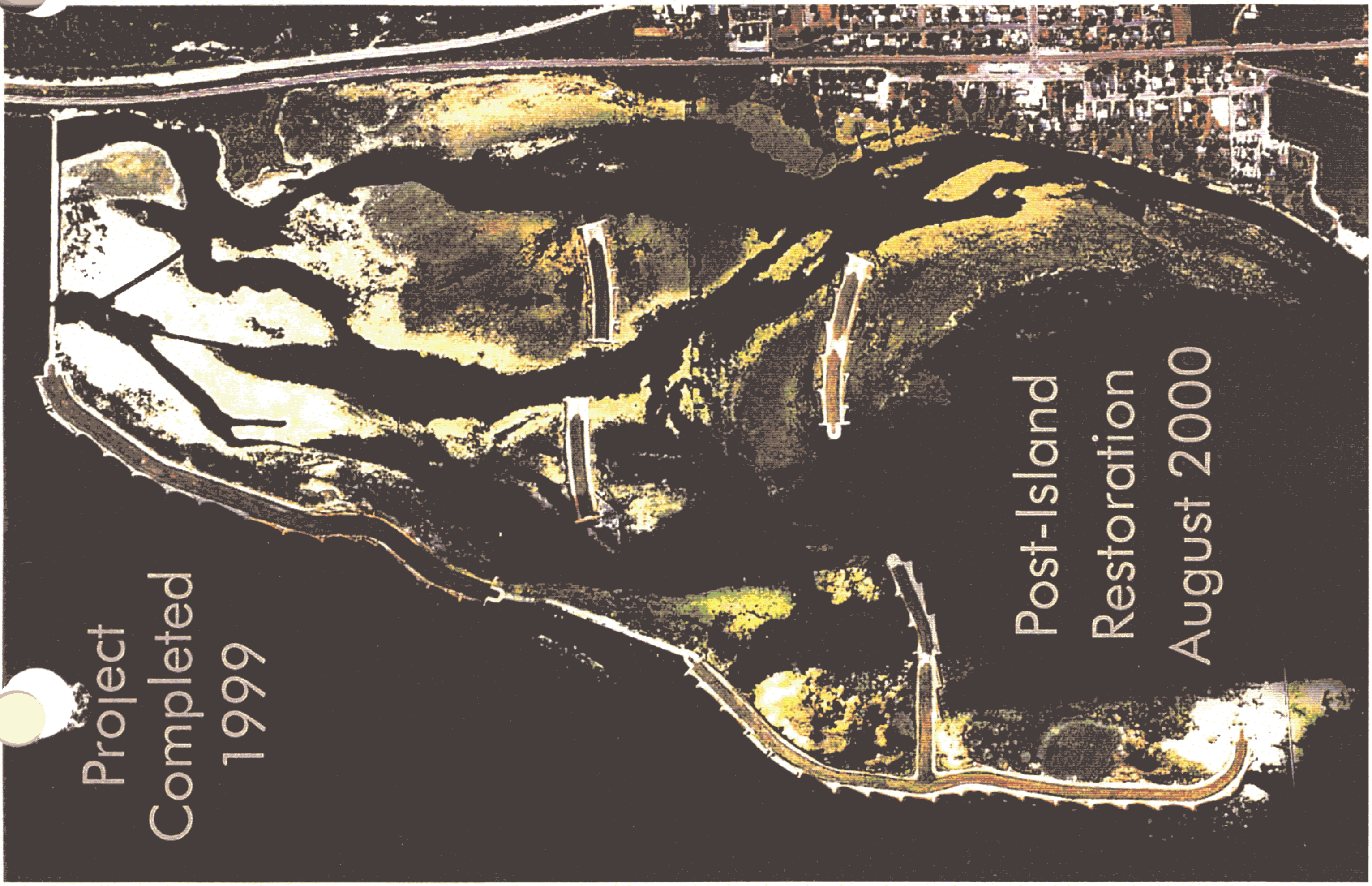
ED-D
DRAWN:
DESIGNED:
CHECKED:
ED-H

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

SPRING LAKE HREP
MISSISSIPPI RIVER - POOL 5
ENVIRONMENTAL
GROIN & VANE DETAILS

DRAWING NUMBER:
PLATE
12
SHT OF


Project
Completed
1999
Post-Island
Restoration
August 2000

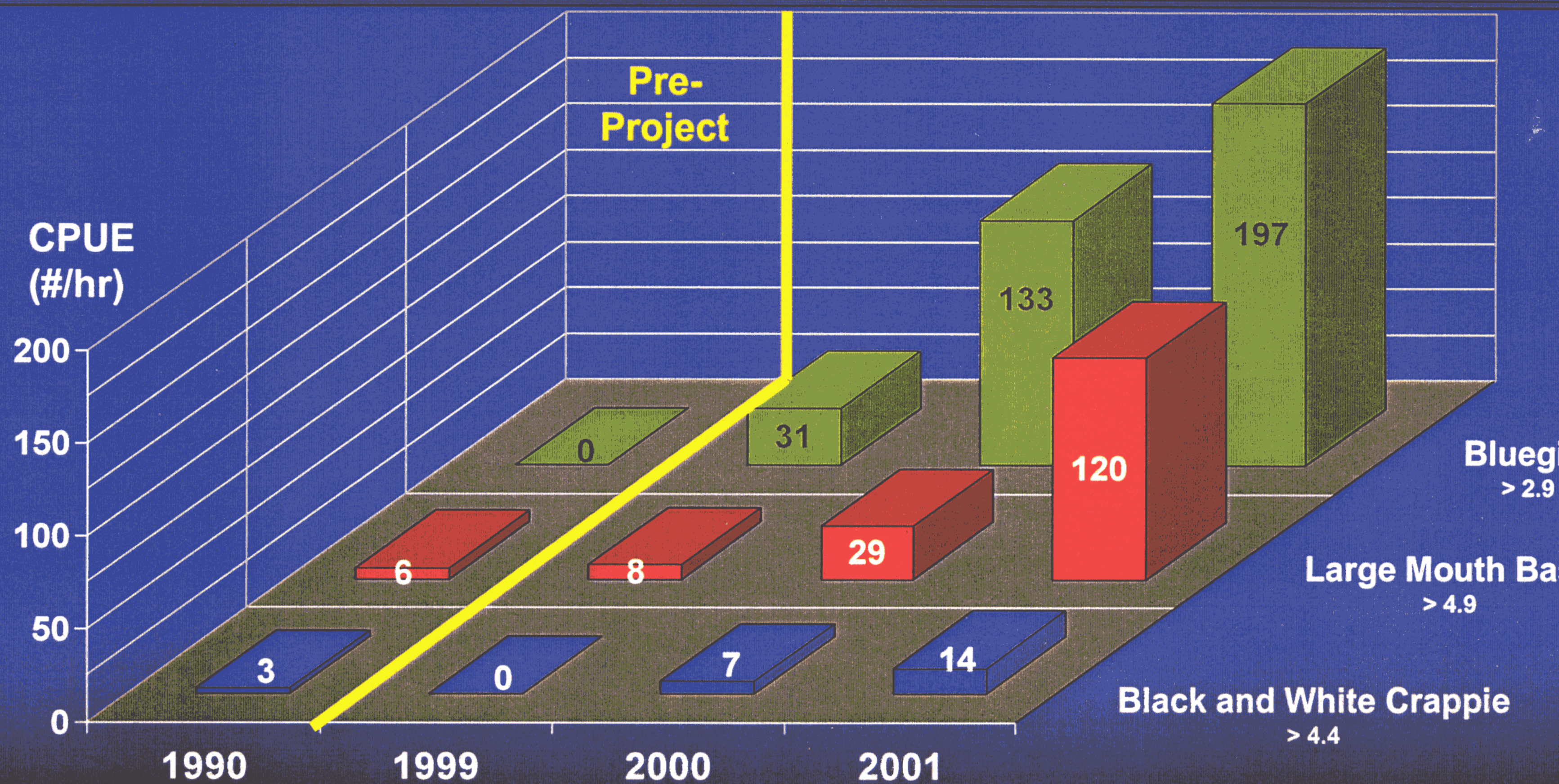

Historical
Islands
October
1961


Pre-Island
Restoration
August 1994

Plate 13

US Army Corps
of Engineers
St. Paul District

Pool 8 Islands Phase II



Cost Estimate Appendix

Attachment 2

APPENDIX

SPRING LAKE - EMP
COST ESTIMATE

GENERAL

1. This appendix contains a summary of the detailed cost estimate prepared for the Spring Lake Environmental Management Program (EMP) project in Pool 5 on the Wisconsin side of the Upper Mississippi River, just upstream of the Lock and Dam No. 5 embankment. The estimate includes construction; planning, engineering and design, and construction management costs. The estimate prepared for this report was developed after review of the project plans, discussions with the design team members, and review of costs for similar construction projects. Guidance for the preparation of the estimate and attachment was obtained from ER 1110-2-1150, Engineering and Design for Civil Works Projects and ER 1110-2-1302, Civil Works Cost Engineering. The estimate was prepared using Micro-Computer Aided Cost Estimating System (MCACES) and is presented in accordance with the Civil Works Breakdown Structure as presented in the Models database for MCACES.

PRICE LEVEL

2. Project element costs are based on May 2002 prices unless noted otherwise in the project cost summary, and incorporate local wage and equipment rates. These costs are considered fair and reasonable to a prudent and capable contractor and include overhead and profit.

PROJECT DESCRIPTION

3. This project consists of backwater dredging, island building, erosion protection using riprap, turfing and willow plantings and construction of riprap control structures. The work is in a backwater area on the left descending bank of the Mississippi River, in an area referred to as Spring Lake.
4. The goal of this project is to maintain and/or improve fish and wildlife habitat in Pool 5 by maintaining the existing area of islands and backwater areas. This will be accomplished by constructing islands and rock mound protection structures.
5. The main report and other attachments contain more detailed descriptions of the project features and address their intended functions.

COST RELATIONSHIPS

6. Mobilization and demobilization was included to represent the costs associated with transporting mechanical dredging equipment and hydraulic dredging equipment to the project site. Mechanical dredging plant will be used to construct rock riprap mounds and bank protection. Hydraulic plant will be used for dredging and placement of sand for construction of the islands. A small hydraulic dredging plant will also be used for placement of fines, which will be obtained from the fine borrow area. Required access dredging will be used as random fill for the island mudflat areas.

7. The construction costs in this estimate are based on assigning a production rate to a crew suited to accomplish the work. Material prices have been included in each feature. Costs associated with movement of equipment between individual features have been included in each feature's construction cost. Including the costs associated with movement of equipment between features in the cost for each feature, allows the individual features to be added and removed without affecting the basic mobilization and demobilization cost.

8. Hydraulic dredging costs include the costs associated with assembling and breaking down pipe as well as the cost for dredging.

CONTINGENCY DISCUSSION

9. After review of the project documents and discussion with the design engineers, contingencies were developed which reflect the uncertainties associated with each item. These contingencies are based on uncertainties in quantities, unit pricing and items of work not defined or recognized at the time of design. Quantity and design uncertainties are assigned by the designers, while Cost Engineering assigns unit price uncertainties. Generally, the levels of uncertainty used for the estimate are as follows:

   a. For unit pricing: 5 to 15 percent

   b. For quantities and unanticipated items of work: 5 to 30 percent

10. The following discussion of major project features indicates the assumptions made and the rational for contingencies. For other elements not addressed below, the assignment of contingencies is appropriate to account for the uncertainty in design and quantity calculation.

   a. Feature 06, Fish and Wildlife Facilities. This project feature includes all the construction for this project.

      1. The contingencies assigned to mobilization line items are primarily based on the unknown mobilization distance.

      2. The contingency assigned to the hydraulic dredging portions of the estimate is based on the available information on the availability of sand in the project area. Dredging production is based on pumping distances, so a change in the location and/or quantity of sand at a particular location will have a direct impact on the unit price for sand.

      3. The contingency assigned to the rock mounds and rock erosion protection are based on the bathymetric data available.

      4. The contingencies assigned to the planting portions of the project are based on the minimal design work that is completed, as well as the limited number of subcontractors available to do this type of work.

CONSTRUCTION METHODS

11. General. Since both marine and land based equipment will be required for the project, it was generally assumed that marine equipment would be available to transport land based equipment to remote sites that would otherwise be inaccessible. Ten hour work days are assumed throughout the estimate.

12. Hydraulic Dredging. Hydraulic dredging methods were assumed to be used for all sand dredging / island building, access dredging and the fines dredging obtained from the fine borrow area.
13. Mechanical Dredging Equipment. Mechanical dredging equipment was assumed to be used for all rock placement activities.
14. Access. Transportation to and from the project area will be by barge. For access to individual islands, various amounts of access dredging will be required. Access dredging can be accomplished using hydraulic dredging equipment for the random fill required for the mudflat areas. The mudflat areas can be adjusted in size to accommodate changes in the amount of access dredging.
15. Sand. A source of sand for island building was identified as the area between Island 2 and Island 4.
16. Fines / Topsoil. After the fines have been dredged and placed on the islands, they will require time to dry before being spread by land based equipment. It was assumed that mechanical equipment would have to be mobilized the second year for reworking and spreading the fines.

MCACES COST ESTIMATE

17. Both a hard copy and an electronic copy of the detailed MCACES estimate are available for review. To reduce reproduction requirements, a copy of the detailed MCACES estimate is not included in this appendix but can be reviewed by contacting the Cost Engineering and Specifications Section.

OPERATIONS AND MAINTENANCE ESTIMATE

18. A detailed operation and maintenance cost estimate for this project has been prepared and is included at the end of this appendix. The estimate is for O&M costs for the new features only. The estimate is based on the assumption that 5% of the rock would be replaced every 10 years.

PROJECT COST SUMMARY SHEET - SPRING LAKE EMP

Environmental Management Program

Project: Spring Lake EMP
Location: Pool 5 - Mississippi River

Date: May 24, 2002

PREPARED BY: Jeffrey L. Hansen, CEMVP-ED-D

REVIEWED and APPROVED BY: Michael S. Dahlquist
Chief, Cost Engineering and Specification Section

No.	Description	Total Estimated Amount	Contingency		Estimated Amount Plus Contingency	Index Factor To 10 / 2002	Index Cost To 10 / 2002	Midpoint Of Featue Year	Index to Midpoint Factor	Fully Funded Amount	Fully Funded Contingency	Fully Funded Amount Plus Contingency
			Amount	Percent								
06	Fish and Wildlife Facilities	$2,085,900	$652,900	31%	$2,738,800	0.011	$2,769,000	JAN 2005	0.011	$2,132,000	$667,000	$2,799,000
30	Planning, Engineering and Design	$316,000	$80,500	25%	$396,500	0.021	$405,000	JUL 2003	0.037	$335,000	$85,000	$420,000
31	Construction Management	$130,200	$33,400	26%	$163,600	0.021	$167,000	JAN 2005	0.102	$146,000	$38,000	$184,000
	Estimated Project Cost	$2,532,100	$766,800	30%	$3,298,900		$3,341,000			$2,613,000	$790,000	$3,403,000

NOTES: Costs are based on May 2002 unit pricing.

Spring Lake - Preliminary Estimate - Using Sand From Spring Lake 23-May-2002

ED-D (JLH)

CWBS	Item Description	Quantity	Unit	Unit Price	Amount	Contingencies Amount	Contingencies %	Total w/ Contingencies

This estimate is based on a source of **sand from an area within Spring Lake** on the upstream side of the dike at L/D 5. This preliminary estimate is based on conceptual plans to compare the relative cost of the different islands, rock mounds and access dredging. Quantities are based on X-sections similar to other EMP projects. Contingecies are based on the level of detail design and some estimated quantities. Prices are based on historical and average bid prices from similar island building projects. This estimate should not be used for budget purposes.
The project is located entirely within the backwaters of the Mississippi River.

CWBS	Item Description	Quantity	Unit	Unit Price	Amount	Contingencies Amount	%	Total w/ Contingencies
06	**FISH AND WILDLIFE FACILITIES**							
06 03	WILDLIFE FACILITIES AND SANCTUARY							
06 03 73	HABITAT AND FEEDING FACILITIES							
06 03 73 02	SITEWORK							
06 03 73 02 01	**Mobilization and Demobilization**							
06 03 73 02 01	Base Mob / Demob	1	JOB	****	$227,000	$68,100	30%	**$295,100**
06 03 73 02 02	**Rock Sill**							
06 03 73 02 02	Mob / Demob + Site Prep	1	JOB	****	$4,500	$1,600	35%	
06 03 73 02 02	Riprap	193	CY	$46.24	$8,900	$2,700	30%	
06 03 73 02 02	Subtotal Construction for Rock Sill				$13,400	$4,300		
30 01	Planning, Engineering & Design (17%)				$2,300	$800	35%	
31 01	Construction Management (7%)				$900	$300	35%	
	Total Estimate - Rock Sill				**$16,600**	**$5,400**		**$22,000**
06 03 73 02 03	**Rock Mound 1**							
06 03 73 02 03	Mob / Demob + Site Prep	1	JOB	****	$4,500	$1,600	35%	
06 03 73 02 03	Riprap	1,308	CY	$46.24	$60,500	$18,200	30%	
06 03 73 02 03	Subtotal Construction for Rock Mound 1				$65,000	$19,800		
30 01	Planning, Engineering & Design (17%)				$11,100	$2,800	25%	
31 01	Construction Management (7%)				$4,600	$1,200	25%	
	Total Estimate - Rock Mound 1				**$80,700**	**$23,800**		**$104,500**
06 03 73 02 04	**Rock Mound 2**							
06 03 73 02 04	Mob / Demob + Site Prep	1	JOB	****	$4,500	$1,600	35%	
06 03 73 02 04	Riprap	618	CY	$46.24	$28,600	$8,600	30%	
06 03 73 02 04	Subtotal Construction for Rock Mound 2				$33,100	$10,200		
30 01	Planning, Engineering & Design (17%)				$5,600	$1,400	25%	
31 01	Construction Management (7%)				$2,300	$600	25%	
	Total Estimate - Rock Mound 2				**$41,000**	**$12,200**		**$53,200**

Spring Lake - Preliminary Estimate - Using Sand From Spring Lake

23-May-2002

ED-D (JLH)

CWBS	Item Description	Quantity	Unit	Unit Price	Amount	Contingencies Amount	%	Total w/ Contingencies
06 03 73 02 05	**Rock Mound 3**							
06 03 73 02 05	Mob / Demob + Site Prep	1	JOB	****	$4,500	$1,600	35%	
06 03 73 02 05	Riprap	590	CY	$46.24	$27,300	$8,200	30%	
06 03 73 02 05	Subtotal Construction for Rock Mound 3				$31,800	$9,800		
30 01	Planning, Engineering & Design (17%)				$5,400	$1,400	25%	
31 01	Construction Management (7%)				$2,200	$600	25%	
	Total Estimate - Rock Mound 3				**$39,400**	**$11,800**		**$51,200**
06 03 73 02 06	**Rock Mound 4**							
06 03 73 02 06	Mob / Demob + Site Prep	1	JOB	****	$4,500	$1,600	35%	
06 03 73 02 06	Riprap	2,796	CY	$46.24	$129,300	$38,800	30%	
06 03 73 02 06	Subtotal Construction for Rock Mound 4				$133,800	$40,400		
30 01	Planning, Engineering & Design (17%)				$22,700	$5,700	25%	
31 01	Construction Management (7%)				$9,400	$2,400	25%	
	Total Estimate - Rock Mound 4				**$165,900**	**$48,500**		**$214,400**
06 03 73 02 07	**Island 1**							
06 03 73 02 07	Mob / Demob + Site Prep	1	JOB	****	$9,200	$3,200	35%	
06 03 73 02 07	Sand	8,182	CY	$2.85	$23,300	$7,000	30%	
06 03 73 02 07	Fines	1,600	CY	$15.80	$25,300	$8,900	35%	
06 03 73 02 07	Sand Berm	671	CY	$5.70	$3,800	$1,100	30%	
06 03 73 02 07	Mud Flat (from access dredging)	4,458	CY	$7.04	$31,400	$9,400	30%	
06 03 73 02 07	Rock Groins - 11	451	CY	$50.96	$23,000	$6,900	30%	
06 03 73 02 07	Riprap Ends - 1	195	CY	$46.24	$9,000	$2,700	30%	
06 03 73 02 07	Plantings - Willows	1,800	EA	$2.00	$3,600	$1,300	35%	
06 03 73 02 07	Turf	1.00	AC	$3,240.00	$3,200	$1,000	30%	
06 03 73 02 07	Subtotal Construction for Island 1				$131,800	$41,500		
30 01	Planning, Engineering & Design (17%)				$22,400	$6,700	30%	
31 01	Construction Management (7%)				$9,200	$2,800	30%	
	Total Estimate for Island 1				**$163,400**	**$51,000**		**$214,400**
06 03 73 02 08	**Island 2**							
06 03 73 02 08	Mob / Demob + Site Prep	1	JOB	****	$9,200	$3,200	35%	
06 03 73 02 08	Sand	50,328	CY	$2.85	$143,400	$43,000	30%	
06 03 73 02 08	Fines	9,414	CY	$15.80	$148,700	$52,000	35%	
06 03 73 02 08	Sand Berm	836	CY	$5.70	$4,800	$1,400	30%	
06 03 73 02 08	Mud Flat (from access dredging)	10,194	CY	$4.15	$42,300	$12,700	30%	
06 03 73 02 08	Rock Groins - 7	287	CY	$50.96	$14,600	$4,400	30%	
06 03 73 02 08	Riprap Ends - 2	496	CY	$46.24	$22,900	$6,900	30%	
06 03 73 02 08	Rock Vanes - 13	367	CY	$56.10	$20,600	$6,200	30%	
06 03 73 02 08	Plantings - Willows	2,400	EA	$2.00	$4,800	$1,700	35%	
06 03 73 02 08	Turf	4.30	AC	$3,240.00	$13,900	$4,200	30%	
06 03 73 02 08	Subtotal Construction for Island 2				$425,200	$135,700		
30 01	Planning, Engineering & Design (17%)				$72,300	$18,100	25%	
31 01	Construction Management (7%)				$29,800	$7,500	25%	
	Total Estimate for Island 2				**$527,300**	**$161,300**		**$688,600**

Spring Lake - Preliminary Estimate - Using Sand From Spring Lake 23-May-2002

ED-D (JLH)

CWBS	Item Description	Quantity	Unit	Unit Price	Amount	Contingencies Amount	Contingencies %	Total w/ Contingencies
06 03 73 02 09	**Island 3**							
06 03 73 02 09	Mob / Demob + Site Prep	1	JOB	****	$9,200	$3,200	35%	
06 03 73 02 09	Sand	97,821	CY	$2.85	$278,800	$83,600	30%	
06 03 73 02 09	Fines	12,854	CY	$15.80	$203,100	$71,100	35%	
06 03 73 02 09	Sand Berm	2,568	CY	$5.70	$14,600	$4,400	30%	
06 03 73 02 09	Mud Flat (from access dredging)	13,319	CY	$4.15	$55,300	$16,600	30%	
06 03 73 02 09	Rock Groins - 22	902	CY	$50.96	$46,000	$13,800	30%	
06 03 73 02 09	Riprap Ends - 3	576	CY	$46.24	$26,600	$8,000	30%	
06 03 73 02 09	Mudflat Groins - 4	56	CY	$50.96	$2,900	$900	30%	
06 03 73 02 09	Plantings - Willows	3,700	EA	$2.00	$7,400	$2,600	35%	
06 03 73 02 09	Turf	7.40	AC	$3,240.00	$24,000	$7,200	30%	
06 03 73 02 09	Subtotal Construction for Island 3				$667,900	$211,400		
30 01	Planning, Engineering & Design (17%)				$113,500	$28,400	25%	
31 01	Construction Management (7%)				$46,800	$11,700	25%	
	Total Estimate for Island 3				**$828,200**	**$251,500**		**$1,079,700**
06 03 73 02 10	**Island 4**							
06 03 73 02 10	Mob / Demob + Site Prep	1	JOB	****	$9,200	$3,200	35%	
06 03 73 02 10	Sand	47,025	CY	$2.85	$134,000	$40,200	30%	
06 03 73 02 10	Fines	5,037	CY	$15.80	$79,600	$27,900	35%	
06 03 73 02 10	Sand Berm	3,155	CY	$5.70	$18,000	$5,400	30%	
06 03 73 02 10	Mud Flat (from access dredging)	10,093	CY	$4.15	$41,900	$12,600	30%	
06 03 73 02 10	Rock Groins - 3	123	CY	$50.96	$6,300	$1,900	30%	
06 03 73 02 10	Riprap Ends - 2	505	CY	$46.24	$23,400	$7,000	30%	
06 03 73 02 10	Riprap Vanes - 15	424	CY	$56.10	$23,800	$7,100	30%	
06 03 73 02 10	Mudflat Groins - 8	112	CY	$50.96	$5,700	$1,700	30%	
06 03 73 02 10	Plantings - Willows	1,850	EA	$2.00	$3,700	$1,300	35%	
06 03 73 02 10	Turf	3.50	AC	$3,240.00	$11,300	$3,400	30%	
06 03 73 02 10	Subtotal Construction for Island 4				$356,900	$111,700		
30 01	Planning, Engineering & Design (17%)				$60,700	$15,200	25%	
31 01	Construction Management (7%)				$25,000	$6,300	25%	
	Total Estimate for Island 4				**$442,600**	**$133,200**		**$575,800**
06	**Subtotal Construction**				**$2,085,900**	**$652,900**	**31%**	
30	**Subtotal Planning, Engineering & Design**				**$316,000**	**$80,500**	**25%**	
31	**Subtotal Construction Management**				**$130,200**	**$33,400**	**26%**	
	Total Estimated Preliminary Cost for Spring Lake EMP Using sand obtained from the Spring Lake Area				**$2,532,100**	**$766,800**		**$3,298,900**

Notes: Unit prices are at May 2002 price levels unless otherwise noted.

Spring Lake - Preliminary Estimate - Using Sand From Spring Lake 23-May-2002

ED-D (JLH)

CWBS	Item Description	Quantity	Unit	Unit Price	Amount	Contingencies Amount	Contingencies %	Total w/ Contingencies

Mob / Demob + Site Prep is local moving of equipment from one feature work area to another.
Quantities from conceptual design based on other similar EMP projects.
Sand unit price based on an area within Spring Lake.
Fines unit price based on transporting up to 6,000 LF from fine borrow area. (Wilds Bend Polander)
Sand berms unit price based on 50% increase over Sand unit price due to small x-sectional area.
Mud Flats unit price based on access dredging and minimal handling.
Rock unit price based on quotes for delivery at Buffalo City or Minieska
Willows unit price based on simliar projects (Pool 8 Phase III DPR)
Turf unit price based on simliar projects.

POOL 5 - SPRING LAKE QUANTITIES										
ISLAND	**STATION**	**LENGTH (FT)**	**TOTAL FILL (CY)**	**RANDOM (CY)**	**FINES (CY)**	**GRAN-ULAR (CY)**	**TURF (AC)**	**ROCK (CY)**	**GEO- TEXTILE (SY)**	**WILLOWS (EA)**
ROCK SILL	0+00 TO 1+35	135						193		
ROCK MOUND 1	0+00 TO 12+95	1,295						1,308		
ROCK MOUND 2	0+00 TO 2+00	200						618		
ROCK MOUND 3	0+00 TO 2+00	200						590		
ROCK MOUND 4	0+00 TO 13+00	1,300						2,796		
ISLAND IL1	0+00 TO 18+00	1,800	12,783		1,600	8,182		3,001		1,800
RIPRAP ENDS (1)								195		
GROINS (11)								451		
SAND BERM						671				
MUD FLAT					4,458					
TOTAL IL1			12,783	-	6,058	8,853	-	3,647	-	1,800
ISLAND IL2	0+00 TO 24+00	2,400	59,742		9,414	50,328				2,400
RIPRAP ENDS (2)								496		
GROINS (7)								287		
VANES (13)								367		
SAND BERM						836				
MUD FLAT				9,250	944					
TOTAL IL2			59,742	9,250	10,358	51,164	-	1,150	-	2,400
ISLAND IL3	0+00 TO 37+00	3,700	110,675		12,854	97,821				3,700
RIPRAP ENDS (3)								576		
GROINS (22)								902		
MUDFLAT GROINS (4)								56		
SAND BERM						2,568				
MUD FLAT				13,319						
TOTAL IL3			110,675	13,319	12,854	100,389	-	1,534	-	3,700
ISLAND IL4	0+00 TO 20+50	1,850	52,062		5,037	47,025				1,850
RIPRAP ENDS (2)								505		
GROINS (3)								123		
MUDFLAT GROINS (8)								112		
VANES (15)								424		
SAND BERM						3,155				
MUDFLAT				10,093						
TOTAL IL4			52,062	10,093	5,037	50,180	-	1,164	-	1,850
TOTAL ISLANDS			**235,262**	**32,662**	**34,307**	**210,586**	**-**	**13,000**	**-**	**9,750**

ISLAND	STATION	LENGTH (FT)	TOTAL FILL (CY)	RANDOM (CY)	FINES (CY)	GRAN-ULAR (CY)	TURF (AC)	ROCK (CY)	GEO- TEXTILE (SY)	WILLOWS (EA)
DREDGE CUT		**LENGTH (FT)**		**TOTAL CUT (CY)**	**TOTAL CUT (CY)**					
ACCESS DREDGING										
AC1		1,835		14,657						
AC2		2,300		18,006						
TOTAL ACCESS DREDGING		4,135		32,663	-					
FINE BORROW										
FB1		2,150			19,998					
FB2		1,240			14,165					
TOTAL FINE BORROW		3,390		-	34,163					
TOTAL DREDGING		7,525		32,663	34,163					

OPERATION AND MAINTENANCE

Life Cycle 50 Years
Rate of Return 6.125%

Date Prepared 23-May-2002

SPRING LAKE - EMP

CODE	ITEM DESCRIPTION	ESTIMATED O&M CYCLE	QUANTITY FACTOR	PROJECT QUANTITY	O&M and MAJOR REPLACEMENT COSTS: O&M QUANTITY	UNIT	UNIT PRICE	AMOUNT	EQUIVALENT AVERAGE ANNUAL O&M / MAJOR REPLACEMENT VALUE: PRESENT VALUE	ANNUAL COST	COMMENTS
									$146,008	$9,425	Percentage of Construction 0.34%
	Inspections										
	Periodic Inspections										
	1st 5 years	1 Year	1.00	1	1	JOB	$12,000	$12,000	50,377	3,252	4 people at $1,000 per day for 3 days each = $12,000
	Year 7, 9 and 11	2 Years	1.00	1	1	JOB	$9,000	$9,000	15,887	1,026	Cost of periodics decreases after the 1st 5 years.
	Every 5 years beginning year 15	5 Years	1.00	1	1	JOB	$9,000	$9,000	13,018	840	
	Routine Annual Inspections	1 Year	1.00	1	1	JOB	$2,500	$2,500	38,727	2,500	
	Total Inspections								118,010	7,618	
	Rock Mounds and Rock Sill										
	Rock Sill										
	Riprap	10 Years	0.05	193.00	9.65	CY	$46.24	$446	521	34	
	Rock Mound 1										
	Riprap	10 Years	0.05	1,308.00	65.4	ACRE	$46.24	$3,024	3,533	228	
	Rock Mound 2										
	Riprap	10 Years	0.05	618.00	30.9	ACRE	$46.24	$1,429	1,669	108	
	Rock Mound 3										
	Riprap	10 Years	0.05	590.00	29.5	ACRE	$46.24	$1,364	1,594	103	
	Rock Mound 4										
	Riprap	10 Years	0.05	2,796.00	139.8	ACRE	$46.24	$6,464	7,553	488	
	Island 1										
	Rock Groins	10 Years	0.05	451.00	22.55	CY	$50.96	$1,149	1,343	87	
	Riprap Ends	10 Years	0.05	195.00	9.75	CY	$46.24	$451	527	34	
	Island 2										
	Rock Groins	10 Years	0.05	287.00	14.35	CY	$50.96	$731	854	55	
	Riprap Ends	10 Years	0.05	496.00	24.8	CY	$46.24	$1,147	1,340	86	
	Rock Vanes	10 Years	0.05	367.00	18.35	ACRE	$56.10	$1,029	1,203	78	
	Island 3										
	Rock Groins	10 Years	0.05	902.00	45.1	CY	$50.96	$2,298	2,685	173	
	Riprap Ends	10 Years	0.05	576.00	28.8	CY	$46.24	$1,332	1,556	100	
	Mudflat Groins	10 Years	0.05	56.00	2.8	CY	$50.96	$143	167	11	
	Island 4										
	Rock Groins	10 Years	0.05	123.00	6.15	CY	$50.96	$313	366	24	
	Riprap Ends	10 Years	0.05	505.00	25.25	CY	$46.24	$1,168	1,364	88	
	Rock Vanes	10 Years	0.05	424.00	21.2	CY	$56.10	$1,189	1,390	90	
	Mudflat Groins	10 Years	0.05	112.00	5.6	CY	$50.96	$285	333	22	
	Total O&M								**$146,008**	**$9,425**	

Section 404(b)(1) Evaluation

Attachment 3

SECTION 404(b)(1) EVALUATION

SPRING LAKE ISLANDS HABITAT REHABILITATION AND ENHANCEMENT PROJECT
ENVIRONMENTAL MANAGEMENT PROGRAM
POOL 5, UPPER MISSISSIPPI RIVER, WISCONSIN

I. PROJECT DESCRIPTION

A. Location

Spring Lake is a 500-acre backwater lake located on the Wisconsin side of the Upper Mississippi River (UMR) in lower pool 5, about 1 mile south of Buffalo, Wisconsin. The Spring Lake project area is triangular in shape, bounded by Belvidere Slough to the west, the Wisconsin shore to the east, and the lock and dam 5 dike to the south **(Plate 2).**

B. General Description

This evaluation addresses the impacts resulting from the placement of fill or dredged material in waters of the United States, in compliance with Section 404 of the Clean Water Act. The following actions are being recommended for implementation as part of the Spring Lake Habitat Rehabilitation and Enhancement Project:

1. Construct rock features to protect existing terrestrial and aquatic habitat in upper Spring Lake. The only alternative to these options evaluated was the "no action" alternative, which was not selected because it does not meet the project goals and objects.

2. Construct four island features in Spring Lake to protect/enhance wetland and aquatic habitat. Many alternatives were analyzed during the planning phase of this project. The chosen alternative provided the most benefits at an acceptable cost.

3. Construct four mud flats/shallow-water habitats to increase habitat diversity and provide suitable locations for dredged material placement. The "no action" alternative was not selected because it does not meet the project goals and objectives.

4. Dredge within Spring Lake to provide material for island construction and to allow construction equipment access to the project features.

C. Authority and Purpose

The proposed project would be funded and constructed under authorization of Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The overall purpose of this project is to rehabilitate, enhance, and maintain diverse riverine habitat for fish and wildlife.

D. General Description of Dredged or Fill Material

1. General Characteristics of Material

The material that would be dredged and used for construction of the islands is sand with a low content of silt, clay, and organic material. Fine material dredged from within Spring Lake would be used to top the islands. All island protection and sill(s) would be constructed with quarry-run rock.

2. Quantity of Material

Approximately 210,586 cubic yards of pervious fill material (sand) and 34,307 cubic yards of fine material would be needed to construct the project features. Approximately 13,000 cubic yards of quarry-run rock would be used for protection of the features. Approximately 32,662 cubic yards of random fill material would be dredged for access and used to construct the mud flat features. If more access dredging is required than what is shown in the design, mud flat 2 may be enlarged to hold an additional 10,000 cubic yards of random fill material.

3. Source of Material

The material would be obtained from two different sources. The island bases would be constructed with sand from areas within Spring Lake. The mud flats would be constructed with “random fill” material dredged for access from the interior of Spring Lake. The islands would be topped with fine material from the interior of NE Spring Lake **(Plate 9).** Riprap used for the project features would be obtained from local quarries.

E. Description of the Proposed Discharge Sites

1. Location

The disposal areas for dredged material are located within Spring Lake in pool 5, UMR mile 740.5 to 743. More precise feature (disposal) locations can be found on **Plate 8.**

2. Size

The overall project area is about 500 acres. The placement of fill material would likely affect about 52 acres of habitat. If additional access dredging is needed, mud flat 2 may be increased to cover about 9 acres. In that case, the placement of fill material would likely affect about 57 acres of habitat.

3. Type of Site

Spring Lake is primarily contiguous backwater habitat with a silt and sand bottom. In 2001, the study area included about 13 acres of terrestrial floodplain habitat, 6 acres of emergent aquatic vegetation, 34 acres of rooted floating aquatic vegetation, 117 acres of submerged aquatic vegetation, and 324 acres of open water habitat.

4. Types of Habitat

The habitat types directly affected by the project are contiguous backwater habitat, terrestrial island habitat, and wetland habitat.

F. Description of Disposal Method

Dredging and the placement of fill would be done with a combination of mechanical and hydraulic methods. Rock would be placed mechanically.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations

1. Substrate Elevation and Slope

The islands would have side slopes that vary from 1 vertical on 4 horizontal to 1 vertical on 5 horizontal. Above-water top widths of islands would vary from about 105 to 125 feet, and top elevations would vary from 662 to 663 feet above mean sea level. Mud flats would have an average elevation of 659.6 feet above mean sea level. For more detail, see Plate 11.

2. Sediment Type

Substrate in Spring Lake is predominantly silts and clays over sand. There are, however, areas of relatively clean sand near the surface covered by little or no silt.

3. Dredged/Fill Material Movement

Secondary movement of fill material used to construct the project would be negligible because the constructed features are designed to be stable. Also, the amount of material unintentionally redeposited during mechanical or hydraulic dredging would be negligible because techniques would be used to minimize this impact.

4. Physical Effects on Benthos

Any organisms in the filled and dredged areas would be destroyed. However, the overall project impact to these organisms would be positive because of the improved habitat conditions.

5. Actions Taken to Minimize Impacts

A number of procedures would be used to minimize impacts where needed. Berms would be used to contain dredged material within the designated placement sites. Construction may be restricted to times of the year that do not interfere with organisms of special interest. Silt screens may be used to minimize secondary dredged material movement. It would be required that Wisconsin water quality limitations and monitoring requirements be followed during discharge.

B. Water Circulation, Fluctuation, and Salinity Determination

1. Water

The use of clean fill materials should preclude any significant impacts on water chemistry.

Some minor, short-term decreases in water clarity are expected from the proposed fill activities. The long-term effect from the proposed project features would likely be a minor improvement in water clarity in Spring Lake over present conditions.

The proposed fill activities would likely have no effect on water color, odor, or taste.

Over the long term, the project would likely decrease the winter dissolved oxygen levels in Spring Lake. The decrease in dissolved oxygen levels should be minor because some circulation of water would be maintained to prevent winter fish kills.

The proposed fill activities would likely have no effect on nutrient levels in the water or on the eutrophication rate of Spring Lake.

Over the long term, the proposed fill activities would likely cause a slight increase in winter water temperatures in Spring Lake over those found in the present condition. This would be a positive impact to habitat conditions for backwater fishes.

2. Current Patterns and Circulation

a. Current Velocity and Patterns

The proposed project features would increase the diversity of current velocities within Spring Lake by creating areas with higher and lower velocities than those present now. The current pattern within Spring Lake would also change slightly, but the overall current pattern would remain the same.

b. Stratification

The project would not significantly affect stratification in Spring Lake.

c. Hydrologic Regime

The proposed project would not significantly alter the existing hydrologic regime within the project area or pool 5.

3. Normal Water Level Fluctuations

The proposed fill activities would not likely have a significant effect on normal water level fluctuations in the project area.

4. Salinity Gradient

Not applicable.

5. Actions Taken to Minimize Impacts

No special actions would be taken to minimize the effects of the proposed project on current patterns or flow. The anticipated impacts to current patterns and flow would likely be beneficial.

C. Suspended Particulate/Turbidity Determination

1. Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site

Minor increases in suspended particulates and turbidity levels would occur from the placement of fill material and dredging in the immediate project vicinity. Upon completion of construction activities, suspended particulates and turbidity levels would return to pre-project conditions or may decrease slightly.

2. Effects on Chemical and Physical Properties of the Water Column

Project construction would result in localized turbidity plumes. Related short-term effects of this would be decreased light penetration and reduced aesthetic qualities near the construction site. Suspended particulates are not expected to cause a change in dissolved oxygen, toxic metals, organisms, or pathogens in the water column after project completion.

3. Effects on Biota

The proposed project would likely decrease the amount of sediment entering or being resuspended in Spring Lake. This material would cover substrate and change habitat conditions in the lake more rapidly than with the proposed project in place. Temporary increases in turbidity during construction would likely impair feeding activity of sight-feeding fish and may cause them to temporarily leave the area. These localized short-term increases in turbidity may have a negative impact on mussels in the immediate vicinity of these activities.

4. Actions Taken to Minimize Impacts

No special actions would be taken to minimize the impacts of the proposed project on suspended particulates or turbidity.

D. Contaminant Determinations

There is some sediment-quality data available for Spring Lake and the immediate vicinity (Table 404-1). Contaminants of concern were found to be comparable to those of other backwater sediments in pool 5. No PCB’s or chlorinated hydrocarbons were detected in Spring Lake. Most metal concentrations were within acceptable levels in Spring Lake; however, the chromium concentration in one sample collected in 1991 was higher than that normally accepted. However, because of the relatively low values of other contaminants in the same sample, the value for chromium is suspect of being erroneous. Even so, there is no reason to believe that the proposed project activities would have a significant detrimental impact on contaminant levels in Spring Lake or pool 5.

E. Aquatic Ecosystem and Organism Determination

1. Effects on Plankton

During construction, increases in turbidity and suspended solids near the dredged and filled areas would have a localized suppressing effect on phytoplankton productivity. However, these local effects would be short-term and minor. The plankton populations would recover quickly once construction activities have ceased.

2. Effects on Benthos

The proposed project would affect approximately 69 acres of benthic habitat. The benthic organisms in the affected area would either be covered or dredged. Benthic organisms would quickly be replaced in the dredged areas and would quickly colonize the new rock substrate provided by the riprap. This rock substrate would increase the benthic habitat diversity in the area. The overall conditions for benthic organisms would likely be improved in the project area, mainly because of the increased protection from sediment resuspension.

3. Effects on Nekton

During construction, increases in turbidity and suspended solids near the dredged and filled areas would have a localized suppressing effect on nekton productivity. However, these effects would be local, short-term, and minor. The nekton populations would recover quickly once construction activities have ceased.

4. Effects on Aquatic Food Web

The burial and dredging of existing benthos and localized impacts on plankton productivity could cause a temporary minor impact on the local food web. However, benthos and plankton would recover quickly, and there would likely be no long-term negative effects on the aquatic food web. The anticipated increase in aquatic vegetation coverage and diversity would likely improve the aquatic food web.

Table 404-1.

Parameter	Units	R-Weaver Bottoms	Somerfield Island	Somerfield Island	Belvidere Slough	Somerfield Island	R-Lower Weaver Bottoms	L-Behind Is N&W Spring Lake	N Spring Lake Below Closure	N Spring Lake Below Closure	N Spring Lake Below Closure	N Spring Lake Below Closure	Mount Vernon Light	Mount Vernon Light	Mount Vernon Light	Mount Vernon Light	Mount Vernon Light
River Mile		743.9	743.22	743.1	743.1	743	742.8	742.4	742.4	742.4	742.4	742.4	741.82	741.81	741.8	741.51	741.5
Collection Date	year	1984	1974	1994	1999	1980	1985	1985	1991	1991	1991	1991	1978	1978	1978	1979	1979
Record #		179	180	975	99-11M	181	709	710	1	2	3	4	182	183	184	185	186
Habitat type		3	1	1	3	1	3	3	3	3	3	3	1	1	1	1	1
Total Organic Carbon	%	NA	NA	0.027	0.7	NA	NA	NA	1.60	1.90	0.63	2.40	NA	NA	NA	NA	NA
Moisture Content	%	NA	NA	22.7	NA	NA	NA	NA	27.5	36.9	25.0	33.0	NA	NA	NA	NA	NA
Volatile Solids	%	NA	NA	0.76	2.5	NA	NA	NA	2.1	2.9	1.5	2.5	NA	NA	NA	NA	NA
Sand (>0.200 mm)	%	4	100	99.6	83.1	96	NA	NA	51	58	66	50	99	99	92	95	98
Silts & Clays	%	96	0	0.4	16.9	4	NA	NA	49	42	34	50	1	1	8	5	2
Arsenic	ppm	11	<0.6	0.83	1.6	NA	<7	<7	0.4	1.1	0.8	0.7	ND	NA	ND	ND	ND
Cadmium	ppm	2	<0.7	0.39	0.16	1.43	<0.3	0.6	0.05	0.1	0.05	0.2	<10	NA	<10	<10	<10
Chromium	ppm	24	33	4.6	9.8	28	19	29	9.3	11	57	9.5	<10	NA	<10	<10	<10
Copper	ppm	12	5	2.1	5.9	4.48	11	22	5.6	7.3	3.4	7.1	<10	NA	<10	<10	<10
Cyanide	ppm	NA	NA	<0.06	<11	NA	NA	NA	<0.5	<0.5	<0.5	<0.5	NA	NA	NA	NA	NA
Lead	ppm	20	<7	1.6	4.5	0.12	14	21	3.4	4.2	<2.5	4.3	<10	NA	<10	<10	<10
Manganese	ppm	NA	NA	170	430	NA	<1020	<825	140	180	56	120	170	NA	270	290	200
Mercury	ppm	NA	0.4	<0.05	0.028	<0.01	0.05	0.05	<0.02	<0.02	<0.02	<0.02	ND	NA	0.75	0	0
Nickel	ppm	20	26	3.9	6.6	22.6	18	20	4.7	6.9	1.9	3.3	20	NA	<10	<10	<10
Ammonia	ppm	NA	NA	NA	0.59	NA	NA	NA	0.4	1.1	0.8	2.0	NA	NA	NA	NA	NA
Zinc	ppm	48	13	10.1	22	75.4	61.5	83.2	24	28	14	22	4	NA	<10	10	10
a-BHC	ppb	NA	NA	<0.25	<0.048	NA	<10	<10	<1.0	<1.0	<1.0	<1.0	NA	NA	NA	NA	NA
b-BHC	ppb	NA	NA	<0.25	<0.048	NA	<10	<10	<1.0	<1.0	<1.0	<1.0	NA	NA	NA	NA	NA
g-BHC	ppb	NA	NA	<0.25	<0.041	NA	<10	<10	<1.0	<1.0	<1.0	<1.0	NA	NA	NA	NA	NA
d-BHC	ppb	NA	NA	<0.25	<0.042	NA	<10	<10	<1.0	<1.0	<1.0	<1.0	NA	NA	NA	NA	NA
Chlordane	ppb	<0.5	<10	<0.25	<6.1	<0.4	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
4,4'-DDD	ppb	<0.5	<10	<0.5	<0.087	<0.2	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
4,4'-DDE	ppb	<0.5	<10	<0.5	<0.084	<0.2	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
4,4'-DDT	ppb	<0.5	<10	<0.5	<0.098	<0.4	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
Dieldrin	ppb	<0.5	<10	<0.5	<0.084	<0.2	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
Endrin	ppb	<0.5	<10	<0.5	<0.094	<0.2	<10	<10	<1.0	<1.0	<1.0	<1.0	ND	ND	ND	ND	ND
Heptachlor	ppb	NA	NA	0.25	<0.043	NA	<10	<10	<1.0	<1.0	<1.0	<1.0	NA	NA	NA	NA	NA
Aroclor – 1006	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor – 1221	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor – 1232	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor – 1242	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor – 1248	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor – 1254	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Aroclor - 1260	ppb	NA	NA	<5	<1.2	NA	NA	NA	<10	<10	<10	<10	NA	NA	NA	NA	NA
Total PCBs	ppb	14	ND	NA	ND	ND	ND	ND	NA	NA	NA	NA	ND	ND	6	ND	3

Habitat type: 1 = main channel, 3 = backwater; NA – Not available; ND – Not Detected

5. **Effects on Special Aquatic Sites**

The proposed project activities would temporarily have a negative impact on wetland-type habitat within the project area. However, in the long term, the proposed project would likely have a positive impact on this habitat by increasing its diversity.

6. **Threatened and Endangered Species**

Two federally protected species have historically been known to inhabit the general project area: the bald eagle (*Haliaetus leucocephalus*) and the Higgins' eye pearlymussel (*Lampsilis higginsii*). In 2000 and 2001, the Corps of Engineers conducted mussel surveys in and near the proposed project area (see attached mussel survey report). No Higgins' eye pearlymussels were collected during these efforts. Furthermore, *Lampsilis higginsii* has not been collected in pool 5 in recent years. Therefore, it is unlikely that the proposed project would affect this species. There are currently no active bald eagle nests in the general project vicinity, and use of the area by bald eagles for feeding and perching is not significant. Therefore, it is unlikely that the proposed project would affect this species. It is the St. Paul District's determination that there would be no project related impacts to the Higgins' eye pearly mussel or the bald eagle. Concurrence by the U.S. Fish and Wildlife Service would be obtained prior to project construction.

Four State-listed mussel species were collected in or near the project area during sampling in 2000 and 2001. One round pigtoe mussel (*Pleurobema coccineum*), listed as threatened in Minnesota, was collected within the project area. Six additional round pigtoe mussels were collected outside, but near the project area. Other State-listed species collected near but outside the project area were: one black sandshell mussel (*Ligumia recta*), listed as special concern in Minnesota; two hickorynut mussels (*Obovaria olivaria*), listed as special concern in Minnesota; and three monkeyface mussels (*Quadrula metanevra*), listed as threatened in Minnesota and Wisconsin. Because only one individual of a State-listed species was collected within the project area, it is unlikely that the proposed project would have a significant effect on any State-listed or non-listed mussel species.

7. **Other Wildlife**

The proposed project would likely have a positive long-term effect on other wildlife such as waterfowl, shorebirds, turtles, and other wildlife species that would utilize habitat in the project area.

8. **Actions Taken to Minimize Impacts**

No special actions are required.

F. **Proposed Disposal Site Determinations**

1. **Mixing Zone Determination**

Dredged material placement, and dredging to obtain borrow material and equipment access would cause a minor increase in turbidity levels in the immediate project vicinity. However, no long-term adverse impacts to water quality would likely occur from any of the proposed project features/activities.

2. Determination of Compliance with Applicable Water Quality Standards

It is not anticipated that the proposed project would violate Wisconsin's water quality standards for toxicity. Rock riprap would be obtained from approved pits and quarries in the project area, and the sand fill that would be used is likely clean. This area does not have a history of contamination, which should insure that State water quality standards would not be violated during placement of this material. Water quality certification would be obtained from Wisconsin prior to project construction.

3. Potential Effects on Human Use Characteristics

a. Municipal and Private Water Supply

No municipal or private wells would be affected by the proposed project.

b. Recreational and Commercial Fisheries

The proposed project is designed in part to improve habitat for fishes in Spring Lake. Therefore, the proposed project would likely have a positive impact on recreational fishing in the area. The proposed project would not likely have a significant effect on commercial fishing.

c. Water Related Recreation and Aesthetics

The proposed habitat improvements would likely have a positive impact on recreation in the project area. Construction equipment access dredging would also provide access for recreational boat traffic. The proposed island features and the resulting improvements to aquatic vegetation would be viewed as aesthetically pleasing to most. However, the proposed rock features may be viewed as aesthetically displeasing.

d. Cultural Resources

Interest in the archaeological record of the Upper Mississippi River valley, including the area around Spring Lake in pool 5, has been ongoing since the middle of the nineteenth century (e.g., Lapham 1855). By the later part of the twentieth century, several cultural resource investigations had been conducted within and around the proposed project area. Most of these investigations were on terraces and upland landforms. Nine precontact and 11 historic sites have been identified within 1 mile of the proposed project area (e.g., Penman 1981; Rusch and Penman 1982). As of 1990, there were no cultural resources determined eligible or listed on the National Register of Historic Places. Two cultural resource surveys have been conducted along the floodplain of pool 5 (Johnson and Hudak 1975; Pleger 1997). The pool 5 surveys mainly consisted of visual inspection of shorelines. No cultural resources have been identified within the limits of the Spring Lake Habitat Rehabilitation and Enhancement Project (HREP) area, and none of the previously identified sites will be affected by the proposed project.

A Phase I cultural resources survey was conducted in 1990 across land areas designated to be affected by the dike and closure structures according to plans proposed in the Definite Project Report/Environmental Assessment (SP-12) issued in August 1991 (Withrow 1990). The Phase I survey consisted of a literature review and subsurface testing. No cultural resources were identified.

Only a portion of the current Spring Lake HREP was examined in the 1990 cultural resource survey. Areas previously surveyed include the boat landing area at the far northern end of Spring Lake, the existing portion of the original peninsula upstream from sill 1, and the two existing islands proposed for protection by rock mounds 2 and 3 (Plate 9). The current Spring Lake HREP proposes to place island protection (rock mounds 1 and 4) along two island complexes that will require a cultural resource survey.

A Phase I cultural resource survey of the Spring Lake HREP land areas not previously investigated will be conducted during the 2002 field season. Any cultural resources sites identified in the project construction limits will be evaluated for eligibility to the National Register of Historic Places. Potential project impacts to eligible properties will be mitigated prior to construction, if said impacts cannot be avoided.

G. Determination of Cumulative Effects on the Aquatic Ecosystem

A number of factors will affect the future environment of the UMR and, in this case, Spring Lake. Some of those factors include the continued operation and maintenance of the navigation system, hydrologic and hydraulic processes in an altered environment, commercial traffic, public use, point and nonpoint source pollution, commercial and residential development, agricultural practices and watershed management, and exotic species. The factors most likely to affect the future of Spring Lake are those related to sedimentation in the project area. The proposed project would likely decrease the sedimentation rate in the project area only slightly. Because of the general decrease in backwater habitat on the UMR, this would be viewed as a positive effect. The project would increase the habitat diversity in pool 5, which would be a positive effect on the ecosystem of the UMR.

H. Determination of Secondary Effects on the Aquatic Ecosystem

No significant secondary effects on the aquatic ecosystem would be expected from the proposed action.

III. FINDING OF COMPLIANCE WITH RESTRICTIONS ON DISCHARGE

1. No significant adaptations of the guidelines were made relative to this evaluation.

2. The proposed fill activity would comply with the Section 404(b)(1) guidelines of the Clean Water Act. The placement of fill is required to provide the desired benefits.

3. There are no practical and feasible alternatives to the placement of fill in the proposed sites that would meet the objectives and goals of this project.

4. The proposed fill activity would comply with State water quality standards. The disposal operation would not violate the Toxic Effluent Standards of Section 307 of the Clean Water Act.

5. The proposed projects would not harm any endangered species or their critical habitat.

6. The proposed fill activities would not result in significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing. The proposed activities would not adversely affect plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability and on recreational, aesthetic, and economic values would not occur.

7. To minimize the potential for adverse impacts, dredged material not required to construct project features would be trucked to an approved upland placement site. Because the proposed action would result in few adverse effects, no additional measures to minimize impacts would be required.

8. On the basis of this evaluation, I specify that the proposed disposal site complies with the requirements of the guidelines for discharge of fill material.

13 August 2003
Date

ROBERT L. BALL
Colonel, Corps of Engineers
District Engineer

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Habitat Evaluation Appendix

Attachment 4

HABITAT EVALUATION PROCEDURE AND INCREMENTAL ANALYSIS
SPRING LAKE ISLANDS
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

INTRODUCTION

The Wisconsin Department of Natural Resources (WDNR) and the U.S. Fish and Wildlife Service (USFWS) have determined that the primary management objectives for the Spring Lake HREP are the improvement of habitat for backwater centrarchids and waterfowl. Secondarily, habitat improvements for riverine fish species, turtles, shorebirds, mussels, invertebrates, and terrestrial plant and animal species would be enhanced where possible, and as a result of the primary management objectives. A number of features were evaluated to meet these habitat goals (Table HEP-1).

Table HEP-1. Spring Lake HREP Proposed Feature List.

ID	Feature Type	Primary Purpose(s)
S1	Sill	Reduce winter flows behind peninsula.
RM1	Rock Mound	Prevent erosion of the peninsula.
RM2-4	Rock Mound	Prevent the erosion of the small islands.
IL1a	Island	Reduce wind fetch and provide protection from winter flows.
IL1b	Island	Reduce wind fetch and provide protection from winter flows.
IL2	Island	Reduce wind fetch to promote a diverse vegetation community.
IL3	Island	Reduce wind fetch and provide protection from winter flows.
IL4	Island	Reduce wind fetch to promote a diverse vegetation community.
IL5	Island	Reduce wind fetch to promote a diverse vegetation community.
FB1-2	Fine Borrow	Fine sediment dredged to top islands.
AC1-2	Access Dredging	Dredging to provide access during construction of features.

This is an evaluation of the potential habitat benefits that would result from the construction of the proposed project features. Because the primary management objectives are to improve backwater centrarchid and waterfowl habitat, the potential benefits of the proposed project features were evaluated using species models that would reflect habitat benefits to those species.

METHODS

The U.S. Fish and Wildlife Service's 1980 version of Habitat Evaluation Procedures (HEP) was used to quantify and evaluate the potential project effects and benefits. The HEP methodology utilizes a Habitat Suitability Index (HSI) to rate habitat quality on a scale of 0 to 1 (1 being optimum). Habitat Units (HUs) are calculated by multiplying the number of acres of available habitat by the HSI (1 acre of optimum habitat = 1 HU). The HUs are added over the life of the project and then divided by the project life (usually 50 years) to obtain the Average Annual Habitat Units (AAHUs). By comparing the AAHUs available in a project area without a proposed feature to those available with a proposed feature, the incremental benefits of different features can be quantified.

Multiplying the total cost by the current interest rate for a 50-year project life gives the average annual cost of the project (AAC). The AAC is divided by the AAHUs, which results in the AAC/HU for the project. The project cost is justified if the AAC/HU is within an acceptable range. During the planning and implementation of Environmental Management Program habitat projects within the St. Paul District, an AAC/HU of $2000 has generally been accepted as justifiable, although an $3000 has been accepted in some circumstances.

Two HSI models were used in this evaluation. A bluegill habitat suitability index model developed by the USFWS with a modification for winter conditions developed by Gary Palesh and Dennis Anderson of the U.S. Army Corps of Engineers (USACE) was used to evaluate centrarchid habitat in Spring Lake. A dabbling duck migration model for the upper Mississippi River developed by Randall Devendorf of the USACE was used to evaluate waterfowl habitat in Spring Lake. This model was developed to evaluate the quality of fall migration habitat, was distributed for peer review, and the final draft was completed on May 4, 2001.

The HSI models require a wide variety of data to quantify the habitat of a study area. Bathymetric, land use, vegetation, and water quality data used in this evaluation were in the possession of the USACE or obtained from several sources including the Upper Midwest Environmental Science Center in La Crosse, WI, and the WDNR. Most of this data was available in, or converted to a GIS format to facilitate the analysis.

The proposed project features were placed into groups that were subsequently analyzed for potential habitat benefits and costs. Features were grouped together based on function, and/or interdependence. Rock features were placed into two groups defined by their influence on small island or peninsula habitat. Mudflat features were assumed to be a part of their corresponding island features. Fine-borrow and access-dredging features were not analyzed separately because they would be needed for the construction of other features. Therefore, the costs of the fine-borrow and access-dredging features are included with the costs of other features, and do not require separate analyses.

Features IL1a and IL1b were two alternative designs for a single island feature (IL1) in upper Spring Lake. The habitat benefits and costs for these features were compared to facilitate a decision on the most cost-effective alternative.

To aid the analysis, a priority was assigned to each of the proposed features. First, it was determined that it would be most important to protect the existing terrestrial habitat from further erosion. Therefore, it was determined that RM1 and S1 would be the most important features to construct, with RM2-4 being next important. All other project features are dependent on the construction of these features. The four island features were more difficult to assign a priority. However, doing so was less important because the effects of those features are largely independent of each other with a few exceptions.

Nevertheless, a priority was assigned to these features in the following order of highest to lowest: IL1 because it is "adding" to the benefit of the existing peninsula and would potentially have the greatest benefit for the least cost; IL2 because it would be constructed at the outer boundary of Spring Lake and would benefit a large area; IL4 for the same reason as IL2, but would protect a smaller area than IL2; IL3 because it is being built on the interior of Spring Lake and would likely have a high cost-benefit ratio; IL5 because it would have the least benefit and would likely be constructed after IL2 and IL4.

Most features would be dependent on the prior construction of other features based on their priority and interdependence (see Table HEP-2). Multiplicative effects were accounted for by subtracting the effect of a preceding feature from the effect of the feature being analyzed. This way, the same effect on a particular area would not be attributed to two features and, thereby, counted twice. For example, IL3 would be constructed after IL2, both of which provide wind fetch protection to a small overlapping area. Because IL3 is dependent on construction of IL2, the wind fetch benefits to the overlapping area are only attributed to IL2.

Table HEP-2. Feature Grouping (in order of descending priority) and Assumed Relationship (Dependence) to Other Feature Groups.

Feature Group	Dependent Features
S1 and RM1	None – analyzed over existing conditions.
S1 and RM1-4	None – analyzed over existing conditions.
IL1	S1 and RM1-4.
IL2	S1 and RM1-4.
IL4	S1 and RM1-4.
IL3	S1, RM1-4, IL2.
IL5	S1, RM1-4, IL2, IL4.

HUs were calculated for the project area for target year 0 (TY0) (existing conditions), TY1 (first year after construction), TY 10, and TY 50 (assumed end of project life). The HUs gained by each feature were calculated for the entire project area, rather than dividing the project area into sub-areas for each feature. The incremental gain in HUs was calculated for each feature as the increase over the HUs that would be gained by the dependent (preceding) feature listed in Table HEP-2. Therefore, the HUs for a single species can be calculated for the proposed project area by adding the incremental gains in HUs of any combination of features providing the rules of dependence in Table HEP-2 are followed.

There were a number of broad assumptions made during this analysis: 1) the present forces acting on Spring Lake would remain constant throughout the life of the project; 2) the period of analysis for the project (project life) was 50 years; 3) the models used in the analysis adequately represent the habitat requirements of the respective species. More specific assumptions made for calculating the HUs for each feature include: 1) without the project, the small islands in upper Spring Lake would erode within 10 years, and the unprotected portion of the peninsula would erode within 50 years; 2) the shallow water at the east end of IL3 would freeze nearly to the bottom in winter, thereby effectively cutting off flows; 3) a cut would not form through the shallow water area east of IL3 except possibly during the most extreme flooding events; 4) in the absence of IL3 the area around it would not be protected well enough to establish a diverse vegetation community with only IL1 and IL2 in place because of shallow water, relatively long wind fetch, and unconsolidated substrates; 5) mudflats would likely succeed to emergent vegetation within 10 years of project construction; 6) in the absence of project features, the bathymetric diversity of Spring Lake would be greatly reduced because of bottom leveling by wind and wave action; 7) the operation of the 9-Foot Channel Navigation Project would not change; 8) the HSI models used in this evaluation are adequate for characterizing habitat in Spring Lake. The HSI calculations were completed for each proposed project feature based on these assumptions and others as indicated in attached Habitat Suitability Matrices (Enclosure 1).

The HSI for the existing (no-action) condition and that attributable to each feature was calculated for each target year (Table HEP-3). These values were used to calculate the AAHUs gained by each proposed project feature. The "Incr. Gain - AAHU" in Table HEP-3 for each feature is the incremental gain in AAHUs over the AAHUs attributable to the dependent features listed in Table HEP-2. A cost estimate was then obtained for each feature that was used to calculate the corresponding AAC/HU. Features proposed for construction are highlighted in Table HEP-3 for the HSI evaluation model that identified the most cost-effective habitat outputs.

RESULTS

The results of the HEP analysis can be found in the Habitat Suitability Matrices and in Table HEP-3. The bluegill and dabbling duck models analyses produced 158 and 102 AAHUs respectively, for the no-action alternative. All feature group analyses showed likely improvements in the AAHUs for the dabbling duck model, whereas all but three feature group analyses showed improvements in AAHUs for the bluegill model. The feature group that would likely produce the greatest incremental gain in combined benefits for bluegills and dabbling ducks was RM1-4 & S1 with a total gain of 69 AAHUs. Incidentally, this was the feature group that was determined to have highest priority. The feature with the next greatest overall gain was IL3 with 64 AAHUs. The feature that would likely provide the least overall gain was IL5 with a total of 2 AAHUs.

The results of the incremental analysis can also be found in Table HEP-3. All features but one were less than $2000/AAHU when evaluated with the bluegill model, the dabbling duck model, or both. Feature IL5 did not provide measured bluegill benefits and the AAC/HU calculated by the dabbling duck model was $17,027.

Two designs for IL1 were evaluated. The bluegill model analysis provided the most benefits for both alternatives and therefore was used in the following comparison. The analysis of design alternative IL1a produced 24 AAHUs with an AAC/HU of $2527. The analysis of design alternative IL1b produced 14 AAHUs with an AAC/HU of $1017. While design IL1a would provide 10 more AAHU than design IL1b, it has an additional

AAC of $46,007. This means that the additional HUs gained by design IL1a would cost $4600/AAHU.

Total project mobilization costs were allocated to each feature group based on the proportionate cost of that feature group. It could be argued that the mobilization cost would be incurred if only one feature group were constructed. Therefore, as a check, an incremental analysis was completed with all of the mobilization costs added to the cost of feature group RM1-4 & S1, the likely minimum project. This resulted in an AAC/HU of $1226 for that feature group.

DISCUSSION

For bluegills and migrating ducks, the project area currently lacks some important habitat qualities that would decline further by the end of the project life with the no-action alternative. Quality overwintering habitat is the primary bluegill deficiency in the project area. More specifically, the area lacks habitat protected from winter flow with relatively warm water. The poor conditions for these two habitat variables account for the majority of low suitability for bluegill habitat in the project area. For migrating ducks the project area is lacking a diversity of plant communities and total acreage of aquatic plants, and each of these variables would likely decline further by the end of the project life. Also lacking, are visual barriers that would provide security, and thermal protection (wind protection) that would prevent energy loss.

Any of the presented feature groups would have differing impacts on these key variables of bluegill and migrating duck habitat. Some feature groups do a better job of affecting some variables than others, while some affect all variables. While the resource (bluegills or ducks) that would benefit the most by the construction of a given feature group is presented as feature justification, some feature groups provide multiple benefits that are not captured by the methods used here. What follows is a description of all the more obvious benefits that would likely result from the construction of each feature group.

It is important to note that bluegill benefits derived from dredging borrow material were not included in the numerical HSI analyses. It was not included because the many uncertainties in quantities, borrow areas, and borrow area configurations made such estimates problematic. However, these benefits are real and should be considered while selecting features for construction, just as other factors such as combined bluegill and duck benefits should be considered.

RM1-4 & S1

The rock mounds would serve to protect the existing islands from further erosion, thereby stabilizing the northern end of the project area. This would also prevent the future loss of the aquatic plant beds currently being protected by these islands. The sill (S1) would decrease flows into upper Spring Lake. This would increase the winter habitat suitability for bluegills in this area by decreasing velocities and by reducing the inflow of cold water. However, there would still be some limitation of the habitat quality for overwintering bluegills in the upper end of Spring Lake because of the relatively shallow water. Dredging borrow material in this area for other features would rectify this deficiency.

IL1 and Mudflat: This island feature would be constructed as an extension of the existing peninsula. Its greatest habitat benefit would be the increase in area protected from winter flows for bluegills. While this island would not be positioned in a fashion to provide good wind fetch protection, it would likely elicit a small vegetation response and would provide some thermal protection for ducks. The mudflat would provide some shallow water for ducks and some loafing habitat. It would also become vegetated with emergents, thereby increasing the acreage of a vegetation community with little coverage now. Also, the required fill would be taken from within the project area, thereby creating additional deepwater habitat. Topsoil for the island would be taken from upper Spring Lake and would improved overwintering habitat there.

IL2 and Mudflat: The primary benefits gained by constructing this feature would be to migrating ducks. Because of its configuration relative to the flow direction, there would be little area protected from winter flows for bluegills. This island feature, however, is positioned to provide good protection from prevailing winds and would likely elicit a good vegetation response. It would also provide a visual barrier and thermal protection for migrating ducks. The associated mudflat would provide loafing and shallow-water habitat and would become vegetated with emergents. Fill required for construction of this feature group would benefit fish by providing deepwater habitat.

IL3 and Mudflat: This island feature would provide many benefits to bluegills and migrating ducks. There would likely be a significant area on the downstream side of the island protected from winter flows, thereby creating habitat with low velocities and warmer temperatures. The curved arm at the far eastern end of the island is positioned so that the shallow water between the island and shore would freeze nearly to the bottom, thereby cutting off cold winter flows. Also, much borrow material would be needed to construct this feature, some of which would be taken from upper Spring Lake. This would provide deep water required for quality overwintering habitat there. This island feature would protect a large area from wind and would likely elicit a good vegetation response over that area. It would also provide a visual barrier and thermal protection from many directions for migrating ducks. The mudflat would provide shallow-water habitat and would become vegetated with emergents.

IL4 and Mudflat: This feature group would provide much of the same types of benefits as the IL2 feature group would, only in a different location. There would be little benefit to overwintering bluegills, but significant benefits to migrating ducks. These benefits would be provided by the improvement in vegetation and the increase in areas with visual barriers and thermal protection.

IL5: Because this feature would protect little or no area from winter flow, it would provide few or no benefits to bluegills. This feature would provide some protection from prevailing winds and would likely elicit a good vegetation response.

However, it would provide some protection to an area that would likely already be protected by IL2. This feature would provide some limited thermal protection and a small visual barrier. It does not include a mudflat but borrow material used in island construction would be dredged from within Spring Lake and would provide additional deepwater habitat.

There are many additional benefits attributable to these features that were not captured by the habitat models or the previous discussion. The island features would provide habitat for many terrestrial animals. Turtles would likely nest on the islands and minor features such as sand deposits would likely be added to facilitate this. Island features would be placed to enhance existing flowing-channel habitat to improve localized conditions for riverine species of fish and mussels. Numerous species of aquatic insects would benefit by the increase in vegetation coverage and diversity. Overall, the proposed project would provide many habitat benefits to a wide array of organisms.

Table HEP-3. Spring Lake HREP HEP and Incremental Analysis.

Bluegill Model - 485 acres of available habitat						Cumulative Habitat Units				Incr. Gain	Total Cost	AAC	AAC/HU
Feature Group	TY0 HSI	TY1 HSI	TY10 HSI	TY50 HSI	Exist HU	TY0-TY1	TY1-TY10	TY10-TY50	AAHU	AAHU	($1,000)	($)	($)
No Action	0.35	0.35	0.35	0.28	170	170	1537	6174	158	0	0	0	0
The incremental gain in AAHU for the following features was calculated using the no action "base" with 158 AAHU.													
RM1 & S1	0.35	0.41	0.41	0.4	170	184	1790	7857	197	39	139	8,665	**222**
RM1-RM4 & S1	0.35	0.41	0.41	0.4	170	184	1790	7857	197	39	489	30,484	**782**
The incremental gain in AAHU for the following features was calculated using RM1-RM4 & S1 as a "base project" with 197 AAHU.													
IL1a	0.35	0.46	0.46	0.45	170	196	2008	8827	221	24	973	60,657	**2527**
IL1b	0.35	0.44	0.44	0.43	170	192	1921	8439	211	14	235	14,650	**1017**
IL2	0.35	0.41	0.41	0.4	170	184	1790	7857	197	0	756	47,129	ND
IL3	0.35	0.45	0.44	0.44	170	194	1942	8536	213	17	1186	73,935	4393
IL4	0.35	0.41	0.41	0.4	170	184	1790	7857	197	0	632	39,399	ND
IL5	0.35	0.41	0.41	0.4	170	184	1790	7857	197	0	543	33,851	ND

Dabbling Duck Model - 497 acres of available habitat						Cumulative Habitat Units				Incr. Gain	Total Cost	AAC	AAC/HU
Feature Group	TY0 HSI	TY1 HSI	TY10 HSI	TY50 HSI	Exist HU	TY0-TY1	TY1-TY10	TY10-TY50	AAHU	AAHU	($1,000)	($)	($)
No Action	0.27	0.27	0.22	0.17	134	134	1096	3877	102	0	0	0	0
The incremental gain in AAHU for the following features was calculated using the no action "base" with 102 AAHU.													
RM1 & S1	0.27	0.27	0.22	0.19	134	134	1096	4075	106	4	139	8,665	2179
RM1-RM4 & S1	0.27	0.27	0.27	0.26	134	134	1208	5268	132	30	489	30,484	1014
The incremental gain in AAHU for the following features was calculated using RM1-RM4 & S1 as a "base project" with 132 AAHU.													
IL1a	0.27	0.3	0.3	0.28	134	142	1342	5765	145	13	973	60,657	4749
IL1b	0.27	0.29	0.29	0.28	134	139	1297	5666	142	10	235	14,650	1489
IL2	0.27	0.3	0.32	0.32	134	142	1387	6362	158	26	756	47,129	**1841**
IL3	0.27	0.34	0.36	0.37	134	152	1566	7256	179	47	1186	73,935	**1564**
IL4	0.27	0.3	0.31	0.31	134	142	1364	6163	153	21	632	39,399	**1861**
IL5	0.27	0.27	0.27	0.27	134	134	1208	5368	134	2	543	33,851	**17027**

Notes:

ND = not defined

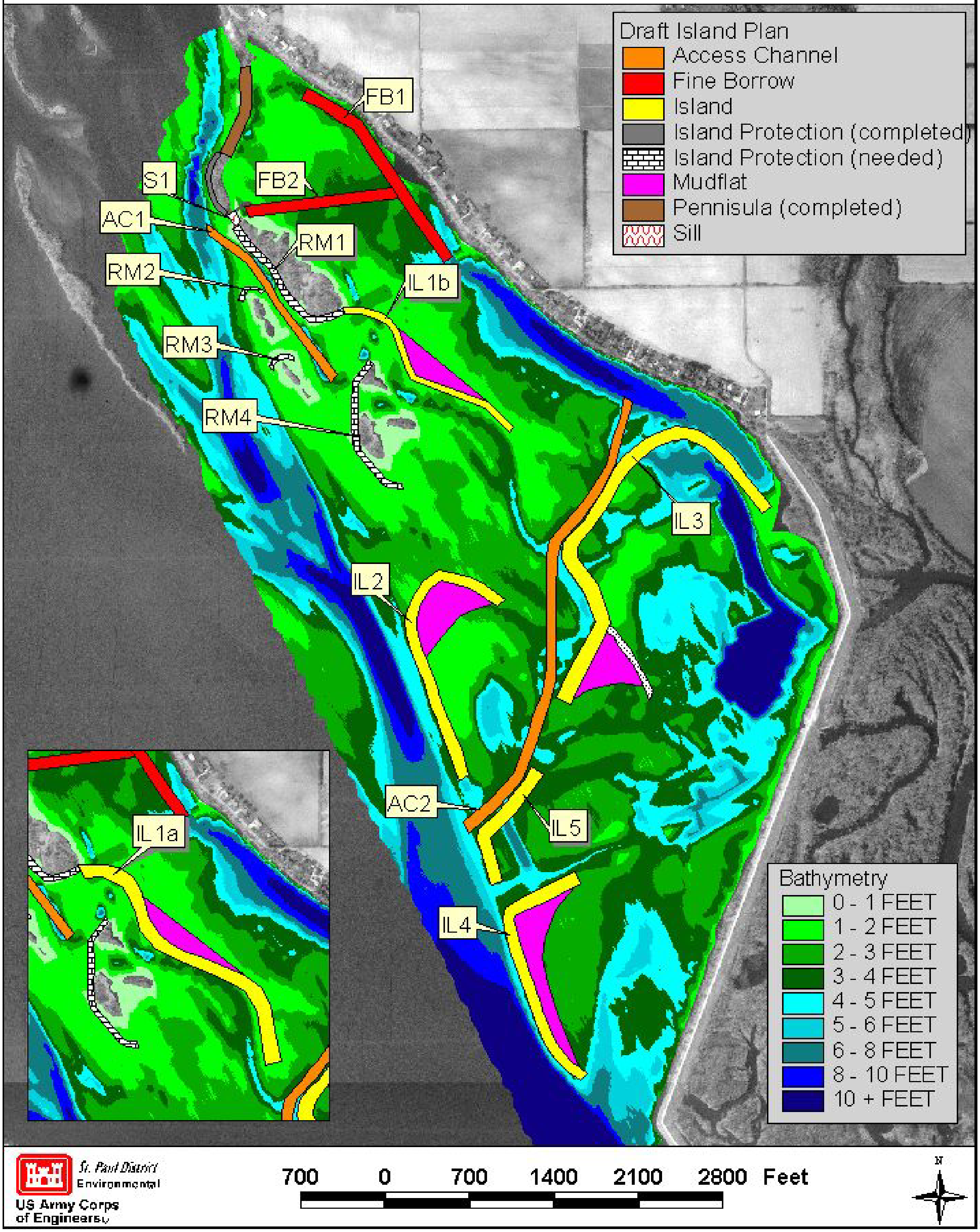
Highlighted features are those proposed for construction and the evaluation model that produced the lowest AAC/HU.

Even though the combined feature group of RM1-RM4 & S1 is justified based on the bluegill model, the incremental increase from RM1 & S1 (the addition of RM2 - RM 4) would be justified based on the dabbling duck model at a cost of $839/AAHU.

The AAC/HU for all features are independent of those features not listed as dependent in Table HEP-2.

Project mobilization costs were allocated to each feature based on the proportionate cost of each feature.

Figure 1. Spring Lake HREP Island Plan



Existing Conditions - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - 150 acres of cover.
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	Spring Lake data collected for Weaver Bottoms Rehabilitation Project, 1985-1995
V7	pH Range	Class A	1	assumed non-limiting
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	minimum DO of 7.5 ppm from WDNR Data August 1996 below peninsula
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM
Vc	Water Temperature	ave-0.4 C	0.15	1995 Winter Monitoring Data from WDNR-LTRM
Vd	Current Velocity	ave-2 cm/s	0.19	1995 Winter Monitoring Data from WDNR-LTRM
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.72	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.15	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.15	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.35	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	~31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	ave-0.4 C	0.15	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vd	Current Velocity	ave-2 cm/s	0.19	1995 Winter Monitoring Data from WDNR-LTRM - no change
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.72	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.15	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.15	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.35	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres; Available Bluegill Habitat - 488 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.7	loss of some "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss of dense vegetation; still greater than 15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.59	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.6	loss of some depth due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no appreciable change
Vc	Water Temperature	<0.4 C	0.15	loss of small islands has minimal effect on cold water flows
Vd	Current Velocity	>2 cm/s	0.19	loss of small islands has minimal effect on flows
	Winter Cover (Cw-c)		0.6	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.72	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.15	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.15	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.35	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres; Available Bluegill Habitat - 490 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.65	loss of "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of dense vegetation; still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no appreciable change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no appreciable change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no appreciable change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no appreciable change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no appreciable change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no appreciable change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.55	loss of depth due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no appreciable change
Vc	Water Temperature	<0.4 C	0.1	decrease in area protected from cold water flows with loss of peninsula
Vd	Current Velocity	>2 cm/s	0.15	decrease in area protected from flows with loss of peninsula
	Winter Cover (Cw-c)		0.55	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.70	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.15	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.1	Cw-ot = Vd
	Winter HSI		0.41	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.1	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.28	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Existing Conditions - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		64 acres or 13%
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~3 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		15.5 acres or 3% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 132.5

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year One Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~3 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		No change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 132.5

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year 10 Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike), rarely if ever flooded in fall.
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks.
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Based on 1989 landcover.
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No significant change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		No significant change.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		>89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Loss of beds with loss of small islands.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 1	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Five communities present, but 4 are relatively limited.
b) 4 - 6 vegetation communities present	6	ENTER	1995 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 4	Loss of one community with loss of small islands.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			loss of small islands in upper SL would result in the
a) >75%	10		loss of one species and/or the coverage of food plant
b) 50 -75%	8		species.
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 4	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 110.4

TOTAL= 20
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.22

Target Year 50 Conditions Without Project - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		No significant change.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		>89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Loss of beds with loss of peninsula.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 1	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Only submergent community and one other remains.
b) 4 - 6 vegetation communities present	6	ENTER	Likely limited amounts of floating-leaved rooted
c) 2-4 vegetation communities present	4	VALUE= 2	aquatics.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			loss of large island in upper SL would result in further
a) >75%	10		loss of species and/or the coverage of food plant
b) 50 -75%	8		species.
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 2	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Loss of island but shallow water areas increase.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Loss of islands would result in a decrease in the
b) <5% of the area protected	3		thermal protection.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 1	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 82.83

TOTAL= 15
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.17

Target Year One Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.7	loss of some "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss of dense vegetation; still greater than 15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.59	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.6	loss of some depth due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no appreciable change
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.6	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.65	loss of "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of dense vegetation; still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no appreciable change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no appreciable change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no appreciable change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no appreciable change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no appreciable change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no appreciable change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no appreciable change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.55	loss of depth due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no appreciable change
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.55	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.40	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		64 acres or 13%
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~3 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		15.5 acres or 3% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 132.5

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year 10 Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike), rarely if ever flooded in fall.
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks.
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Based on 1989 landcover.
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No significant change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		No significant change.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		<89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Loss of beds with loss of small islands.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 1	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Five communities present, but 4 are relatively limited.
b) 4 - 6 vegetation communities present	6	ENTER	1995 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 4	Loss of one community with loss of small islands.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			loss of small islands in upper SL would result in the
a) >75%	10		loss of one species and/or the coverage of food plant
b) 50 -75%	8		species.
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 4	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		Loss of small islands but increase in shallow water.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 1.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 107.7

TOTAL= 20
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.22

Target Year 50 Conditions With RM1 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		No significant change.
b) >5% - ≤10%	5		
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		<89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No significant change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 1	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Three communities remain but two are limited.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 3	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Species composition remains constant but coverage
a) >75%	10		of important species decreases in unprotected areas.
b) 50 -75%	8		
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 3	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		No significant change.
b) 5% - 10%	2		
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 1.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 96.64

TOTAL= 18
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.19

Target Year One Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	Spring Lake data collected for Weaver Bottoms Rehabilitation Project, 1985-1995
V7	pH Range	Class A	1	assumed non-limiting
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	minimum DO of 7.5 ppm from WDNR Data August 1996 below peninsula
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.71	small islands protect some pool (~9 acres)
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.61	small islands protect some pool
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.61	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.66	small islands protect some pool (~9 acres) - no change
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no significant change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no significant change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no significant change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no significant change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no significant change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no significant change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no significant change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.56	small islands protect some pool - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	Increase in temp E of peninsula with construction of S1
Vd	Current Velocity	ave-2 cm/s	0.19	No appreciable change in velocity with construction of S1
	Winter Cover (Cw-c)		0.56	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.40	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~3 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		No change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 132.5

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year 10 Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		
b) >5% - ≤10%	5		No significant change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 132.5

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year 50 Conditions With RM1-RM4 and S1 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		
b) >5% - ≤10%	5		No significant change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	Some loss of coverage in unprotected areas.
d) 10 - 25%	4	VALUE= 5	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Areas with water depths < 4 inches and low islands.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		about 1% of area protected.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497 TOTAL= 23
Habitat Units = 127 MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.26

Target Year One Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.25	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.24	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.25	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.24	Cw-ot = Vd
	Winter HSI		0.54	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.25	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.46	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.71	loss of some "pool" area to due leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.62	loss of some "pool" area to due leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.25	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.24	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.62	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.25	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.24	Cw-ot = Vd
	Winter HSI		0.54	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.25	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.46	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.66	loss of some "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.57	loss of some "pool" area due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.25	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.24	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.57	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.25	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.24	Cw-ot = Vd
	Winter HSI		0.53	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.25	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.45	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 476 acres - Terrestrial (islands/mudflats) 21 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	Still <20%
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		slightly increased due to mudflat.
c) >10% - <15%	7		Still <5%
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Slight decrease with Island and Mudflat.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 147.4

TOTAL= 27
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.30

Target Year 10 Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike), rarely if ever flooded in fall.
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks.
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Based on 1989 landcover.
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No significant change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		May decrease with mudflat succession to emergent veg.
c) >10% - <15%	7		Value is still 1.
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Increased coverage of emergent and floating-leaved
c) 25 - 40%	7		vegetation.
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	No further change.
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 149.1

TOTAL= 27
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.30

Target Year 50 Conditions With RM, S1, IL1a, and MF1a - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		Increased due to mudflat.
c) >10% - <15%	7		Assumed no further change.
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		<89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	Some loss of coverage in unprotected areas.
d) 10 - 25%	4	VALUE= 5	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		24.5 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	No further change.
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 140.8

TOTAL= 26
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.28

Target Year One Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.23	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.22	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.74	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.23	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.22	Cw-ot = Vd
	Winter HSI		0.53	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.23	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.44	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.71	loss of some "pool" area to due leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.62	loss of some "pool" area to due leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.23	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.22	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.62	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.74	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.23	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.22	Cw-ot = Vd
	Winter HSI		0.52	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.23	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.44	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 476 acres - Terrestrial (islands/mudflat) 21 acres; Available Bluegill Habitat - 476 acres (Option A covers 9 acres)

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.66	loss of some "pool" area due to leveling by wave action
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.57	loss of some "pool" area due to leveling by wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.23	Island protects about 25 acres from cold water flows
Vd	Current Velocity	<2 cm/s	0.22	Island protects about 25 acres from flows
	Winter Cover (Cw-c)		0.57	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.74	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.23	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.22	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.23	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.43	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 476 acres - Terrestrial (islands/mudflats) 21 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	Still <20%
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		slightly increased due to mudflat.
c) >10% - <15%	7		Still <5%
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Slight decrease with Island and Mudflat.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 144.7

TOTAL= 26
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.29

Target Year 10 Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike), rarely if ever flooded in fall.
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks.
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Based on 1989 landcover.
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No significant change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		May decrease with mudflat succession to emergent veg.
c) >10% - <15%	7		Value is still 1.
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Increased coverage of emergent and floating-leaved
c) 25 - 40%	7		vegetation.
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	No further change.
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 146.3

TOTAL= 27
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.29

Target Year 50 Conditions With RM, S1, IL1b, and MF1b - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres, Available Duck Habitat - 497 acres.

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change.
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~5 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		Increased due to mudflat.
c) >10% - <15%	7		Assumed no further change.
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		<89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	Some loss of coverage in unprotected areas.
d) 10 - 25%	4	VALUE= 5	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		24.5 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection, especially from east-west wind.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Some barrier provided by island.
b) Barriers from most directions/sources of disturbance	3	ENTER	No further change.
c) Multiple lines of barriers	5	VALUE= 2	

Acres of Available Habitat = 497
Habitat Units = 138.1

TOTAL= 25
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.28

Target Year One Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.72	island protects some "pool" area from wind and wave action (~ 9 acres)
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	island protects existing vegetation - no increase
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.62	island protects some "pool" area from wind and wave action (~ 9 acres)
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.62	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.67	island protects some "pool" area from wind and wave action (~ 9 acres)
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	island protects existing vegetation - no increase
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no significant change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no significant change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no significant change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no significant change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no significant change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no significant change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no significant change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.57	island protects some "pool" area from wind and wave action (~ 9 acres)
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.57	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.40	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	Still <20%.
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~7 acres - ArcView analysis of bathymetry and mudflat.
b) >5% - ≤10%	5		Still <5%
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Slight decrease with island and mudflat.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 3	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Slight increase with island.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 149.1

TOTAL= 27
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.30

Target Year 10 Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		1/4 of the area protected from wave action will convert
c) 25 - 40%	7		to emergent and/or rooted floating aquatics (~8 acres).
d) 40 - 60%	10	ENTER	~ 87%
e) 60 -75%	7	VALUE= 4	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No significant change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 157.4

TOTAL= 29
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.32

Target Year 50 Conditions With RM, S1, IL2, and MF2 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		1/4 of the area protected from wave action will convert
c) 25 - 40%	7		to emergent and/or rooted floating aquatics.
d) 40 - 60%	10	ENTER	No further change.
e) 60 -75%	7	VALUE= 4	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		25 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No significant change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 157.4

TOTAL= 29
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.32

Target Year One Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.24	Island protects about 20 acres from cold water flows in lower SL
Vd	Current Velocity	<2 cm/s	0.23	Island protects about 20 acres from flows in lower SL
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.24	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.23	Cw-ot = Vd
	Winter HSI		0.54	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.24	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.45	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.73	Significant area protected by island
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	>31%	0.95	~10 acre increase in dense vegetation.
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.59	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.63	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.82	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.63	Significant area protected by island
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.24	Island protects about 20 acres from cold water flows in lower SL
Vd	Current Velocity	<2 cm/s	0.23	Island protects about 20 acres from flows in lower SL
	Winter Cover (Cw-c)		0.63	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.24	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.23	Cw-ot = Vd
	Winter HSI		0.53	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.24	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.44	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.68	Loss of some "pool" habitat in unprotected areas.
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	>31%	0.95	~10 acre increase in dense vegetation.
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no significant change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no significant change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no significant change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no significant change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no significant change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no significant change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no significant change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.58	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.79	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.58	Loss of some "pool" habitat in unprotected areas.
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.24	Island protects about 20 acres from cold water flows in lower SL
Vd	Current Velocity	<2 cm/s	0.23	Island protects about 20 acres from flows in lower SL
	Winter Cover (Cw-c)		0.58	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.75	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.24	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.23	Cw-ot = Vd
	Winter HSI		0.52	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.24	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.44	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~6 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		Increased by mudflat.
c) >10% - <15%	7		Still <5%
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Slight decrease with island and mudflat.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 3	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants) (multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		~28 acres or 6% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		Protection from multiple directions.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Island provides barrier.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 2.5	

Acres of Available Habitat = 497
Habitat Units = 168.4

TOTAL= 31
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.34

Target Year 10 Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		
c) 25 - 40%	7		1/4 of the area protected from wave action will convert
d) 40 - 60%	10	ENTER	to emergent and/or rooted floating aquatics (~20 acres)
e) 60 -75%	7	VALUE= 4.5	~85%
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		28 acres or ~6% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		Protection from multiple directions.
c) at least 5% of the area protected	5	ENTER	No change.
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Island provides barrier.
b) Barriers from most directions/sources of disturbance	3	ENTER	No significant change.
c) Multiple lines of barriers	5	VALUE= 2.5	

Acres of Available Habitat = 497
Habitat Units = 179.5

TOTAL= 33
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.36

Target Year 50 Conditions With RM, S1, IL3, and MF3 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		
c) 25 - 40%	7		1/4 of the area protected from wave action will convert
d) 40 - 60%	10	ENTER	to emergent and/or rooted floating aquatics.
e) 60 -75%	7	VALUE= 4.5	No further change.
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Minor increase in important food plant coverage.
a) >75%	10		
b) 50 -75%	8		
c) 25 - 50%	6	ENTER	
d) 10 - 25%	4	VALUE= 6.5	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		~28 acres or 6% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		Protection from multiple directions.
c) at least 5% of the area protected	5	ENTER	No change.
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Island provides barrier.
b) Barriers from most directions/sources of disturbance	3	ENTER	No significant change.
c) Multiple lines of barriers	5	VALUE= 2.5	

Acres of Available Habitat = 497
Habitat Units = 182.2

TOTAL= 33
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.37

Target Year One Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry - no change
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry - no change
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.72	island protects some area from wind and wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	Island protects existing dense veg - no significant increase
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.62	island protects some area from wind and wave action
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.62	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.67	loss of "pool" area due to leveling by wave action in unprotected areas
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	island protects existing veg - some loss in other areas
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no significant change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no significant change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no significant change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no significant change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no significant change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no significant change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no significant change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.57	loss of "pool" area due to leveling by wave action in unprotected areas
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.57	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.40	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		Still <20%
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~8 acres - ArcView analysis of bathymetry and mudflat.
b) >5% - ≤10%	5		Still <5%
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Slight decrease with island and mudflat.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 3	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants) **(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)**			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		24 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		Slight increase with island.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 149.1

TOTAL= 27
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.30

Target Year 10 Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No significant change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No significant change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		1/4 of the area protected from wave action will convert
c) 25 - 40%	7		to emergent and/or rooted floating aquatics (~3 acres).
d) 40 - 60%	10	ENTER	~88%
e) 60 -75%	7	VALUE= 3.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		24 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No significant change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 154.6

TOTAL= 28
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.31

Target Year 50 Conditions With RM, S1, IL4, and MF4 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Assume no appreciable change from current
b) <1 mile with some residues remaining	3	ENTER	conditions.
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		May decrease with mudflat succession to emergent
b) >5% - ≤10%	5		wetland. Value is still 1.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		
b) 10 - 25 %	5		1/4 of the area protected from wave action will convert
c) 25 - 40%	7		to emergent and/or rooted floating aquatics.
d) 40 - 60%	10	ENTER	No further change.
e) 60 -75%	7	VALUE= 3.5	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		At least one community increases in extent.
b) 4 - 6 vegetation communities present	6	ENTER	
c) 2-4 vegetation communities present	4	VALUE= 5.5	
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		24 acres or 5% - ArcView analysis of bathymetry.
b) 5% - 10%	2		Areas with water depths < 4 inches and low islands.
c) >10% - 15%	3	ENTER	No significant change.
d) >15% - <30%	4	VALUE= 1.5	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Increased protection with island.
b) <5% of the area protected	3		No significant change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 3	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No significant change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1.5	

Acres of Available Habitat = 497
Habitat Units = 154.6

TOTAL= 28
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.31

Target Year One Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	45.6%	0.75	221 acres > 3 feet deep; ArcView analysis of bathymetry
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation
V3	% Cover (vegetation)	31%	1	2001 LTRM vegetation data for Spring Lake - no change
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	Spring Lake data collected for Weaver Bottoms Rehabilitation Project, 1985-1995
V7	pH Range	Class A	1	assumed non-limiting
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	minimum DO of 7.5 ppm from WDNR Data August 1996 below peninsula
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce
	Food (Cf)		0.61	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	23.3%	0.65	113 acres > 4 feet deep; ArcView analysis of bathymetry
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.65	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.51	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 10 Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<45%	0.71	small area protected from wave action
V2	% Cover (logs & brush)	< 5%	0.3	very limited - based on visual observation - no change
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	data collected for Weaver Bottoms Rehabilitation Project, 1985-1995 - no change
V7	pH Range	Class A	1	assumed non-limiting - no change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	7.5 ppm from WDNR Data August 1996 below peninsula - no change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V11	Avg. Water Temp. (Spawning)	22 C	1	average temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V12	Max. Early Summer Temp. (Fry)	26 C	1	maximum temp. during June from WDNR data for pool 5 1984 - 1997 - no change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	maximum summer temp. (July) from WDNR data for pool 5 1984 - 1997 - no change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no change
	Food (Cf)		0.60	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.65	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.83	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	<23.3%	0.61	small area protected from wave action that would not be protected by IL2 or IL4
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.61	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.50	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.41	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year 50 Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI) **BLUEGILL MODEL**, Riverine Version.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres; Available Bluegill Habitat - 485 acres

EXISTING HSI BLUEGILL MODEL (non-winter)		Conditions		Comments
Variable	Description	DATA	HSI	
V1	% Pool Area	<46%	0.66	loss of much "pool" in unprotected areas
V2	% Cover (logs & brush)	< 5%	0.2	estimated at near zero
V3	% Cover (vegetation)	<31%	1	some loss of veg cover in unprotected areas, still >15%
V4	% Littoral Area	nf	nf	not a factor in the riverine model
V5	Avg. Total Dissolved Solids (TDS)	nf	nf	not a factor in the riverine model
V6	Avg. Turbidity	< 30 ppm	1	assume no significant change
V7	pH Range	Class A	1	assumed non-limiting - assume no significant change
V8	Min. Dissolved Oxygen (DO) - Summer	Class A	1	assume no appreciable change
V9	Salinity	N/A	N/A	not applicable to the UMR
V10	Max. Midsummer Temp. (Adult)	27.5 C	0.9	assume no significant change
V11	Avg. Water Temp. (Spawning)	22 C	1	assume no significant change
V12	Max. Early Summer Temp. (Fry)	26 C	1	assume no significant change
V13	Max. Midsummer Temp. (Juvenile)	27.5 C	0.85	assume no significant change
V14	Avg. Current Velocity	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V15	Avg. Current Velocity (Spawning)	na	1	in areas 3 to 10 feet deep; Assumed to be non-limiting - no significant change
V16	Avg. Current Velocity (Fry)	na	1	in areas 1 to 3 feet deep; Assumed to be non-limiting - no significant change
V17	Avg. Current Velocity (Juvenile)	na	1	in areas 1 to 10 feet deep; Assumed to be non-limiting - no significant change
V18	Stream Gradient	~0	1	assumed to be nearly zero in lower Pool 5 - no change
V19	Reservoir Drawdown	nf	nf	not a factor in the riverine model
V20	Substrate Composition	Class B	0.7	fines are present, gravel is assumed to be scarce - no appreciable change
	Food (Cf)		0.51	Cf = (V1 * V2 * V3) ^ (1/3)
	Cover (Cc)		0.60	Cc = (V2 + V3) / 2
	Water Quality (Cwq)		0.97	Cwq = [V6 + V7 + 2V8 + 2(V10 * V12 * V13) ^(1/3))] / 6
	Reproduction (Cr)		0.89	Cr = (V11 * V15 * V20) ^ (1/3)
	Other (Cot)		1.00	(((V14 + V16 + V17) / 3) + V18) / 2
	HSI		0.80	(Cf * Cc * Cwq^2 * Cr * Cot) ^ (1/6)
WITH WINTER HSI MODIFICATIONS				
Variable	Description			
Va	Water Depth	10%-20%	0.56	loss of depth due to leveling by wave action in unprotected areas
Vb	Dissolved Oxygen	>5 mg/l	1	1995 Winter Monitoring Data from WDNR-LTRM - no significant change
Vc	Water Temperature	>0.4 C	0.2	No change
Vd	Current Velocity	>2 cm/s	0.19	No appreciable change in velocity with construction of island
	Winter Cover (Cw-c)		0.56	Cw-c = Va
	Winter Water Quality (Cw-wq)		0.73	Cw-wq = (2Vb + Vc) / 3
	Corrected Cw-wq		0.2	Lesser of Vb or Vc if Vb or Vc is <= 0.4
	Winter Other (Cw-ot)		0.19	Cw-ot = Vd
	Winter HSI		0.49	(Cw-c * Cw-wq^2 * Cw-ot) ^ (1/4)
	Corrected Winter HSI		0.2	If Cw-wq is <= 0.4, use that value
	Composite HSI with Winter Modifications		0.40	(sum. HSI * wint. HSI)^(1/2) - assumes habitat is connected to other suitable habitat

Target Year One Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 485 acres - Terrestrial (islands) 12 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		~3 acres - ArcView analysis of bathymetry.
b) >5% - ≤10%	5		No change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		Insignificant decrease with island.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Island provides some loafing structure.
b) 5% - 10%	2		
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Some added protection with island.
b) <5% of the area protected	3		
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat =	497	TOTAL=	25
Habitat Units =	136.4	MAXIMUM POSSIBLE TOTAL =	90
		HSI =	0.27

Target Year 10 Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 488 acres - Terrestrial (islands) 9 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		ArcView analysis of bathymetry.
b) 40 - 50%	8		No change.
c) 30 - 40%	6	ENTER	
d) 20 - 30%	4	VALUE= 1	
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		
b) >5% - ≤10%	5		No significant change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	No change.
d) 10 - 25%	4	VALUE= 6	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Island provides some loafing structure.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Some added protection with island.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 136.4

TOTAL= 25
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Target Year 50 Conditions With RM, S1, and IL5 - Spring Lake: Habitat Suitability Index (HSI),
DABBLING DUCK MIGRATION HABITAT MODEL - UPPER MISSISSIPPI RIVER.
Area: Lake - 490 acres - Terrestrial (islands) 7 acres

VARIABLE		VALUE	COMMENTS
1) Distance to bottomland hardwoods, species composition and water availability			
a) < 1 mile, > 25% pin oaks (or small acorns), water predictable	5		< 1 mile (area SE of dike).
b) < 1 mile, <25% pin oaks (or small acorns), water predictable	4		< 25% oaks (much less)
c) <1 mile, >25% pin oaks (or small acorns), water predictable 1 to 3 years	3	ENTER	Water predictable but very few mast trees
d) <1 mile, <25% pin oaks (or small acorns), water predictable 1 to 3 years	2	VALUE= 2	No change
e) >1 mile, or <1 mile and water unpredictable	1		
2) Distance to Cropland and Cropland Practices			
a) <1mile, with residues undisturbed	5		Crop fields near.
b) <1 mile with some residues remaining	3	ENTER	Assume normal fall tillage, if performed, is chisel plow
c) >1 mile to any cropland; or <1 mile, with residues disced or plowed.	1	VALUE= 2	not moldboard. No change.
3) Water Depth 4-18 Inches in fall			
a) >50%	10		Area in this depth range may increase slightly due to
b) 40 - 50%	8		island erosion and leveling by wave action; however,
c) 30 - 40%	6	ENTER	the coverage is not expected to increase to 20% of the
d) 20 - 30%	4	VALUE= 1	study area.
e) < 20%	1		
4) Water Depths < 4 Inches in fall			
a) 0 - 5%	1		
b) >5% - ≤10%	5		No significant change.
c) >10% - <15%	7		
d) 15% - 25%	10	ENTER	
e)>25% - <35%	7	VALUE= 1	
f) 35% - <50%	5		
g)≥50%	1		
5) Percent Open Water			
a) < 10%	1		89% - ArcView analysis of 2001 vegetation data.
b) 10 - 25 %	5		No Change.
c) 25 - 40%	7		
d) 40 - 60%	10	ENTER	
e) 60 -75%	7	VALUE= 2	
f) 75 - 90%	5		
g) > 90%	1		
6) Plant Community Diversity			
a) >6 vegetation communities present	10		Six communities present, but 5 are limited.
b) 4 - 6 vegetation communities present	6	ENTER	2001 vegetation data.
c) 2-4 vegetation communities present	4	VALUE= 5	No change.
d) < 2 vegetation communities present	1		
7) Important food plant coverage (% of veg. beds containing important food plants)			
(multiply value by .5 if vegetation beds cover < 20% of the evaluation area)			Based on 2001 LTRM veg data.
a) >75%	10		Assume 25-50% of the vegetation beds would be
b) 50 -75%	8		comprised of two important food plant species.
c) 25 - 50%	6	ENTER	Some loss of coverage in unprotected areas.
d) 10 - 25%	4	VALUE= 5.5	
e) <10%	1		
8) Percent of the Area containing Loafing Structures			
a) ≤5%	1		Island provides some loafing structure.
b) 5% - 10%	2		No significant change.
c) >10% - 15%	3	ENTER	
d) >15% - <30%	4	VALUE= 1.2	
e) ≥30%	5		
9) Structure to Provide Thermal Protection			
a) 0% of the area protected	1		Some added protection with island.
b) <5% of the area protected	3		No change.
c) at least 5% of the area protected	5	ENTER	
d) >5% of the area protected or at least 5% of area protected & several locations within an area	7	VALUE= 2.5	
e) At least 5% of area protected and protection provided from winds originating from all directions	10		
10) Disturbance in the Fall			
a) Closed to hunting and no other human activity occurs	10		No change.
b) Closed to hunting, human activity during migration is minimal or access restricted	8	ENTER	
c) Closed to hunting but considerable human activity during migration	5	VALUE= 1	
d) Open to hunting, access unrestricted	1		
11) Visual Barriers			
a) None present or limited	1		No change.
b) Barriers from most directions/sources of disturbance	3	ENTER	
c) Multiple lines of barriers	5	VALUE= 1	

Acres of Available Habitat = 497
Habitat Units = 133.6

TOTAL= 24
MAXIMUM POSSIBLE TOTAL = 90

HSI = 0.27

Spring Lake Mussel Survey Report **November 2001**

A Habitat Rehabilitation and Enhancement Project (HREP) is being planned for pool 5 Spring Lake near Buffalo City, Wisconsin. A major part of this project involves the construction of islands to protect this backwater from the effects of wind and wave action, and cold winter flows. These constructed islands would help restore some of the habitat qualities that were lost as the natural islands in the area eroded over time.

Constructing islands involves the placement of material in aquatic environments, covering substrates and the organisms inhabiting them. Also, the material to construct these features is usually dredged in the near vicinity, an activity that will also disturb the sediments and kill benthic organisms. Mussels are an important group of benthic organisms that have undergone a decline in both the numbers and species in the river since the construction of the locks and dams. For these reasons, it is important to assess the mussel population in and near the proposed construction area of Spring Lake to help prevent the further decline of this group of animals.

Mussel surveys were conducted in and near Spring Lake in 2000 and 2001. Twenty-two transects were conducted with a skimmer dredge (mussel sled) (Table 1). Mussels were identified, enumerated, and returned to the water. The path of the skimmer dredge was recorded by GPS and reproduced in ArcView (Figure 1).

Within the interior of Spring Lake, nine species of mussels were collected. Most were found in relatively small numbers. The most common species collected were threeridge (*Amblema plicata*), threehorn (*Obliquaria reflexa*), and pigtoe (*Fusconaia flava*). One round pigtoe (*Pleurobema coccineum*), a species listed as threatened in Minnesota, was collected at site 2001081610. No Wisconsin or federally listed species was collected within the interior of Spring Lake. It is likely that although construction of islands within Spring Lake would destroy some mussels, the impact to the population would be small, and therefore outweighed by the environmental benefits gained by the project.

During project planning, an area southwest of Spring Lake was identified as a possible source of sand for island construction. Four mussel transects were conducted in this area in 2001 (ID#: 2001080812, 2001080813, 2001080814, 2001081618). These transects produced 12 species and 465 individuals. Four state-listed species were collected: (1) black sandshell (*Ligumia recta*), (1) hickorynut (*Obovaria olivaria*), (1) monkeyface (*Quadrula metanevra*), (2) round pigtoe. Dredging in this area would destroy many mussels that may be part of a source population for pool 5. Therefore, borrow material will not be taken from this site.

Five transects were collected outside the proposed project area. Nine mussel species were collected, two of which are state-listed: (1) hickorynut, (2) monkeyface. Also, overall numbers of mussels collected in these transects were good. No project features are being proposed for this area.

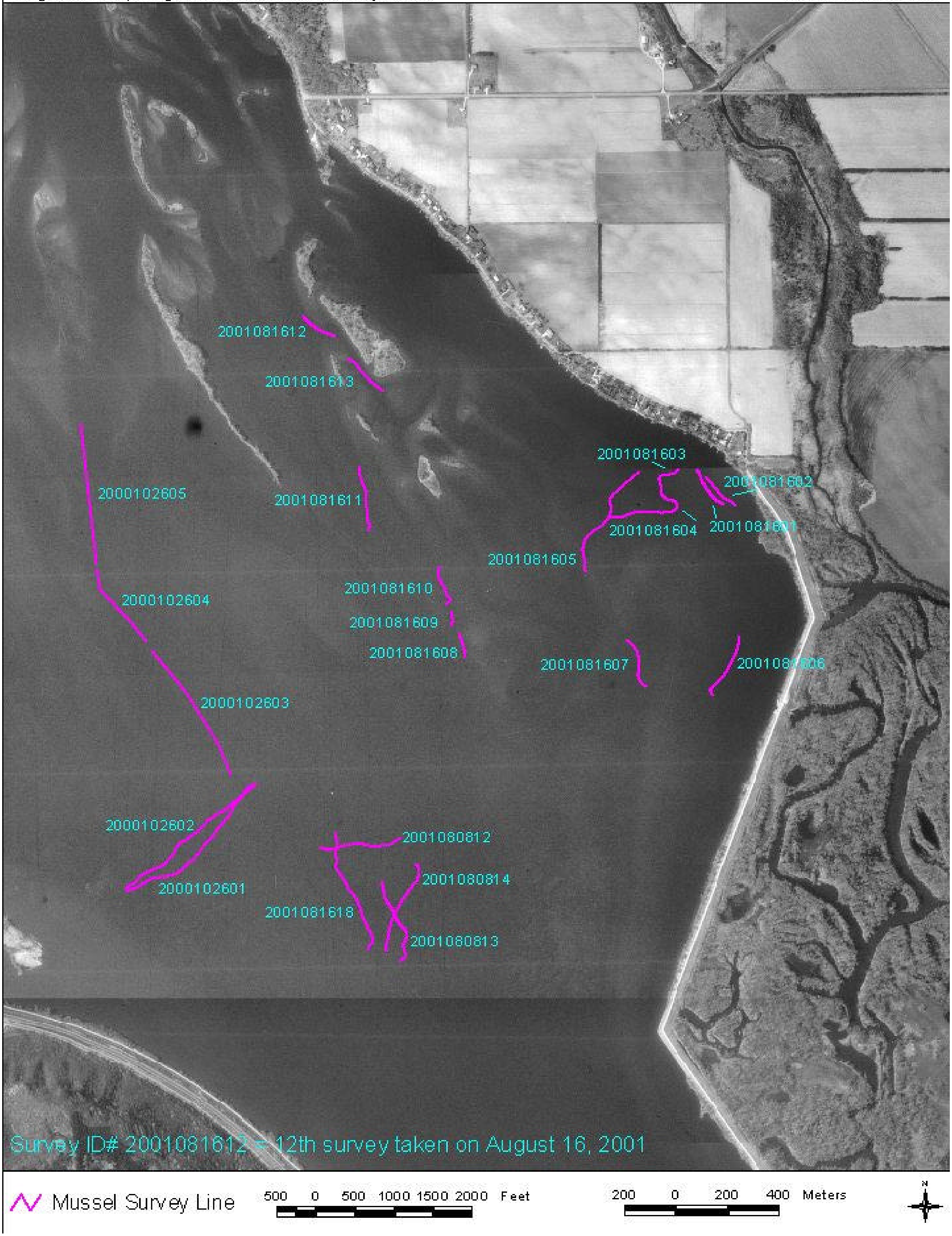
Table 1.

		STATUS				Spring Lake Mussel Survey Data															
						Transects Within Spring Lake															
SPECIES	COMMON	FED	WI	MN	IA	2001081601	2001081602	2001081603	2001081604	2001081605	2001081606	2001081607	2001081608	2001081609	2001081610	2001081611	2001081612	2001081613			
Ligumia recta	BLACK SANDSHELL			**SC**																	
Ellipsaria lineolata	BUTTERFLY		**E**	**T**	**T**																
Truncilla truncata	DEERTOE															2					
Lampsilis siliquoidea	FAT MUCKET																				
Truncilla donaciformis	FAWNFOOT																				
Anodonta suborbiculata	FLAT FLOATER																				
Leptodea fragilis	FRAGILE PAPERSHELL								1						1			1			
Anodonta grandis	GIANT FLOATER																				
Obovaria olivaria	HICKORYNUT			**SC**																	
Lampsilis higginsi	HIGGINS' EYE	**E**	**E**	**E**	**E**																
Taxolasma parvus	LILLIPUT																				
Quadrula quadrula	MAPLELEAF																				
Quadrula metanevra	MONKEYFACE		**T**	**T**																	
Actinonaias ligamentina	MUCKET			**T**																	
Anodonta imbecillis	PAPER FLOATER																				
Fusconaia flava	PIGTOE					4		1	1				4	8		17	3	3			
Quadrula pustulosa	PIMPLEBACK															1	1				
Potamilus alatus	PINK HEELSPLITTER																				
Potamilus ohiensis	PINK PAPERSHELL																				
Tritogonia verrucosa	PISTOLGRIP		**T**	**T**	**E**																
Lampsilis cardium	POCKETBOOK															1					
Arcidens confragosus	ROCKSHELL		**T**	**E**	**E**																
Pleurobema coccineum	ROUND PIGTOE			**T**											1						
Elliptio dilatata	SPIKE			**SC**																	
Strophitus undulatus	STRANGE FLOATER				**T**																
Obliquaria reflexa	THREEHORN					4	2	1					4		1	12	1	1			
Amblema plicata	THREERIDGE					31	3	3	7	1		4		4	1	30	2	4			
Quadrula nodulata	WARTYBACK		**T**	**E**																	
Megalonaias nervosa	WASHBOARD			**T**																	
Lasmigona complanata	WHITE HEELSPLITTER						1														
Lampsilis teres	YELLOW SANDSHELL		**E**	**E**	**E**																
Live Mussels Absent																					
Survey Method (S = mussel sled, D = diver)						S	S	S	S	S	S	S	S	S	S	S	S	S			
Minimum Depth (m)						0.4	0.4	0.4	0.3	0.4	2.3	0.3	0.4	0.4	0.4	0.5	0.3	0.3			
Maximum Depth (m)						1.0	1.9	2.2	2.0	1.9	8.8	0.7	1.8	1.9	0.8	1.5	3.0	1.0			

Table 2.

						Spring Lake Mussel Survey Data															
		STATUS				Proposed Borrow Site					Outside Project Area										
SPECIES	**COMMON**	FED	WI	MN	IA	2001080812	2001080813	2001080814	2001081618		2000102601	2000102602	2000102603	2000102604	2000102605						
Ligumia recta	BLACK SANDSHELL			**SC**					1												
Ellipsaria lineolata	BUTTERFLY		**E**	**T**	**T**																
Truncilla truncata	DEERTOE					2		3	33		2	2	1		2						
Lampsilis siliquoidea	FAT MUCKET																				
Truncilla donaciformis	FAWNFOOT																				
Anodonta suborbiculata	FLAT FLOATER																				
Leptodea fragilis	FRAGILE PAPERSHELL											1			1						
Anodonta grandis	GIANT FLOATER																				
Obovaria olivaria	HICKORYNUT			**SC**					1				1								
Lampsilis higginsi	HIGGINS' EYE	**E**	**E**	**E**	**E**																
Taxolasma parvus	LILLIPUT																				
Quadrula quadrula	MAPLELEAF					1															
Quadrula metanevra	MONKEYFACE		**T**	**T**					1			1	1								
Actinonaias ligamentina	MUCKET			**T**																	
Anodonta imbecillis	PAPER FLOATER																				
Fusconaia flava	PIGTOE					32	11	2	13		3	13	5	1	1						
Quadrula pustulosa	PIMPLEBACK					12		7	6			4	1		1						
Potamilus alatus	PINK HEELSPLITTER																				
Potamilus ohiensis	PINK PAPERSHELL								1												
Tritogonia verrucosa	PISTOLGRIP		**T**	**T**	**E**																
Lampsilis cardium	POCKETBOOK					4		3	2			1									
Arcidens confragosus	ROCKSHELL		**T**	**E**	**E**																
Pleurobema coccineum	ROUND PIGTOE			**T**		4			2												
Elliptio dilatata	SPIKE			**SC**																	
Strophitus undulatus	STRANGE FLOATER				**T**																
Obliquaria reflexa	THREEHORN					28	3	14	24		2	16	3	2							
Amblema plicata	THREERIDGE					108	26	25	95		10	36	12								
Quadrula nodulata	WARTYBACK		**T**	**E**																	
Megalonaias nervosa	WASHBOARD			**T**																	
Lasmigona complanata	WHITE HEELSPLITTER					1															
Lampsilis teres	YELLOW SANDSHELL		**E**	**E**	**E**																
Live Mussels Absent																					
Survey Method (S = mussel sled, D = diver)						S	S	S	S		S	S	S	S	S						
Minimum Depth (m)						3.0	1.5	1.5	3.0		2.0	2.0	4.0	3.5	2.8						
Maximum Depth (m)						3.5	4.0	4.0	4.0		3.5	4.7	5.0	4.5	3.8						

Figure 1. Spring Lake Mussel Survey Data — November 2001



Hydraulics Appendix

Attachment 5

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INTRODUCTION

This Appendix summarizes the hydrodynamic analyses completed for the Spring Lake Islands, Habitat Rehabilitation and Enhancement Project (HREP). This project is located about 1.25 miles below the center of Buffalo City, Wisconsin. A natural peninsula extends from the Wisconsin shore at the upper end of Spring Lake, and a series of barrier islands form the west side of the upper half of the lake. In the past, the peninsula had been breached by floods, allowing flow into the upper end of the lake. The Spring Lake Peninsula habitat project closed the breach and provided rockfill protection for the remaining peninsula and for 450 feet of existing barrier island. The west side of the lower half of the lake is open to Belvidere Slough and pool 5. The Wisconsin shoreline forms the east boundary of the lake and the lock and dam 5 dike forms the lower boundary. The ultimate goal of this project is to restore and maintain backwater fisheries habitat and enhance aquatic plant bed development in Spring Lake for fish and wildlife. This will be accomplished by reducing winter flows through the area and reducing wave induced erosion and resuspension of bottom sediments. A series of islands, rock closures and mudflats will be employed to achieve these goals. The design and layout specifications are discussed in further detail in the following sections.

SPRING LAKE

EXISTING PHYSICAL CONDITIONS

The Spring Lake project area is 460 acres in size and has a mean depth of 4.0 feet. In 1995, an island was constructed in upper Spring Lake, effectively repairing a breach in the natural peninsula. The western boundary of the project area is defined by the peninsula and series of island remnants in upper Spring Lake and Belvidere Slough in mid to lower Spring Lake. The Lock & Dam 5 dike defines the eastern and southern boundaries of the project area.

HYDROLOGY

DISCHARGE-DURATION, DISCHARGE FREQUENCY, AVERAGE DISCHARGE

Discharge-duration and stage-duration data for Spring Lake is shown in Table 5-2. This Discharge-duration data, from Lock & Dam 5, is equivalent to the discharge duration at Spring Lake. Stage data was added based on the Spring Lake stage-discharge curve developed for this project. The discharges corresponding to the 2, 5, 10, 50, 100 and 500 year floods are given in Table 5-1. The average discharge in the project area is approximately 40,000 cfs.

Table 5-1. Discharge – Frequency at Spring Lake.

Time of Return (Years)	Discharge (cfs)
2	82,000
5	125,000
10	150,000
50	210,000
100	240,000
500	310,000

Table 5-2. Lock and Dam 5 Discharge – Duration and Stage – Duration Data (1972-2001)

Time of Return	WSE (ft)	Flow (cfs)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	All Year	Apr-Oct
		185000				0.46										
		180000				0.69										
		175000				0.80										0.11
		170000				0.92										0.13
		165000				1.26	0.33	0.46							0.17	0.29
		160000				1.61	0.44	0.69							0.23	0.39
		155000				1.95	0.44	0.69	0.22						0.27	0.47
10 yr		150000				2.18	0.56	0.69	0.33						0.31	0.53
		145000				2.53	0.67	0.80	0.44						0.37	0.63
		140000				2.99	0.89	0.80	0.67						0.44	0.76
		135000			0.11	3.33	0.89	0.80	0.78		0.34				0.52	0.87
		130000			0.22	4.02	1.00	0.80	0.89		0.46	0.22			0.63	1.05
5 yr	662.00	125000			0.67	5.40	1.45	0.92	1.78		0.57	0.33			0.93	1.48
	661.60	120000			1.00	6.32	2.11	0.92	1.89		0.57	0.44			1.11	1.74
	661.40	115000			1.11	7.13	2.89	1.03	2.11		0.69	0.44			1.28	2.03
	661.30	110000			1.56	8.28	3.89	1.03	2.11		0.69	0.56			1.51	2.35
	661.20	105000			1.78	10.92	5.01	1.03	2.11		0.80	0.67			1.86	2.92
	661.10	100000			2.34	15.29	6.79	1.72	2.11		0.80	0.67			2.47	3.88
	661.00	95000			2.89	19.43	8.57	2.76	2.78	0.11	0.80	1.11			3.20	5.04
	660.90	90000			4.23	24.37	11.68	3.68	3.23	0.22	0.92	1.89			4.18	6.53
2 yr	660.85	85000			5.67	29.31	15.57	4.37	3.89	0.33	0.92	2.22			5.20	8.04
	660.75	80000			7.90	33.91	19.47	4.94	4.34	0.44	0.92	2.89	0.11		6.25	9.51
	660.65	75000			9.90	40.11	26.59	6.55	5.01	0.56	1.15	3.56	0.23		7.82	11.88
1.5 yr	660.55	70000			11.79	45.63	32.37	9.66	7.34	1.67	1.38	4.00	0.46		9.55	14.52
	660.45	65000		0.24	14.02	52.87	40.49	12.07	10.46	3.78	1.72	5.12	1.15		11.86	18.01
	660.35	60000		0.61	17.13	59.66	45.72	16.55	14.02	5.12	2.53	6.56	3.79		14.35	21.38
	660.30	55000		0.73	20.13	65.63	50.61	23.33	20.47	6.34	5.29	9.90	5.98	0.11	17.43	25.86
	660.20	50000		0.85	24.92	71.49	54.62	32.18	27.70	8.34	8.05	13.46	8.62	1.23	21.02	30.74
AVG	660.10	45000		1.46	29.48	76.21	60.51	40.34	33.93	12.46	12.87	15.80	12.87	2.13	24.91	35.92
WSE	660.00	40000	0.11	1.95	35.04	80.00	66.74	51.38	43.27	17.58	18.97	20.58	18.16	4.48	29.95	42.54
	659.90	35000	0.56	3.66	43.83	82.76	72.75	64.25	50.61	26.47	27.47	27.14	31.49	10.87	36.93	50.10
	659.88	30000	4.78	5.24	54.28	87.82	78.09	74.14	61.51	36.48	36.78	36.82	46.67	20.96	45.44	58.70
	659.85	25000	17.58	13.90	65.07	93.45	83.76	79.20	69.97	49.50	47.82	48.05	61.26	39.01	55.88	67.31
	659.90	20000	36.04	33.54	77.09	98.16	90.99	84.25	76.75	65.52	61.84	63.29	76.44	57.29	68.57	77.20
	659.90	15000	67.74	70.24	90.55	99.54	95.11	91.95	84.54	80.53	78.16	76.08	91.15	74.66	83.38	86.51
	659.95	10000	93.10	91.10	98.11	100.00	100.00	97.59	93.66	91.21	95.06	94.77	95.86	89.13	94.97	96.02
		5000	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	99.77	99.22	99.91	100.00
		0	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

HYDRODYNAMICS

DISCHARGE DISTRIBUTION

Information on discharge measurements collected in Pool 5 are contained in reference 1 and summarized below. Sites where discharge measurements have been collected are shown on Figure 5.1. Site discharge is discussed as a percentage of total river discharge (or reference discharge) at the upstream or downstream lock and dam. To facilitate this discussion, the percentages given are for a reference discharge of 40,000 cfs unless stated otherwise. The accuracy of individual discharge measurements is discussed in reference 1. Usually the measured total river flow was within 10 percent of the calculated Lock and Dam flow.

Table 5-3. Discharge Distribution at Spring Lake inlet sites 3, 4, 5, and 6.

Site	Discharge (cfs)	Percentage of Lock & Dam 5 Discharge
3&4	440	1.10
5	300	0.75
6	0	0.00

STAGE-DISCHARGE

The plan of operation of Lock & Dam 5 is discussed in detail in the Lock & Dam 5 operation manual and is briefly described here.

The primary control point for Pool No. 5 is at river mile 748.5 where project pool, Elevation 660.00, is maintained by the operation of Dam No. 5 until the discharge at the dam exceeds 28,000 cfs. At this flow the maximum allowable drawdown of the pool at the dam, 0.5 foot to Elevation 659.50 is reached, and the regulation of the pool is shifted to secondary control at the dam. As the discharge increases above 28,000 cfs, the pool level at the dam is held at Elevation 659.50, the stage at all other points in the pool is allowed to rise, and the operating head at the dam will decrease. When the discharge exceeds 116,000 cfs, the head at the dam will be reduced to just a swell head of less than a foot, and all the gates are then raised clear of the water. As the flow increases above 116,000 cfs, open river conditions are in effect, and the dam is out of control. On the recession, the gates are returned to the water when the pool at the dam drops to Elevation 659.50, secondary control elevation is maintained at the dam until the water level at the primary control point drops to project pool, Elevation 660.00 at a flow of 28,000 cfs. At the latter flow, control of the pool is returned to the primary control point, and as the discharge decreases, the water surface at the dam will rise, the drawdown will decrease, and the operating head at the dam will increase. The lock miter gates are never used for regulation of the discharge. When the pool level exceeds Elevation 662.5, the gate operating motors must be removed from the machinery pits, and the upper miter gates are kept in the closed position while the lock is out of operation.

Figure 5.2 shows the stage-discharge curves for Lock and Dam 5.

FLOW VELOCITIES

Spring Lake average adjusted velocities were collected at inlet site 5, and inlet site 3 and 4 combined. Inlet locations are shown on Figure 5.1. The average adjusted velocities for the two locations are given in Table 5-4.

Table 5-4. Average Adjusted Velocity at Spring Lake inlet sites 3, 4, and 5.

Date	Avg. Adjusted Velocity (fps)	Lock & Dam 5 Discharge (cfs)	% of Lock & Dam 5 Discharge
Site #5			
18-Apr-95	0.774	65,875	0.87
16-May-95	0.746	72,000	0.81
19-Oct-95	0.658	52,575	0.79
13-Sep-95	0.310	33,625	0.62
Site #3 & #4			
18-Apr-95	0.613	65,750	1.02
16-May-95	0.577	71,600	1.10
19-Oct-95	0.556	52,600	1.25

HYDRAULIC RESIDENCE TIME

The hydraulic residence time in Spring Lake for existing conditions is given in Table 5-5.

Table 5-5. Existing Hydraulic Residence Time - Spring Lake.

Miss. River Disch. (cfs)	Volume (ft^3)	Inflow (cfs)	Hydraulic Residence Time (days)
20,000	78,134,635	220	4.11
40,000	80,150,400	440	2.11
67,000	91,371,456	737	1.43
82,000	96,180,480	902	1.23
125,000	116,218,080	1375	0.98

WAVE ACTION

Wave characteristics of height, length, and period can be determined using "Slope Protection for Dams and Lakeshores" April 1988, Soil Conservation Service. The maximum orbital wave velocity (Um) at the bottom due to wave action can then be determined using the following equation:

$$Um = \frac{3.14 * H}{T * \sinh(2 * 3.14 * d/l)}$$

Um = maximum orbital wave velocity at bottom (fps)
H = wave height in transitional water depths (ft)
T = wave period in transitional water depths (s)
l = wave length (ft)
d = local water depth (ft)

Wave characteristics were determined for a constant northwesterly wind speed of 31 mph, a local water depth of 4 feet, and a wind fetch of 6,000 feet. The predominant wind directions in the Spring Lake area are northwesterly and southeasterly. A wind fetch of 6,000 feet is representative of both predominant wind directions. The highest wind stress factor is for a northwesterly wind (31 mph), so a northwesterly wind will produce the highest orbital velocity. The 31 mph wind speed doesn't represent a maximum wind speed, however based on wind data from meteorological stations at Rochester, MN, it exceeds 95 percent of the recorded wind speeds. Wave characteristics are shown in Table 5-6.

Table 5-6. Analytical Predictions of Existing Wave Characteristics – Spring Lake.

Fetch (ft)	Wind Direction	Water Depth (ft)	Wave Height (ft)	Max. Orbital Velocity at Bottom (fps)
6,000	NW	4	1.0	0.85

PROJECT DESIGN

SPRING LAKE GOALS, OBJECTIVES, CRITERIA

Table 5-7. Goals/Objectives/Criteria Affecting Hydraulic Design for Goal 1.

Goal 1: Improve aquatic habitat for Centrarchids.

Objective/Criteria	Design Feature
Optimize distribution of water flows entering Spring Lake.	Closure islands located to reduce inflow in protected areas.
Increase the extent of water >3 feet deep sheltered from river current in proximity to macrophyte beds, with adequate D.O. (>5 mg/l) for centrarchid habitat.	Islands to develop/maintain deep water, low-to-no flow areas in proximity to macrophyte beds. Notched sill will allow very small flow (10 cfs) into Spring Lake to meet D.O. objective.
Maintain or increase the areal extent, interspersion, density, and species composition of macrophyte beds.	Islands located to protect shallow habitat.
Increase island shoreline length.	Gradually sloping shoreline.
Maintain an interspersion of flowing channel habitat.	Islands located adjacent to existing channels.
Provide rock and gravel in flowing channels for lithophillic species.	Offshore rock mound adjacent to existing channels.
Decrease suspended solids concentrations.	Islands located to reduce wind fetch.

Goal 2: Improve wildlife habitat.

Objective/Criteria	Design Feature
Maintain or increase the areal extent, interspersion, density, and species composition of macrophyte beds.	Islands located to protect shallow habitat.
Increase the length of shoreline and area of islands.	Gradually sloping shoreline. Shallow mudflats to increase area.
Decrease suspended solids concentrations.	Islands located to create low flow areas and reduce wind fetch.
Increase areal coverage of sand/mud habitat.	Mudflats.

SPRING LAKE HYDRAULIC DESIGN FACTORS

In addition to the goals/objectives/criteria, various opportunities and constraints were considered in the hydraulic design. These will be referred to as hydraulic design factors and are listed below.

1. Island position and orientation is often a function of local bathymetry and aquatic habitat. However, if possible, islands should be oriented based on flow directions in the project area and prevailing wind directions. An island oriented with its long axis perpendicular to the dominant flow direction will result in the largest sheltered area downstream of the island. An island oriented with its long axis perpendicular to prevailing wind directions will maximize the area of reduced wave energy.

2. Since one of the goals of the project is to enhance aquatic vegetation growth, islands should target shallower areas where this growth is more likely to occur.

3. Generally, islands should decrease in elevation in the downstream direction so that overtopping begins at the downstream end where hydraulic forces are less.

4. The combination of height and width should be such that the activities of burrowing animals does not result in continuous pathways for water conveyance through the islands. A minimum top width of 40 feet should be utilized.

5. Islands should be constructed in shallow water for shoreline stability. This will also stabilize the shallow water area sheltered by the island.

6. Island side slopes should be 1V:5H or flatter to minimize rill erosion from local runoff.

7. Rock islands or structures should be placed at a lower elevation than sand islands to act as overflow spillways and reduce head differentials across sand islands when they are overtopped.

8. Rocky structures should incorporate woody structures for habitat benefit.

9. A culvert is located in the dike of the southeastern border of Spring Lake. The culvert conveys approximately 300 cfs from Spring Lake into the Whitman Wildlife area. The culvert will pull water through the deep hole in Southern Spring Lake. In order to establish an over-wintering habitat in this area, the flows through the culvert may have to be regulated in the winter. Once the project features are in place, this area will require monitoring to determine the appropriate culvert regulation.

SPRING LAKE DESIGN

The Spring Lake design is based on:

- Previous design/experience/monitoring,
- Goals/Objectives/criteria,
- Hydraulic Design Factors,
- Other design factors.

Other design factors include: economics, constructability, and aesthetics. Access to the proposed island sites is one of the most important cost and constructability factors. If possible, islands should be positioned near natural channels or deep areas to provide equipment access.

ISLAND LAYOUT

Island layout was based on the following goals/objectives/criteria:

Overwintering Habitat:

- 3 discrete areas, 20 acres minimum,
- Current velocity <0.3 cm/sec over 80% of the area,
- D.O. > or = to 5 ppm,
- Water depths >4 feet over 40% of the area and >7 feet over 15% of the area,
- Connected to adjacent flowing river habitats.

Spawning, Rearing and Juvenile Habitat:

- D.O.> or = to 5 ppm,
- Current velocity < 0.5 cm/sec,
- Aquatic vegetation cover of ~80%.

Maintain or Increase Areal Extent, Interspersion, Density and Species Composition of Macrophyte Beds:

Provide ≥75 acres meeting the following criteria:

- Water depths <2 feet,
- Protected from dominant wind fetches,
- Current velocities generally <0.5 ft/sec.

Provide ≥ 125 acres meeting the following criteria:

- Water depths <4 feet,
- Protected from dominant wind fetches.

Maintain an Interspersion of Flowing Channel Habitat:

- Continuous flowing channels bordered by islands,
- Areas of scour, eddies and varying velocities,
- Variety of substrates (sand, silt, clay, gravel, cobble, wood, etc.),
- Connected to other channels,
- Variety of water depths.

Decrease Suspended Solids Concentrations:

- Construct islands to reduce wave resuspension of bottom sediments,
- Construct islands to create areas free from flow.

Four islands are incorporated in this design. Island layout is shown in figures 5.3.

Island 1 is designed mainly to train flows to the existing channel and to increase area of water >3 feet deep sheltered from river current. Island 1 will incorporate the existing island remnants and the recently constructed peninsula to isolate upper and mid Spring Lake from river currents.

Island 2 and Island 4 were designed to train flows to existing channel and reduce wave action. The upper portions of the islands are designed to reduce wind fetch in shallow areas, which will reduce wave action and allow establishment of aquatic vegetation. The lower portions of the islands are designed to train flows to existing channels to improve channel habitat.

Island 3 is designed to reduce wave action and increase area of water >3 feet deep sheltered from river current. In addition, the island is located along one of the access channels to improve channel habitat. Island 3 will isolate deep water in the southeastern portion of Spring Lake from river currents. The island does not connect with the shore, thereby allowing a small amount of flow into the deep hole area to meet D.O. objective.
The island also reduces wind fetch in shallow areas to allow establishment of aquatic vegetation.

Island layout was also based on the following additional design factors:

- Locate islands in shallow water to reduce cost and increase stability,
- Place perpendicular to flows and prevailing winds to shelter maximum area,
- Existing islands should be incorporated into new islands for aesthetics.

ISLAND CROSS SECTION

Island cross section data is shown on Figure 5.4. Dimensions for the island cross section are given in Table 5-8.

Table 5-8. Island Cross Section Dimensions - Spring Lake.

Island	a	b	c (feet)	d	e	Top Elev.	Berm Elev.	f
IL1 (above mudflat)*	10	0	0	0	10	662.5	662.5	20
IL1 (below mudflat)*	10	0	0	0	10	662	662	20
IL2 (above mudflat)	45	5	40	5	30	663	662	125
IL2 (@ mudflat)	45	5	40	5	20	663	662	115
IL2 (below mudflat)	45	0	40	0	30	662	662	115
IL3 (@ mudflat)	30	0	65	0	20	662	662	115
IL3 (no mudflat)	30	0	65	0	30	662	662	125
IL4 (@ mudflat)	45	0	40	0	20	662	662	105
IL4 (no mudflat)	45	0	40	0	30	662	662	115

a = least sheltered side berm width
b = side slope
c = top width
d = side slope
e = most sheltered side berm width
f = total width

* Island one cross section differs from islands 2,3, and 4.

ISLAND TOP ELEVATION

Island top elevations were based on the following hydraulic design factors:

- Island elevation should be near or above bankfull elevations,
- Island should be stepped down in elevation in the downstream direction,
- Rock structures should be placed at lower elevation than the sand islands,
- Vary island elevations for vegetation diversity.

ISLAND WIDTH

Island widths were based on the following goals/objectives/criteria:

- Increase length of shoreline and area of islands.

Island widths were based on the following hydraulic design factors:

- The width should be such that the activities of burrowing animals doesn't result in continuous pathways for water conveyance through the islands,
- Island width should be maximized to reduce erosion potential during floods.

ISLAND SIDE SLOPES

Island side slopes were based on the following goals/objectives/criteria:

- Increase length of shoreline and area of islands.

Island side slopes were based on the following hydraulic design factors:

- Slopes should be 1V:5H or flatter to minimize rill erosion due to local runoff,
- Where riprap is being used, side slopes should be 1V:3H or steeper to reduce rock quantities.

MUDFLAT LAYOUT

A plan view showing proposed mudflat design is shown on Figure 5.3. Mudflat layout was based on the following goals/objectives/criteria:

- Create sand/mudflats in at least 3 locations which are 2-4 acres in size,
- Sand/mudflats located in proximity to islands,
- Enhance micro-topography within expanses of sand/mudflats.

MUDFLAT TOP ELEVATION

Mudflat top elevations were based on the following goals/objectives/criteria:

- Water depths of 0-0.25 feet during normal summer conditions.

Mudflat top elevations were based on the following hydraulic design factors:

- 4 – 5 inches below average water surface elevations during the fall migration period (Sep. – Nov.).

Mudflat top elevations were set at 659.6. The average fall water surface elevation in Spring Lake is 660. Therefore, the mudflats will be overtopped by 4.8 inches of water during the fall migration period. A tolerance of plus or minus 0.4 feet will be used for construction of mudflats so the micro-topography is created. The specifications for this project should clearly state that this is only a tolerance and that continuously over- or under-building for large reaches of mudflats is unacceptable.

MUDFLAT WIDTH AND AREA

Mudflat widths and areas are shown in Figure 5.3.

Table 5-9. Mudflat Widths and Areas - Spring Lake.

Mudflat	Width (widest point to point) (ft)	Area (Acres)
MF1	935	1.8
MF2	1,115	2.6
MF3	595	2.3
MF4	1082	3.2

SHORELINE STABILIZATION

A plan view showing the proposed shoreline stabilization is shown in Figure 5.5. Shoreline stabilization used at Spring Lake falls into 4 general categories: Rock revetments, rock groins (mudflat stabilization), off-shore rock mounds (existing island remnant stabilization) and rock/biotechnical combinations. Rock revetments will be utilized on all exposed island tips. Unless otherwise specified, revetments will consist of an 18 inch layer of rock on a 1V:3H slope. Rock groins will be utilized to stabilize mudflats where necessary. Off-shore rock mounds will be utilized to stabilize existing island remnants. Rock/biotechnical combinations will be utilized in all other areas where stabilization is necessary. For the rock/biotechnical areas, willows will be planted near the back of the berm for stabilization purposes. The rock/biotechnical areas will also incorporate woody structures in the rock. Approximately every third structure on an island will have a tree with root wad. Figure 5.6 shows the design for groins with trees and Figure 5.7 shows the design for vanes with trees. Table 5-10 provides stabilization dimensions.

Table 5-10. Rock Stabilization Dimensions – Spring Lake.

Rock Feature	Top Elev	Top Width	Side Slope	Length
Revetment	Top of Island	--	1:3	--
Groins (mudflat)	659.6	3	1:1.5	30
Groins/Biotechnical*	662	3	1:1.5	30
Vanes/Biotechnical*	662	3	1:1.5	30
Rock Mounds	662.5	varies	1:1.5	3

*Include a tree with root wad for every third groin and vane.

ROCK SILL

A rock sill was designed to allow flood flows into upper Spring Lake. A notch in the sill was designed to allow 10 cfs of water into upper Spring Lake during the winter season to meet the D.O. criteria of 5 ppm. The dimensions of the rock sill are given in Table 5-11.

Table 5-11. Rock Sill Dimensions – Spring Lake.

Rock Feature	Top Elev.	Top Width	Side Slope	Length
Notched Sill	661	10	1:3	105

TOP ELEVATION

The following goals/objectives/criteria were considered:

- A minimum of 3 discrete areas with a minimum size of 20 acres per site,
- Current velocity <0.3 cm/sec,
- D.O. > 5 ppm.

The following hydraulic design criteria were considered:

- Rock structures should be at a lower elevation than sand islands to act as an overflow spillway.

The primary goal of the project, fisheries, and the main criteria to achieve that goal, reduce winter flows, was considered. Since winter fisheries are the most critical part of the overall fisheries goals, the months October through February were focused on. Twenty years data were utilized to determine the water surface elevation at Spring Lake during the winter months. A sill top elevation of 661 was assumed. The data was then used to determine the number of times the sill would be overtopped in the winter months. Table 5-12 shows this data:

Table 5-12. Number of Overtopping Events During the Winter Months – Spring Lake.

Year	Data Set	Events > 661
00-01	115	0
99-00	155	0
98-99	155	0
97-98	155	0
96-97	144	0
95-96	142	0
94-95	93	0
93-94	1	0
92-93	93	0
91-92	155	8 (3 in Nov., 5 in Dec.)
90-91	93	0
89-90	155	0
88-89	155	0
87-88	155	0
86-87	155	15 (14 in Oct., 1 in Sept.)
85-86	155	5 (5 in Oct.)
84-85	155	0
83-84	155	0
82-83	14	0
81-82	45	0

Total	2445	28 = 1.15%

The 1.15% overtopping rate is acceptable from a winter fisheries standpoint. Therefore, the sill top elevation is set at 661.

SILL NOTCH

The following criteria/goals/objectives were considered:

- D.O. > 5ppm.

The following hydraulic design criteria were considered:
- Notch should allow 10 cfs of water into upper Spring Lake during the winter months (October – February).
- Water depth > 1 foot to avoid freezing.

Notch is 8.0 feet wide, 3 feet deep, with 1:1.33 side slopes.

ACCESS CHANNELS

Main purpose is to provide access for construction equipment barge and rock barge. Also will provide channel habitat.

Table 5-13 shows channel dimensions.

Table 5-13. Access Channel Dimensions – Spring Lake.

Channel	Length (ft)	Width (ft)	Area (ft^2)	Depth (ft)	Volume (ft^3)
AC1	1070	70	74,900	6	449,400
AC2	4180	70	292,600	6	1,755,600
Fine Borrow	2000	70	140,000	6	840,000

REFERENCES

1. Hendrickson, J.S. and F.R. Haase (1997). Upper Mississippi River Hydrodynamics: Discharge Distribution and Water Surface Elevations in Pool 5, 1975-96. Internal Report Compiled by the U.S. Army Corps of Engineers, St. Paul District.

2. Hendrickson, J.S. (1996). Mississippi River Shoreline Stabilization Designs 1987 – 1996. Internal Report compiled by the U.S. Army Corps of Engineers, St. Paul District.

3. *http://www.mvp-wc.usace.army.mil/*

4. Soil Conservation Service (1988). Slope Protection for Dams and Lakeshores.

5. U.S. Army Corps of Engineers, St. Paul District. (1970). Reservoir Regulation Manual – Appendix 5, Lock and Dam No. 5.

6. *Upper Mississippi River System Environmental Management Program. Definite Project Report/Environmental Assessment (SP-12). Spring Lake Peninsula. Habitat Rehabilitation and Enhancement Project. Pool5, Upper Mississippi River, Buffalo County, Wisconsin.*

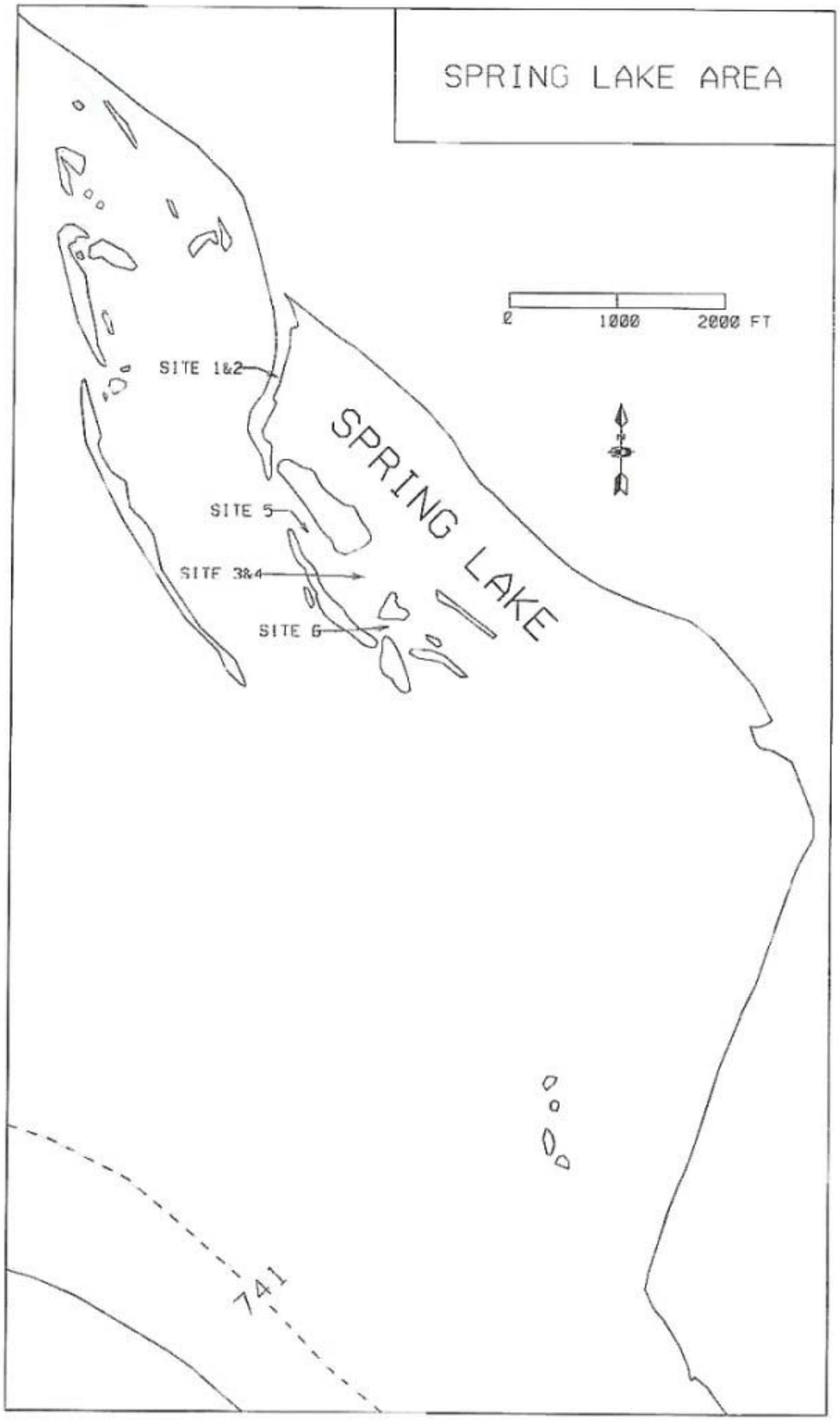
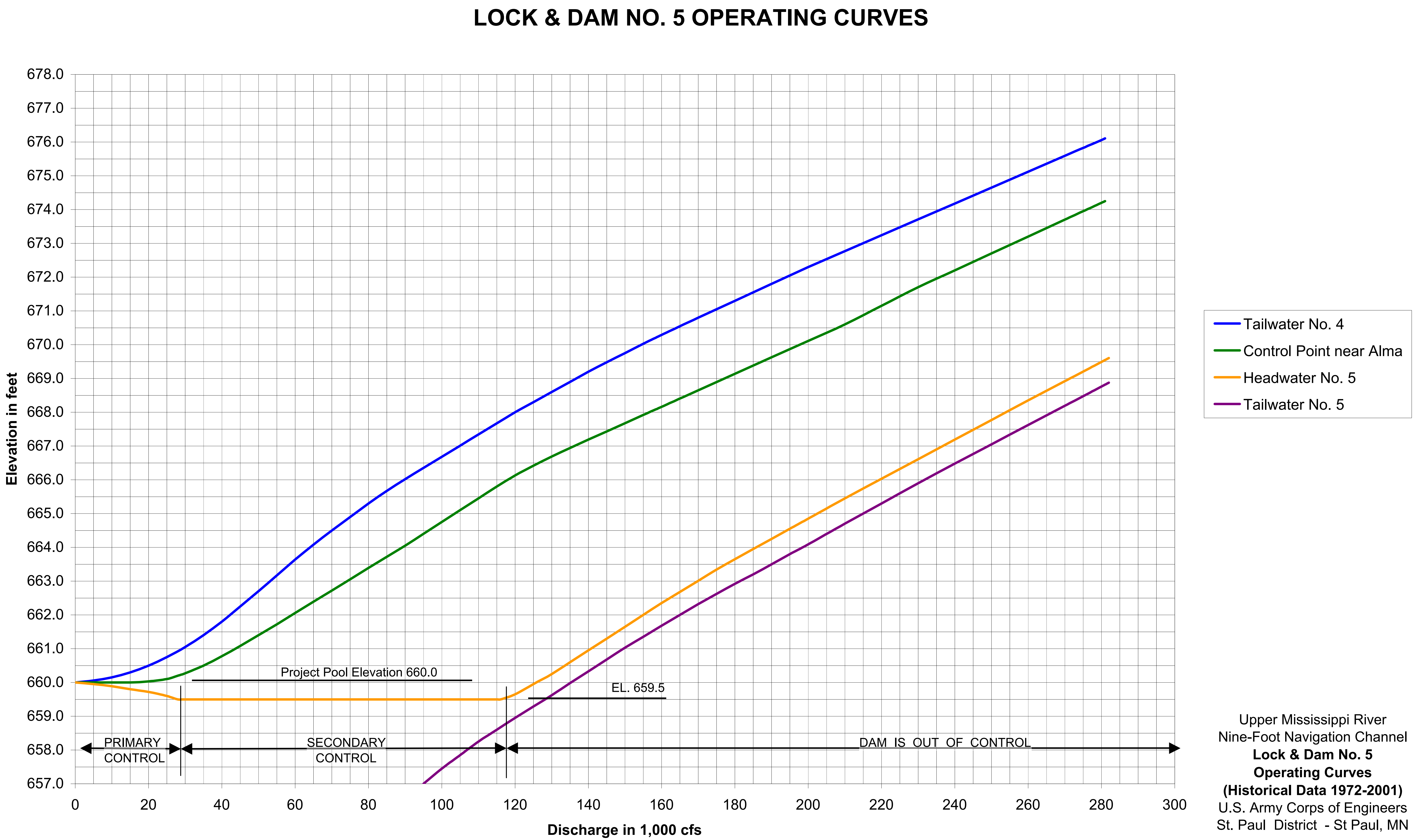
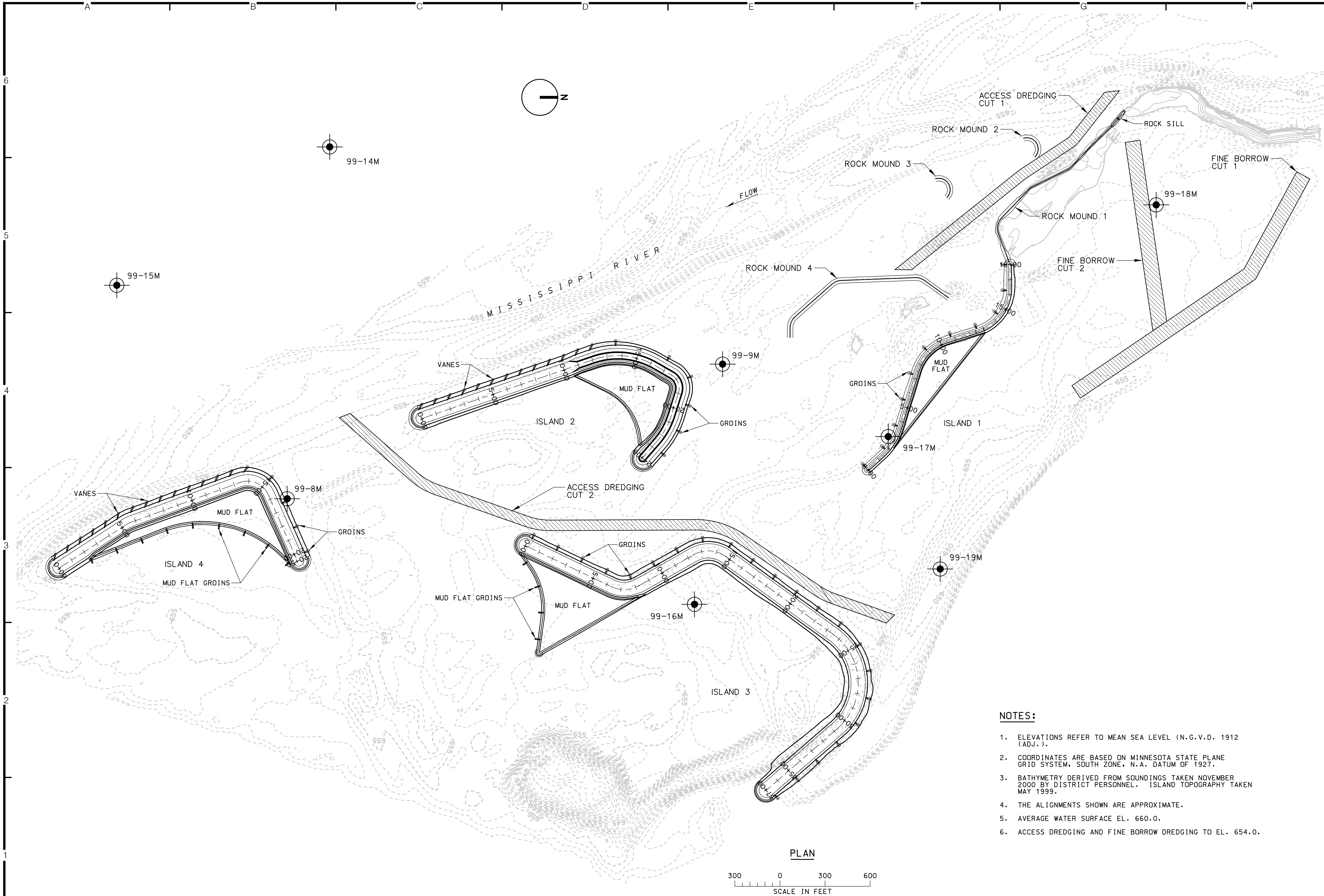

SPRING LAKE AREA
0
1000
2000 FT
SITE 1&2
SPRING LAKE
SITE 5
SITE 3&4
SITE 6
741

Figure 5.1



Upper Mississippi River
Nine-Foot Navigation Channel
Lock & Dam No. 5
Operating Curves
(Historical Data 1972-2001)
U.S. Army Corps of Engineers
St. Paul District - St Paul, MN

Figure 5.2



NOTES:

1. ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 (ADJ.).
2. COORDINATES ARE BASED ON MINNESOTA STATE PLANE GRID SYSTEM, SOUTH ZONE, N.A. DATUM OF 1927.
3. BATHYMETRY DERIVED FROM SOUNDINGS TAKEN NOVEMBER 2000 BY DISTRICT PERSONNEL. ISLAND TOPOGRAPHY TAKEN MAY 1999.
4. THE ALIGNMENTS SHOWN ARE APPROXIMATE.
5. AVERAGE WATER SURFACE EL. 660.0.
6. ACCESS DREDGING AND FINE BORROW DREDGING TO EL. 654.0.

PLAN

300 0 300 600
SCALE IN FEET

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

DESIGNED: LKT/JJF
CHECKED: TMG
ED-D
DRAWN: LKT
DESIGNED: KLL
CHECKED: JSH
ED-H

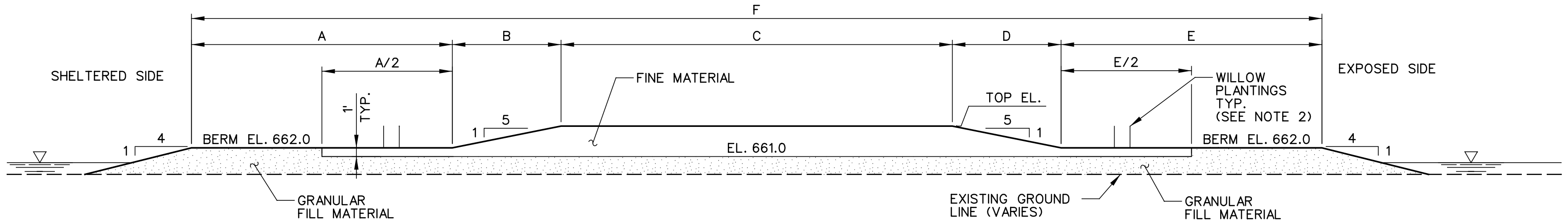
SCALE: AS SHOWN
DATE: APR 2002
CADD FILE NAME: M5RC10401.DGN
SOL. NO:
AE APPROVING OFFICIAL:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

SPRING LAKE HREP
MISSISSIPPIRIVER - POOL 5
ENVIRONMENTAL
SITE LAYOUT

DRAWING NUMBER:
PLATE
10

SHT OF



NOTE:

1. GROINS/VANES NOT SHOWN FOR CLARITY.
2. TWO ROWS OF WILLOW CUTTINGS SHALL BE PLANTED ALONG THE SHORELINES OF ALL ISLANDS WITH A 2 FT. SPACING BETWEEN STAGGERED ROWS AND WILLOWS.

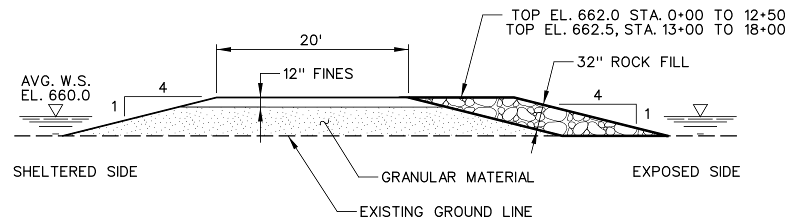
SECTION

ISLANDS 2, 3 & 4

SCALE: 1" = 10'-0"

10 0 10 20
SCALE IN FEET

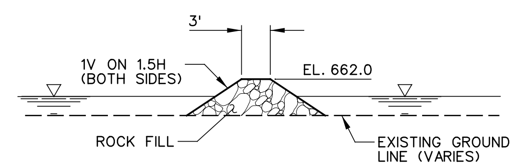
ISLAND DIMENSIONS (FEET)							
ISLAND NAME	A	B	C	D	E	F	TOP EL.
ISLAND 2 STA. 0+00 TO 10+50	45	0	40	0	30	115	662.0
ISLAND 2 STA. 11+00 TO 23+00	45	5	40	5	20	115	663.0
ISLAND 2 STA. 23+50 TO 24+00	45	5	40	5	30	125	663.0
ISLAND 3 STA. 0+00 TO 7+75	30	0	65	0	30	125	662.0
ISLAND 3 STA. 8+25 TO 37+00	30	0	65	0	20	115	662.0
ISLAND 4 STA. 0+00 TO 2+00	45	0	40	0	30	115	662.0
ISLAND 4 STA. 2+50 TO 18+50	45	0	40	0	20	105	662.0



TYPICAL SECTION

ISLAND 1

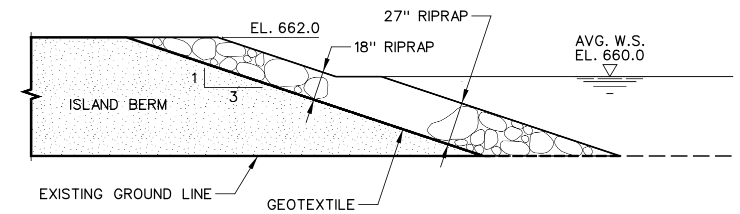
SCALE: 1" = 10'-0"



TYPICAL SECTION

ROCK MOUND ISLAND PROTECTION

SCALE: 1" = 10'-0"



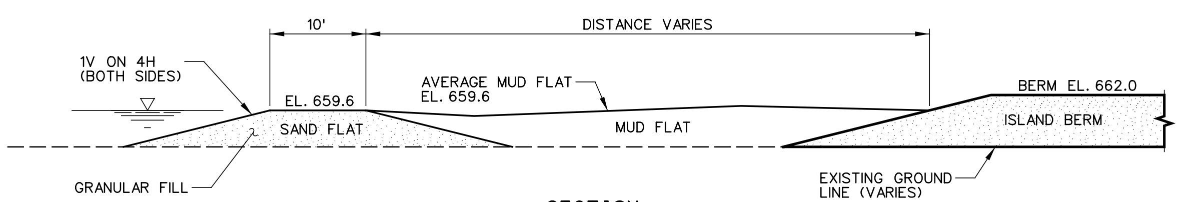
1. RIPRAP REQUIRED TO TOP OF ISLANDS 2, 3 & 4 AT EACH END.
2. STOP GEOTEXTILE 0.5 FT FROM TOP OF ISLAND.

DETAIL

ISLAND RIPRAP END PROTECTION

SCALE: 1" = 5'-0"

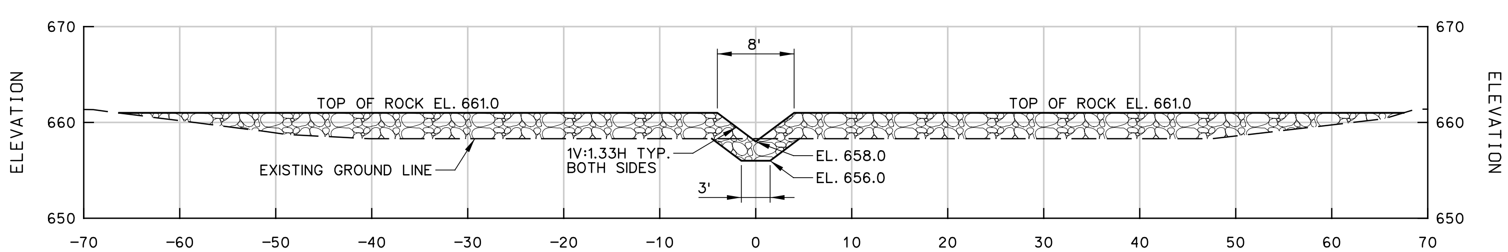
5 0 5 10
SCALE IN FEET



SECTION

TYPICAL MUD/SAND FLAT

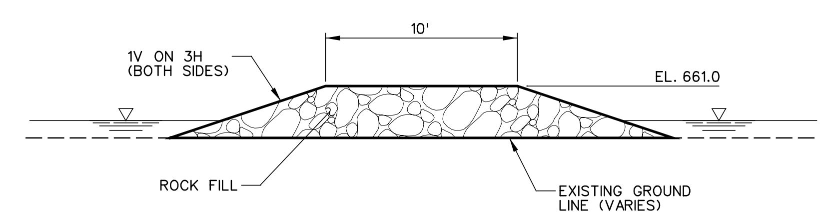
SCALE: 1" = 10'-0"



LONGITUDINAL SECTION

ROCK SILL

SCALE: 1" = 10'-0"



TYPICAL CROSS SECTION

ROCK SILL

SCALE: 1" = 5'-0"

US Army Corps of Engineers
St. Paul District

Symbol | Description | Date | Appr.

DESIGNED: ED-D
CHECKED:
DRAWN:
DESIGNED: ED-H
CHECKED:

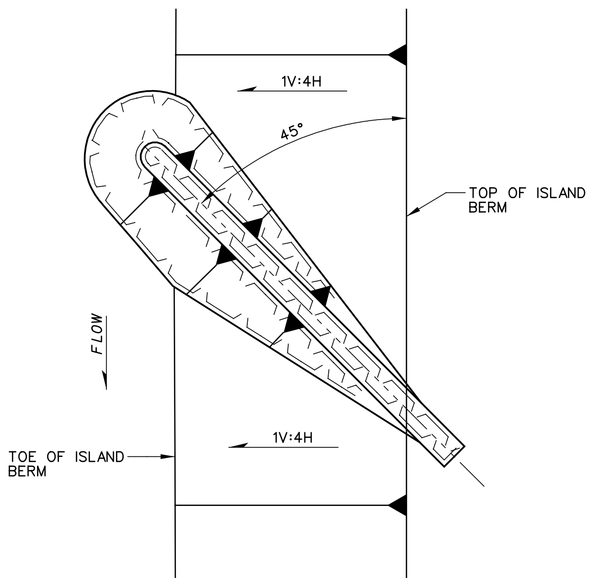
SCALE: AS SHOWN
DATE: APR 2002
CADD FILE NAME: m0rc30402.DGN
SOL. NO.:
AE APPROVING OFFICIAL:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

SPRING LAKE HREP
MISSISSIPPI RIVER - POOL 5
ENVIRONMENTAL
ISLAND
TYPICAL SECTIONS & DETAILS

DRAWING NUMBER:
PLATE 11

SHT OF



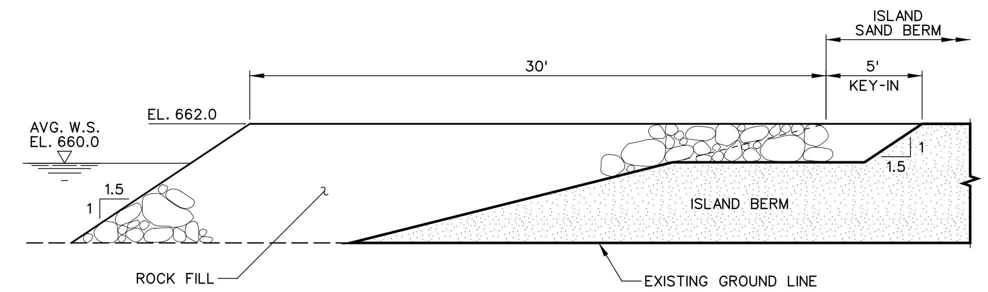
PLAN

TYPICAL ROCK VANE

SCALE: 1" = 10'-0"

10 0 10 20

SCALE IN FEET



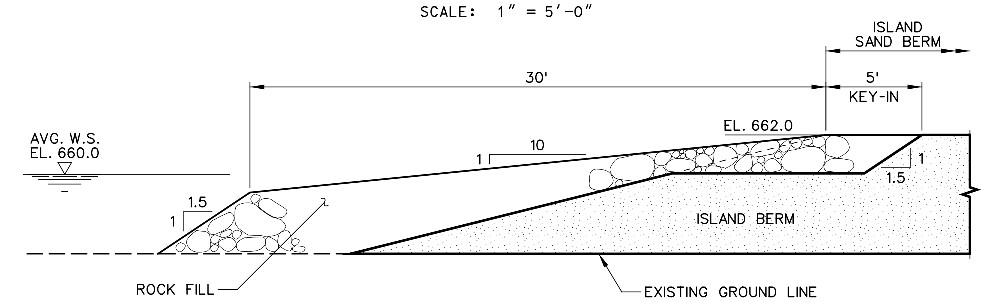
NOTES:

1. TOP OF MUD FLAT GROINS AT EL. 659.6.
2. ROCK GROINS SHALL BE PLACED PERPENDICULAR TO THE ISLAND.

LONGITUDINAL SECTION

ROCK GROIN

SCALE: 1" = 5'-0"



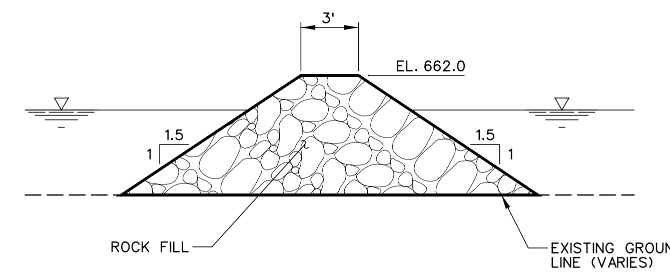
LONGITUDINAL SECTION

TYPICAL ISLAND ROCK VANE

SCALE: 1" = 5'-0"

5 0 5 10

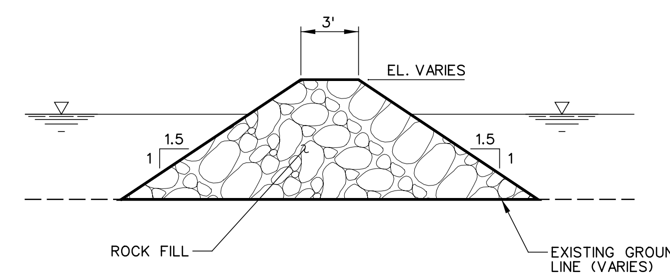
SCALE IN FEET



CROSS SECTION

TYPICAL ISLAND ROCK GROIN

SCALE: 1" = 5'-0"



CROSS SECTION

TYPICAL ISLAND ROCK VANE

SCALE: 1" = 5'-0"

US Army Corps of Engineers
St. Paul District

Symbol | Description | Date | Appr.

DESIGNED: CHECKED: DRAWN: DESIGNED: CHECKED:

SCALE: AS SHOWN
DATE: APR 2002
CADD FILE NAME: MSRC30403.DGN
SOL. NO.:
AE APPROVING OFFICIAL:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

SPRING LAKE HREP
MISSISSIPPI RIVER - POOL 5
ENVIRONMENTAL
GROIN & VANE DETAILS

DRAWING NUMBER:
PLATE 12
SHT OF

Geotechnical Appendix

Attachment 6

TABLE OF CONTENTS

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT

SPRING LAKE ISLANDS
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
SPRING LAKE, UPPER MISSISSIPPI RIVER
BUFFALO COUNTY, WISCONSIN
ATTACHMENT NO. 6
GEOTECHNICAL DESIGN

1. GENERAL:

Geologic information for the Spring Lake HREP was obtained from the following sources: The Physical Geography of Wisconsin, by Lawrence Martin, Wisconsin Geological and Natural History Survey; USGS Hydrologic Atlas HA-548 (1975); The Geology and Underground Waters of Southern Minnesota (Thiel, 1944, pp 433-438, University of Minn. Press); Wisconsin Geologic and Natural History Bulletin No. XXXVI; and from Corps of Engineers soil borings.

2. PHYSIOGRAPHY

3. The Spring Lake Island, Habitat Rehabilitation, and Enhancement Project (HREP) is located in the Mississippi River between river miles 741 and 742. Along this portion of its course, the Mississippi River Valley is located in the Central Lowlands Physiographic Province of the United States. This province may be further subdivided into the Western Uplands Physiographic Region of Wisconsin. Approximately 3/4 of the Wisconsin Western Uplands, and most of the Southeast Minnesota Uplands, were not overridden by glacial ice during the Wisconsin Stage of the Pleistocene Epoch and is known as the Driftless Area. Topographic features of the Driftless Area today are thought to reflect conditions as they were over much of Wisconsin prior to glaciation.

4. The uplands region adjacent to the river has been dissected into a system of ridges and valleys with practically no broad upland areas remaining. Buffalo County in Wisconsin and Winona County in Minnesota are dominated by this ridge and valley topography. The steep sided valleys are known locally as coulees. Numerous tributary rivers and streams dissect the uplands on both sides of the river and continue to contribute sediment to the Mississippi River Basin.

5. The Mississippi River lies in a broad, bedrock gorge or trench. The gorge is a U-shaped feature with steep-sided limestone bluffs rising 400 to 500 feet above river level on either side. A well -developed, broad alluvial terrace parallels the river on the Wisconsin side, with a less prominent terrace paralleling the river on the Minnesota side. In the vicinity of Spring Lake, the gorge is between 3 to 6 miles wide. The river gradient averages about 2 inches per mile during normal flow conditions. The Spring Lake area was once a part of an extensive Mississippi River floodplain complex consisting of side channels, meanders, and sloughs that typify low gradient conditions.

6. GENERAL GEOLOGY:

Although the Mississippi River gorge probably existed as far back as 180 million years ago, the major geologic event that created the valley we see today occurred approximately 10,000 years ago, near the end of the Pleistocene Epoch. During this period, the Mississippi gorge was filled with glacial outwash sand and gravel deposits. After deposition of the outwash sediments, Glacial River Warren carried large volumes of meltwater from the southward outflow of glacial Lake Agassiz and eroded the outwash deposits while simultaneously scouring and deepening the bedrock valley. As the flow of Glacial River Warren diminished, the deeply eroded gorge filled with up to 200 feet of Quaternary fluvial material. The large supply of sediment from the Mississippi headwaters and its tributary streams, coupled with a diminished supply of water at the end of glacial melting, led to the development of a braided stream environment. River conditions were characterized by numerous channels, swampy depressions, natural levees, islands, and shallow lakes. Completion of the Locks and Dams during the 1930's flooded the area and inundated the river valley and obscured the braided stream characteristics. Away from the navigation channel, lacustrine sediments now form a relatively thin, stratified, veneer of organic sediments, clays, silts, and sands over most of the present river bottom.

7. Over most of the upland areas there is a thin deposit of glacial drift and loam with scattered pebbles and boulders. Wind-blown silt, or loess, extends down the slopes of the main valleys nearly to the streams. Loess deposits on the uplands and on the valley slopes can reach a thickness of up to 15 feet, but are typically much less.

8. Natural springs emerge at numerous points along the base of the cliffs and along deeply incised stream valleys bordering the river. Most are thought to issue from upland formations, and their discharges are generally small.

9. Exposures of bedrock can be seen along the Mississippi River bluffs. Ordovician Period Dolomite of the Prairie du Chien Formation caps the bluffs and ridges. Below the Prairie du Chien Formation, the bluffs consist of the following Cambrian rock formations, in descending order: Jordan Sandstone, St. Lawrence Siltstone and Dolomite, and the Franconia Glauconitic Sandstone. Below the terraces along the river is the Dresbach Formation, which is composed of the Ironton and Galesville Sandstone, Eau Claire Sandstone, and the Mt. Simon Sandstone.

10. The Mississippi gorge is entrenched into the Dresbach Formation. This unit is a marine-deposited quartz sandstone. The sandstone is relatively easy to erode, and it accounts for the wide, U-shaped geometry of the bedrock gorge. A Precambrian red clastic group, the Hinkley Sandstone, lies below the Dresbach Formation. The Hinkley Sandstone rests on an undifferentiated Precambrian crystalline rock formation that is assumed to be thousands of feet thick.

11. Textural analyses of soil samples and drill cuttings from borings at Lock and Dam 5 and

from Spring Lake confirmed the absence of glacial drift in the ancestral gorge. The Quaternary material above the bedrock surface in the river valley is typical fluvial clays, silts, and sands with occasional fine gravel. Twelve borings taken in 1999 in Spring Lake confirmed that an abundance of poorly sorted loose sands with minor amounts of organic-rich sandy clays and silts underlie the project area. Several borings indicated that discontinuous soft clay layers exist between one and five feet below the lake bottom. Clay layer thickness varied from one boring location to another. The cohesive sediments discovered in these borings were similar in composition and are possibly a remnant of the floodplain that existed prior to the construction of the Mississippi River Lock and Dam system.

12. The structural geology of this portion of the Mississippi gorge has not been determined in detail. Regionally, the sedimentary rocks dip gently and thicken to the southwest, conforming to the Precambrian basement rocks. Solution weathering in the Dolomite is common. Stress relief joints that tend to parallel the trend of the Mississippi gorge can be observed in rocks along the river bluffs. The region is considered structurally stable and without tectonic disturbances of regional or local magnitude.
.

13. GENERAL GEOTECHNICAL DESIGN:

The Geotechnical Design philosophy used for Environmental Management Program (EMP) projects is different than that used for flood control projects. The acceptable level of risk is higher for EMP's because their design purpose is to create animal habitat, and their alignments can be easily adjusted. Whereas, flood control projects protect lives and property and alignments are often difficult to change. For these reasons, stability and settlement analyses were completed using an average of parameters obtained at other Upper Mississippi River valley construction sites. If the factor-of-safety is above 1.3, it is assumed to be stable. If failures do occur, the alignment of the islands can be easily changed during construction.

14. SELECTED PLAN SUMMARY:

An approximate layout of the selected plan is shown on Plate 6-1. Generally, the project side slopes are 4H to 5H:1V for islands and 1.5H:1V for rock groins and vanes. Erosion protection includes: rock groins along the sides of islands subjected to wave action, rock vanes along islands next to the slough that runs along the main-channel side of the project, and rock mounds. The table below lists the lengths of the various features of the selected plan with its geotechnical aspect(s).

Feature	Volume (CY)	Geotechnical Part
Islands	211,000 Sand 67,000 Random/Fines	Clean sand base with fine material on top
Rock for overflow sections/groins/mounds	13,000	Rock gradation Side slope

15. SUBSURFACE INVESTIGATIONS:

The St. Paul District obtained a total of 12 borings for the Spring Lake Islands project. The locations for the borings are shown on Plate 6-1 with the logs shown on Plates 6-2 and 6-3. The borings were taken near the proposed islands as they were aligned in 1999, and in areas where it was thought sand might be found. They don't have a generalized stratigraphy. The table below shows for each boring how thick the top layer of soft to very soft of fine-grained soil is:

Boring No.	99-9M	99-10M	99-11M	99-12M	99-16M
Soft Layer Thickness, ft. (m.)	1.0 (0.3)	0.8 (0.2)	1.0 (0.3)	6.8 (2.1)	1.5 (0.5)

Boring No.	99-17M	99-18M	99-19M
Soft Layer Thickness, ft. (m.)	2.0 (0.6)	4.6 (1.4)	10+ (3+)

The testing results on the samples taken from this subsurface investigation were as follows:

Testing Summary		
Type of Test	Number of Tests Completed	Results
Percent passing the no. 200 sieve	6	Range 6.5% to 30.6%

16. SLOPE STABILITY:

A slope stability analysis using EM 1110-2-1913 was only completed for Case I (end of construction conditions), because this is the only case that applies. Much of the islands length is only 6 feet high and much of the stratigraphy has a thin layer of fine material above sand. However, the islands are up to 8 feet high in some areas and in these areas the clay layer thickness cannot be determined from the borings. For these reasons, a stability analysis was completed for one island cross section which is typical for all the islands. The stability plate is on Plate 6-4, with the input data for UTEXAS 4 on Plate 6-5. UTEXAS 4 is a general-purpose computer program used for limit equilibrium slope stability computations. No shear strength testing was completed for the Spring Lake Islands project. Instead, an average of the shear strength found at other Upper Mississippi River projects was used. As the table below shows, the average End-of-Construction (EOC) strengths minus one standard deviation for other EMP projects is 240 psf, which was rounded down to 200 psf. The section was stable assuming a shear-strength of 200 psf with a computed factor-of-safety equal to 1.36. In the locations where the shear strengths are below 170 psf the factor-of-safety of the critical section will be below the 1.3 required. In these locations, the island side-slopes may fail during construction. This will necessitate adjustments to the alignment of the island, which may mean greater quantities of fill.

EOC Strengths for EMP Projects

Project Name	Type Project	Number of	Sample	Type of Test	p (tsf)	q (tsf)
AMBROUGH SLOUGH						
	EMP	1998 - 1 MU	1	Q	0.91	0.41
				average q - stdev		
CAPOLI SLOUGH						
	EMP	1999 - 1 MU	2	Q	0.73	0.23
	EMP	1999 - 1 MU	2	Q	1.25	0.25
	EMP	1999 - 1 MU	2	Q	2.25	0.25
	EMP	1999 - 3 MU	1	Q	0.83	0.33
	EMP	1999 - 3 MU	1	Q	1.39	0.39
	EMP	1999 - 3 MU	1	Q	2.44	0.44
				average q - stdev		0.23
CONWAY LAKE						
	EMP	2001 - 3 MU	1	Q	0.56	0.31
	EMP	2001 - 3 MU	1	Q	0.87	0.37
	EMP	2001 - 3 MU	1	Q	1.35	0.35
	EMP	2001 - 6 MU	1	UNCONFINED	0.14	0.14
				average q - stdev		0.19
POOL 8						
	EMP	1987 - 3 MU	1	Q	0.67	0.17
	EMP	1987 - 3 MU	1	Q	1.17	0.17
	EMP	1987 - 3 MU	1	Q	2.21	0.21
	EMP	1987 - 4 MU	2	Q	0.64	0.14
	EMP	1987 - 4 MU	2	Q	1.34	0.34
	EMP	1987 - 4 MU	2	Q	2.29	0.29
	EMP	1987 - 4 MU	4	Q	0.82	0.32
	EMP	1987 - 4 MU	4	Q	1.34	0.34
	EMP	1987 - 4 MU	4	Q	2.42	0.42
	EMP	1987 - 5 MU	1	Q	0.55	0.05
	EMP	1987 - 5 MU	1	Q	1.06	0.06
	EMP	1987 - 5 MU	1	Q	2.05	0.05

Project Name	Type Project	Number of	Sample	Type of Test	p (tsf)	q (tsf)

POOL 8						
	EMP	1995 - 40 MU	1	UNCONFINED	0.37	0.37
	EMP	2000 - 52 MU	1	Q	0.51	0.26
	EMP	2000 - 52 MU	1	Q	0.72	0.22
	EMP	2000 - 52 MU	1	Q	1.29	0.29
	EMP	2000 - 62 MU	1	UNCONFINED	0.44	0.44
	EMP	2000 - 66 MU	1	UNCONFINED	0.37	0.37
					average q - stdev	**0.13**
TREMPEALEAU NWR						
	EMP	1991 - 7 MU	1	Q	1.37	0.87
	EMP	1991 - 7 MU	1	Q	2.34	0.34
	EMP	1993 - 18 MU	1	Q	0.61	0.11
	EMP	1993 - 18 MU	1	Q	1.14	0.14
	EMP	1993 - 18 MU	1	Q	2.22	0.22
	EMP	1993 - 21 MU	1	Q	0.60	0.10
	EMP	1993 - 21 MU	1	Q	1.14	0.14
	EMP	1993 - 21 MU	1	Q	2.19	0.19
	EMP	1993 - 22 MU	1	UNCONFINED	0.12	0.12
	EMP	1993 - 22 MU	3	Q	0.66	0.16
	EMP	1993 - 22 MU	3	Q	1.19	0.19
	EMP	1993 - 22 MU	3	Q	2.23	0.23
					average q - stdev	**0.02**
					Overall average q - stdev	**0.12**

17. SETTLEMENT AND DISPLACEMENT:

The potential settlement of the islands was estimated using the CONSOL computer program. CONSOL calculates the amount and the time rate of consolidation for one-dimensional drainage conditions in horizontally layered soil masses. The time rate of consolidation is calculated using an implicit finite difference procedure. The proposed islands will be placed in locations where islands have existed in the past, according to surveys taken before the locks and dams were built. The parameters $C_c = 0.3$, $e_0 = 0.9$, and OCR= 1.2, were used. These are averages of testing done for other EMP projects in backwaters of the Upper Mississippi River valley. Soil stratigraphy from boring no. 99-19M was used as the worst case boring with the thickest clay layer. A summary of the input and results of the CONSOL run is shown on Plate 6-6 with the most-likely long-term settlement of 0.6 feet computed. A Taylor's series reliability analysis, according to J. M. Duncan[(1)] ,was completed and is shown on Plate 6-7. The results of the analysis were that there is a 20% chance of an ultimate settlement of 0.77 ft. and that there is a 5% chance of less then 0.3-ft. of settlement. EMP projects are different then other construction projects in that it is important that the constructed islands are not higher then designed. If the islands were overbuilt for settlement but remained high, they would be overtopped less frequently, which would provide less flood plain habitat. Also, experience has shown that islands constructed in the Upper Mississippi River Valley do not appear to settle as much as calculations show. This is possibly due to calculations over estimating settlement and/or due to some settlement occurring during construction. For this reason, and because the computed settlement was so small, the islands will not be overbuilt. The displacement of the rock and sand was assumed to be 0.5 ft.

18. MATERIAL SOURCES:

All the borrow area locations are shown in the main report. Sand was found at the channel bottom in the area of Belvidere Slough near borings nos. 99-14M and 99-15M. However, subsequent surveys have shown that this area contains a major mussel resource, therefore it will not be used as a borrow site. The soils within the backwater being protected could be suitable for sand borrow if some means were used to separate the sand from the fines or if water quality standards were relaxed. Borings nos. 99-18M and 99-19M appear suitable for fines borrow. The delineation of any borrow sites near the dam, will be kept at least 100 feet away from the toe of Dam No. 5.

19. CONSTRUCTIBILITY:

This project proposes constructing islands by hydraulically placing dredged sand to an elevation that is 0.5 ft above the water surface. This will be followed with constructing the rest of the island out of random fill and fines. This construction technique has been used for other similar EMP projects without problems.

20. ROCK GRADATION:

Both rockfill and riprap are available locally. Numerous dolomite quarries have been developed in the Prairie du Chien Formation adjacent to the Mississippi River valley. Acceptable quality rock for this project is available within a 10-mile radius of Spring Lake. The calculation of the minimum weight of the 50 percent-less-than-by-weight rocks for the rockfill is explained in the Hydraulic Appendix. The selected gradation is shown on Plate 6-8 and in the table below:

Table: Rock Gradation

Percent Less-than-by-Weight:	Maximum, lbs. (kg.):	Minimum, lbs. (kg.):
100	300 (136)	100 (45)
50	120 (54)	40 (18)
15	25 (12)	8 (4)

21. FUTURE WORK:

No additional borings or tests will be done to define the subsurface stratigraphy on this project. However, the work for plans and specifications may include borings and testing to better define the limits of borrow sites. Additionally, plans and specifications work will include designating specific quarries, further defining riprap placement, input to the specifications, and review of the contract documents.

Bibliography

1. **Duncan, J. M.** (1999). *Factors of Safety and Reliability in Geotechnical Engineering*, American Society of Engineers

2. **Martin, Lawrence**. *The Physical Geography of Wisconsin*, Wisconsin Geological and Natural History Survey, (1932)

3. **Young, H. L., and R. G. Borman,** *Water Resources of Wisconsin – Trempealeau-Black River Basing*, U.S.G.S Hydrologic Investigations Atlas (1973)

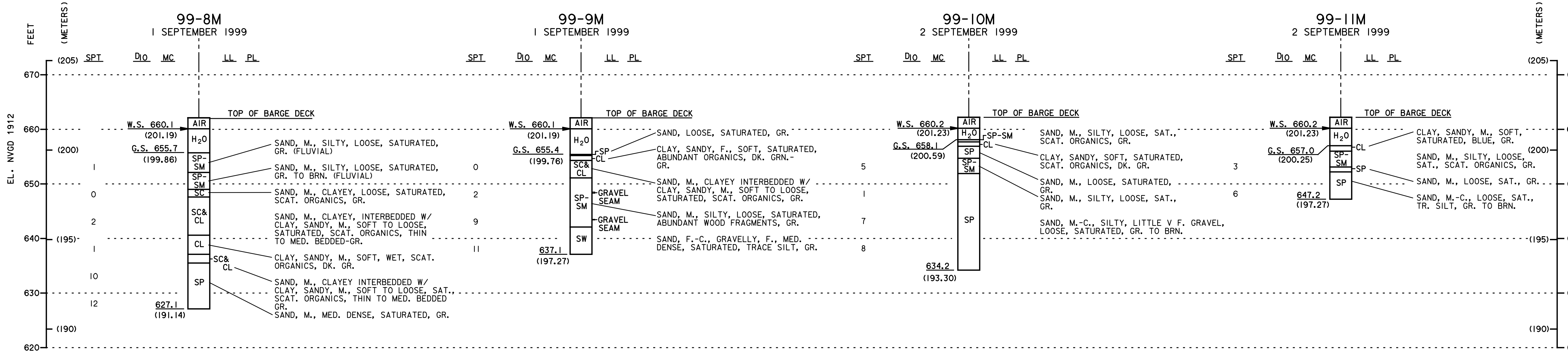
Legend

- BORINGS PLANNED FOR P & S
- BORINGS DONE FOR DPR

SPRING LAKE ISLANDS: BORING LOCATIONS

0 500 1,000 2,000 Feet

PLATE 6-1

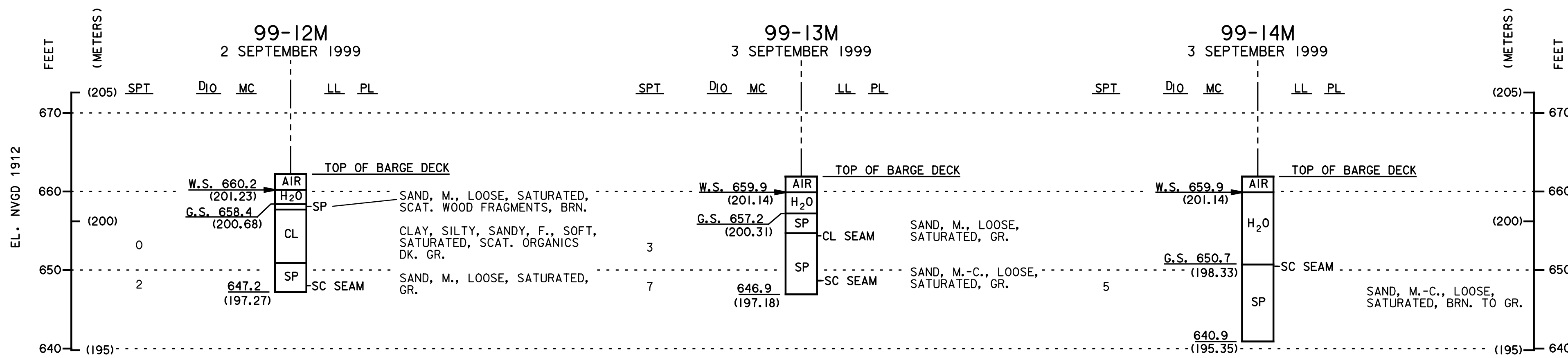


NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 646.9', BELOW CASING HOLE STABILIZED WITH DRILLING FLUID.
3. ALL CASING REMOVED. BORING ALLOWED TO CAVE.

NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 647.1', BELOW CASING HOLE STABILIZED WITH DRILLING FLUID.
3. ALL CASING REMOVED. BORING ALLOWING TO CAVE.

NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 649.2', BELOW CASING HOLE STABILIZED WITH DRILLING FLUID.
3. HEAVING SANDS BELOW EL. 636.2'.
4. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 649.2'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.



NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 649.2'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 648.9'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 643.9'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

GENERAL BORING NOTES

1. GENERAL: THE UNIFIED SOIL CLASSIFICATION SYSTEM IS USED TO IDENTIFY BASIC SOIL TYPE. THE LEGEND REPRESENTS ONLY THE BASIC SOILS. TO COMPLETE THE CLASSIFICATION, PERTINENT INFORMATION IS ADDED TO THE RIGHT OF THE BORING STAFF, NOTES PERTAINING TO A SPECIFIC BORING ARE SHOWN BELOW THE BORING STAFF.

2. MOISTURE CONTENT: THE NATURAL MOISTURE CONTENT IN PERCENT OF DRY WEIGHT (MC) IS SHOWN TO THE LEFT OF THE BORING STAFF.

3. BLOW COUNT (SPT): BLOW COUNTS ARE SHOWN TO THE LEFT OF THE BORING STAFF AND, EXCEPT AS NOTED, ARE THE NUMBER OF BLOWS NECESSARY TO DRIVE THE SAMPLER USED A DISTANCE OF 12". STANDARD BLOW COUNTS ARE FOR A STANDARD PENETRATION TEST (SPT) USING A 1⅜" X 2" SAMPLER, 140 LB. HAMMER AND A 30" DROP. FOR NON-STANDARD BLOW COUNTS, SAMPLER SIZE, HAMMER WEIGHT AND HEIGHT OF DROP ARE AS SHOWN.

4. ATTERBERG LIMITS: LIQUID LIMIT (LL) AND PLASTIC LIMIT (PL) ARE SHOWN TO THE RIGHT OF THE BORING STAFF.

5. D_{10} SIZE: THE GRAIN SIZE IN MILLIMETERS OF WHICH 10% OF THE SAMPLE IS FINER IS SHOWN TO THE LEFT OF THE BORING STAFF.

6. RQD: ROCK QUALITY DESIGNATION (RQD) IS SHOWN TO THE LEFT OF THE PERCENT RECOVERY COLUMN. ROD IS THE PERCENT RECOVERY CONSISTING OF UNBROKEN PIECES LONGER THAN 4".

7. % RECOVERY: PERCENT CORE RECOVERY IS SHOWN TO THE LEFT OF THE BORING STAFF. PERCENT RECOVERY IS LENGTH OF CORE RECOVERED/LENGTH OF CORE CUT X 100. UNLESS SPECIFIED OTHERWISE, ALL CORE IS 4" DIAMETER.

8. ELEVATIONS REFERENCED TO N.G.V.D. 1912 ADJ.

9 THE BORINGS SHOW SUMMARIES OF INFORMATION RECORDED ON THE ORIGINAL FIELD LOGS. THESE LOGS ARE AVAILABLE FOR INSPECTION AT THE ST. PAUL DISTRICT OFFICE. ARRANGEMENTS TO INSPECT LOGS CAN BE MADE BY CALLING (651) 290-5599.

CONVERSION NOTES

TO CONVERT FEET TO METERS, MULTIPLY FEET BY 0.3048 = METERS.

TO CONVERT INCHES TO MILLIMETERS, MULTIPLY INCHES BY 25.4 = MILLIMETERS

GENERAL BORING LEGEND

84-1M	YEAR OF BORING-BORING NUMBER, BORING TYPE (EG: M=MACHINE, A=AUGER, TP=TEST PIT, P=PIEZOMETER).
1 MAY 1984	DATE OF BORING
W.S. 1026.7	WATER SURFACE ELEVATION ON DAY OF BORING
G.S. 1020.2	GROUND SURFACE ELEVATION AT BORING
GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURE, LITTLE OR NO FINES
GP	POORLY GRADED GRAVELS, LITTLE OR NO FINES
GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SM	SILTY SANDS, SAND - SILT MIXTURES
SC	CLAYEY SANDS, SAND - CLAY MIXTURES
ML	INORGANIC SILTS, LIQUID LIMIT LESS THAN 50
MH	INORGANIC SILTS, LIQUID LIMIT GREATER THAN 50
CL	INORGANIC CLAYS, LOW TO MEDIUM PLASTICITY, LIQUID LIMIT LESS THAN 50
CH	INORGANIC CLAYS, HIGH PLASTICITY, LIQUID LIMIT GREATER THAN 50
OL	ORGANIC SILTS OR CLAYS, LOW PLASTICITY, LIQUID LIMIT LESS THAN 50
OH	ORGANIC SILTS OR CLAYS, MEDIUM TO HIGH PLASTICITY, LIQUID LIMIT GREATER THAN 50
PT	PEAT
SP-SM	BORDERLINE MATERIAL
SP& SM	STRATIFIED MATERIAL
1	LOCATION AND SAMPLE NUMBER FOR UNDISTURBED SAMPLE
	NO RECOVERY
W.L. 726.7	WATER LEVEL ON DATE OF BORING
700.1	ELEVATION AT BOTTOM OF BORING
(238.56)	ELEVATION IN METERS

US Army Corps of Engineers
St. Paul District

Symbol | Description | Date | Appr.

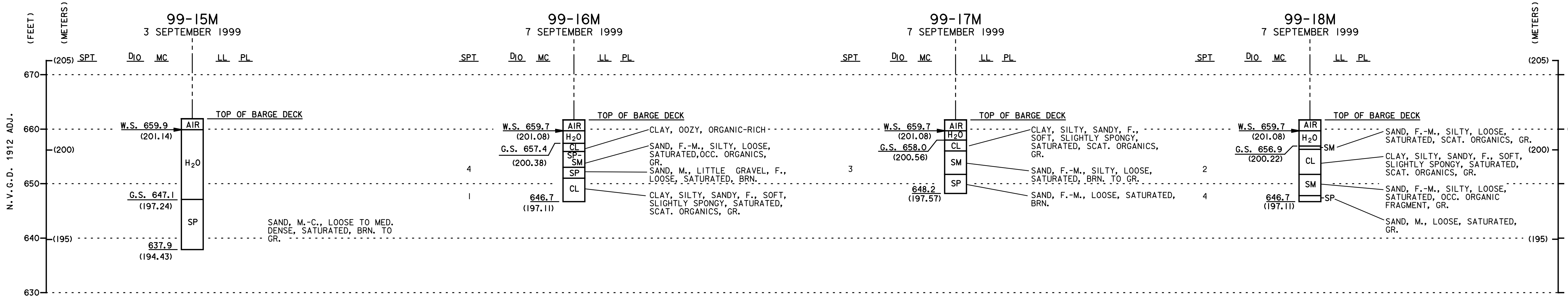
DESIGNED: KSN
CHECKED: JJF/KSN
DRAWN: GRS
DESIGNED:
CHECKED:
SCALE: AS SHOWN
DATE: DEC. 1999
CADD FILE NAME: spb2t0002.dgn
SOL NO: DACW37-93-B-0044
AE APPROVING OFFICIAL:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

REFERENCE DRAWING
POOL #5 SPRING LAKE ISLANDS
GEOLOGICAL DATA
LEGEND, GENERAL NOTES &
BORING LOGS; 99-8M, 99-9M, 99-10M
99-11M, 99-12M, 99-13M & 99-14M

DRAWING NUMBER:
PLATE 6-2

SHT 1 OF 2

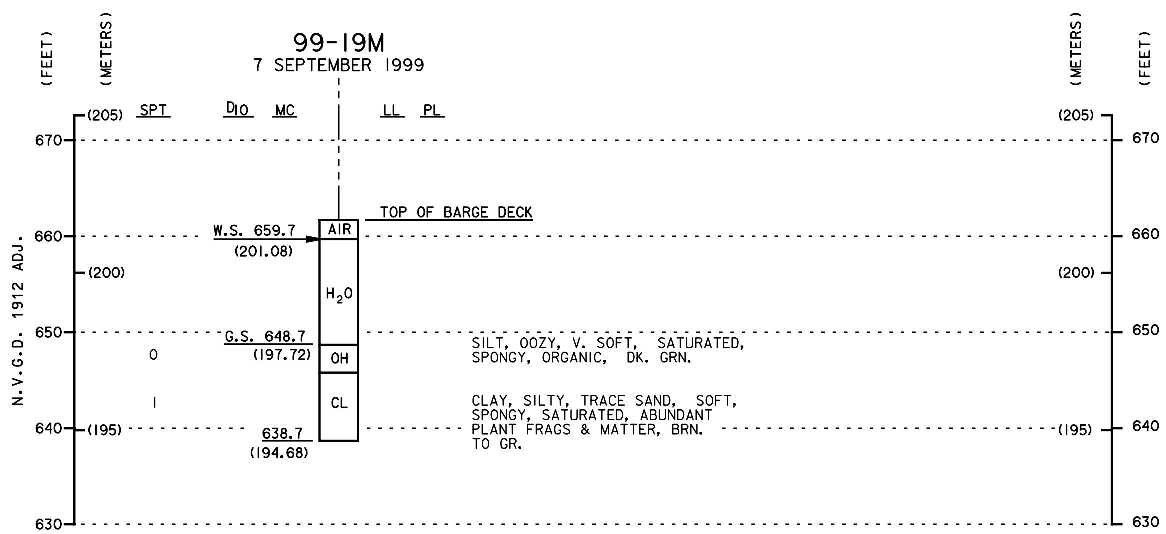


NOTES (99-15M)
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 642.9'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES (99-16M)
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 648.7'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES (99-17M)
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 651.7'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

NOTES (99-18M)
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 648.7'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.



NOTES
1. BORING OBTAINED FROM FLOATING PLANT.
2. 4" ALUMINUM CASING SET TO EL. 641.7'.
3. ALL CASING REMOVED. HOLE ALLOWED TO CAVE.

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

DESIGNED: KSN
CHECKED: JJF/KSN
DRAWN: GRS
SCALE: AS SHOWN
DATE: DEC. 1999
CADD FILE NAME: spbt210003.dgn
SOL. NO.: DACW37-93-B-0044
AE APPROVING OFFICIAL:
ED-D
ED-H
DESIGNED:
CHECKED:

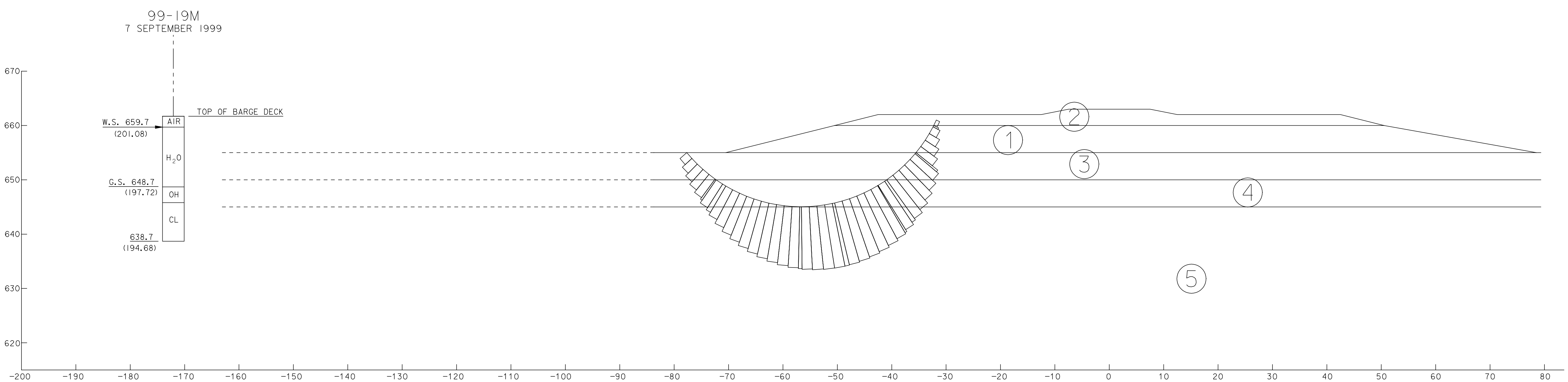
DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

POOL #5
REFERENCE DRAWING
SPRING LAKE ISLANDS
GEOLOGICAL DATA
BORING LOGS; 99-15M, 99-16M, 99-17M, 99-18M & 99-19M

DRAWING NUMBER:
PLATE 6-3

SHT 2 OF 2

SOIL NO.	DESCRIPTION	UNIT WEIGHT (psf) MOIST	SATURATED	ESTIMATED Q-STRENGTHS c (psf)	PHI (DEGREES)	CRITICAL CIRCULAR FAILURE CENTER COORDINATES X	Y	RADIUS	FACTOR OF SAFETY
1	SAT. SAND FILL		120	0	28	-56.6	672.3	27.26	1.36
2	SAND FILL	115		0	28				
3	OH		110	150	0				
4	CL		90	200	0				
5	SP		120	0	25				



NOTES:
1. UNLESS OTHERWISE NOTED, UNITS SHOWN ARE IN FEET.
2. ELEVATIONS REFER TO MEAN SEA LEVEL (N.G.V.D. 1912 ADJ.)

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

DESIGNED: ED-D
CHECKED:
DRAWN:
DESIGNED: ED-H
CHECKED:
SCALE:
DATE:
CADD FILE NAME:
SOL. NO:
AE APPROVING OFFICIAL:

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

SPRING LAKE EMP - DPR
ISLAND STABILITY ANALYSIS

DRAWING NUMBER:
PLATE 6-4
SHT OF

HEADING

Spring Lake Islands EMP

Levee top= 663

GRAPHICS

PROFILE LINES

1	1	Embankment fill saturated
100.00	655.00	
120.00	660.00	
221.00	660.00	
249.00	655.00	
2	2	Embankment fill moist
120.00	660.00	
128.00	662.00	
158.00	662.00	
163.00	663.00	
178.00	663.00	
183.00	662.00	
213.00	662.00	
221.00	660.00	
3	3	Foundation soil (CH)
-50.00	655.00	
100.00	655.00	
252.00	655.00	
255.00	654.00	
265.00	654.00	
268.00	655.00	
418.00	655.00	
4	4	Foundation soil (MH)
-50.00	650.00	
418.00	650.00	
5	5	Foundation soil (SP)
-50.00	645.00	
418.00	645.00	

MATERIAL PROPERTIES

1 Embankment fill saturated

120

C

0.00 28

0

2 Embankment fill moist

115

C

0.00 28

0

3 Foundation soil (CH)

100

C

150.00 0

0

4 Foundation soil (MH)

100

C

200.00 0

0

5 Foundation soil (SP)

100

C

0.00 25

0

ANALYSIS/COMPUTATION DATA

Circular Search 1

114.00 675.00 0.10 550.00

POINT

114.00 635.00

ITErations

100

CRACK

1 DEPTH

WATER

1 DEPTH

SIDE

1

PROCEDURE

SPENCER

COMPUTE

top_el		c_q
655	OH	150.00
650	CL	200.00
645	SP	0.00

```
UTEXAS4 - Version: 1.0.0.1 - Latest Revision: 4/15/99
Licensed for use by: Joel Face, U. S. Army Corps of Engineers
Time and date of run: Thu Nov 15 15:07:28 2001
Input file: C:\...\My Documents\spring\utex\springNOsp2.prn

                        Spring Lake Islands EMP

                        Levee top=   663

TABLE NO. 33
*********************************************
* 1-STAGE FINAL CRITICAL CIRCLE INFORMATION *
*********************************************
X Coordinate of Center . . . . . . . . . . . . .  113.90
Y Coordinate of Center . . . . . . . . . . . . .  672.30
Radius . . . . . . . . . . . . . . . . . . . . .  27.26
Factor of Safety . . . . . . . . . . . . . . . . 1.357
Side Force Inclination/Lambda  . . . . . . . . . 5.34
Number of Circles Tried  . . . . . . . . . . . .  255
Number of Circles F Calculated for . . . . . . .  255
Time Required for Search (seconds) . . . . . . .  1.7
```

```
CONSOL -- 1-D CONSOLIDATION ANALYSIS---------------------
|                                                        |
|                   --  VERSION 2.0  --                  |
|                                                        |
|     VIRGINIA TECH DEPARTMENT OF CIVIL ENGINEERING      |
|                                                        |
----------------------------------------------------------
```

DATE: 10-30-2001
INPUT FILE: springoc.dat
OUTPUT FILE: springoc.OUT
PLOT FILE: springoc.PLT

TITLE: Settlement of Spring Lake Islands

**** C O N T R O L   D A T A ****

NUMBER OF COMPRESSIBLE UNITS	7
NUMBER OF SOIL LAYERS	10
NUMBER OF DIFFERENT SOILS	2
ELEVATION OF THE GROUND SURFACE	655.00
ELEVATION OF THE TOP OF THE COMPRESSIBLE SOIL MASS ..	655.00
GROUND WATER ELEVATION	660.00
UNIT WEIGHT OF WATER	62.40
MST. UT. WT. OF SOIL BTWN. GS & COMP. SOIL MASS	.00
SAT. UT. WT. OF SOIL BTWN. GS & COMP. SOIL MASS	.00

**** U N I T   B O U N D A R Y   D A T A ****

UNIT NUMBER	TOP BOUNDARY	BOTTOM BOUNDARY	DRAINAGE CONDITION
1	1	3	2
2	3	4	2
3	4	5	2
4	7	7	2
5	8	8	2
6	9	9	2
7	10	10	2

**** S O I L   P R O P E R T Y   D A T A ****

SOIL TYPE	UNIT WEIGHT	VOID RATIO	Cc	Ccs	Cv	Cvs
1	111.00	.90	.30	.03	1.00	200.00
2	125.00	1.50	.00	.00	10.00	200.00

**** SUBLAYER DATA ****

LAYER	CENTER ELEV	BOTTOM ELEV	THICK	OVERBN PRESSURE	PRECONS PRESSURE	SOIL TYPE
1	654.50	654.00	1.00	24.30	24.30	1
2	653.75	653.50	.50	60.75	60.75	1
3	653.00	652.50	1.00	104.20	104.20	2
4	652.00	651.50	1.00	166.80	166.80	2
5	651.00	650.50	1.00	229.40	229.40	2
6	650.00	649.50	1.00	292.00	292.00	2
7	649.00	648.50	1.00	354.60	354.60	2
8	647.00	645.50	3.00	458.80	458.80	1
9	644.00	642.50	3.00	604.60	604.60	1
10	638.75	635.00	7.50	912.25	912.25	2

**** NUMBER OF LOADCASES TO BE ANALYSED: 1

**** LOADCASE: 1 ****
**** INFINITE STRIP FILL ****

TIME INTERVALS: .00 .02 .10 .50 1.00 2.00
4.00 10.00 20.00 30.00 40.00

OLD FILL ELEVATION 655.00
NEW FILL ELEVATION 663.00
CHANGE IN FILL THICKNESS 8.00
MOIST UNIT WEIGHT OF FILL 120.00
SATURATED UNIT WEIGHT OF FILL 125.00
STRIP LOAD WIDTH 100.00
SETTLEMENT LOCATION FROM CENTERLINE ... .00
BUOYANCY EFFECT OPTION 1

LAYER	THICK.	VOID RATIO	INITIAL PRESSURE	PRECONS. PRESSURE	FINAL PRESSURE	ULT. SETTL.
1	1.00	.90	24.30	24.30	697.30	.23
2	.50	.90	60.75	60.75	733.74	.09
3	1.00	1.50	104.20	104.20	777.18	.00
4	1.00	1.50	166.80	166.80	839.74	.00
5	1.00	1.50	229.40	229.40	902.25	.00
6	1.00	1.50	292.00	292.00	964.72	.00
7	1.00	1.50	354.60	354.60	1027.11	.00
8	3.00	.90	458.80	458.80	1130.66	.19
9	3.00	.90	604.60	604.60	1274.72	.15
10	7.50	1.50	912.25	912.25	1576.56	.00

ULTIMATE SETTLEMENT WITHOUT CORRECTION FOR BUOYANCY : .67

FOR THIS LOAD CASE		ACCUMULATED		SURFACE
TIME	SETTLEMENT	TIME	SETTLEMENT	ELEVATION
.01	.53	.01	.53	662.47
.02	.53	.02	.53	662.47
.10	.55	.10	.55	662.45
.50	.58	.50	.58	662.42
1.00	.59	1.00	.59	662.41
2.00	.59	2.00	.59	662.41
4.00	.59	4.00	.59	662.41
10.00	.59	10.00	.59	662.41
20.00	.59	20.00	.59	662.41
30.00	.59	30.00	.59	662.41
40.00	.59	40.00	.59	662.41

**** C O M P L E T E   T I M E   S E T T L E M E N T   R E C O R D ****

TIME	SETTLEMENT
.01	.53
.02	.53
.10	.55
.50	.58
1.00	.59
2.00	.59
4.00	.59
10.00	.59
20.00	.59
30.00	.59
40.00	.59

Taylor's Series Reliability: for Spring Lake Islands Settlement

1.) Determine most-likely-value (mlv) settlement = S_{mlv}

Using a CSETT settlement analysis with the following guesses at parameters:

$ocr := 1.2$ $C_c := .3$ $C_r := .03$ $C_v := 1 \cdot \frac{ft^2}{yr}$ $e := .9$

$d_c := 6.0 \cdot ft$ $S_{mlv} := .57 \cdot ft$

2.) Estimate standard deviations of parameters that involve uncertainty.

Over Consolidation Ratio (ocr):

Highest Conceivable Value $HCV := 2$

Lowest Conceivable Value $LCV := 1$

$$\sigma_{ocr} := \frac{HCV - LCV}{6} \qquad \sigma_{ocr} = 0.2$$

Compression Index (C_c):

Highest Conceivable Value $HCV := 1.3$

Lowest Conceivable Value $LCV := .1$

$$\sigma_{Cc} := \frac{HCV - LCV}{6} \qquad \sigma_{Cc} = 0.2$$

These extreme values were obtained from TR 3-604 "Eng. Properties...", 1962, Fig. 25.

Recompression Index (C_r):

Highest Conceivable Value $HCV := .1$

Lowest Conceivable Value $LCV := .01$

$$\sigma_{Cr} := \frac{HCV - LCV}{6} \qquad \sigma_{Cr} = 0.015$$

These extreme values were obtained from NAVFAC DM-7.1 "Soil Mechanics", Table 6.

Void Ratio (e):

Highest Conceivable Value $HCV := 2.4$

Lowest Conceivable Value $LCV := .5$

$$\sigma_e := \frac{HCV - LCV}{6} \qquad \sigma_e = 0.32$$

Depth of Clay layer (d_c):

Highest Conceivable Value $HCV := 20 \cdot ft$

Lowest Conceivable Value $LCV := 3 \cdot ft$

$$\sigma_{dc} := \frac{HCV - LCV}{6} \qquad \sigma_{dc} = 2.8\,ft$$

3.) Compute Coefficient of Variation (COV):

Over Consolidation Ratio (ocr):

$S_{ocrp} := .55 \cdot ft$

$S_{ocrm} := .59 \cdot ft$

$\Delta S_{ocr} := S_{ocrm} - S_{ocrp}$ $\qquad \Delta S_{ocr} = 0.04\ ft$

Compression Index (C_c):

$S_{Ccp} := .76 \cdot ft$

$S_{Ccm} := .37 \cdot ft$

$\Delta S_{Cc} := S_{Ccp} - S_{Ccm}$ $\qquad \Delta S_{Cc} = 0.39\ ft$

Recompression Index (C_r):

$S_{Crp} := .6 \cdot ft$

$S_{Crm} := .6 \cdot ft$

$\Delta S_{Cr} := S_{Crp} - S_{Crm}$ $\qquad \Delta S_{Cr} = 0\ ft$

Void Ratio (e):

$S_{ep} := .5 \cdot ft$

$S_{em} := .69 \cdot ft$

$\Delta S_e := S_{em} - S_{ep}$ $\qquad \Delta S_e = 0.19\ ft$

Depth of Clay layer (d_c):

$S_{dcp} := .92 \cdot ft$

$S_{dcm} := .5 \cdot ft$

$\Delta S_{dc} := S_{dcp} - S_{dcm}$ $\qquad \Delta S_{dc} = 0.42\ ft$

4.) Compute Coefficient of Variation (COV) (continued):

$$\sigma_S := \left[\left(\frac{\Delta S_{ocr}}{2}\right)^2 + \left(\frac{\Delta S_{Cc}}{2}\right)^2 + \left(\frac{\Delta S_{Cr}}{2}\right)^2 + \left(\frac{\Delta S_e}{2}\right)^2 + \left(\frac{\Delta S_{dc}}{2}\right)^2\right]^{.5}$$

$\sigma_S = 0.303\,\text{ft}$

$$COV := \frac{\sigma_S}{S_{mlv}} \cdot 100$$

$COV = 53.1\%$

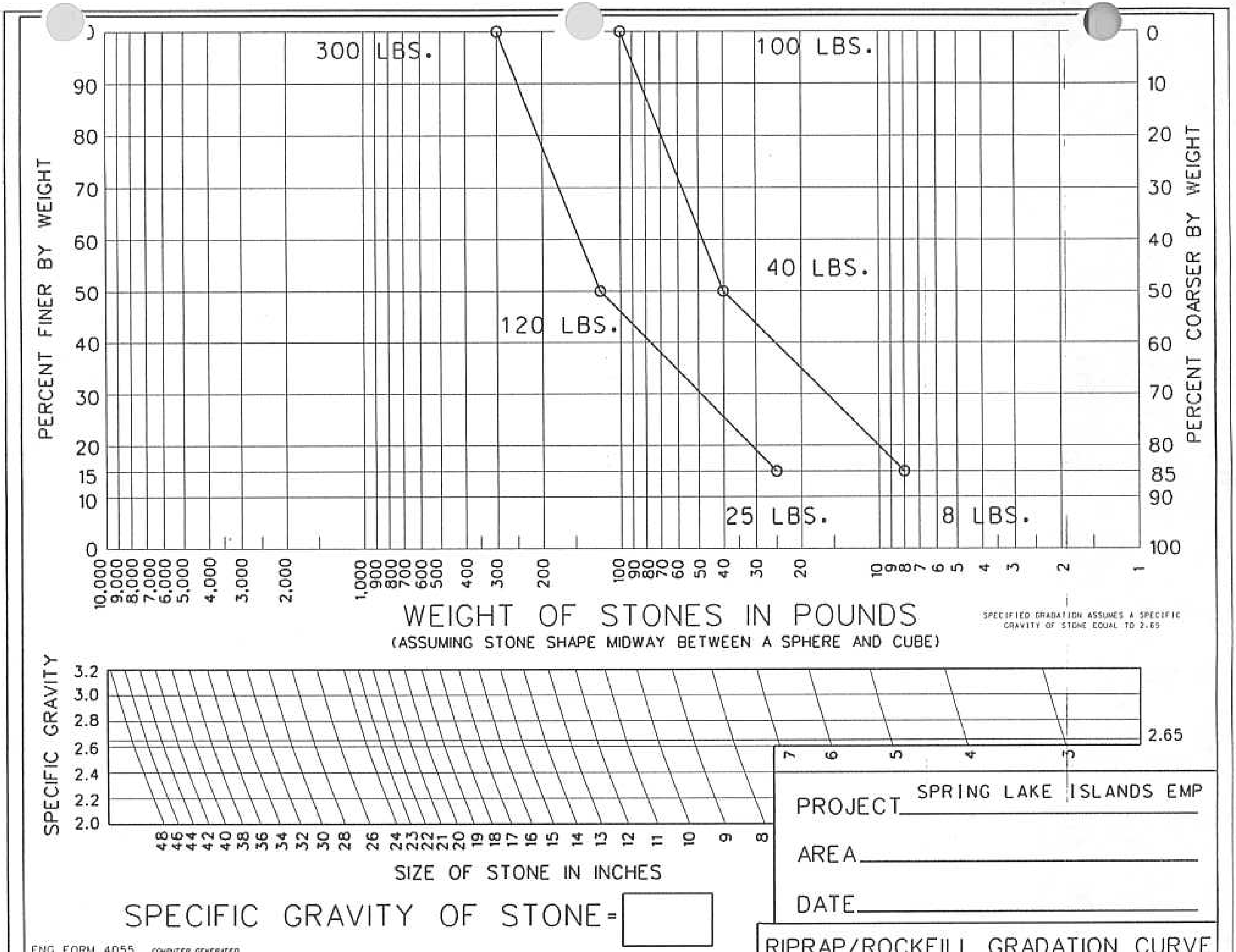
5.) Compute Possible Settlement (PS):

Settlement ratio (SR) with a chance of occurrence of 20% and a $COV = 53.1$ % is $SR := 1.344$. This yields a PS of the following:

$PS := SR \cdot S_{mlv}$ $\quad PS = 0.77\,\text{ft}$

6.) Compute risk of Small Settlement (SS):

With a $COV = 53.1$ % and $SS := 0.5 \cdot \text{ft}$ there is a 50% chance of the SS occurring. which means that there is a 50% chance of getting less than .5 ft. of settlement


300 LBS.
100 LBS.
40 LBS.
120 LBS.
25 LBS.
8 LBS.
PERCENT FINER BY WEIGHT
PERCENT COARSER BY WEIGHT
WEIGHT OF STONES IN POUNDS
(ASSUMING STONE SHAPE MIDWAY BETWEEN A SPHERE AND CUBE)
SPECIFIED GRADATION ASSUMES A SPECIFIC GRAVITY OF STONE EQUAL TO 2.65
SPECIFIC GRAVITY
SIZE OF STONE IN INCHES
SPECIFIC GRAVITY OF STONE =
PROJECT SPRING LAKE ISLANDS EMP
AREA
DATE
RIPRAP/ROCKFILL GRADATION CURVE
ENG FORM 4055

Memorandum of Agreement

Attachment 7

MEMORANDUM OF AGREEMENT
BETWEEN
THE UNITED STATES FISH AND WILDLIFE SERVICE
AND
THE DEPARTMENT OF THE ARMY
FOR
ENHANCING FISH AND WILDLIFE RESOURCES
OF THE
UPPER MISSISSIPPI RIVER SYSTEM
SPRING LAKE ISLANDS PROJECT
BUFFALO COUNTY, WISCONSIN

I. PURPOSE

The purpose of this memorandum of agreement (MOA) is to establish the relationships, arrangements, and general procedures under which the U.S. Fish and Wildlife Service (USFWS) and the Department of the Army (DOA) will operate in constructing, operating, maintaining, repairing, and rehabilitating the Spring Lake Islands separable element of the Upper Mississippi River System - Environmental Management Program (UMRS-EMP).

II. BACKGROUND

Section 1103 of the Water Resources Development Act of 1986, Public Law 99-662, authorizes construction of measures for the purpose of enhancing fish and wildlife resources in the Upper Mississippi River System. The project area is managed by the USFWS and is on land managed as a national wildlife refuge. Under conditions of Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, all construction costs of those fish and wildlife features for the Spring Lake Islands project are 100 percent Federal, and pursuant to Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580, all costs of operation and maintenance for the Spring Lake Islands project are 100 percent Federal.

III. GENERAL SCOPE

The project to be accomplished pursuant to this MOA shall consist of rehabilitating and improving the fish and wildlife habitat in lower pool 5 of the Mississippi River. The project consists of constructing four islands, one rock sill and protection for three existing islands and one peninsula. Dredging would occur in Spring Lake to improve habitat conditions for the backwater fish community.

The purpose of these structures is to improve fish and wildlife habitat by reducing flows in the area, improving conditions for the growth of aquatic plants, and increasing overall habitat diversity by restoring islands lost to erosion and protecting existing islands from additional erosion.

IV. RESPONSIBILITIES

A. The DOA is responsible for:

1. Construction. Construction of the project features to include necessary stabilization and vegetation measures.

2. Major Rehabilitation. The Federal share of any mutually agreed upon rehabilitation of the project that exceeds the annual operation and maintenance requirements identified in the Integrated Definite Project Report and Environmental Assessment, Spring Lake Island Habitat Rehabilitation and Enhancement Projects, dated August 2003, and that is needed as a result of specific storm or flood events.

3. Construction Management. Subject to and using funds appropriated by the Congress of the United States, and in accordance with Section 906(e) of the Water Resources Development Act of 1986, Public Law 99-662, the DOA will construct the Spring Lake Island project as described in the Integrated Definite Project Report and Environmental Assessment, Spring Lake Island Habitat Rehabilitation and Enhancement Projects, dated August 2003, applying those procedures usually followed or applied in Federal projects, pursuant to Federal laws, regulations, and policies. The USFWS will be afforded the opportunity to review and comment on all modifications and change orders prior to the issuance to the contractor of a Notice to Proceed. If the DOA encounters potential delays related to construction of the project, the DOA will promptly notify the USFWS of such delays.

4. Maintenance of Records. The DOA will keep books, records, documents, and other evidence pertaining to costs and expenses incurred in connection with construction of the project to the extent and in such detail as will properly reflect total costs. The DOA shall maintain such books, records, documents, and other evidence for a minimum of 3 years after completion of construction of the project and resolution of all relevant claims arising therefrom, and shall make available at its offices, at reasonable times, such books, records, documents, and other evidence for inspection and audit by authorized representatives of the USFWS.

B. The USFWS is responsible for operation, maintenance, and repair. Upon completion of construction as determined by the District Engineer, St. Paul, the USFWS shall accept the project and shall operate, maintain, and repair the project as defined in the Integrated Definite Project Report and Environmental Assessment entitled "Spring Lake Island Habitat Rehabilitation and Enhancement Project," dated August 2003, in accordance with Section 107(b) of the Water Resources Development Act of 1992, Public Law 102-580.

V. MODIFICATION AND TERMINATION

This MOA may be modified or terminated at any time by mutual agreement of the parties. Any such modification or termination must be in writing. Unless otherwise modified or terminated, this MOA shall remain in effect for a period of 50 years after initiation of construction of the project.

VI. REPRESENTATIVES

The following individuals or their designated representatives shall have authority to act under this MOA for their respective parties.

USFWS: Regional Director
U.S. Fish and Wildlife Service
Bishop Henry Whipple Federal Building
1 Federal Drive
Fort Snelling, Minnesota 55111-4056

DOA: District Engineer
U.S. Army Corps of Engineers, St. Paul District
190 Fifth Street East
St. Paul, Minnesota 55101-1638

VII. EFFECTIVE DATE OF MOA

This MOA shall become effective when signed by the appropriate representatives of both parties.

THE DEPARTMENT OF THE ARMY

BY: ______________________
ROBERT L. BALL
Colonel, Corps of Engineers
District Engineer

DATE: 15 DEC 03

THE U.S. FISH AND WILDLIFE SERVICE

Charles M. Wooley
Acting Regional Director

BY: ______________________
for ROBYN THORSON
Regional Director
U.S. Fish and Wildlife Service

DATE: 3/24/04

Coordination/Coorespondence

Attachment 8

The draft Definite Project Report/Environmental Assessment or Executive Summary/Notice of Availability (*) was sent to the following agencies, interests, media, and libraries. In addition, the Executive Summary/Notice of Availability was sent to all private citizens on the project mailing list.

Congressional
Sen. Mark Dayton (Twin Cities Office)
Sen. Russell Feingold (La Crosse Office)
Sen. Herbert Kohl (Madison Office)
Sen. Norm Coleman (St. Paul Office)
Rep. Ron Kind (La Crosse Office)
Rep. Gil Gutknecht (Rochester Office)
Rep John Kline (Burnsville Office)

Federal
Environmental Protection Agency – Region V Administrator
Department of Transportation - Region V Administrator
U.S. Coast Guard – St. Paul Office
U.S. Geological Survey – St. Paul and Madison Offices
U.S. Geological Survey – Upper Midwest Environmental Sciences Center
National Park Service – Midwest Regional and St. Paul Offices
National Resource Conservation Service – St. Paul and Madison Offices
Advisory Council on Historic Preservation
U.S. Fish and Wildlife Service (Hartwig, Hultman, Drieslein, Wege, Thiel, Dobrovolny)

State of Wisconsin

Department of Natural Resources (Hassett, G. Benjamin, Janvrin, Marron, Brecka, M. Anderson, R. Benjamin)
Department of Transportation
State Historic Preservation Office

State of Minnesota

Department of Natural Resources (Merriam, Balcom, Sc. Johnson, St. Johnson, Denz, Dieterman)
Minnesota Pollution Control Agency (Carrigan, Mader, Senjen)
Department of Transportation
State Historic Preservation Office
Water and Soil Resource Board

State of Iowa

Department of Natural Resources (Szcodronski)

Local Government

Alma, Wisconsin
Buffalo City, Wisconsin
Buffalo County, Wisconsin
Cochrane, Wisconsin
Fountain City, Wisconsin
Kellogg, Minnesota
Wabasha County, Minnesota

Interest Groups

American Rivers
Audubon Society
Ducks Unlimited
Gopher State Sportsmen Club
Lewiston Sportsmen Club
McKnight Foundation
Mississippi River Regional Planning Commission
Nature Conservancy
Mississippi River Citizen Commission
Upper Mississippi Waterways Association
Associated Sportsmen Club
Badger State Sportsmen Club
Izaak Walton League
La Crosse County Conservation Alliance
MARC 2000
Mississippi Sportsmen Club
Mississippi River Revival
Sierra Club
Upper Miss. R. Conservation Committee

Media/Libraries

Courier Press*
Lake City Graphic*
Winona Daily News*
Cochrane Recorder*
La Crosse Tribune*
Arcadia News Leader*
Galesville Republican*

KAGE Radio (Winona)*
WIZM Radio (La Crosse)*
WKBT TV (La Crosse)*
WLSU Radio (La Crosse)*
KQAL Radio (Winona)*
WKBH Radio (La Crosse)*
WLAX-TV (La Crosse)*
WXOW TV (La Crosse)*

Alma Public Library
Red Wing Public Library
La Crosse County Library
Wabasha Public Library
Galesville Public Library
La Crescent Public Library
La Crosse Public Library
Winona Public Library

DEPARTMENT OF THE ARMY
DEPARTMENT OF THE ARMY
ST PAUL DISTRICT CORPS OF ENGINEERS
190 FIFTH STREET EAST
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

March 11, 2003

Environmental and Economic Analysis Branch
Planning, Programs and Project Management Division

SUBJECT: Spring Lake Islands Habitat Rehabilitation and Enhancement Project, Buffalo County, Wisconsin (SHSW # 90-0162 and 02-1174/BF)

Mr. Sherman Banker
Compliance Archaeologist
Division of Historic Preservation
State Historical Society of Wisconsin
816 State Street
Madison, Wisconsin 53706-1482

Dear Mr. Banker:

The following is in response to your letter of November 18, 2002, concerning the St. Paul District, U.S. Army Corps of Engineers (Corps) assessment that there are no historic properties within the area of potential effect of the above referenced project. Specifically, your office has noted that submerged resources (e.g., shipwrecks and other historic structures) were not discussed and that there is a possibility that submerged archaeological sites may be affected. Your office recommends a soil coring or other investigations be conducted. Below you will find additional cultural resource information for the project and the Corps' proposed course of action.

Most of the Spring Lake Habitat Rehabilitation and Enhancement Project area is situated over areas that, prior to inundation from construction of Lock and Dam 5 during the late 1930s, consisted of floodplain, back channels, and wetlands. It is unlikely that submerged resources in the form of shipwrecks exist in the project area. Further, a literature review indicates that no shipwrecks, or other historic structures, are identified or known to have existed within the project area. Specifically, the northern access channel will be excavated over an area that prior to inundation was along the course of a narrow back channel, well away from the main river channel and Pomme de Terre Slough. The areas selected for fine borrow were previously a wetland. Therefore, the Corps believes that no submerged resources or other historic structures will be affected by the proposed project in these areas.

The southern proposed access channel will transect areas that prior to inundation consisted of back channels, wetlands, a small lake, and general floodplain that would have been seasonally dry. As there is a potential for archaeological sites, now inundated, to exist within portions of the area proposed for this channel, a soil coring program will be conducted along the footprint of the proposed channel in the spring of 2003. Any cultural resources sites identified in the project construction limits will be evaluated for eligibility to the National Register of Historic Places. Potential project impacts to eligible properties will be mitigated prior to construction, if said impacts cannot be avoided.

Please contact Mr. Bradley Perkl, Corps archaeologist, at 651-290-5370 with any questions.

Sincerely,

For Terry J. Birkenstock
Chief, Environmental and Economic
Analysis Branch

WISCONSIN
WISCONSIN HISTORICAL SOCIETY

Headquarters Building
816 State Street
Madison, WI 53706-1482
608-264-6400

November 18, 2002

Mr. Bradley Perkl
U.S. Army Corps of Engineers
190 Fifth Street East
St. Paul MN 55101-1638

SHSW#: 02-1174/BF
RE: Spring Lake Islands Habitat Rehabilitation & Enhancement

Dear Mr. Perkl:

We have reviewed the above referenced project as required for compliance with Section 106 of the National Historic Preservation Act and 36 CFR Part 800: Protection of Historic Properties, the regulations of the Advisory Council on Historic Preservation governing the Section 106 review process.

We do not concur with your assessment that there are no historic properties within the area of potential effect of the proposed undertaking. The submittal does not discuss what was done to identify any submerged resources in the proposed project area such as shipwrecks or other submerged historic structures. There is also a possibility that there are submerged prehistoric archeological sites in the project area. Some type of soil coring or other investigations are needed to determine if there are submerged in situ archeological features in the project area.

If you have any questions concerning these matters, please call me at (608) 264-6507.

Sincerely,

Sherman Banker

Sherman Banker
Office of Preservation Planning

Responses to Wisconsin DNR Comments

Comment #1

3.2.1 - Winter discharge - Average Jan-Feb river flows are closer to 15,000 cfs based on the USGS gage at Winona.

Response: Flows between October and February were used to calculate winter discharges.

Comment #2

3.2.1 - Spring Lake Velocity - There is substantially more data than what was referenced here (i.e. Lucchesi and Benjamin, 1988), some of which was paid for by the USCOE. 1988 was low flow and not representative of an average winter. Monitoring conducted in 1992, 1995 and 2001 show winter inflow velocities to Spring Lake approach 0.3 to 0.5 ft/s. Backwater velocities exceeding 0.1 ft/s have been found in Spring Lake and influence mixing and winter thermal stratification. Some of the more recent studies are referenced elsewhere in the DPR. The Wisconsin DNR has done water quality monitoring in Spring Lake during 1988, 1992, 1995 and 2001. Copies of these reports or summaries are enclosed. We recommend providing a summary of this more recent information in this section and elsewhere in the DPR. The 1995 and 2001 monitoring would be most appropriate for use since they represent conditions in Spring Lake after the peninsula was reconstructed. These 2 years should be he basis for most of the discussion on current conditions, not the studies which are 20+ years old.

Response: Concur. Report will be revised to include winter water velocity information from 1995 and 2001.

Comment #3

3.3 - TSS concentrations in Spring Lake - Where is the reference for this data? We believe there are data available (Site 18?) - from the Weaver Bottoms Resource Analysis Plan/Reports.

Response: Concur. Report will be revised to include the above TSS data.

Comment #4

3.3 - Depth-stratified sediment contaminant data have been collected on May 21, 1991 by the USCOE and WDNR. The elevated chromium levels reported in Table 404-1 in Attachment 3 for record #3 in 1991 is incorrect. The value is 11 ug/g not 57 based on a July 25, 1991 Letter from Robert Whiting which included the results from Pace Lab.

Response: The report included with the referenced letter does list the value as 57 and not 11. However, this value seems unusually high in relation to values listed in

the report for chromium and other contaminants for the same area. It is possible that this value is listed in error, which will be discussed in this section.

Comment #5
3.3 – Add to the discussion that an area called Spring Lake existed prior to impoundment.

Response: Concur. Will add language.

Comment #6
3.4 - Winter WQ data. The majority of Spring Lake is not protected from flows. Therefore the winter water temperatures are close to 0.0 degrees C for over 80% of the area. In general, the high inflows result in colder water being introduced with typical temperatures around 0.35. Spatial sampling during the winter of 1995 showed an average surface water temperature of 0.3 and average bottom temperature of 0.4. The majority of Spring Lake is also influenced by velocity, with an average surface velocity in unprotected areas of 2.2 cm/second. There has been substantial information collected that is not referenced in this section of the DPR.

Response: Concur. See response to Comment 2 above. Section will be revised to include more pertinent information.

Comment #7
3.5 – A comparison of 1989 and 2001 vegetation coverage should be made in this section. The comparison will show a dramatic decline in percent coverage of aquatic vegetation in that time period. The observation of Wisconsin DNR staff is that a drastic decline in aquatic vegetation occurred in 1990 and aquatic vegetation remained sparse in the project area throughout the 1990's. A slight increase in aquatic vegetation was observed in 2000 and 2001.

Response: Concur. Section will be revised to include more pertinent information.

Comment #8
3.6.1 - The Wisconsin Department of Natural Resources conducted netting and electrofishing surveys of the Spring Lake fishery during the late-80s and mid-90s. Thirty-six species were sampled during the fall of 1987 and the spring of 1988 (Lucchesi and Benjamin 1989). During these surveys, the dominant species were bluegill (31.3% of the total catch), black crappie (12.9%), common carp (10.0%) and yellow perch (7.5%). During the fall of 1995 and the spring of 1996, thirty-one species were sampled (Brian Brecka, Wisconsin DNR, Alma, personal communication). Dominating the catch were freshwater drum (17.3%), white bass (17.3%), black crappie (16.5%) and gizzard shad (13.1%). Comparing the two sampling periods, panfish species (bluegill, black crappie and yellow perch) were a higher percent of the catch during the 80s (51.4%) than during the 90s (18.6%). This significant difference is likely due to differences in the aquatic vegetation along with other factors. Lucchesi and Benjamin (1989) reported large beds *of*

aquatic macrophytes in the upper reaches of Spring Lake. They also warned that high flow rates and increased sedimentation due to a breached peninsula might further degrade this habitat. Although the peninsula was replaced in 1995, losses of vegetation and depth occurred and will not likely return without physical improvements.
We recommend replacing the present last paragraph in this section with the one above.

Response: Concur. The above paragraph will be slightly revised and used to replace the last paragraph in this section.

Comment #9
3.7 – An important point which is missing in this section of the report is the reason for an increase in island acreage from 1994-1998 due to the construction of the peninsula. This needs to be added. Also, a map showing a comparison of 1975, 1989 and 2001 vegetation coverage would be very informative. The present wording leads the reader to believe that all 570 acres surveyed by LTRMP in 2001 was vegetated. No mention is made of the percent of area which was open water. Add percent of open water to the discussion and comparison of vegetation in the same area in 1975, 1989 and 2001.

Response: Concur. Section will be revised as recommended.

Comment #10
4.1 - Since closure at the upper end, current velocities in Spring Lake are not greater than 0.1 meters/s (0.3 ft/s) during the winter. Velocities exceeding 0.1 m/s were found near the inflows prior to 1995.

Response: The text will be revised to include velocity data and the statement regarding winter fishery habitat being limited by velocities greater than 0.1 m/sec will be removed because it is too general. It will be replaced with a reference to the velocity requirements of bluegill (greater than 3 cm/s is severely limiting and 0 cm/s is ideal strictly from a velocity perspective).

Comment #11
4.2 – The flow into Spring Lake continued to increase past 1977 due to continued erosion of the peninsula and other islands. This is supported by the information provided in sections 4.2.1.

Response: Concur. Section will be revised to reflect this change.

Comment #12
4.2.1 – Plates 4 and 5 should be referenced in this section. The reason for the "increase" in island acreage should be included in this section. The reason for the increase was the construction of the peninsula. Furthermore, plate 5 clearly indicates that island loss has

continued in the project area. Several of the original island masses were smaller or gone when looking at size and location from 1994-1998.

Response: Concur. Section will be revised as recommended.

<u>Comment #13</u>
4.3 – The loss of islands is also a factor contributing to turbidity increase due to resuspension and changes in aquatic plant beds. Please add to discussion in last 2 paragraphs on page 4-3.

Response: Concur. Discussion will be revised as recommended.

<u>Comment #14</u>
4.3 - FYI - Korschgen's (and others) light penetration/TSS relationship for Pool 8 has been published in Aquatic Botany 58 (1997) 1-9. What are the turbidity levels in Spring Lake, and how do they compare with other parts of the UMR? We suspect that the values for this portion of Pool 5 are low compared to other UMR pools (i.e. due to the influence of Lake Pepin and no major inflows on the east side of Pool 5).

Response: Concur. Section will be revised to include available turbidity data.

<u>Comment #15</u>
5.2 – Goal A: Spring lake does not presently support a popular fishery. We recommend replacing the justification for this goal with the following discussion:

The Spring Lake fishery traditionally supported backwater species such as bluegill, black crappie, yellow perch and largemouth bass. It is not uncommon to find local anglers that recollect an extremely popular winter fishery that received pressure from more than one hundred ice shanties. This quality winter fishery occurred as late as the mid-80s. However, fishery declines appeared to occur due to increased flow, decreased depth and loss of aquatic vegetation. Recent winters have brought only a few anglers to Spring Lake. Management goals for Spring Lake are to maintain year-round backwater fishery habitat and prevent future degradation of the aquatic plant community.

Response: Concur. Section will be revised as recommended.

<u>Comment #16</u>
5.2 -- Objective A1 D. We recommend modifying the following objectives to include a depth criteria for meeting the objective of water velocity. Suggested modification is: Mid-depth current velocity <0.3 cm/sec over 80 % of the area.

Response: Concur. Objective will be modified as recommended.

Comment #17

5.2 – General comment: It would be more appropriate to look at the joint occurrence of temperature, DO and velocity for setting/specifying "minimal" centrachid habitat conditions. Based on Wisconsin DNR monitoring of the Lake Onalaska Dredge Cut, we have proposed DO > 3 mg/L, Temp > 1C and velocity < 1 cm/s. These things can be tweaked somewhat but we believe this approach provides a better way to assess winter conditions since they are based on actual measurements. For example it is not likely/common to have DO > 5 and Temp > 2 C during mid-winter conditions due to thermal stratification and reduced photosynthetic activity under ice and snow cover. Perhaps this type of discussion may be appropriate to add in a later section of the DPR (i.e. 7.5.1.1).

Response: It would be more appropriate to look at the joint occurrence of variables for setting minimal habitat conditions. However, the number of combinations of factors this could lead to makes the approach impractical for the purpose here. However, some discussion reflecting this will be added to section 7.5.1.1.

Comment #18

7.0 – Islands have also been constructed in Pools 9 and 10. These should be added to the discussion.

Response: Concur. The discussion will be modified as recommended.

Comment #19

7.0 - The benefits of increasing the depth in the project area as borrow for the islands was not included in any of the analysis. This feature will definitely improve habitat conditions in several of the alternatives. We recommend that the analysis be done with inclusion of the benefits of the dredge cuts **or** the discussion be modified to clearly indicate that the benefits of the islands was not included in any of the analysis with 1 or 2 examples of how including consideration of the dredge cuts increases the habitat value of areas in the Spring Lake.

Response: Concur. The discussion will be modified as recommended.

Comment #20

7.4.1.1 – And the Habitat Evaluation Appendix – Alternative 6, which evaluates the construction of island 3, should include an increase in winter water temperature and reduction of velocities for the area of Spring Lake protected by island 3. We estimate that the winter water temperature will increase to approximately 1.5 degrees C on average and velocities will be undetectable throughout much of the protected area.

Response: The evaluation of Alternative 6 does include an increase in winter water temperature and a reduction in velocities in the area protected by island 3. The evaluation assumes that the island would protect 20 acres of habitat deeper than 4 feet, and within the protected area temperature and velocity would approach optimal values.

Comment #21

7.4.1.1 b – Island 3 will be a major location for the disposal of dredged material. Therefore, the HEP analysis, or discussion, should include credit for the increase of deep water in the upper portions of the project area.

Response: Concur. Included additional discussion will be revised as recommended.

Comment #22

7.6.1 – Add mention that alternative evaluation did not include the benefits of dredging in the project area. The dredging in the upper portion of the project area is considered critical to us for meeting the biological objective of improving backwater fishery habitat. Also, the discussion for Alternative 6 should include the benefits it would provide for the upper portions of the project area if it is built and the borrow was obtained from the areas indicated on Plate 9.

Response: Concur. Included additional discussion as noted above.

Add a reference to Plate 9 at the end of this section.

Response: Concur. Reference added.

Comment #23

8.1.1 - Deposition of fines and sand (bedload) are both concerns we have for the area. Based on the island configuration in the interior, we doubt that adequate velocities will be present to "flush" accumulated fine materials during flood events. We are concerned that additional bedload may enter the area if the sills are not high enough. Please review the hydraulic analysis to determine if higher sill elevations may be appropriate if reduction of bedload entering the area may be a greater concern.

Response: Two main criteria are used to determine sill height: 1. Water surface elevation associated with a 1.5–2 year flood, and 2.Top elevation of the adjacent natural landmass. In this instance, the top elevation of natural features was determined to be the governing criteria. Rock sills are designed to overtop first in a flooding event. During initial overtopping, the potential for erosion is the highest because head differential and velocity are at their greatest. If the top elevation of the rock sill is higher than the surrounding landmass, the water will be directed

over the natural features, causing erosion. Due to this, sill elevation should not be raised.

Additionally, given the distance of Spring Lake from a sediment source and frequency of overtopping, sedimentation should not be a problem.

Comment #24

8.1.2 – Some of the rock mounds may function similar to the seed islands in Pool 8. The discussion should include mention of the potential secondary benefit of accumulating material over time.

Response: Concur. Included additional discussion as noted above.

Comment #25

8.1.3.2 and 8.1.3.3 - We recommend adding trees (ash, maple, river birch) as plantings to these islands in addition to the grass/forb mix.

Response: Concur.

Comment #26

8.1.5 - Construction Restrictions - It is likely that lower TSS limits would be required based on the demonstration that lower limits are achievable. Further, restrictions would be placed on sand borrow sources to ensure the base of islands are constructed with minimal fines (i.e. P200 < 10%).

Response: Concur.

Comment #27

Item a. We do not concur that waterfowl migration season is a restriction on construction. Spring Lake is not part of a waterfowl hunting closed area, which is where this restriction is sometimes applied. Remove this restriction.

Response: Concur. Restriction has been removed.

Comment #28

It is likely that portions of some islands may be constructed mechanically. This option should be added to c and d.

Response: Concur. Included additional discussion as noted above.

Comment #29
Item e should include mention that the upper dredge cuts will be mandatory for the purpose of meeting one of the primary goals, which is improving over-wintering habitat for backwater fish species.

Response: Concur. Included additional discussion as noted above.

Comment #30
8.4.1 – A cost comparison of obtaining sand borrow from the main channel and the disposal sites was done during project planning. A discussion of the increased cost of obtaining the material from these locations should be included in the DPR.

Response: Concur. Included additional discussion in cost comparison.

Comment #31
8.4.1 - Proposed borrow source for sand material. Have there been adequate borings collected between islands 2 and 4 to show that suitable material is available? We believe sand is readily available adjacent to the deep hole located in the area downstream of island 3. This was the site for sand borrow used for the construction of the lock and dam 5 dike. Additional borings for the area may also be included in the planning and as built drawings for lock and dam 5 dike. If so, these should be referenced in this section and included in the DPR geotech appendix.

Response: Concur. The geotechnical engineer has scheduled additional borings.

Comment #32
Table 8-4 – Remove reference to no work during the waterfowl season.

Response: Concur. Reference removed.

Comment #33
Page 10-2 – There is no 2001 photo on plate 13. Remove reference to 2001 photo.

Response: Concur. Reference removed.

Comment #34
Pages 12-1 and Page 12-2, Table 12-1 - This table references NPS (EMTC) which no longer exists.

Response: Concur. Changed NBS to USGS and EMTC to UMESC.

Comment #35

Plate 11 - Mud/Sand flat x-section - The top elevation is lower than Pool 5 control pool elevation by 0.4 ft. We assume this is the proposed elevation once the berm has stabilized. We recommend that the planned x-section dimension of this berm during the construction phase also be included.

Response: See Hydraulic Appendix page 5 of 12 for mudflat design.

Comment #36

404(b)(1) B. page 4 - Water Circulation - We would not expect winter DO to increase in Spring Lake as a result of this project. Instead, winter DOs would be expected to decrease due to increased thermal stratification and increased hydraulic retention time (greater SOD). Decreasing the hydraulic retention time may lead to greater phytoplankton concentrations at times. Increased growths of submersed aquatic vegetation will also contribute to increased summer DO/temperature stratification and greater opportunities for filamentous algae and floating-leafed vegetation (i.e. Lemna) development. This vegetation will have a strong influence on circulation, mixing and reaeration.

Response: Concur. Statement will be revised to indicate a decrease in DO.

Comment #37

404(b)(1) C. page 5 - Turbidity - Summer turbidity levels would decrease noticeably if 80% SAV coverage is realized as a result of reduced sediment resuspension and increased hydraulic retention time.

Response: It is possible that turbidity levels would decrease noticeably. However, due to many confounding factors such as increased algal growth caused by increased retention time and decreased suspended solids, it is difficult to predict the significance of the decrease in turbidity.

Comment #38

404(b)(1) page 7 - Table 404-1. The chromium value reported for record #3 collected in 1991 needs to be changed as indicated above. The PCB listing is for Aroclors 1016 but should include Aroclors 1221 to 1260.

Response: The chromium value is not in error – see response to comment number 4. Text in 404 will be revised as stated in response to comment number 4. The PCB listing is for total PCBs; 1016 was listed in error. Table will be revised to include Aroclors 1006 – 1260.

Comment #39
Hydrodynamics - page 5-4 - Pool 8 should be changed to Pool 5 (first sentence).

Response: This has been fixed in the appendix.

Comment #40
Hydrodynamics - page 5-5 - Table 5-4. What about winter measurements? These have been made by the WDNR at the inlets in the mid to early 1990s. I believe this information has been provided to Jon Hendrickson and Dan Wilcox in the past.

Response: Concur. Included additional data as noted above.

Comment #41
We recommend that a discussion on the impacts of the earthen dike culverts at Dam 5 be included. We didn't see any discussion in the main body of the report concerning the expected influence these culverts have in controlling current velocities, DO and temperature in the project area, especially during winter conditions. It may be desirable to reduce the winter flows through these culverts to optimize winter habitat conditions in Spring Lake as well as Fountain City Bay. We noticed that this is covered in the Hydraulics sections. This information should be discussed in the main portion of the report as well with potential options identified.

Response: A culvert is located in the dike of the southeastern border of Spring Lake. The culvert conveys approximately 300cfs from Spring Lake into the Whitman Wildlife area. The culvert will pull water through the deep hole in southern Spring Lake. In order to establish an over-wintering habitat in this area, the flows through the culvert may have to be regulated in the winter. Once the project features are in place, this area will require monitoring to determine the appropriate culvert regulation.

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

WISCONSIN
DEPT. OF NATURAL RESOURCES

Scott McCallum, Governor
Darrell Bazzell, Secretary
Scott A. Humrickhouse, Regional Director

La Crosse Service Center
State Office Building, Room 104
3550 Mormon Coulee Road
La Crosse, Wisconsin 54601
Telephone 608-785-9000
FAX 608-785-9990

October 30, 2002

Mr. Tom Novak, Project Manager
U.S. Army Corps of Engineers, St. Paul District
Army Corps of Engineers Centre
190 fifth St. East
St. Paul, MN 55101-1638

Dear Mr. Novak:

We have completed review of the draft Definite Project Report/Environmental Assessment for Spring Lake Islands Habitat Rehabilitation and Enhancement Project, dated September 2002. We concur with the recommended plan. Many of our comments focus on omissions of information regarding the present physical and biological conditions of the project area. Reports and summaries of water quality conditions in Spring Lake are referenced in our comments below and enclosed for your information

3.2.1 - Winter discharge - Average Jan-Feb river flows are closer to 15,000 cfs based on the USGS gage at Winona.

3.2.1 - Spring Lake Velocity - There is substantially more data than what was referenced here (i.e. Lucchesi and Benjamin, 1988), some of which was paid for by the USCOE. 1988 was low flow and not representative of an average winter. Monitoring conducted in 1992, 1995 and 2001 show winter inflow velocities to Spring Lake approach 0.3 to 0.5 ft/s. Backwater velocities exceeding 0.1 ft/s have been found in Spring Lake and influence mixing and winter thermal stratification. Some of the more recent studies are referenced elsewhere in the DPR. The Wisconsin DNR has done water quality monitoring in Spring Lake during 1988, 1992, 1995 and 2001. Copies of these reports or summaries are enclosed. We recommend providing a summary of this more recent information in this section and elsewhere in the DPR. The 1995 and 2001 monitoring would be most appropriate for use since they represent conditions in Spring Lake after the peninsula was reconstructed. These 2 years should be he basis for most of the discussion on current conditions, not the studies which are 20+ years old.

3.3 - TSS concentrations in Spring Lake - Where is the reference for this data? We believe there are data available (Site 18?) - from the Weaver Bottoms Resource Analysis Plan/Reports.

3.3 - Depth-stratified sediment contaminant data have been collected on May 21, 1991 by the USCOE and WDNR. The elevated chromium levels reported in Table 404-1 in Attachment 3 for record #3 in 1991 is incorrect. The value is 11 ug/g not 57 based on a July 25, 1991 Letter from Robert Whiting which included the results from Pace Lab.

3.3 – Add to the discussion that an area called Spring Lake existed prior to impoundment.

3.4 - Winter WQ data. The majority of Spring Lake is not protected from flows. Therefore the winter water temperatures are close to 0.0 degrees C for over 80% of the area. In general, the high inflows result in colder water being introduced with typical temperatures around 0.35. Spatial sampling during the winter of 1995 showed an average surface water temperature of 0.3 and average bottom temperature of 0.4. The majority of Spring Lake is also influenced by velocity, with an average surface velocity in unprotected areas of 2.2 cm/second. There has been substantial information collected that is not referenced in this section of the DPR.

3.5 – A comparison of 1989 and 2001 vegetation coverage should be made in this section. The comparison will show a dramatic decline in percent coverage of aquatic vegetation in that time period. The observation of Wisconsin DNR staff is that a drastic decline in aquatic vegetation occurred in 1990 and aquatic vegetation remained sparse in the project area throughout the 1990's. A slight increase in aquatic vegetation was observed in 2000 and 2001.

3.6.1 - The Wisconsin Department of Natural Resources conducted netting and electrofishing surveys of the Spring Lake fishery during the late-80s and mid-90s. Thirty-six species were sampled during the fall of 1987 and the spring of 1988 (Lucchesi and Benjamin 1989). During these surveys, the dominant species were bluegill (31.3% of the total catch), black crappie (12.9%), common carp (10.0%) and yellow perch (7.5%). During the fall of 1995 and the spring of 1996, thirty-one species were sampled (Brian Brecka, Wisconsin DNR, Alma, personal communication). Dominating the catch were freshwater drum (17.3%), white bass (17.3%), black crappie (16.5%) and gizzard shad (13.1%). Comparing the two sampling periods, panfish species (bluegill, black crappie and yellow perch) were a higher percent of the catch during the 80s (51.4%) than during the 90s (18.6%). This significant difference is likely due to differences in the aquatic vegetation along with other factors. Lucchesi and Benjamin (1989) reported large beds of aquatic macrophytes in the upper reaches of Spring Lake. They also warned that high flow rates and increased sedimentation due to a breached peninsula might further degrade this habitat. Although the peninsula was replaced in 1995, losses of vegetation and depth occurred and will not likely return without physical improvements.

We recommend replacing the present last paragraph in this section with the one above.

3.7 – An important point which is missing in this section of the report is the reason for an increase in island acreage from 1994-1998 due to the construction of the peninsula. This needs to be added. Also, a map showing a comparison of 1975, 1989 and 2001 vegetation coverage would be very informative. The present wording leads the reader to believe that all 570 acres surveyed by LTRMP in 2001 was vegetated. No mention is made of the percent of area which was open water. Add percent of open water to the discussion and comparison of vegetation in the same area in 1975, 1989 and 2001.

4.1 - Since closure at the upper end, current velocities in Spring Lake are not greater than 0.1 meters/s (0.3 ft/s) during the winter. Velocities exceeding 0.1 m/s were found near the inflows prior to 1995.

4.2 – The flow into Spring Lake continued to increase past 1977 due to continued erosion of the peninsula and other islands. This is supported by the information provided in sections 4.2.1

4.2.1 – Plates 4 and 5 should be referenced in this section. The reason for the "increase" in island acreage should be included in this section. The reason for the increase was the construction of the peninsula. Furthermore, plate 5 clearly indicates that island loss has continued in the project area. Several of the original island masses were smaller or gone when looking at size and location from 1994-1998.

4.3 – The loss of islands is also a factor contributing to turbidity increase due to resuspension and changes in aquatic plant beds. Please add to discussion in last 2 paragraphs on page 4-3.

4.3 - FYI - Korschgen's (and others) light penetration/TSS relationship for Pool 8 has been published in Aquatic Botany 58 (1997) 1-9. What are the turbidity levels in Spring Lake, and how do they compare with other parts of the UMR? We suspect that the values for this portion of Pool 5 are low compared to other UMR pools (i.e. due to the influence of Lake Pepin and no major inflows on the east side of Pool 5).

5.2 – Goal A: Spring lake does not presently support a popular fishery. We recommend replacing the justification for this goal with the following discussion:

The Spring Lake fishery traditionally supported backwater species such as bluegill, black crappie, yellow perch and largemouth bass. It is not uncommon to find local anglers that recollect an extremely popular winter fishery that received pressure from more than one hundred ice shanties. This quality winter fishery occurred as late as the mid-80s. However, fishery declines appeared to occur due to increased flow, decreased depth and loss of aquatic vegetation. Recent winters have brought only a few anglers to Spring Lake. Management goals for Spring Lake are to maintain year-round backwater fishery habitat and prevent future degradation of the aquatic plant community.

5.2 -- Objective A1 D. We recommend modifying the following objectives to include a depth criteria for meeting the objective of water velocity. Suggested modification is: Mid-depth current velocity <0.3 cm/sec over 80 % of the area.

5.2 – General comment: It would be more appropriate to look at the joint occurrence of temperature, DO and velocity for setting/specifying "minimal" centrachid habitat conditions. Based on Wisconsin DNR monitoring of the Lake Onalaska Dredge Cut, we have proposed DO > 3 mg/L, Temp > 1C and velocity < 1 cm/s. These things can be tweaked somewhat but we believe this approach provides a better way to assess winter conditions since they are based on actual measurements. For example it is not likely/common to have DO > 5 and Temp > 2 C during mid-winter conditions due to thermal stratification and reduced photosynthetic activity under ice and snow cover. Perhaps this type of discussion may be appropriate to add in a later section of the DPR (i.e. 7.5.1.1).

7.0 – Islands have also been constructed in Pools 9 and 10. These should be added to the discussion.

7.0 - The benefits of increasing the depth in the project area as borrow for the islands was not included in any of the analysis. This feature will definitely improve habitat conditions in several of the alternatives. We recommend that the analysis be done with inclusion of the benefits of the dredge cuts **or** the discussion be modified to clearly indicate that the benefits of the islands was not included in any of the analysis with 1 or 2 examples of how including consideration of the dredge cuts increases the habitat value of areas in the Spring Lake.

7.4.1.1 – And the Habitat Evaluation Appendix – Alternative 6, which evaluates the construction of island 3, should include an increase in winter water temperature and reduction of velocities for the area of Spring Lake protected by island 3. We estimate that the winter water temperature will increase to approximately 1.5 degrees C on average and velocities will be undetectable throughout much of the protected area.

7.4.1.1 b – Island 3 will be a major locations for the disposal of dredged material. Therefore, the HEP analysis, or discussion, should include credit for the increase of deep water in the upper portions of the project area.

7.6.1 – Add mention that alternative evaluation did not include the benefits of dredging in the project area. The dredging in the upper portion of the project area is considered critical to us for meeting the biological objective of improving backwater fishery habitat. Also, the discussion for Alternative 6 should include the benefits it would provide for the upper portions of the project area if it is built and the borrow was obtained from the areas indicated on Plate 9.

Add a reference to Plate 9 at the end of this section.

8.1.1 - Deposition of fines and sand (bedload) are both concerns we have for the area. Based on the island configuration in the interior, we doubt that adequate velocities will be present to "flush" accumulated fine materials during flood events. We are concerned that additional bedload may enter the area if the sills are not high enough. Please review the hydraulic analysis to determine if higher sill elevations may be appropriate if reduction of bedload entering the area may be a greater concern.

8.1.2 – Some of the rock mounds may function similar to the seed islands in Pool 8. The discussion should include mention of the potential secondary benefit of accumulating material over time.

8.1.3.2 and 8.1.3.3 - We recommend adding trees (ash, maple, river birch) as plantings to these islands in addition to the grass/forb mix.

8.1.5 - Construction Restrictions - It is likely that lower TSS limits would be required based on the demonstration that lower limits are achievable. Further, restrictions would be placed on sand borrow sources to ensure the base of islands are constructed with minimal fines (i.e. P200 < 10%).

Item a. We do not concur that waterfowl migration season is a restriction on construction. Spring Lake is not part of a waterfowl hunting closed area, which is where this restriction is sometimes applied. Remove this restriction.

It is likely that portions of some islands may be constructed mechanically. This option should be added to c and d.

Item e should include mention that the upper dredge cuts will be mandatory for the purpose of meeting one of the primary goals, which is improving over-wintering habitat for backwater fish species.

8.4.1 – A cost comparison of obtaining sand borrow from the main channel and the disposal sites was done during project planning. A discussion of the increased cost of obtaining the material from these locations should be included in the DPR.

8.4.1 - Proposed borrow source for sand material. Have there been adequate borings collected between islands 2 and 4 to show that suitable material is available? We believe sand is readily available adjacent to the deep hole located in the area downstream of island 3. This was the site for sand borrow used for the construction of the lock and dam 5 dike. Additional borings for the area may also be included in the planning and as built drawings for lock and dam 5 dike. If so, these should be referenced in this section and included in the DPR geotech appendix.

Table 8-4 – Remove reference to no work during the waterfowl season.

Page 10-2 – The is no 2001 photo on plate 13. Remove reference to 2001 photo.

Pages 12-1 and Page 12-2, Table 12-1 - This table references NPS (EMTC) which no longer exists.

Plate 11 - Mud/Sand flat x-section - The top elevation is lower than Pool 5 control pool elevation by 0.4 ft. We assume this is the proposed elevation once the berm has stabilized. We recommend that the planned x-section dimension of this berm during the construction phase also be included.

404(b)(1) B. page 4 - Water Circulation - We would not expect winter DO to increase in Spring Lake as a result of this project. Instead, winter DOs would be expected to decrease due to increased thermal stratification and increased hydraulic retention time (greater SOD). Decreasing the hydraulic retention time may lead to greater phytoplankton concentrations at times. Increased growths of submersed aquatic vegetation will also contribute to increased summer DO/temperature stratification and greater opportunities for filamentous algae and floating-leafed vegetation (i.e. Lemna) development. This vegetation will have a strong influence on circulation, mixing and reaeration.

404(b)(1) C. page 5 - Turbidity - Summer turbidity levels would decrease noticeably if 80% SAV coverage is realized as a result of reduced sediment resuspension and increased hydraulic retention time.

404(b)(1) page 7 - Table 404-1. The chromium value reported for record #3 collected in 1991 needs to be changed as indicated above. The PCB listing is for Aroclors 1016 but should include Aroclors 1221 to 1260.

Hydrodynamics - page 5-4 - Pool 8 should be changed to Pool 5 (first sentence).

Hydrodynamics - page 5-5 - Table 5-4. What about winter measurements? These have been made by the WDNR at the inlets in the mid to early 1990s. I believe this information has been provide to Jon Hendrickson and Dan Wilcox in the past.

We recommend that a discussion on the impacts of the earthen dike culverts at Dam 5 be included. We didn't see any discussion in the main body of the report concerning the expected influence these culverts have in controlling current velocities, DO and temperature in the project area, especially during winter conditions. It may be desirable to reduce the winter flows through these culverts to optimize winter habitat conditions in Spring Lake as well as Fountain City Bay. We noticed that this is covered in the Hydraulics sections. This information should be discussed in the main portion of the report as well with potential options identified.

We look forward to the completion of the Spring Lake DPR and construction of the project. Please contact Jeff Janvrin at the above address, phone 608-785-9005, or e-mail Jeff.Janvrin@dnr.state.wi.us, if you have any questions regarding our comments.

Sincerely,

Jeffrey A. Janvrin
Mississippi River Habitat Specialist

c: Scot Johnson, MNDNR, with enclosures
Bob Drieslein, USFWS
Gary Wege, USFWS

PM-A/Novak

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MINNESOTA 55101-1638

REPLY TO
ATTENTION OF

September 16, 2002

Project Management Branch
Planning, Programs and Project Management Division

Mr. Jeff Janvrin
Habitat Projects Coordinator
Wisconsin Department of Natural Resources
State Office Building
3550 Mormon Coulee Road
La Crosse, Wisconsin 54601

Dear Mr. Janvrin:

Enclosed for review and comment is the preliminary draft Definite Project Report and Environmental Assessment for the Spring Lake Islands Habitat Rehabilitation and Enhancement Project. This report is being reviewed concurrently by the U.S. Fish and Wildlife Service and the Minnesota Department of Natural Resources.

Please provide any comments you may have by October 16, 2002. If you concur with the recommended plan, we would appreciate a letter indicating your support of the project. We would include your letter in the public review draft of the report.

If have any questions or need additional information, please contact me at (651) 290-5524 or at tom.novak@mvp02.usace.army.mil.

Sincerely,

Thomas Novak

Tom Novak
Project Manager

Enclosure (3 copies)

Copy Furnished:
Brian Brecka (1 copy)

Responses to Minnesota DNR Comments

Our review of the draft DPR suggests to us that the monitoring information presented within the text of the document does not adequately support the proposed HREP. Moreover, many of the HREP objectives are quantitative while the characterization of the project area's current conditions is very generalized and dependent on old monitoring data.

The following examples illustrate the lack of monitoring data to support the need for Objective A1:

"Objective A1: Create and/or enhance overwintering (November – March) habitat for Centrarchids meeting the following criteria:

A. A minimum of three discrete areas.
B. A minimum of 20 acres per area.
C. Dissolved Oxygen levels ≥ 5 mg/l.
D. Current Velocity< 0.3 cm/sec over 80% of the area."

Comment #1

DPR Page 3-3 "A detailed analysis of riverbed elevation changes in the Spring Lake area cannot be made because of a lack of accurate and complete hydrographic surveys over time."

The 2001 Flood was the second largest flood on record. The 2001 Flood had the potential to scour and deposit large amounts of sand in the project area. To support the need for Objective A1A "A minimum of three discrete areas." and Objective A1B "A minimum of 20 acres per area", a survey should be completed to determine the current bathymetric conditions within the project area.

Response: The 2001 high water event did have the potential to scour and deposit sand within the project area. However, given the distance of Spring Lake from a sediment source, the changes are likely small in scale. To determine the current conditions, a more detailed survey can be taken during the plans and specifications stage.

Comment #2

DPR Page 3-1 "Current velocities are usually low throughout Spring Lake. Velocities measured under the ice were generally less than 0.1 ft/sec (Lucchesi and Benjamin, 1988)."

Response: While current velocities are generally low throughout Spring Lake, they are too high to support the goal of a winter fishery. The objective velocity to provide over-wintering habitat was established as 0.3cm/sec (0.01ft/sec).

Comment #3

DPR Page 3-4 "During winter, areas within Spring Lake that are protected from current tend to be warmed by the river bottom, perhaps from an influx of groundwater, to temperatures up to several degrees warmer than the near-freezing water in the flowing channels. Winter warm temperatures under the ice are quite stable…"

If Spring Lake water is warm and stable in areas protected from current, the Objective A1D calling for "current velocity < 3 cm/sec over 80% of the area" may already have been met for the project area. Are there more recent flow velocity data sets available for winter ice conditions that show a problem throughout the project area? Are there water temperature maps or profiles available for winter ice conditions in the project area?

Response: While it is unclear in the quoted text, it is not implied that most of Spring Lake is protected from current. It should have been stated that these conditions currently exist in a relatively small area behind the repaired peninsula. However, there are more recent data that show high current velocities do exist in most of Spring Lake. This information will be included in the DPR to support the project objectives.

Comment #4

DPR Page 3-4 "Dissolved oxygen in Spring Lake is normally above the 5-mg/l concentrations necessary to sustain most forms of aquatic life."

Objective A1C, Dissolved Oxygen levels $\geq$ 5mg/l, appears to have been met already. However, the data cited is 14 years old and from a different part of Pool 5. If this objective is not already met under the current environmental conditions, more recent data from the Spring Lake Area should be referenced or collected.

Response: More recent data are available, however, these data show that this objective is being met in Spring Lake. It is often the case that in areas with high flows that winter DO will be above 5 mg/l and will even approach saturation. This objective was included because in projects such as this when current velocities, and consequently, water exchanged rates are decreased, DO levels will also decrease. Without this objective it would be likely that a project would be developed that would actually have a negative impact on winter fisheries by creating habitat with ideal flow velocities but no DO. Clarification for this objective will be added to the report.

Comment #5

DPR Page 3-5 "No population estimates of fish in Spring Lake are available. Average standing stock of bluegill in backwater lakes, sloughs, and side channels of the UMR pools is 21.2 kg/hectare (Pitlow 1987). Standing stock of largemouth bass from the same set of samples averaged 5.5 kg/hectare. Populations of blue gill and bass in Spring Lake may be somewhat higher than these figures because of the protected backwater character of the area."

If the Spring Lake blue gill and bass populations are somewhat higher than the average because of the protected backwater character of the area, what is the justification for Objective A1? Does more recent monitoring data document a problem in the area?

Response: The above narrative from the report should have stated, that "Populations of bluegill and bass in Spring Lake may have been similar to these figures when it was a protected backwater prior to island erosion". There are no population estimates available for Spring Lake. However, this section will be revised to include the limited data that is available that shows a probable decline in the populations of backwater fishes in Spring Lake.

In our opinion, an analysis of some of the additional proposed project objectives would likely provide similar results. The documentation within the DPR text simply does not justify the project in many cases. If there are better data sets or observations that can be referenced and documented within the text, this project would have a much better chance at being endorsed and/or approved. If the stated objectives remain as quantitative as they are now, a large amount of pre-project field data must be collected to characterize the project area and justify the project. A similar level of post-project monitoring would be needed to document the benefits of the project.

Problem Identification Section

Statements within the Problem Identification Section are not always supported by the monitoring data referenced within the text of the document. For example:

Comment #6
DPR Page 4-1"Existing habitat conditions in Spring Lake are deficient in meeting management goals."

The monitoring data provided in the DPR suggests that conditions in Spring Lake may already meet Objective A1's criteria.

Response: Text will be revised to clarify current Spring Lake conditions.

Comment #7
DPR Page 4-1 "Wildlife habitat includes the open water areas, submergent vegetation, emergent vegetation and the islands. The primary wildlife habitat deficiency is the increasing lack of aquatic vegetation to wave action."

Yet the vegetation information provided in DPR Page 3-4 states: " ...The emergent vegetation beds in the Lost Island-Belvidere Slough area are evenly distributed throughout, although Spring Lake had a higher coverage than the other areas surveyed

(Nielsen et al. 1978). Emergent species found in Spring Lake during this study were water lily, arrowhead, narrow-leaf arrowhead, burreed, cattail, and lotus. A total of 15 species of submergent aquatic plants were also identified within Spring Lake in the study including coontail, wild celery, river pondweed, curly-leaf pondweed, waterweed, and water star grass…" and

Response: More recent vegetation data will be incorporated into the DPR and the text will be reviewed and revised to show the current trend in the loss of vegetation coverage and diversity.

Comment #8
DPR Page 3-7 states, "Interspersion of shallow open water, submergent and emergent aquatic plant beds has not been quantified; however, it appears good."

To support the statement that there is an increasing lack of aquatic vegetation, more recent data should be presented to show/quantify the decline.

Concur. More recent data from the Wisconsin DNR has been included.

Comment #9
The 2001 LTRMP Land Cover/Land Use Assessment in the Coordination/Correspondence Attachment 8 states: "Despite the later date all submersed and emergent vegetation appeared vigorous and health because of the warmer than usual weather and excellent water quality."

Figure 1 shows a visual comparison of a 1984 true color photograph to a 2001 infrared photograph – but does not provide a numeric comparison of aquatic vegetation acreages. Table 1 only shows acreages for 2001. Figure 2 in this assessment illustrates a diverse and widespread distribution of aquatic plants in the Spring Lake Habitat Project. Again, where are the monitoring results that show the decline in aquatic plant beds?

Response: Simple aquatic plant coverage is not the only criterion that should be applied to plant bed quality. Aquatic plant diversity should also be considered. An analysis and discussion showing changes in plant bed diversity and coverage will be included in the report.

Comment #10
Section 4.2 Historically Documented Changes in Habitat - "A reduction in the fisheries output and aquatic plant bed area has been observed."

Where are the data sets or who observed these changes and how were they documented over time?

Response: The Paragraph has been revised as follows, "Flow into Spring Lake increased because the peninsula forming the head of the lake was breached

during the period from 1964 to 1977. The loss of barrier islands, the breach in the peninsula, and the decline of aquatic vegetation changed flow conditions and wave action in the lake. Although quantitative data on declines in use by waterfowl and other wildlife are not available, local resource managers believe that the lake has a much greater potential for habitat use than currently exists. This reasoning is based on the fact that the area was more heavily used by fish and wildlife in the past and the physical changes are producing habitat conditions that are not as conducive to their use."

Comment #11
Section 4.2.1 "The loss of barrier islands in Spring Lake is well documented".

Also documented, in Table 4-1 Island Loss in the Spring Lake Area, is an increase in island area from 1994 to 1998 . The 1998 acreage is actually greater than what was present in 1989. This could be interpreted at an indication the Spring Lake area has actually turned the corner and is now entering a period of aggradation that is resulting in the natural development of new islands. More discussion is needed here.

Response: The completion of the upper peninsula breach closure project in 1995 did help stabilize the upper portion of Spring Lake. However, erosion of the lower barrier island chain has continued. Wind and wave action have been identified as the principal cause of erosion. The predominant wind directions in the Spring Lake project area are northwesterly and southeasterly, with a wind fetch of 6,000 feet. These conditions allow a wave height up to 1 foot. Continued barrier island loss, caused by these conditions, will not be halted unless the wind fetch is disrupted.

Comment #12
Section 4.3.1 "The turbidity observed in Spring Lake may be the result of several factors, including the resuspension of fine substrates by wind-induced turbulence, the importation of suspended solids via the breach in the peninsula, the growth of planktonic algae, and feeding of rough fish."

There are no turbidity observations or measurements provided in the text of the DPR to show that there is a turbidity problem let alone the identification of a main cause of the problem.

Response: Concur. Report will be revised to include the TSS data. See Wisconsin Comment/Response No. 3.

Comment #13
In the Coordination/Correspondence Attachment 8, a 1998 technical memo from Pat Foley states: "Since TSS in Spring Lake is already low, it is doubtful that it can be reduced further... To complete the hydraulic design for Spring Lake, a decision must be made on whether an island is needed."

On what Total Suspended Solids (TSS), turbidity or other data was a decision made to build islands?

Response: Concur. Report will be revised to include the TSS data. See Wisconsin Comment/Response #3.

Comment #14

DPR 4.3 Factors Influencing Habitat Change – This section completely misses the point that the area has been permanently inundated by 9-Foot Channel Project. This section should explain the environmental impacts occurring with the Spring Lake area in the context of the navigation reservoir impoundment.

Response: In addition to previous paragraphs, i.e. Section 4.2.3, the following paragraph has been added to 4.3. Construction of L/D 5 submerged the natural levees and floodplain in the lower end of Pool 5 resulting in continuous flow of water and sediment through the floodplain for all conditions. The higher parts of the natural levee became islands. Submergence caused changes in vegetation communities resulting in decreased floodplain resistance and increased floodplain conveyance with time. For river flows near and well above bank full, the majority of the conveyance is now in the floodplain in the lower pool 5. This has decreased the hydraulic slope in the pools and subsequently the fluvial processes of erosion and deposition in channels.

Comment #15

DPR 4.4 Estimated Future Habitat Types and Conditions – There are plans being developed to change how water levels are managed in Pool 5 and therefore it is likely that the water regime will change. The potential changes and benefits of a water level drawdown should be explained in detail within this section. Natural island formation is occurring rapidly just upstream of the Spring Lake area. The potential for islands to form and be stabilized in conjunction with the development of additional emergent plant beds associated with water level drawdowns should be explained as a possible alternative to the selected plan. The future habitat conditions discussion should be tempered by this potential development.

Response: The presence of emergent beds and deposition of sediment related to a drawdown will help stabilize the landmass in Spring Lake. However, the distance of Spring Lake from a significant sediment source will prevent rapid natural island formation. The repairs completed on the upper peninsula have cut off sediment from Belvidere Slough, which fed the area in the late 80s and early 90s. Additionally, natural reestablishment of the barrier chain will be hindered by the presence of wave action. Wind driven wave action has been identified as the primary cause of erosion.

The magnitude, timing, and frequency of drawdowns are insufficient to cause rapid changes in river planform in lower pool 5. If there is a response of natural levee or island growth, it will be years before there is a significant change in planform. In the mean time the Spring Lake Island project will provide improved and desired habitat conditions. In addition, the longevity of emergent plant beds created by future water level management in pool 5 will be increased by the Spring Lake project. These two forms of river restoration (hydrologic as in water level management, and planform as in island construction) compliment each other and must be done in parallel.

Comment #16

DPR 8-11 The Corps' Operation and Maintenance staff at Fountain City are still receptive to discussing the possible use of Lost Island sand in the Spring Lake project.

Response: See Wisconsin DNR Comment #30 and COE response. In addition, we've had continued discussion with Steve Tapp, Dan Krumholz (Channel Maintenance) and Gary Palesh (Pool 5 Drawdown Initial Report) and there are still no cost savings to either the EMP or O&M Channel Maintenance Program to do the above.

Comment #17

DPR 8-12 The schedule is not consistent with the text as far as when construction is planned to begin.

Response: Concur. Schedule has been revised.

Comment #18

DPR 12-1 Pool 5 is not considered a key pool by the LTRM program. The Lake City LTRMP Field Station has recently completed some water quality, fish and vegetation monitoring in Pool 5 as the LTRM Program sought to expand its monitoring coverage to include pools adjacent to the key pools. With the current level of funding in the appropriation bill, it is doubtful that any LTRMP monitoring will be done in Pool 5 in 2003. However, in our opinion, HREP funds could be used by the Corps to support future LTRMP monitoring activities that are deemed necessary for proper evaluation of HREPs.

Response: Concur. The entire paragraph has been deleted.

Comment #19

Table 12-1 This table needs to be updated to reflect the correct names of the federal agencies involved in the proposed evaluation.

Response: Concur. Table 12-1 has been revised.

Comment #20

Figures 7, 7.1 and 9 These figures need better titles on the plates to differentiate old proposed plans from the selected plan.

Response: Concur. Titles have been revised.

Comment #21

Geotechnical Appendix – Attachment 8 The statement that the area was not glaciated during the Pleistocene is wrong. The geology section should be updated using more current references.

Response: Concur. The sentence was reworded to say "Approximately 3/4 of the Wisconsin Western Uplands, and most of the Southeast Minnesota Uplands, were not overridden by glacial ice during the Wisconsin Stage of the Pleistocene Epoch and is known as the Driftless Area."

Comment #22

The DNR's MRT believes that until the necessary monitoring data is included in the DPR to support the project, a request for endorsement or approval of the Spring Lake HREP project should be deferred. We have been in contact with the WDNR and apparently they have additional water quality and fisheries monitoring data that will help support the proposed project. LTRM submerged vegetation data is available for the Spring Lake area for 2001 when approximately 100 random sites were sampled by Lake City and Onlalska Field Stations. In addition, the Lake City Field Station sampled approximately 30 sites in 2002.

Response: Additional data has been supplied by the Wisconsin DNR has been incorporated into the report.

Minnesota Department of Natural Resources

DNR Waters
1801 South Oak Street
Lake City, Minnesota 55041

651/345-5601

October 21, 2002

Mr. Tom Novak, Project Manager
St. Paul District, Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
St. Paul, Minnesota 55101-1638

Dear Mr. Novak:

Re: draft Spring Lake HREP Definite Project Report (DPR) and Environmental Assessment (EA)

Representatives from the Department of Natural Resources' (DNR) Mississippi River Landscape Team (MRT) have completed their review of the draft Definite Project Report and Environmental Assessment for the Spring Lake Habitat Rehabilitation and Enhancement Project (HREP) dated September 10, 2002. The DNR's MRT is an inter-disciplinary team comprised of field and central office professional staff that work with Upper Mississippi River programs and projects. The MRT would like to take this opportunity to recognize and thank the Corps staff for their efforts in the development of the draft DPR.

The intent of our comments today are to provide the Corps with constructive input into the HREP planning process that will result in a planning document that can be endorsed by the River Resources Forum, approved by Mississippi Valley Division and result in a wise expenditure of federal taxpayers monies to improve fish and wildlife habitat in the Spring Lake project area.

Our review of the draft DPR suggests to us that the monitoring information presented within the text of the document does not adequately support the proposed HREP. Moreover, many of the HREP objectives are quantitative while the characterization of the project area's current conditions is generalized and dependent on old monitoring data.

The following examples illustrate the lack of monitoring data to support the need for Objective A1:

"Objective A1: Create and/or enhance overwintering (November – March) habitat for Centrarchids meeting the following criteria:

A. A minimum of three discrete areas.
B. A minimum of 20 acres per area.
C. Dissolved Oxygen levels $\geq$ 5 mg/l.
D. Current Velocity< 0.3 cm/sec over 80% of the area."

DPR Page 3-3 *"A detailed analysis of riverbed elevation changes in the Spring Lake area cannot be made because of a lack of accurate and complete hydrographic surveys overtime."*

The 2001 Flood was the second largest flood on record. The 2001 Flood had the potential to scour and deposit large amounts of sand in the project area. To support the need for Objective A1A "A minimum of three discrete areas." and Objective A1B "A minimum of 20 acres per area", a survey should be completed to determine the current bathymetric conditions within the project area. A comparison of bathymetric surveys before and after the 2001 Flood can be used to illustrate trends in the project area.

DPR Page 3-1 *"Current velocities are usually low throughout Spring Lake. Velocities measured under the ice were generally less than 0.1 ft/sec (Lucchesi and Benjamin, 1988)."*

DPR Page 3-4 *"During winter, areas within Spring Lake that are protected from current tend to be warmed by the river bottom, perhaps from an influx of groundwater, to temperatures up to several degrees warmer than the near-freezing water in the flowing channels. Winter warm temperatures under the ice are quite stable..."*

If Spring Lake water is warm and stable in areas protected from current, the Objective A1D calling for "current velocity < 3 cm/sec over 80% of the area" may already have been met for the project area. Are there more recent flow velocity data sets available for winter ice conditions that show a problem throughout the project area? Are there water temperature maps or profiles available for winter ice conditions in the project area?

DPR Page 3-4 *"Dissolved oxygen in Spring Lake is normally above the 5-mg/l concentrations necessary to sustain most forms of aquatic life."*

Objective A1C, Dissolved Oxygen levels ≥ 5mg/l, appears to have been met already. However, the data cited is 14 years old and from a different part of Pool 5. If this objective is not already met under the current environmental conditions, more recent data from the Spring Lake Area should be referenced or collected.

DPR Page 3-5 *"No population estimates of fish in Spring Lake are available. Average standing stock of bluegill in backwater lakes, sloughs, and side channels of the UMR pools is 21.2 kg/hectare (Pitlow 1987). Standing stock of largemouth bass from the same set of samples averaged 5.5 kg/hectare. Populations of blue gill and bass in Spring Lake may be somewhat higher than these figures because of the protected backwater character of the area."*

If the Spring Lake blue gill and bass populations are somewhat higher than the average because of the protected backwater character of the area, what is the justification for Objective A1? Does more recent monitoring data document a problem in the area?

In our opinion, an analysis of other proposed project objectives would likely provide similar results. The documentation within the DPR text simply does not justify the project in many cases. If there are better data sets or observations that can be referenced and documented within the text, this project would have a much better chance at being endorsed and/or approved. If the stated objectives remain as quantitative as they are now, a large amount of pre-project field data should be collected to characterize the project area and justify the project. A similar level of post-project monitoring may be needed to document the benefits of the project.

Problem Identification Section

Statements within the Problem Identification Section are not always supported by the monitoring data referenced within the text of the document. For example:

DPR Page 4-1 *"Existing habitat conditions in Spring Lake are deficient in meeting management goals."*

The monitoring data provided in the DPR suggests that conditions in Spring Lake may already meet Objective A1's criteria.

DPR Page 4-1 *"Wildlife habitat includes the open water areas, submergent vegetation, emergent vegetation and the islands. The primary wildlife habitat deficiency is the increasing lack of aquatic vegetation to wave action."*

Yet the vegetation information provided in DPR Page 3-4 states: *" ...The emergent vegetation beds in the Lost Island-Belvidere Slough area are evenly distributed throughout, although Spring Lake had a higher coverage than the other areas surveyed (Nielsen et al. 1978). Emergent species found in Spring Lake during this study were water lily, arrowhead, narrow-leaf arrowhead, burreed, cattail, and lotus. A total of 15 species of submergent aquatic plants were also identified within Spring Lake in the study including coontail, wild celery, river pondweed, curly-leaf pondweed, waterweed, and water star grass..."* **and**

DPR Page 3-7 states, *"Interspersion of shallow open water, submergent and emergent aquatic plant beds has not been quantified; however, it appears good."*

To support the statement that there is an increasing lack of aquatic vegetation, more recent data should be presented to show/quantify the decline.

The 2001 LTRMP Land Cover/Land Use Assessment in the Coordination/Correspondence Attachment 8 states: *"Despite the later date all submersed and emergent vegetation appeared vigorous and healthy because of the warmer than usual weather and excellent water quality."*

Figure 1 shows a visual comparison of a 1984 true color photograph to a 2001 infrared photograph – but does not provide a numeric comparison of aquatic vegetation acreages. Table 1 only shows acreages for 2001. Figure 2 in this assessment illustrates a diverse and widespread distribution of aquatic plants in the Spring Lake Habitat Project. Again, where are the monitoring results that show the decline in aquatic plant beds?

Section 4.2 Historically Documented Changes in Habitat - *"A reduction in the fisheries output and aquatic plant bed area has been observed."*

Where are the data sets or who observed these changes and how were they documented over time?

Section 4.2.1 *"The loss of barrier islands in Spring Lake is well documented".*

While the loss of islands since the 1930s is clearly illustrated, also documented in Table 4-1 Island Loss in the Spring Lake Area is an increase in island area from 1994 to 1998 . The 1998 acreage is actually greater than what was present in 1989. This could be interpreted at an indication the Spring Lake area has actually turned the corner and is now entering a period of aggradation that is resulting in the natural development of new islands. More discussion is needed here.

Section 4.3.1 *"The turbidity observed in Spring Lake may be the result of several factors, including the resuspension of fine substrates by wind-induced turbulence, the importation of suspended solids via the breach in the peninsula, the growth of planktonic algae, and feeding of rough fish."*

There are no turbidity observations or measurements provided in the text of the DPR to show that there is a turbidity problem let alone the identification of a main cause of the problem.

In the Coordination/Correspondence Attachment 8, a 1998 technical memo from Pat Foley states: *"Since TSS in Spring Lake is already low, it is doubtful that it can be reduced further... To complete the hydraulic design for Spring Lake, a decision must be made on whether an island is needed."*

On what Total Suspended Solids (TSS), turbidity or other data was a decision made to build islands?

Other Comments

DPR 4.3 Factors Influencing Habitat Change – This section completely misses the point that the area has been permanently inundated by 9-Foot Channel Project. This section should explain the environmental impacts occurring with the Spring Lake area in the context of the navigation reservoir impoundment.

DPR 4.4 Estimated Future Habitat Types and Conditions – There are plans being developed to change how water levels are managed in Pool 5 and therefore it is likely that the water regime will change. The potential changes and benefits of a water level drawdown should be explained in detail within this section. Natural island formation is occurring rapidly just upstream of the Spring Lake area. The potential for islands to form and be stabilized in conjunction with the development of additional emergent plant beds associated with water level drawdowns should be examined as a possible alternative to the selected plan. The future habitat conditions discussion should be tempered by this potential development.

DPR 8-11 The Corps' Operation and Maintenance staff in Fountain City are still receptive to discussing the possible use of Lost Island Containment Site sand in the Spring Lake project.

DPR 8-12 The schedule is not consistent with the text as far as when construction is planned to begin.

DPR 12-1 Pool 5 is not considered a key pool by the LTRM program. The Lake City LTRMP Field Station has recently completed some water quality, fish and vegetation monitoring in Pool 5 as the LTRM Program sought to expand its monitoring coverage to include pools adjacent to the key pools. With the current level of funding in the appropriation bill, it is doubtful that any LTRMP monitoring will be done in Pool 5 in 2003. However, in our opinion, HREP funds could be used by the Corps to support future LTRMP monitoring activities that are deemed necessary for proper evaluation of HREPs.

Table 12-1 This table needs to be updated to reflect the correct names of the federal agencies involved in the proposed evaluation.

Figures 7, 7.1 and 9 These figures need better titles on the plates to differentiate old proposed plans from the selected plan.

Geotechnical Appendix – Attachment 8 The statement that the area was not glaciated during the Pleistocene is wrong. The geology section should be updated using more current references.

The DNR's MRT believes that until the necessary monitoring data is included in the DPR to support the project, a request for endorsement or approval of the Spring Lake HREP project should be deferred. We have been in contact with the WDNR and apparently they have additional water quality and fisheries monitoring data that will help support the proposed project. LTRM submerged vegetation data is available for the Spring Lake area for 2001 when approximately 100 random sites were sampled by Lake City and Onlaska Field Stations. In addition, the Lake City Field Station sampled approximately 30 sites in 2002.

Thank you for the opportunity to comment on the draft DPR and EA. It is our hope that the Corps and other partners will give our comments due consideration before moving ahead with project planning activities. Please give me a call if you would like to discuss or to set up a meeting to go over our comments. I can be contacted at the address and phone number listed above.

Sincerely,

Scot Johnson

Scot Johnson
Mississippi River Hydrologist

cc. Jeff Janvrin, WDNR, LaCrosse
Bob Drieslein, USFWS, Winona
Steve Johnson, MDNR, St. Paul
Dave Leuthe, MDNR, New Ulm
Tim Schlagenhaft, MDNR, Rochester
Dan Dieterman, MDNR, Lake City
Kevin Staufer, MDNR, Lake City

PM A/Novak

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MINNESOTA 55101-1638

REPLY TO
ATTENTION OF

September 16, 2002

Project Management Branch
Planning, Programs and Project Management Division

Mr. Scot Johnson
Habitat Projects Coordinator
Minnesota Department of Natural Resources
1801 South Oak Street
Lake City, Minnesota 55041

Dear Mr. Johnson:

Enclosed for review and comment is the preliminary draft Definite Project Report and Environmental Assessment for the Spring Lake Islands Habitat Rehabilitation and Enhancement Project. This report is being reviewed concurrently by the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources.

Please provide any comments you may have by October 16, 2002. If you concur with the recommended plan, we would appreciate a letter indicating your support of the project. We would include your letter in the public review draft of the report.

If have any questions or need additional information, please contact me at (651) 290-5524 or at tom.novak@mvp02.usace.army.mil.

Sincerely,

Thomas Novak

Tom Novak
Project Manager

Enclosure (2 copies)

Copy Furnished:
Steve Johnson (2 copies)

Responses to USFWS Comments

Comment #1

1. On the second page of the Executive Summary of the Report, it is stated that project construction is scheduled to begin in 2003 and be completed in 2004. Is the reference here to fiscal years? The schedule shown on page 15-1 indicates that construction would begin in 2004 and be completed in 2005. Which statement is correct?

Response: Concur. Schedule has been corrected.

Comment #2

2. Under Section 3.62, first paragraph, the second sentence should be revised to read, "Common species include the coot and a variety of waterfowl including the mallard, blue-winged teal and woodduck".

I would also suggest deleting the words, "large numbers of" from the third sentence in that paragraph.

Response: Concur. Text will be revised as suggested.

Comment #3

3. Objective B1,E. on page 5-8 states that 10-20 waterfowl loafing sites will be provided at scattered locations throughout the study area. There are no details on this and there is no mention made of it in the Cost Estimate Appendix. We strongly support this objective but think clarification is needed. Placement of trees along the shoreline such as was done on Polander Island complex could meet the requirements here.

Response: Concur. Cost Estimate will be corrected. Details will be added during Plans and Specifications.

Comment #4

4. Under Section 8.1.3. Islands, the Service would suggest that some limited plantings of native shrubs and trees be made. This would enhance plant diversity of the islands and if care is taken to specify locally available nursery stock, the cost may not exceed that of planting native grasses and forbs on the same site. The Service would be willing to provide the labor for tree and shrub plantings if that is desired to help keep project costs down.

Response: Concur. See response to Wisconsin DNR comment #25.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Upper Mississippi River National Wildlife and Fish Refuge
51 E. Fourth Street - Room 101
Winona, Minnesota 55987

IN REPLY REFER TO:

September 23, 2002

Mr. Tom Novak, Project Manager
Department of the Army
St. Paul District Corps of Engineers
Army Corps of Engineers Center
190 Fifth St. East
St. Paul, MN 55101-1638

Dear Mr. Novak:

Thank you for the opportunity to review the preliminary draft Definite Project Report and Environmental Assessment for the Spring Lake Islands Habitat Rehabilitation and Enhancement Project.

Based on our review of the draft report, we have a number of comments and questions which follow:

1. On the second page of the Executive Summary of the Report, it is stated that project construction is scheduled to begin in 2003 and be completed in 2004. Is the reference here to fiscal years? The schedule shown on page 15-1 indicates that construction would begin in 2004 and be completed in 2005. Which statement is correct?

2. Under Section 3.62, first paragraph, the second sentence should be revised to read, "Common species include the coot and a variety of waterfowl including the mallard, blue-winged teal and woodduck."

   I would also suggest deleting the words, "large numbers of" from the third sentence in that paragraph.

3. Objective BI, E. on page 5-8 states that 10-20 waterfowl loafing sites will be provided at scattered locations throughout the study area. There are no details on this and there is no mention made of it in the Cost Estimate Appendix. We strongly support this objective but think clarification is needed. Placement of trees along the shoreline such as was done on the Polander Island complex could meet the requirement here.

4. Under Section 8.1.3. Islands, the Service would suggest that some limited plantings of native shrubs and trees be made. This would enhance plant diversity of the islands and if care is taken to specify locally available nursery stock, the cost may not exceed that of planting native grasses and forbs on the same site. The Service would be willing to provide the labor for tree and shrub plantings if that is desired to help keep project costs down.

Aside from the comments/questions noted above, the Fish and Wildlife Service concurs with the recommended plan for the Spring Lake Islands HREP and we encourage the Corps of Engineers to move forward and maintain the momentum of this project as it moves closer to implementation.

We look forward to working with you and representatives of Wisconsin and Minnesota natural resource agencies on this project in the future.

Sincerely,

James Nissen
Acting Complex Manager

cc: Tim Schlagenhaft, MN DNR
Jeff Janvrin, WI DNR
Gary Wege, USFWS, Bloomington, MN
Jon Kauffeld, USFWS, Twin Cities, MN

PM-A/Novak

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MINNESOTA 55101-1638

REPLY TO
ATTENTION OF

September 16, 2002

Project Management Branch
Planning, Programs and Project Management Division

Mr. Bob Drieslein
Refuge District Manager
U.S. Fish and Wildlife Service
51 East Fourth Street
Winona, Minnesota 55987

Dear Mr. Drieslein:

Enclosed for review and comment is the preliminary draft Definite Project Report and Environmental Assessment for the Spring Lake Islands Habitat Rehabilitation and Enhancement Project. This report is being reviewed concurrently by the Wisconsin and Minnesota Departments of Natural Resources.

Please provide any comments you may have by October 16, 2002. If you concur with the recommended plan, we would appreciate a letter indicating your support of the project. We would include your letter in the public review draft of the report.

If have any questions or need additional information, please contact me at (651) 290-5524 or at tom.novak@mvp02.usace.army.mil.

Sincerely,

Thomas Novak

Tom Novak
Project Manager

Enclosure (6 copies)

Novak, Tom MVP-PM-A

From: Sullivan, John F (DNR - LaCrosse) [SulliJ@mail01.dnr.state.wi.us]
Sent: Thursday, March 07, 2002 1:43 PM
To: Jeff Janvrin (E-mail); Clark, Steven J MVP
Subject: RE: Spring Lake HREP - Sediment Evaluation

Steve-

I think the sediment monitoring that was done for the Spring Lake Closure provides adequate information to assess the next phase. So I don't believe we need additional bulk chemical data to evaluate the proposed dredge cut. I am assuming that you will be preparing a 404(b)(1) evaluation for this project. The historic sediment data for Pool 5 should be adequate to assess the sediment contamination potential. As far as I know, the most recent data for lower Pool 5 is a surface composite sample collected as part of a post-flood evaluation effort in 1994 (i.e. Sullivan & Moody 1996). A copy of this should be in your District's library.

> ----------
> From: Clark, Steven J
> MVP[SMTP:Steven.J.Clark@mvp02.usace.army.mil]
> Sent: Wednesday, March 06, 2002 2:26 PM
> To: Jeff Janvrin (E-mail); John Sullivan (E-mail)
>
> <<File: rock island design.jpg>>
> Jeff and John - here is a jpeg of the design. Keep in mind that we are
> not certain where we are dredging for access and borrow (it looks now like
> we may expand the "big hole" for borrow). John - does this general area
> of pool 5 have a history of "excessive" contamination (do you have any
> major concerns)?
>
> <<rock island design.jpg>>
>
>

PUBLIC MEETING NOTICE

SPRING LAKE ISLANDS
HABITAT REHABILITATION AND ENHANCEMENT PROJECT

Since 1987, the St. Paul District Corps of Engineers, in cooperation with the U.S. Fish and Wildlife Service and the Wisconsin and Minnesota Departments of Natural Resources, has been investigating measures for fish and wildlife habitat restoration within Spring Lake. Spring Lake is an area of approximately 500 acres located in pool 5 of the Upper Mississippi River just above the Lock and Dam 5 dike adjacent to Buffalo City, Wisconsin. The study has been conducted under the Upper Mississippi River System - Environmental Management Program (UMRS-EMP).

Date: **February 25, 2002**

Time: **6:30 p.m. – 8:30 p.m.**

Location: **Buffalo City Community Room**
245 East 10th Street
Buffalo City, Wisconsin

Preliminary studies have been essentially completed and a draft report is being prepared recommending a number of measures to restore and enhance fish and wildlife habitat within the study area. These include:

- Construction of islands and rock features to provide protection from wind, waves, and flow.
- Construction of a channel for construction contractor and public access.
- Construction of mud/sandflats for waterfowl habitat and excess material placement.
- Dredging in the upper part of Spring Lake to provide topsoil for islands and to provide depth for fish habitat.

The purpose of the public meeting is to discuss the recommended habitat restoration features and provide the public an opportunity to provide comment on the recommended plan.

If there are any questions concerning the public meeting, please contact Tom Novak, Project Manager, at (651) 290-5524 or at tom.novak@.usace.army.mil.

RECORD OF ATTENDANCE

Meeting SPRING LAKE ISLANDS

Date 25 FEB 2002

This information will be used for the purpose of knowing who attended this meeting.
Please include your address if you wish to be on the project mailing list. Thank you.

Name (please print)	Address (optional)	Representing (optional)
Gene Smith	1355 S. River Rd	
Barb Smith	1355 So River Rd	
Jan Moe	1353 So " "	/
Burt Moe	" " "	
Tom Murray	S2935A INDIAN CREEK RD.	
Dick GORDON	S2935 Indian Creek Rd.	
Brian Bjarke	1368 South River Rd.	
STEVE BURMEISTER	165 W 9th ST	
CLIFFORD BURMEISTER	281 W 12th St.	
NICK SERSOGIKO	473 W. 26TH	
Brett LADUKE	340 W 18st	
GAYLE LEWIS	S2322 CTY RD OO COCHRANE, WI.	
CHAD KUSIDOWSKI	376 N. BELVIDERE BUFFALO CITY	
Matt Forest	127 W 6th St Buffalo City	
RON WOZNEY	S2922A INDIAN CR RD FOUNTAIN CITY	
Ray Mueller	S1946 Prairie St F.C.	
ROBERT SIEKER	530 S MAIN FC	
Dale O. Hoch	S2028 Hickory Alma	
[illegible]	S2[illegible] Alma	
Nancy Sagan	1305 So River BC.	
Larry Ross	P.O. BOX [illegible] F. City WI. 54629	

PAGE 1

RECORD OF ATTENDANCE

Meeting SPRING LAKE ISLANDS   Date 25 FEB 2002

This information will be used for the purpose of knowing who attended this meeting.
Please include your address if you wish to be on the project mailing list. Thank you.

Name (please print)	Address (optional)	Representing (optional)
JACK HILT	1400 S. RIVER RD	SELF
GARY ROBINSON	96 E 1ST ST. Buffalo City	SELF
JOHN FANDREY	1372 S. RIVER Rd. Buff City	SELF
GENE GLOMSKI	81 3RD St B. City	SELF
Ray Spreeman	64 W 3rd St B. City	SELF
Phil Brown	1303 S. River Rd BC	Self
H R Goeldner	280 State Road 35 N ALMA WI 54610	—
Jack Scherer	Cochrane 54622	—
Dan Wiki Wilcox	Buffalo City 54622	City of Buffalo City
Dan Liethe	Cochrane 54622	Self
Ron Cieszynski	Fountain City 54629	Self
BARRY AUER	BUFFALO CITY 54622	"
Patti Stinson	1394 S River Rd Buf City	Self
Bill Scievers	↓ ↓	"
Ben Burmester	Buffalo city	Self
Brian Michaels	88 W 12th St Buffalo City	Self.
Tony L Boggs	1725 S RIVER RD	SELF
Warren Rivette	S2394 CTH 00	Self.
Bruce McFadin	164 W 24th	Buffalo City
David Pintard	1329 S. River Rd	" "
Ken Krenzke	S River Rd	" "

PAGE 2

RECORD OF ATTENDANCE

Meeting SPRING LAKE ISLANDS

Date 25 FEB 2002

This information will be used for the purpose of knowing who attended this meeting.
Please include your address if you wish to be on the project mailing list. Thank you.

Name (please print)	Address (optional)	Representing (optional)
Luann Rinn	181 W. 7th Buffalo City	Self.
Jim Pearson	1335 S River Rd	Self -
Dave Becker	1025 N. Front St. Buffalo	Self
Joan Weaver	1382 S. River Rd. Buffalo	self
Eugene Weaver	1382 S. River Rd. Buffalo	Self
[illegible]	RR#1 Box 37 Kellogg Mn 55945	Self
Joel Malanaphy	1384 S River Rd Buff City	self
Karl Hoffmann	645 S. River Rd.	
Joan Schnabel	Box 5 Fountain City WI	self / the river
Susan Keller	1325 S. River Rd. Buffalo City	SELF
Jeff Falk	Box 5 Ftn City	Self
Ed Anniuk	450 W 24 Buffalo	Self
Deb Bartell	Clerk of Buffalo City	City
Mark Prevost	S2401 N. Herman Buffalo City	self - WWA
Sandy Michaels	88 W. 12th St. B.C.	B+S Express
John Weaver	1103 S. River Rd. B.C.	
Frank Kuhlman	1111 S. 2nd St. Alma	Self
Keith Brauneiter	1225 Mississippi St LaCrosse WI 54601	Self Wisconsin Waterfowl Association

Novak, Tom MVP-PM-A

From: Sullivan, John F (DNR - LaCrosse) [SulliJ@mail01.dnr.state.wi.us]
nt: Thursday, February 14, 2002 3:27 PM
Clark, Steven J MVP
Cc: Janvrin, Jeff A
Subject: RE: Pool 5 Spring Lake

Interestingly, I just talked with Jeff about this project. Your map is different that the one Jeff had. His showed more islands.

Anyway, I suggested to Jeff that the upper cut might be better - more head and greater mixing into the upper end of the project. However, we sure don't want a lot of flow through here, otherwise we will defeat the purpose of the upper dredge cuts. Right now, I am think about 10 cfs during winter conditions! I don't have a serious problem with bringing it in the lower cut, but we would probably want to see more flow here say 30-50 cfs. I don't think we need both cuts. Don't worry about providing oxygen flows everywhere. The fish can handle these gradients. Further, algae can play a major role even with out flows in some years with little snow (like this one!).

> ----------
> From: Clark, Steven J
> MVP[SMTP:Steven.J.Clark@mvp02.usace.army.mil]
> Sent: Thursday, February 14, 2002 2:57 PM
To: John Sullivan (E-mail)
ubject: Pool 5 Spring Lake
>
> <<File: spring lake notches.jpg>>
> John - I could use your opinion on an aspect of the Spring Lake HREP
> design we are working on. The attached image shows the current plan on a
> DOQ of the area. We are looking at a number of features, mostly islands.
> The upper end of the lake is of interest as over wintering habitat for
> centrarchids (as you probably know). We are proposing to protect the
> existing peninsula, construct a sill or dike in a hole in the peninsula
> (labeled notch 1), construct a rock dike/island structure off the bottom
> of the peninsula (shown as a red-checked reverse S) with a notch (notch
> 2), and dredging in the upper end for fine material. The area behind the
> island and peninsula is being protected for over wintering habitat but we
> must provide a minimum flow into the area for DO. I was always under the
> impression that we were going to introduce flow at notch 1. However, Jeff
> Janvrin now wants to introduce flow at notch 2. I believe he realizes
> that the upper end of the lake will go anoxic during late winter, but he
> says he is OK with that and what they are trying to accomplish is a
> gradient of conditions. I am afraid that if we only introduce flow
> through notch 2 too much of the upper end of the lake will go anoxic too
> soon and we would be defeating the purpose. Please take a look at it and
> let me know what you think, or call me so we can discuss it. Thanks.
>
> <<spring lake notches.jpg>>
> Steven J. Clark
> Fisheries Biologist
> U.S. Army Corps of Engineers, St. Paul District
> 190 5th Street East
St. Paul, MN 55101-1638 USA
Phone: (651) 290-5278
Fax: (651) 290-5258
> steven.j.clark@mvp02.usace.army.mil
>

Novak, Tom MVP-PM-A

From:	Janvrin, Jeff A [JanvrJ@mail01.dnr.state.wi.us]
nt:	Thursday, February 01, 2001 1:52 PM
:	'Novak, Tom'
ubject:	FW: Winter Survey at Spring Lake and Fountain City Bay area

fyi

> \----------
> From: Sullivan, John F (DNR - LaCrosse)
> Sent: Thursday, February 01, 2001 1:44 PM
> To: Janvrin, Jeff A; Benjamin, Ron; 'Hendrickson, Jon'
> Cc: Brecka, Brian J.
> Subject: Winter Survey at Spring Lake and Fountain City Bay area
>
> Brian Brecka and I conducted a water quality survey of Spring Lake and Fountain City Bay yesterday (Jan 31, 2001). This document is a quick summary FYI.
>
> Spring Lake
>
> A huge area of open water exists in the area north and west of spring Lake. To our dismay, both the upper cut (new opening) and the lower cut to spring lake were open and flowing into Spring Lake. We tried to gage the upper cut (about 50 ft wide), but it was too deep for wading. Based on a few velocity measurements and an estimated x-sectional area of 100 sq ft, I would estimate the upper cut flow at 25 cfs. The inflow had a DO of 13 mg/L and temperature of 0.6 C.
>
> Surface (1.5-2 ft depth) DOs in Spring lake were very good (around 12.5-13 mg/L) with cold water (0.2 C). Bottom DOs were a few tenths lower than surface measurements but had "warmer" water (0.6 - 0.9 C), even in the deep areas (10-11 ft) in lower Spring Lake. Surface and mid-depth velocities ranged from 0.06 to 0.12 ft/s with higher velocities noted below the lower cut. Obviously, the large volume of flow into this area has negatively influenced centrarchid habitat.
>
> Fountain City Bay
>
> Since we were not able to gage the inflows at Spring Lake, I suggested to Brian that we make a few measurements in the FCB area.
>
> Our first site was mid-channel off the upper boat landing (Merrick State Park) in Fountain City Bay. DO and Temperature were essentially uniform top to bottom (11 ft) with measurements of about 11 mg/L and 0.0 C. The surface and mid-depth velocity was about 0.2 ft/s. As observed in the past, the high velocities isothermal conditions are due to the Spring Lake culvert and Waumandee Creek.
>
> Next, Brian took me to his secret fishing spots in the FCB backwaters to the west of the park. Surface or mid-depth DOs were good (about 10 mg/L) with temperatures of about 0.7 C. One site (Duck Pond) had a surface (1.5 ft) DO of 10.3 and bottom (3.5 ft) DO of 1.2 mg/L in 3.5 ft of water with temperatures of 0.4 and 2.4 C, respectively.
>
> Next Week
>
> Due to higher winds and colder weather, I am rescheduling the Stoddard survey for next week. I may also attempt to get a second survey of Long Lake.
>
> John F. Sullivan

Novak, Tom MVP-PM-A

From: Janvrin, Jeff A [JanvrJ@mail01.dnr.state.wi.us]
Sent: Thursday, February 01, 2001 1:52 PM
To: 'Novak, Tom'
Subject: FW: Winter Survey at Spring Lake and Fountain City Bay area

fyi

> ----------
> From: Sullivan, John F (DNR - LaCrosse)
> Sent: Thursday, February 01, 2001 1:44 PM
> To: Janvrin, Jeff A; Benjamin, Ron; 'Hendrickson, Jon'
> Cc: Brecka, Brian J.
> Subject: Winter Survey at Spring Lake and Fountain City Bay area
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> past, the high velocities isothermal conditions are due to the Spring Lake
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> ft) DO of 10.3 and bottom (3.5 ft) DO of 1.2 mg/L in 3.5 ft of water with
> temperatures of 0.4 and 2.4 C, respectively.
>
> Next Week
>
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> survey for next week. I may also attempt to get a second survey of Long
> Lake.
>
>

Spring Lake Islands
Interagency Meeting No. 3

January 30, 2002
0930 hrs- 1230 hrs
USFWS - Winona

AGENDA

1. Purpose of the Meeting

    - The purpose of the meeting is (1) discuss proposed project features, HEP evaluation, comparison of design features base on the December package (2) discuss and come to an agreement on proposed project features.

2. Project Features – December 01 Plan

    - Alternatives/Options
    - Proposed Alternative (Corps Jan 02 Plan)
    - Recommendations

3. Schedule –

    - Public Meeting date
    - Solicitation/Award -
        - Constraints - no new starts in FY 03
        - Opportunities – Pool Plans/Water Level Management

Spring Lake
30 January 2002

Tom Novak	COE	651-290-5524
Gary Wege	FWS	612/725-3548 ext 207
Pam Thiel	FWS	608-783-8431
Brian Brecka	WDNR	608-685-6221
KARI LAYMAN	COE	651-290-5424
Steve Clark	CoE	651-290-5278
Eric Nelson	FWS	507/494-6234
JEFF JANVRIN	WDNR	608/785-9005
Job Drieslein	USFWS	507-494-6229
Michelle Marron	WDNR	608-685-6221
Patrick Short	WDNR	608 326 8818
DAN DIETERMAN	MNDNR	651 345 3365
Scot Johnson	MDNR	651 345-5601
KEITH BESEKE	US FWS	507-452-4232
MARK ANDERSEN	WDNR	608-785-9994
Ron Benjamin	WDNR	" 785-9012

Novak, Tom MVP-PM-A

From:	Janvrin, Jeff A [JanvrJ@mail01.dnr.state.wi.us]
Sent:	Thursday, November 30, 2000 10:04 AM
To:	Benjamin, Ron; 'Beseke, Keith'; Brecka, Brian J.; 'Drieslein, Bob'; 'Novak, Tom'; 'Schlagenhaft, Tim'
Cc:	Benjamin, Gretchen L; 'Davis, Mike'; 'Johnson, Scot'; Sullivan, John F (DNR - LaCrosse); Wetzel, John F
Subject:	Spring Lake Islands Proposal

Spring Lake Island HREP new g ...

Attached are the goals, objectives, criteria and a proposed feature map for Spring Lake Islands HREP. This was prepared based on comments from the last meeting and a follow-up meeting with Brian Brecka, Jeff Janvrin and Bob Drieslein. In other words, everyone still needs to look at it and provided comments.

Tom, please forward this to COE staff working on the project, since I did not have all of their emails.

<<Spring Lake Island HREP new g and o.doc>>

Jeffrey A. Janvrin
Mississippi River Habitat Specialist

Wisconsin Department of Natural Resources
State Office Building, Room 104
50 Mormon Coulee Road
La Crosse, WI 54601
phone: 608-785-9005
fax: 608-785-9990
janvrj@dnr.state.wi.us

Spring Lake Island HREP,
Pool 5, Upper Mississippi River
Goals, Objectives, Criteria and Features

Introduction: Spring Lake is an area of approximately 300 acres located just above the Lock and Dam 5 dike adjacent to Buffalo City, Wisconsin. Historically the area had a diversity of habitats which included: wooded terrestrial islands, emergent wetlands, smaller flowing sloughs, submersed plant communities and open water which was devoid of vegetation due to depth. The "deepest" areas in the complex are Spring Lake proper, which is adjacent to the shoreline, and the area which was dredged to obtain material for construction of the dike. Before the islands eroded away, much of the area served as an overwintering site for centrarchids. It is likely that Spring Lake was also dominated by a centrarchid community before impoundment due to its depth and lack of flow.

The area was selected as a site for an Environmental Management Program Habitat Rehabilitation and Enhancement Project in 1987 with the final Definite Project Report (DPR) completed in August 1991. The DPR recommended the construction of Spring Lake Peninsula to reduce sedimentation and flow into the Spring Lake complex and also recommended the construction of islands to replace historic islands which had eroded and further improve habitat for fish and wildlife species. Due to financial constraints, only the Peninsula was constructed in 1992 and the design of the proposed island complex was not detailed. The agencies are now in the process of developing a Supplemental DPR to initiate construction of the islands proposed and justified in the 1991 DPR.

The 1991 DPR for Spring Lake included a series of goals and objectives for the project area along with criteria to ensure the quality of the habitat created would be suitable for a multitude of target species. These goals and objectives focused on improving habitat conditions for riverine and backwater fish species with an emphasis on overwintering habitat for centrarchids and wildlife habitat improvements for waterfowl (diver and dabblers) migratory habitat, wading birds and aquatic mammals (furbearers).

The goals, objectives and criteria were reviewed by the agencies for the supplemental DPR. Based on this review, the agencies determined that the general goals and objectives were still accurate, however, experience with other HREPs, and monitoring of completed projects, has resulted in a revision of some objectives, criteria and proposed features and addition of goals aimed at restoring specific habitat types not addressed in the 1991 DPR. These habitat types include: sand/mud habitat for turtles and waterbirds, mussel habitat in the flowing channels, and optimization of connectivity of various habitat types.

The main 1991 objective which has changed is "Decrease water flows from entering Spring Lake." During the development of the 1991 DPR the focus was on reducing discharge into the complex as much as possible. Experience with and monitoring of completed projects shows that "fighting" the discharge into an area can cause operation and maintenance problems. Additionally, water discharge into the Spring Lake area is partially related to the water control structure located in the dike which provides flow to the Whitman Wildlife area backwaters in Pool 5A. This structure "pulls" water into the Spring Lake complex and must be accounted for when proposing features for the Spring Lake Islands HREP. Therefore the agencies are proposing that rather than reduce the discharge into the complex, it is more desirable from a maintenance and habitat diversity standpoint to maintain discharges into Spring Lake by "routing" the flow through reestablishment of historic channels by employing specific project features.

The planning team also noted that no reference to a time frame of "Maintain" conditions was presented. Therefore, some of the objectives were changed to reference a specific time frame based on historical data which can be used as a guide to envision the desired habitat conditions.

Revised Goals, Objectives and Criteria:

The following objective was revised to reflect the desire to diversify flow distribution within the complex rather than strictly control discharge into the project area:

- ~~Decrease~~ Optimize the distribution of water flows ~~from~~ entering Spring Lake

The following objective was added to address habitat types not specifically mentioned in the 1991 DPR:

- Increase the aerial coverage of sand/mud habitat

Criteria/features for the objectives in the 1991 DPR and those listed above are as follows *(species/guilds to be benefited are present in parentheses and italics).*

Optimize the distribution of water flows entering Spring Lake *(invertebrates, migratory and brood rearing habitat for waterfowl and shorebirds, spawning habitat for backwater fish species, turtle habitat, riverine species, freshwater mussels)*

- Reestablish inlets and flowing channels which existed in the 1951 photo coverages
- Provide for multiple no flow habitats

Increase the extent of water greater than 3 feet deep sheltered from river current in proximity to macrophyte beds, and with adequate dissolved oxygen for centrarchid habitat *(centrarchids and associated backwater fish and wildlife species)*

OVERWINTERING HABITAT -- A minimum of 3 discrete areas with a minimum size of 20 acres per site which meet the following:

- Current velocity <0.3 cm/sec over 80 % of the area
- Water temps as follows:
  4°C over 35% of the area
  2-4°C over 30% of the area
  0-2°C over 35% of the area
- Dissolved oxygen $\geq$ 5 ppm
- Water depths >4 feet over >40% of the wintering area and > 7 feet over 15% of the area**
- Connected to adjacent flowing water habitats**

** (The combination of these two criteria will allow for the implementation of a variety of water level management strategies for Pool 5 without creating habitat which would always result in summer fish kills.)

SUMMER HABITAT -- A minimum of 3 discrete areas with a minimum size of 20 acres per site which meet the following:

- Dissolved oxygen $\geq$ 5 ppm
- Aquatic vegetation cover in the range of 25-50%
- Water depths >4 feet over >40% of the wintering area and > 7 feet over 15% of the area**
- Connected to adjacent flowing water habitats**

** (The combination of these two criteria will allow for the implementation of a variety of water level management strategies for Pool 5 without creating habitat which would always result in summer fish kills.)

SPAWNING, REARING AND JUVENILE HABITAT -- To be met in a minimum of 3 areas of 5 acres each with the following criteria:

- Dissolved oxygen levels $\geq$ 5 ppm
- Current velocity < 0.5 cm/sec
- Aquatic Vegetation cover of approximately 80%
- Substrates of sand and/or gravel available for spawning

Increase then maintain the aerial extent, interspersion, density and species composition of macrophyte beds *(waterfowl, shorebirds, wading birds, backwater and riverine fish, turtles)*

- Provide $\geq$ 75 acres with physical attributes conducive to the establishment and maintenance of emergent vegetation. Criteria to be met include:
    - Water depths less than 2 feet
    - Protected from dominant wind fetches
    - Current velocities generally less than 0.5 feet per second
- Provide $\geq$ 125 acres with the physical attributes conducive to the establishment and maintenance of submersed vegetation. Criteria to be met include:
    - Water depth less than 4 feet
    - Protected from dominant wind fetches

Increase the length of shoreline and area of islands *(invertebrates, waterfowl, shorebirds/wading birds, backwater fish species, turtle habitat, riverine fish species, freshwater mussels, terrestrial plant and animal species)*
The construction of islands will be an integral part of meeting many of the other objectives. Following are additional criteria to be considered during island design:

- Islands should be located in locations and configurations comparable to the natural island that previously existing the study area.
- A mix of high and low elevation islands
- Minimize the use of rock
- slopes of 10:1 outward for 30 feet
- Create dynamic shorelines with transition zones (see sand/mud objective)
- Locate islands to induce the maintenance of channels and reduce flows into 3 centrarchid habitat areas
- Islands should be located in shallow water to reduce costs and increase stability
- Existing islands should be incorporated into restored islands for aesthetics
- Position so shoreline stabilization is in shallow water
- Position to minimize access dredging
- Position islands to have the greatest effect on hydraulic and sediment regimes.

Reestablish then maintain an interspersion of flowing channel habitat *(riverine species, freshwater mussels)*

- Reestablish inlets and channels which existed in the 1951 photo coverages
- Continuous flowing channels bordered by islands
- Areas of scour, eddies and varying velocities
- Variety of substrates (sand, silt, clay gravel, cobble, wood, etc.)
- Connected to other channels
- Variety of water depths

Increase the aerial coverage of sand/mud habitat *(shorebirds, wading birds, loafing waterfowl, turtles, homo sapians)*

- Create sand/mudflats in at least 3 locations which are 2-4 acres in size
- Water depths of 0-0.25 feet during normal summer conditions
- Sand/mudflats located in proximity to islands
- Enhance the micro-topography within expanses of sand/mudflats.

Decrease suspended solids concentrations (increase photic zone by .25 meters) *(aquatic vegetation)*

- Construct islands to reduce wave resuspension of bottom sediments
- Construct islands to create areas free from flow.

Other items to consider in design of the project:

1. Provide loafing sites for turtles and waterfowl in protected areas through the installation of "tree drops" at several locations in Spring Lake.
2. Enhance approximately 200 acres for migratory waterfowl habitat with approximately 50 acres in areas away from main boat traffic route. (This seems most appropriate for the lower 1/3 of the area, those areas south of islands A and B. Islands C and D will also offer some areas buffered from boat disturbance in the main travel routes.)
3. Enhance mussel habitat where appropriate based on substrate, water velocities, and depth. The following criteria can be used:

    Velocities: Mid-depth velocities 0.6-1.5 ft/sec during normal flow, mid-depth velocities of $\geq$2.5 ft/sec during bank full conditions

    Depth: 3-6 feet

    Substrate: "River Washed" or rounded rock with the following gradations:

Sieve Size	Percent by Weight Passing
2 inch	95-100
1 inch	80-95
0.5 inch	50-80
0.25	0-50

The substrate should be located in an area that has some transport of sand which will allow "filling" of the spaces between the washed rock without burying the rock. Additionally, larger rock (riprap size) should be scattered throughout the mussel habitat area to allow for variation in substrate distribution due to changes in velocities around the rocks.

Host Considerations: The channel where the mussel habitat is constructed must be continuous and maintain a depth of at least 6 feet. This is to ensure that mussel hosts will have access to the mussel habitat at all river stages (even if 2-3 feet drawdowns are implemented for Pool 8 in the future). *(Note to Gary: What will be the maximum drawdown in the 3 west vicinity given a drawdown of 3 feet at the dam? This is important since we would not want to leave these mussels high and dry during a drawdown or limit host access.)*

Notes on some features presented in draft plan prepared by USFWS and WDNR. The following proposed feature map using a July 31, 1951, aerial photo as a base. Actual location of features will be dependent on bathymetry surveys.

Islands

A1 -- A lower island which has the primary purposes of defining channel habitat and providing conditions suitable for the establishment/maintenance of aquatic vegetation beds within Spring Lake.

A2 -- Lower than A1 to provide for a better mix of topographic relief in the area. This island would preferably be frequently flooded in spring and fall. This will make the terrestrial habitat available for fish to feed and spawn and provide food resources for migratory waterbirds.

B -- A lower island which has the primary purposes of defining channel habitat and providing conditions suitable for the establishment/maintenance of aquatic vegetation beds within Spring Lake.

C -- A medium elevation island in the complex to define channel habitats, improve environmental conditions for aquatic vegetation and improve the channel habitat in Belvidere Slough.

D1, D2, D3, and D4 -- These would be medium elevation islands to create one and maybe two overwintering sites for centrarchids. The complex will also improve channel habitat between the C and D complexes and the D and E complexes. The islands will also improve environmental conditions for aquatic vegetation. A small rock sill(s) could be placed at locations along the island if it is deemed necessary to "equalize" water levels within the Spring Lake complex and perhaps "flush" out flocculant sediment which will likely settle in this area over time.

E1 and E2 -- Island E2 would create overwintering habitat in the northern section of Spring Lake and E2 would create it in Spring Lake proper. These islands will create areas of low/no velocities and also increase winter water temperatures in these 2 water bodies. The islands will also improve channel habitat conditions in the interior of the Spring Lake Complex. A sill may be needed somewhere along island E2 to alleviate hydraulic pressure and reduce O&M costs. Island E1 would be at an elevations comparable to the Spring Lake Peninsula. The elevation for Island E2 should be such that the island is not overtopped October-March more than 1 out of 10 years.

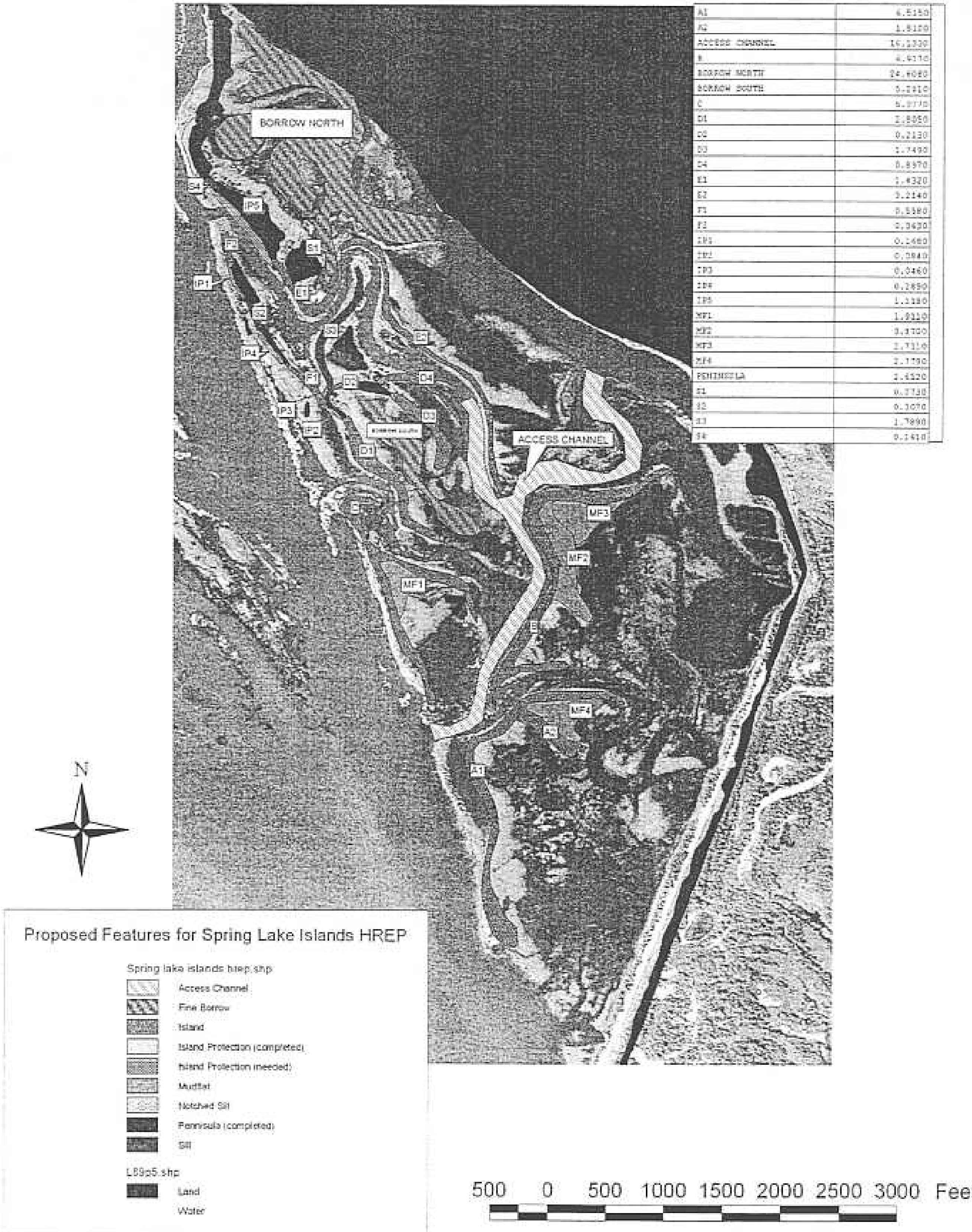
F1 and F2 -- These Islands will improve aquatic vegetation beds adjacent to a flowing channel, help define and improve the quality of flowing channel habitats and both sides, and will also provide wave protection for E1 and the existing island north of E1, thereby reducing the amount of protection needed in IP5. This island chain should incorporate the existing remnant islands in there layout/design. The elevation should be the only slightly higher than the D island complex. a low rock sill (S2) should be included in the F island chain. Recommended elevation is the 2-3 year flood event.

Rock Sills

S1 -- A notched rock sill that would be designed to pass 10 cfs during winter conditions.

S2 -- See description for islands F1 and F2.

S3 -- This rock sill, in combination with the existing channel between proposed islands F and E1 and rock sill S2, will serve as hydraulic pressure relief for the upper end of the Spring Lake complex. The sill should be designed to meet this purpose while at the same time enhancing/maintaining the existing channel.



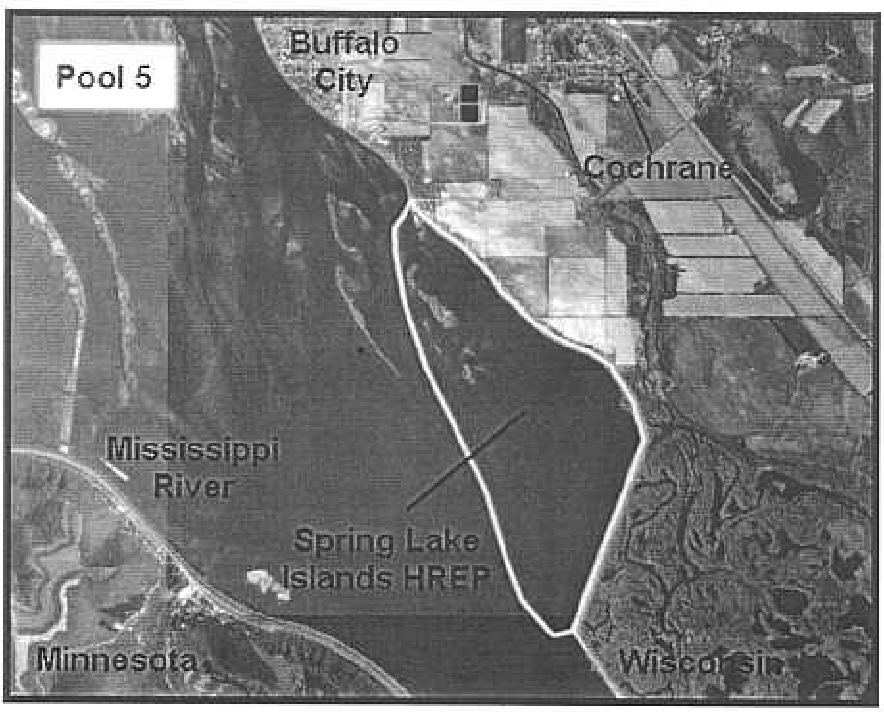
Label	Sum_Acres
A1	6.5150
A2	1.8120
ACCESS CHANNEL	16.1320
B	4.9170
BORROW NORTH	24.6080
BORROW SOUTH	5.2910
C	6.0770
D1	2.8050
D2	0.2130
D3	1.7490
D4	0.8970
E1	1.4320
E2	3.2140
F1	0.5580
F2	0.3620
IP1	0.1660
IP2	0.2840
IP3	0.0460
IP4	0.2650
IP5	1.1380
MF1	1.8310
MF2	3.3700
MF3	2.7310
MF4	2.7790
PENINSULA	2.4520
S1	0.2730
S2	0.3070
S3	1.7890
S4	0.1410

Spring Lake Habitat Project – Pool 5

2001 Land Cover/Land Use Assessment

Resource problem:

Natural islands along the west side of Spring Lake have eroded and many have disappeared since the creation of Pool 5. Previously, these islands protected Spring Lake from the direct effects of the main Mississippi River channel area and reduced wind fetch and associated wave action. This island loss has degraded the shallow water fish and wildlife habitat in the lake because of higher turbidity levels and undesirable conditions for the establishment of aquatic plant beds. The fish and wildlife habitat in Spring Lake had been of high quality because of the diversity present and the physically protected nature of the area. Quiet, protected areas are valuable for fish and wildlife such as largemouth bass, bluegill, wading birds, muskrat, and dabbling ducks. Aquatic plant beds provide a valuable food source for fish and migrating birds.



Project outputs:

The project would slow the continued degradation of about 200 acres of valuable backwater fish and wildlife habitat by permitting Spring Lake to be maintained as a protected, shallow backwater wetland with the proper conditions for high productivity of both fish and wildlife. More than two-thirds of the lake would be directly affected by the project. If suitable material can be dredged from Spring Lake for island fill, it would also provide additional fish habitat.

HABITAT INVENTORY:

On September 25, 2001, color infrared aerial photography of the Spring Lake Islands study area site was collected at a scale of ~1:9,600. This date was later in the growing season than planned but weather and other factors prevented earlier photo acquisition. Despite the later date all submersed and emergent vegetation appeared vigorous and healthy because of warmer than usual weather and excellent water quality. The photo scale was larger than originally intended (1:15,000) due to concurrent collection with another project requiring large-scale photography. Aerial photographs were ground truthed for plant verification and interpreted with the LTRMP 31-Class scheme that assesses vegetation based on the species dominance and approximate hydrology (see Appendix A). Interpreted aerial photo overlays were referenced to the earth in UTM Zone 15, NAD27 through the use of digital orthophoto quarter-quads. Photo interpretation and the final vegetation coverage were each checked using Upper Midwest Environmental Sciences Center's standard quality control/quality assurance protocols.

The table below summarizes the aquatic habitat contained within the HREP study area. Each of these categories is described further in Appendix A. Figure 1 shows the decline of aquatic habitat in Spring Lake since 1984. The location and relative distribution of these classes are shown in Figure 2.

Table 1. Frequency of occurrence and acreage of aquatic vegetation classes in the Spring Lake HREP study area.

UMR_CLASS	FREQ	ACRES
Deep Marsh Perennial	7	1.2
Developed	1	7.8
Floodplain Forest	17	14.7
Levee	3	3.1
Open Water	2	376.5
Rooted Floating Aquatics	17	34.6
Salix Community	3	2.7
Shallow Marsh Perennial	12	5.2
Submerged Aquatic Vegetation	39	124.1
Wet Meadow	1	0.4
Wet Meadow Shrub	4	2.4
	106	572.7

Figure 1. Aquatic vegetation changes in the Spring Lake, 1984-2001

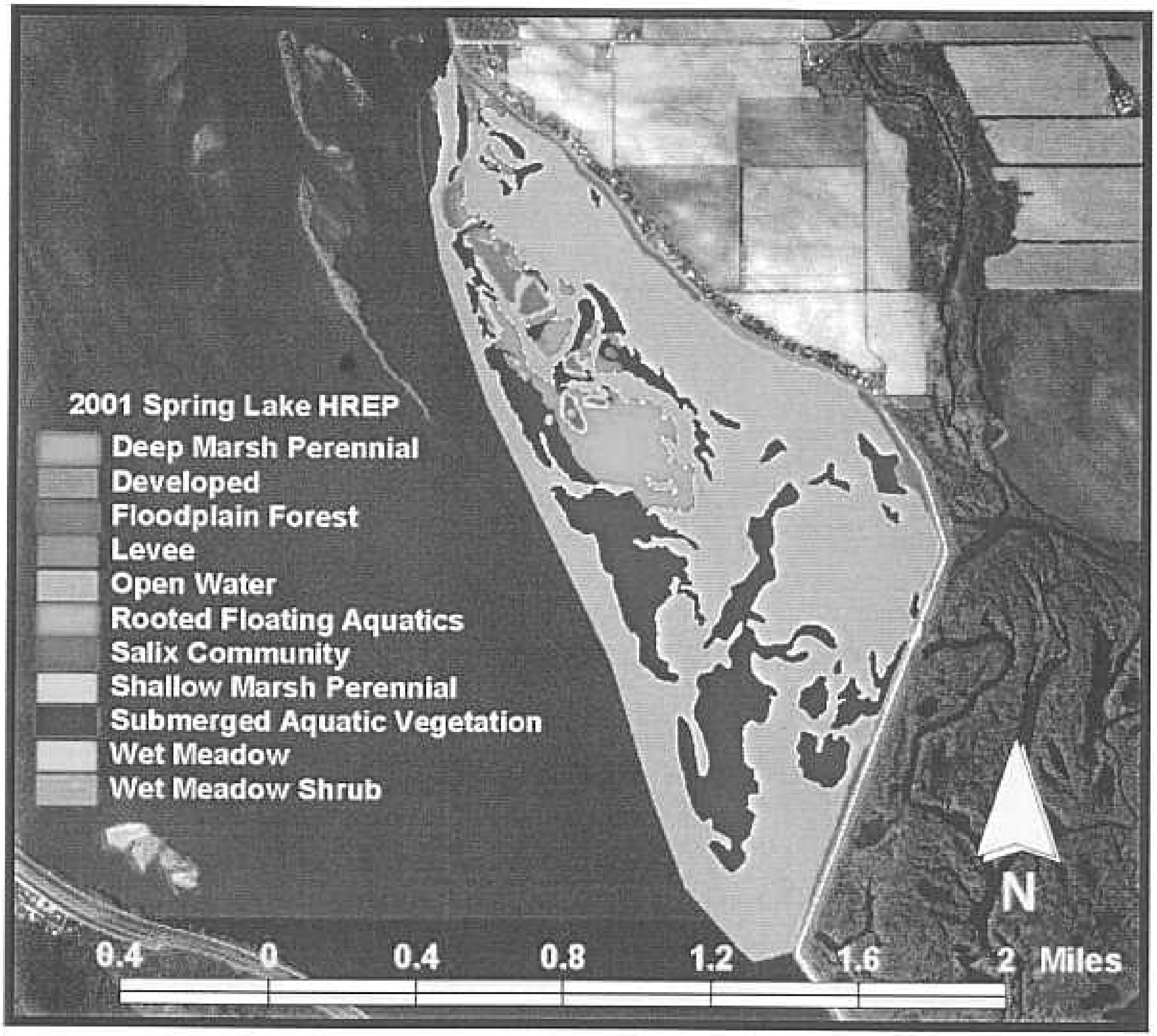


Figure 2. Distribution of aquatic vegetation in Spring Lake Habitat Project, Pool 5 of the Upper Mississippi River.

APPENDIX A

LTRMP 31-Class Vegetation System

UMR_CODE	UMR_CLASS	UMR_CLASS_DESCRIPTION	HYDRO_DESCRIPTION
AG	Agriculture	All obviously cultivated fields. This category may include transitional fallow fields that show evidence of tilling.	Infrequently Flooded Non-Forest
CN	Conifers	All natural or semi-natural evergreen communities. Typically Pine, but occasionally Cedar.	Infrequently Flooded Forest
DMA	Deep Marsh Annual	Dominated by Wild Rice, but may include floating-leaf species, submergents, or deep marsh perennials.	Semipermanently Flooded Non-Forest
DMP	Deep Marsh Perennial	Persistent emergents that prefer lots of water. Dominated by Arrowhead, Bur-reed, and Cattail and may include Pickerelweed, Giant Reed Grass, and Bulrush.	Semipermanently Flooded Non-Forest
DMS	Deep Marsh Shrub	Shrubby vegetation >25%, dominated by Buttonbush and Water Willow, frequently growing in standing water. May include RFA, SV, and deep marsh perennials.	Semipermanently Flooded Shrubs
DV	Developed	Areas that are predominantly artificial in nature such as cities/towns, large farmsteads, and industrial complexes.	Infrequently Flooded Non-Forest
FF	Floodplain Forest	Softwood forests growing on saturated soils near the main channel and in floodplain backwaters. These forest are predominantly Silver Maple, but also include Elm, Cottonwood, Black Willow, and River Birch.	Seasonally Flooded Forest
GR	Grassland	Drier upland grass or grass/forb fields. May include fallow fields, sand prairies, and shrubby vegetation < 25%.	Infrequently Flooded Non-Forest
LF	Lowland Forest	Lowland Forest - More common on southern reaches of the UMRS. These forests grow along the river banks on sites that are drier than FF sites. Typical species include many Hickories, Pecan, River Birch.	Temporarily Flooded Forest
LV	Levee	All continuous dikes or embankments designed for flood protection. More common on southern reaches of the UMRS and typically covered with mixed grass and forbs.	Infrequently Flooded Non-Forest
MUD	Mud	Exposed, non-vegetated mudflats. May occur near the main channel or in backwaters.	Seasonally Flooded Non-Forest
NPC	No Photo Coverage	Gaps in photo coverage. May include areas obscured by clouds or shadows.	No Photo Coverage
OW	Open Water	All non-vegetated open bodies of water.	Permanently Flooded Non-Forest
PC	Populus Community	Predominantly Cottonwood (>50%) but may include willow and other floodplain forest species.	Seasonally Flooded Forest
PN	Plantation	All commercially-grown evergreen plantations, large nurseries, and orchards. Typically will be Red or White Pine.	Infrequently Flooded Forest
PS	Pasture	All grass fields used for the production of livestock.	Infrequently Flooded Non-Forest
RD	Roadside Grass/Forbs	Grass/forb-covered right-of-ways along side of roads, highways, and railroads.	Infrequently Flooded Non-Forest
RFA	Rooted Floating Aquatics	Typically Lotus and Lily, but may include Water Shield and Water Primrose. Frequently grows with submergent vegetation when RFA density is < 90%.	Permanently Flooded Non-Forest
SB	Sand Bar	Exposed sand bars typically found in and near the main channel, and often associated with wing dams and islands.	Temporarily Flooded Non-Forest

SC	Salix Community	Predominantly Willow (>50%) but may include Cottonwood and other floodplain forest species.	Seasonally Flooded Forest
SD	Sand Dunes/Spoil	Sand spoil banks, beaches, and other sparsely-vegetated sandy areas.	Infrequently Flooded Non-Forest
SM	Sedge Meadow	Dominated by mixed Sedges but may include perennial emergents and moist soil grass/forbs.	Temporarily Flooded Non-Forest
SMA	Shallow Marsh Annual	Typically Wild Millet and Beggarsticks and other annual species that favor mudflats and shallow basins.	Seasonally Flooded Non-Forest
SMP	Shallow Marsh Perennial	The transition zone between deep marsh and wet meadow that is dominated by Bulrush, and to a lesser extent Cattail, Arrowhead, Bur-reed, Giant Reed Grass, Smartweed, and other moist soil species.	Seasonally Flooded Non-Forest
SMS	Shallow Marsh Shrub	Mixed shrubs >25%, but typically Sandbar Willow growing near the main channel and in backwaters along with mixed emergents, grasses, and forbs.	Seasonally Flooded Shrubs
SS	Shrub/Scrub	Shrubby vegetation > 25% on drier soils with a mixed grass/forb understory.	Infrequently Flooded Shrubs
SV	Submerged Aquatic Vegetation	All submersed aquatic vegetation.	Permanently Flooded Non-Forest
UF	Upland Forest	Forests growing at the edge or out of the UMRS floodplain. Species include Red/White Oak, Hickories, Elm, and other deciduous trees.	Infrequently Flooded Forest
WM	Wet Meadow	Dominated by moist soil grasses such as Reed Canary Grass and Rice Cutgrass. Also includes Loosestrife, Smartweed, and small inclusions of other mixed emergents, grasses, and forbs.	Saturated Soil Non-Forest
WMS	Wet Meadow Shrub	Mixed shrubby vegetation > 25%, typically Alder, Elder, False Indigo, Dogwood and/or Willow with a sedge/grass/forb understory.	Temporarily Flooded Shrubs
WS	Wooded Swamp	Most common in southern reaches of UMRS. Includes Bald Cypress, Water Tupelo, Sourgum, and Black Ash.	Semipermanently Flooded Forest

Spring Lake Islands HREP
Interagency Coordination Meeting
October 30, 2000

0930 hrs – 1500 hrs

Fountain City Service Base Conference Room

AGENDA

1. Introductions

2. Purpose of Meeting

   - The purpose of the meeting is (1) brief individuals previously not involved in the project, (2) discuss problems/objectives to see if they're still valid, (3) discuss alternative solutions to date and (4) visit the site.

3. Habitat Problems

   - Review problem identification in the DPR.

4. Habitat Project Objectives – General and Specific

   - Review Objectives in the DPR

5. Data what's new, what's old, what's needed

   - Geotechnical - Soil Borings
   - Hydraulics Analysis
   - Environmental

6. Other issues

7. Where do we go from here (summary)

8. Lunch

9. Site Visit

CEMVP-PM-A 30 October 2000

MEMORANDUM FOR RECORD

SUBJECT: Spring Lake Islands HREP

A kickoff meeting to discuss the above product was held on 30 October 2000,at 0920 hrs in the Fountain City Service Base conference room. The discussion items are summarized below. Attendees included:

Tom Novak	Pam Thiel	Brian Brecka
Kari Layman	Bob Dreslein	Jeff Janvrin
Jeff Stanek	Gary Wege	
Joel Face	Keith Beseke	
Steve Clark		

1. Specific Objectives - focus on upper part for centrarcid habit. Also, past public meetings the consensus was maintain the channel and bring back the islands.
   - Include Bob/Jeff's objectives here.
   - One
   - Two
   - Three
   - Public Access

2. Geotechnical issues

   - Dike 5 borrow area data
   -

3. Hydraulic issues

   - Data
   -

4. Environmental issues

   - Mussel survey

5. Action Items

   - Bathymetry
   - Public Meeting

Tom Novak

CEMVP-PE-H (1110-2-1403)

23 June 1998
Schneider/ms/5576

MEMORANDUM FOR Don Powell and Pete Fasbender, PE-M

Subject: Information Needs to complete H&H design of Spring Lake Islands HREP

1. Based on previous meeting notes, project goals include: protecting lake from effects of main channel, reduce wind fetch, reduce wave action, lower turbidity levels, establish aquatic plant beds, reduce bed load sediment, and create deeper holes in Spring Lake. Our thoughts and information needs for these goals are as follows:

Protecting Lake from Effects of Main Channel: We are assuming that this means reduce inflows to Spring Lake. The hydraulic residence times for Spring Lake before and after construction of the Spring Lake Peninsula project are shown in Table 1. Residence times for Peterson Lake and Stoddard Bay are also shown for comparison. To develop a hydraulic design for the Spring Lake project, a desired future hydraulic residence time must be established.

Table 1. Hydraulic residence times for three similar size backwaters on the Upper Mississippi River. A low flow river discharge of 20,000 cfs was used for these calculations.

	Preproject		Postproject	
Site	Discharge (cms)	Residence Time (Days)	Discharge (cms)	Residence Time (Days)
Spring Lake	11.3	2.3	3.5	6.1
Peterson Lake	29.0	1.2	9.3	3.6
Stoddard Bay	60.9	0.4	1.4	16.4

Reduce Wind Fetch and Wave Action: Attachment 1, shows three wind direction figures from the recently completed Weaver Bottoms Report. The predominant wind directions at Lock and Dam 5 are NW and SE. Since the major axis of Spring Lake is aligned in a NW-SE direction, and since the wind fetch in along this axis exceeds 6,000 feet, obviously wave action is a factor affecting conditions in Spring Lake. Given the orientation of Spring Lake and the predominant wind directions, the only way to effectively reduce wave action would be to build an island across Spring Lake at a location approximately 4,000 feet downstream of the head of the lake. To complete a hydraulic design for the Spring Lake project, a decision must be made regarding whether an island across Spring Lake is needed.

Lower Turbidity Levels: Attachement 2, shows suspended sediment concentrations in Spring Lake based on monitoring that was done for the Weaver Bottoms project. The preproject and postproject time periods on these two plots refer to the Weaver Bottoms project, not the Spring

Lake Peninsula project. All of this data was obtained prior to construction of the Spring Lake Peninsula project. Suspended sediment concentrations in Spring Lake are relatively low, averaging 10 and 18 mg/ L for pre- and postproject conditions respectively. In addition, a best fit relationship for this data, would have a negative slope (ie. TSS decreases with increasing discharge). This type of relationship occurs in backwaters where wave action is a factor, and is further evidence that wave action affects conditions in Spring Lake. Since, TSS in Spring Lake is already low, it is doubtful that it can be reduced further. Since, wave action appears to be a primary factor affecting TSS, an island constructed in Spring Lake would be the only effective way to reduce TSS. To complete the hydraulic design for Spring Lake, a decision must be made on whether an island is needed.

<u>Establish aquatic plant beds:</u> To complete the hydraulic design for this project, additional information must be provided on what project features will help establish aquatic plant beds.

<u>Reduce bed load sediment:</u> Bed load sediment was being transported into Spring Lake through the breach at the upstream end of the Lake. The Spring Lake Peninsula project eliminated this source of bed load sediment into Spring Lake. It is unknown whether the downstream openings are a significant source of bed load sediment.

<u>Create deeper holes in Spring Lake:</u> Sediment from within Spring Lake, may be a source of construction material for project features. However, creating deep holes will be a waste of time unless the proper hydraulic and water quality conditions are established. To complete the hydraulic design, these conditions must be established, and the location of backwater dredging must be established.

2. Please provide the information requested above, desired winter hydraulic residence time and whether an island is needed across Spring Lake, to Michelle Schneider. Hydraulics is unable to proceed on the subject project without the requested information. Please contact Michelle Schneider with any questions you may have at extension 5576.

Patrick M. Foley

PATRICK M. FOLEY
Chief, Hydraulic Section

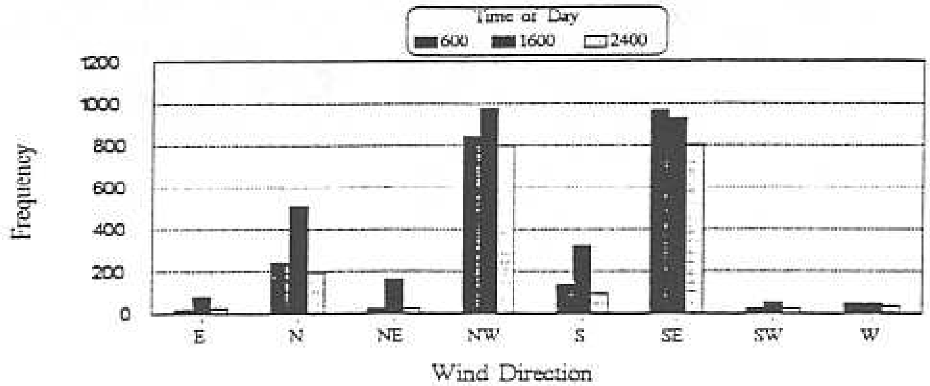


Figure 7. Frequency of wind directions (n=7359) occurring at 0600, 1600 and 2400 hrs., 1987-97, Lock and Dam 5, Upper Mississippi River.

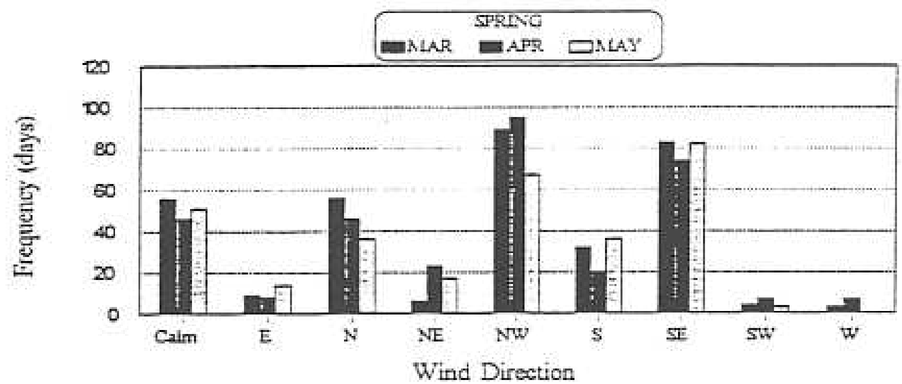


Figure 8. Frequency (days) of wind direction at 1600hrs, during spring months, 1987-97, Lock and Dam 5, Upper Mississippi River.

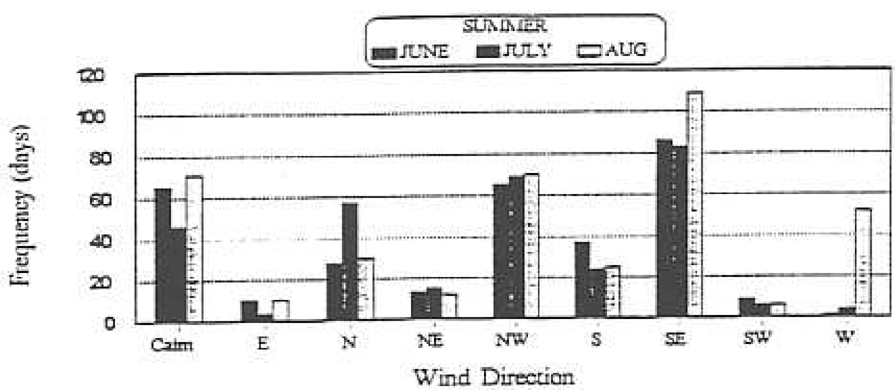
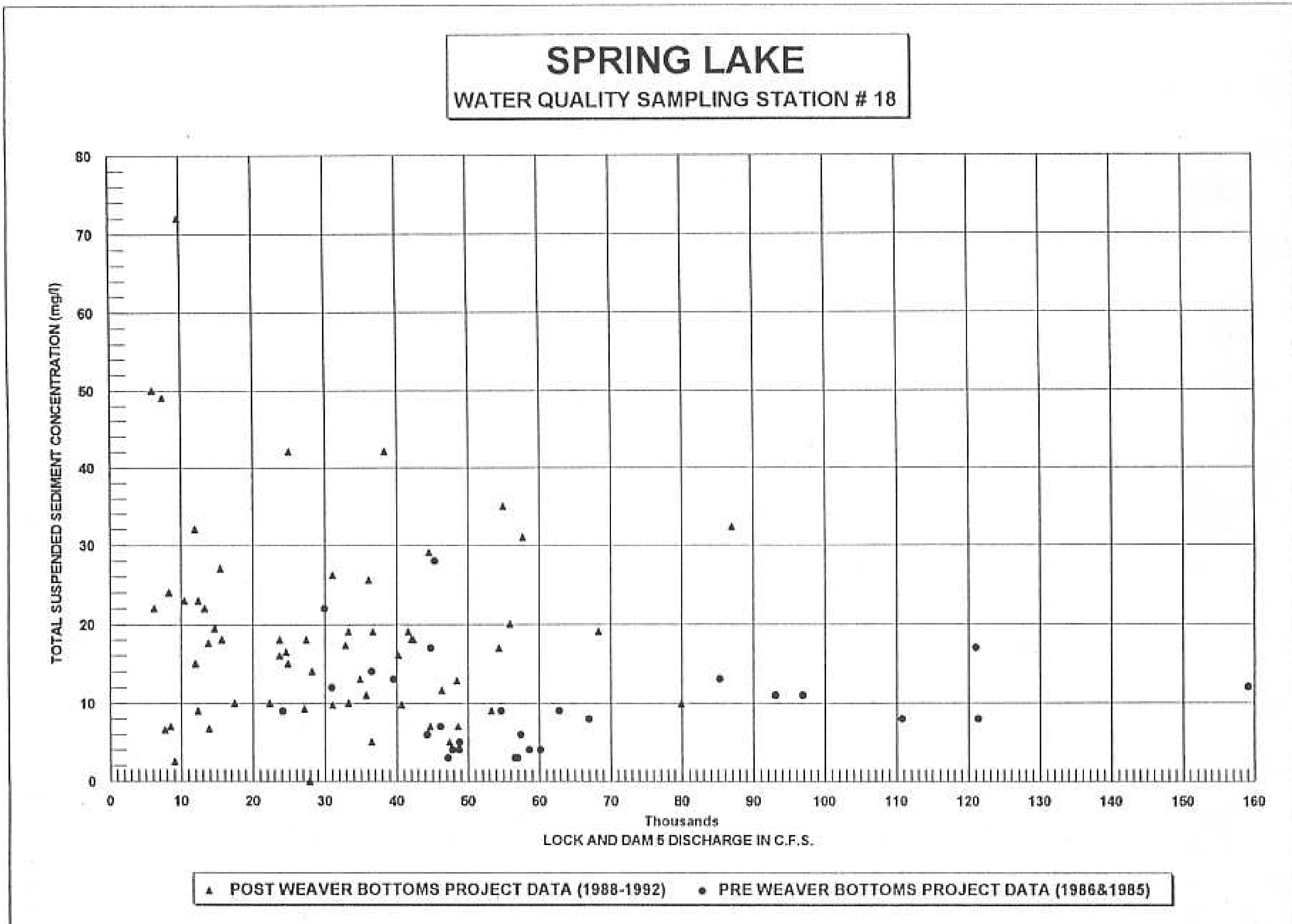


Figure 9. Frequency (days) of wind direction at 1600hrs, by summer months, 1987-97, Lock and Dam 5, Upper Mississippi River.

Attachment 1



Attachment 2