US Army Corps
of Engineers
St. Paul District

UPPER MISSISSIPPI RIVER SYSTEM

ENVIRONMENTAL MANAGEMENT PROGRAM

DEFINITE PROJECT REPORT/

ENVIRONMENTAL ASSESSMENT (SP-15)

TREMPEALEAU NATIONAL WILDLIFE REFUGE

HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 6
UPPER MISSISSIPPI RIVER
TREMPEALEAU AND BUFFALO COUNTIES, WISCONSIN

MAIN REPORT

JANUARY 1994

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ST. PAUL DISTRICT, CORPS OF ENGINEERS
ARMY CORPS OF ENGINEERS CENTRE
190 FIFTH STREET EAST
ST. PAUL, MINNESOTA 55101-1638
JANUARY 1994

EXECUTIVE SUMMARY

Trempealeau National Wildlife Refuge
Habitat Rehabilitation and Enhancement Project

The 5,620-acre Trempealeau National Wildlife Refuge is located adjacent to the Mississippi River on the Wisconsin side at pool 6 near Trempealeau, Wisconsin. The Refuge is located in Trempealeau and Buffalo Counties. It is separated from the main channel by the Burlington Northern Railroad embankment and from the Trempealeau River by a barrier dike. About 75 percent of the Refuge is marsh, open water, and seasonally flooded areas. The remainder is bottomland hardwoods, upland forest and shrublands, and grasslands. It is possible to divide the Refuge into several separate hydrologic units or pools because of natural topography and existing dikes and railroad structures. With the exception of pool A, existing habitat conditions on the Refuge are considered to be very good. However, woody vegetation is expanding in portions of the Refuge, resulting in a gradual decline in the role of the Refuge as a major feeding and resting area for migratory birds. Pool A lacks submerged aquatic vegetation because of turbid water conditions caused by wave action and rough fish activity. Also, winter dissolved oxygen levels are not adequate to establish or maintain a desirable fishery in pool A.

The ultimate goal is to preserve, restore, and enhance plant and animal habitat and to provide breeding, resting, and feeding habitat for migratory birds and marsh wildlife on the Refuge. A primary goal is to provide flexibility in controlling water levels in selected management pools during various times of the year. Specific project objectives include: establishing emergent and submergent aquatic plant growth in pool A; maintaining existing islands; establishing a winter fish refuge in pool A; and providing a flooded marsh and limiting woody plant invasion in pools C and E.

The plan formulation process considered several alternatives for addressing the project objectives. This included building dikes, islands, pump stations, control structures, and providing water supplies and aeration in selected pools. The selected plan would provide the opportunity to control water levels in several areas of the Refuge in order to preserve, restore, and enhance a diversity of indigenous plant and animal communities and to provide breeding, resting, and feeding habitat for migratory birds and marsh wildlife. Fish habitat would also be improved on part of the Refuge.

The selected plan of action includes creating three management pools by constructing three dikes totaling about 17,000 linear feet, three water control structures, a permanent pump station and two portable pump facilities, island stabilization, and an aeration system in one management pool. A 700-acre management pool would be created and a 22,000-gpm pump station would provide the capability to draw the pool down 2 feet to establish and promote the growth of aquatic vegetation and to manage fisheries. This pool would also be aerated at two locations during the winter to improve fish habitat. A 220-acre management pool created in another part of the Refuge would be capable of ponding up to 4 feet of water using 9,000-gpm portable pumps and an inlet from the Trempealeau River. The pool could be used for a spring resting and feeding area, brood use, or fall migration, depending on weather conditions and the type of habitat desired. A third management pool 550 acres in size would be created in the northern part of the Refuge that would be

capable of providing a 2-foot increase in water level using 9,000-gpm portable pumps. The raise in water level would provide a flooded marsh for migratory birds and also limit the encroachment of woody vegetation into the pool. An estimated 220,000 cubic yards of sandfill to build the three dikes would be obtained by dredging from outside the Refuge near the main channel of the Mississippi River, from within pool A, or from a dredged material beneficial use site near Fountain City or Trempealeau, Wisconsin. The total direct construction cost of the project is estimated to be $4,649,000. Indirect costs for planning, engineering, and design efforts and construction supervision and administration bring the total project cost to $5,388,000. Average annual operation and maintenance costs of the project are estimated to be $21,700 and would be the responsibility of the U.S. Fish and Wildlife Service.

The selected plan would improve migratory bird habitat conditions on 3,470 acres of the Refuge. Of these acres, 700 acres in pool A would also have improved fish habitat conditions. These habitat conditions would be improved as a result of the ability to directly manage water levels in 1,470 acres of the Refuge and maintain existing water level conditions in 2,000 acres of the Refuge. Dissolved oxygen levels would be improved in the 700-acre pool A by aeration. Reducing the number and biomass of rough fish and stocking with fish such as largemouth bass, black crappie, and bluegill would improve the fishery. Dredging for topsoil would provide about 2 acres of additional deepwater fish habitat for such species as bluegill and largemouth bass. Erosion at two existing islands would be reduced by protecting the shoreline with rockfill (Kiep's Island) or by reducing the wind fetch (Black Oak Island). Cultural artifacts on the shoreline of Kiep's Island would be protected by rockfill. The dikes would provide about 13 acres of terrestrial habitat for waterfowl and animals. Increased aquatic vegetation would provide habitat for aquatic furbearers and waterfowl. No archaeological or historical sites listed on the National Register would be affected by the proposed project. However, sites deemed eligible or with a high probability of eligibility for inclusion on the National Register would be affected by haul or access routes for construction equipment.

The proposed project has been closely coordinated with the U.S. Fish and Wildlife Service, the Wisconsin and Minnesota Departments of Natural Resources, and the Wisconsin State Historic Preservation Office. A request for water quality certification and a permit for diversion of water is being coordinated with the Wisconsin Department of Natural Resources. An environmental assessment and Finding of No Significant Impact have been prepared in accordance with the requirements of the National Environmental Policy Act. A Section 404(b)(1) evaluation has been prepared for each of the proposed pools in compliance with the Clean Water Act of 1977.

The St. Paul District Engineer has weighed the proposed project accomplishments against its cost and has determined that implementation of the selected plan is a justified expenditure of Federal funds. Therefore, approval of construction by the Secretary of the Army of this interior diking and water level control project at the Trempealeau National Wildlife Refuge is recommended by the District Engineer at a 100-percent Federal construction cost estimated to be $5,388,000.

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
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4. Letter of Intent
5. Coordination
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TREMPEALEAU NATIONAL WILDLIFE REFUGE
DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT (SP-15)

INTRODUCTION

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)(1) 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 -

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

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 U.S. Fish and Wildlife Service (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.

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:

Project Eligibility Criteria -

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 (for wetland restoration and protection) Note: By letter of 5 February 1988, the Office of the Chief of Engineers directed that such projects not be pursued.

(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 which include 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.

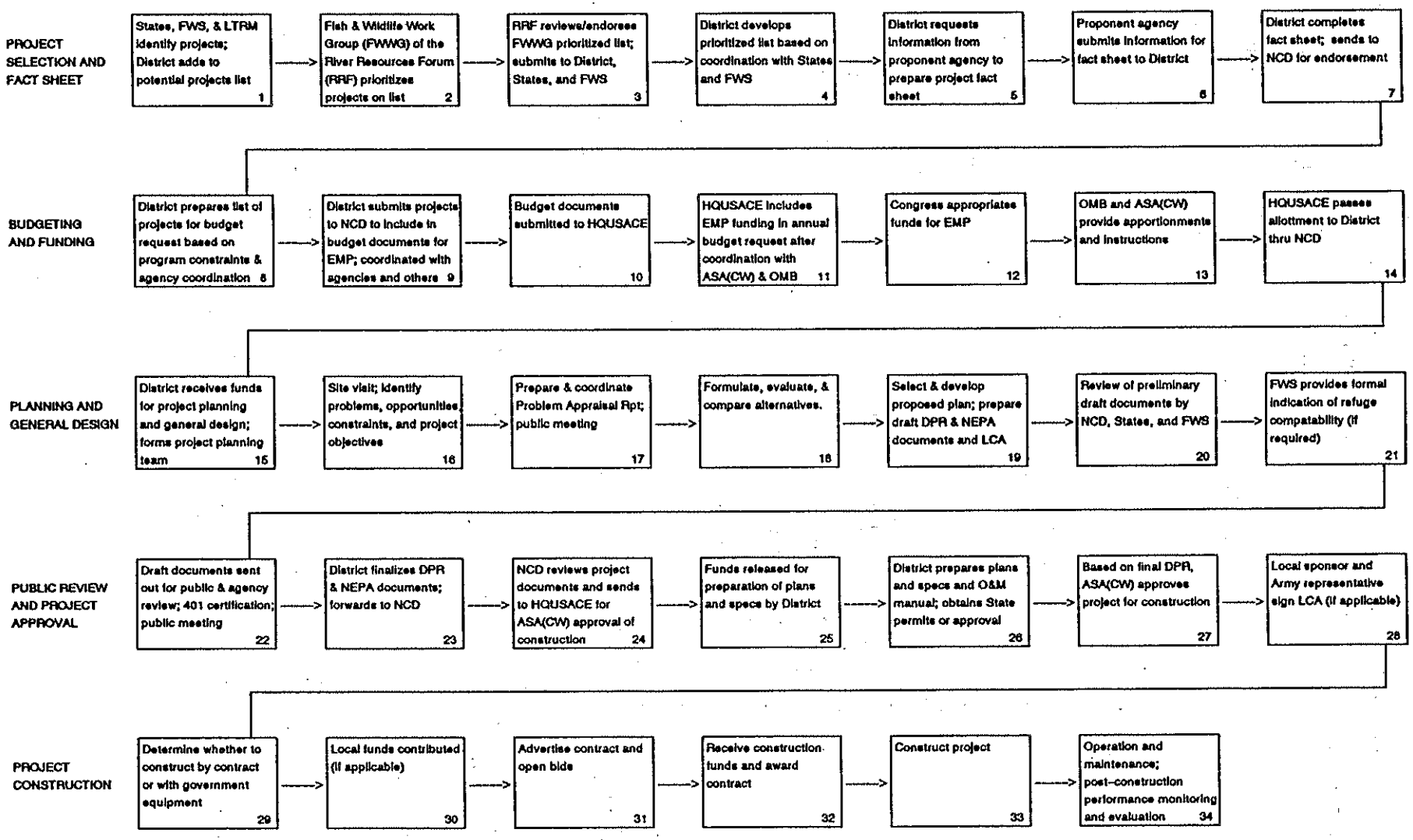
PROJECT IMPLEMENTATION PROCESS

Figure DPR-1 is a flow chart that illustrates the implementation process for habitat projects that is used in the St. Paul District. The major steps in project implementation include: project selection and fact sheet preparation; budgeting and funding of the project; planning and general design; public review and project approval; and project construction and monitoring. The Trempealeau NWR project has progressed to box #22 on the flow chart.

Figure DPR-1

ST. PAUL DISTRICT FLOW CHART FOR THE IMPLEMENTATION OF HABITAT REHABILITATION AND ENHANCEMENT PROJECTS

Upper Mississippi River System – Environmental Management Program (EMP)



KEY

States = Minnesota, Wisconsin, and/or Iowa Departments of Natural Resources
FWS = U.S. Fish and Wildlife Service
LTRM = Long Term Resource Monitoring element of EMP
NCD = North Central Division, Corps of Engineers
HQUSACE = Headquarters U.S. Army Corps of Engineers
ASA(CW) = Assistant Secretary of the Army for Civil Works
OMB = Office of Management and Budget
DPR = Definite Project Report
NEPA = National Environmental Policy Act
LCA = Local cooperation agreement
O&M = Operation and maintenance

21 December 1992

PROJECT SELECTION PROCESS

Projects are nominated for inclusion in the District's habitat program by the respective State natural resource agency and the U.S. Fish and Wildlife Service based on agency management objectives. In September 1986, the States and USFWS 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 were directed to consider critical habitat needs along the Mississippi River and prioritize nominated projects on a biological basis.

In phase one, the individual 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 and prioritized 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, potential for innovative or experimental construction techniques, project longevity, maintenance, and socioeconomic benefits. The second phase of the evaluation involved the development of a prioritized list of the top 20 projects from the entire river system within the St. Paul District. The prioritized list was based on the following factors: numerical ranking from phase one; the desire to implement and evaluate a variety of habitat rehabilitation and enhancement techniques; the application of the LTRM 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. New habitat project proposals continue to be submitted to the FWWG for ranking and the prioritized list is updated annually to guide the project selection process for each budget cycle.

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 Trempealeau National Wildlife Refuge project was recommended and supported as capable of providing significant habitat benefits.

The Trempealeau National Wildlife Refuge project was recommended for study by the U.S. Fish and Wildlife Service (USFWS). In February, 1988, the RRF listing of habitat project priorities for fiscal year 1990 ranked the Trempealeau National Wildlife Refuge (NWR) project as number 11. Table DPR-1 shows the RRF project priorities for fiscal year 1990 and the most recent ranking (June 1993) by the FWWG for fiscal year 1996.

Table DPR-1 - Priority Listing of HREP's

PRIORITY LISTING FOR FY 90

RANK	POOL	PROJECT	SCORE
1	5	Spring Lake, WI	39
2	5A	Polander Lake, MN	38
3	8	Lower Pool 8, WI	38
4	2	Spring Lake, MN	38
5	7	Long Lake, WI	28
6	9	Harper's Slough, IA	37
7	9	Capoli Slough, WI	37
8	3	Sturgeon Lake, MN	37
9	8	East Channel, WI/MN	35
10	6	Blackbird Slough, MN	35
11	6	Trempealeau NWR, WI	27
12	8	Fr.&Smith Slough, WI	34
13	5-10	Bank Stabilization	29
14	MV	Bank Stabilization,MN	31
15	8	Wildcat Landing, MN	31
16	4	Bay City, WI	30
17	8	Root River, MN	29
18	9	Old Raft Channel, MN	29
19	4	Wabasha Channel, MN	29
20	MV	Rice Lake, MN	28

PRIORITY LISTING FOR FY 96

POOL	PROJECT	SCORE
8	Pool 8 Ph III-IV, WI	38
9	Bluff Slough, MN	35
9	Winneshiek Lk Isl, WI	27
7	Black River Delta, WI	29
8	Running Slough, WI	35
9	Lower Pool 9 Isl, IA	27
7	Richmond Island, MN	26
7	Lk Onalaska Bar, WI	28
5	Fisher Island, MN	26
5	Half Moon Lake, MN	26
5	Kruger Slough, MN	25
4	Hershey Slough, MN	25
*MR	Blackdog Lake, MN	27
* 9	Conway Lake, IA	29
*10	Gremore Lake, WI	24

*Unranked (wildcard projects)

Although the score that the Trempealeau NWR project received in the ranking process was not as high as some of the other projects on the list, its isolation from the main channel flow as well as the possible negative effects of that flow on riverine habitat makes the Refuge of prime importance to migratory waterfowl and biologically critical to the Upper Mississippi River ecosystem. The Trempealeau NWR provides tremendous opportunities for waterfowl management and enhancement. It is part of a system of areas closed to waterfowl hunting within the Mississippi Flyway. These closed areas are very important, not only for the food resources and wildlife habitat they provide, but especially for the sanctuary they provide during the hunting season. The Trempealeau NWR is the only closed area in pool 6. Its isolation from the main navigation channel also prevents entry by power boaters for fishing and sightseeing. Any project that improves the water management capability or ultimately improves the food reserves within a unique closed area such as the Trempealeau NWR is extremely important. Funds provided to USFWS for construction within the refuge system are primarily to maintain, rehabilitate, or replace existing structures. Nationwide, only about $20 million annually is allocated for construction. Construction funds to rehabilitate the existing Trempealeau River dike along the north side of the Refuge are being made available, which demonstrates the high priority of the Trempealeau NWR from a national perspective. The cost to construct interior diking on the Refuge for the purpose of maintaining and enhancing migratory bird management makes it highly unlikely that such a project would ever be implemented. Therefore, based on the RRF priority list, public interest, the value of the resource, the opportunity for rehabilitation and enhancement, agency priorities, and program funding constraints and levels, the Trempealeau NWR project was placed on the habitat project schedule and funds were made available to begin general design in fiscal year 1990. Other habitat projects on the priority listing for fiscal year 1990 that also received funding for general design included Spring Lake and Long Lake, Wisconsin, and Polander Lake, Minnesota. Planning for these three projects has been completed and approval of construction has been requested or received.

PARTICIPANTS AND COORDINATION

Participants in the planning process included the Trempealeau National Wildlife Refuge (NWR) and Region 3 Office 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 was a cooperating agency throughout the process as required by regulations developed by the Council on Environmental Quality for the implementation of the National Environmental Policy Act (40 CFR 1500-1508). The following study team members visited the Trempealeau NWR on 19 July 1990 to discuss problems and objectives and were involved in the preparation of this report (additions or changes to team members are in parenthesis):

Don Powell	Project Manager	COE
Gary Palesh	Fisheries Biologist	COE
(Randy Devendorf)	Wildlife Biologist	
Scott Goodfellow	Hydraulic Engineer	COE
(Mark Rodney)	" "	
Winston Riedesel	Civil Engineer	COE
Tim Paulus	Mechanical Design	COE
Keith Boe	Cost Engineer	COE
(Gary Smith)	" "	
Al Kean	Geotechnical Engineer	COE
(Joel Face)	" "	
Keith Beseke	EMP Coordinator	USFWS
Rick Frietsche	Refuge Manager	USFWS
Jim Kline	Trempealeau Refuge	USFWS
Scott Yess	Winona FAO	USFWS
Hannibal Bolton	Fisheries Biologist	USFWS
Rick Berry	Refuge Complex Manager	USFWS
(Jim Fisher)	" " "	
Ron Benjamin	Fisheries Manager	WDNR
(Jeff Janvrin)	EMP Coordinator	WDNR
Jim Talley	Fisheries Biologist	WDNR
Tim Babros	Fisheries Biologist	WDNR
Scot Johnson	Biologist	MDNR
(Mike Davis)	Fisheries Biologist	MDNR

A Problem Appraisal Report was prepared after the site visit and initial meeting to:

* Document the extent of the project area.
* Describe existing and probable future conditions within the Refuge.
* Identify resource management goals for the Refuge.
* Identify planning constraints and opportunities.
* Identify specific habitat objectives for the project area.
* Describe alternative plans to accomplish the stated objectives.
* Identify information and additional data collection needed to select an alternative and design a project.

Correspondence was exchanged between the agencies to coordinate the project at various stages of development. Several additional meetings were held with Refuge representatives and other agencies during the planning and general design phase. An initial public meeting was not held because of the public meetings that were included in the development of a Refuge Master Plan. This study and development of the project were based on the work efforts accomplished during preparation of the Trempealeau National Wildlife Refuge Master Plan and Environmental Assessment. The first public meeting for the Refuge Master Plan, held on 14 October 1980, focused on the determination of which activities should be included in the Refuge Master Plan. Over 110 people attended and developed a list of special concerns and major issues. A second public meeting, held on 3 February 1982, focused on alternative plans that had been developed. Over 75 people attended and everyone was given an opportunity to express their views. The Master Plan, finalized in April 1983, reflected the public and agency desires for the development of the Refuge. A public meeting was held on September 14, 1993, to present the latest findings and solicit public input. About 25 people attended the meeting. The primary concerns voiced were: protecting existing artifacts; keeping lower pool E the same; maintaining a boat launch; getting sand fill from the Refuge; cost; using wells for water supply; and maintenance of the project. The project was generally supported as proposed. Written comments received at the meeting and in response to the draft DPR are included in attachment 5.

A preliminary draft of this report was sent to the U.S. Fish and Wildlife Service and the States of Wisconsin and Minnesota for review and comment. The comments that were received and the results of meetings with the agencies and individuals were used to select and develop the final plan. This report includes the environmental assessment, Finding of No Significant Impact (attachment 2), and Section 404(b)(1) Evaluation (attachment 3). The draft Definite Project Report/Environmental Assessment and/or public notice was sent to the agencies and interests listed in attachment 7.

PROJECT LOCATION AND PURPOSE

The Trempealeau National Wildlife Refuge is a 5620-acre area located in the Mississippi River floodplain on the Wisconsin side of the Mississippi River in pool 6 near Trempealeau, Wisconsin (see Plate 1). The Refuge is separated from the main channel floodwaters by the Burlington Northern Railroad embankment and from the Trempealeau River by a barrier dike. The Refuge includes about 4,310 acres of marsh, open water and seasonally flooded areas, 590 acres of bottomland hardwoods, 400 acres of upland forest and shrublands, and 320 acres of grasslands. The Refuge has been divided into management areas or pools based on physical divisions and management objectives. A map of the Refuge is shown on Plate 2. Most of the Refuge was acquired in 1979 under authority of the Land and Water Conservation Fund Act of 1966.

The overall purposes or goals of this study and project are to preserve, restore and enhance a diversity of indigenous plant and animal communities and to provide breeding, resting and feeding habitat for migratory birds and marsh wildlife on the Trempealeau Refuge. This is consistent with the designated goals of the Refuge as described below.

FISH AND WILDLIFE MANAGEMENT GOALS IN THE PROJECT AREA

The USFWS has direct management responsibilities for the Trempealeau NWR. Based on the authorities under which the Refuge was established, national policies and guidelines for the administration of units within the National Wildlife Refuge System, and public input during the Refuge's master planning studies, the goals that guided the planning and development of a habitat rehabilitation and enhancement project for the Trempealeau National Wildlife Refuge included the following:

(1) To preserve, restore, and enhance a diversity of indigenous plant and animal communities on the Refuge, with particular emphasis on communities or species that are endangered, or threatened with becoming endangered.

(2) To provide breeding, resting, and feeding habitat for migratory birds and marsh wildlife.

(3) To promote greater understanding and appreciation of wildlife and natural ecosystems by providing education and interpretive opportunities for people.

(4) To provide opportunities for compatible, wildlife-related recreation.

To accomplish these goals, major emphasis within the U.S. Fish and Wildlife Service's Refuge Master Plan (defined in the Trempealeau National Wildlife Refuge Master Plan dated 18 April 1983) specifically recommended that action be taken to upgrade existing wildlife and fish habitat through selected development and/or management options. Because of the Refuge's strategic location within the Mississippi River corridor, the 5,200 acres of permanent and seasonal wetlands will continue to provide important resting, feeding, and nesting habitat for migratory birds, particularly migratory and marsh birds. The Refuge serves as a migratory bird sanctuary for pool 6. The Refuge's contribution will become more significant if degradation of nearby Mississippi River backwater areas continues at the present rate because the Refuge is practically isolated from the rest of the river.

In the development of the Master Plan, the Refuge was divided into six specific pools or management areas (A through F). The pool designations are shown on Plate 3. During the master planning process, pool D was integrated into pool B for hydrologic and management reasons and future references in this report will either integrate pool D into pool B or not mention it at all. Although there are currently no physical barriers to separate pools A and B and a portion of pools B and C, the difference in habitat types is evident and was used as a basis for dividing the Refuge into pools. Although management objectives are listed and physical boundaries are shown, pool F is currently in private ownership and no rehabilitation or enhancement measures were formulated for study under the Environmental Management Program. The general habitat management goals as identified in the Master Plan for the individual Refuge pools follow.

Pool A Habitat Management Goals - 1220 acres

- increase diving duck use by 50%;

- maintain existing islands for their intrinsic habitat value and for their value in providing protection to shallow aquatic areas from wind and wave action;

- create additional sheltered habitats for feeding, nesting, and resting areas for fish and wildlife;

- establish and maintain a balanced fishery year-round by reducing the numbers and biomass of rough fish by 50% while increasing numbers of northern pike, black crappie, largemouth bass, bluegill, and yellow perch.

Pool B Habitat Management Goals - 780 acres

- maintain existing beds of aquatic vegetation and their diversity;

- enhance black tern nesting habitat;

- control rough fish populations.

Pool C Habitat Management Goals - 740 acres

- enhance migratory bird, marsh bird and furbearer use through flooding of wet meadow and bog areas;

- limit woody vegetation encroachment on the marsh portions;

- maintain existing floodplain forest habitat for diverse migratory bird use;

- control rough fish populations.

Pool D Habitat Management Goals - 1000 acres (now integrated into pool B)

- maintain migratory bird use;

- provide sanctuary for osprey and cormorant;

- maintain stable water levels.

Pool E Habitat Management Goals - 760 acres

- increase spring migratory bird use in upper pool E;

- limit woody vegetation encroachment in upper pool E marshes;

- maintain existing conditions in lower pool E;

- control rough fish populations in all of pool E.

Pool F Habitat Management Goals - 420 acres (not included in this study because of private ownership)

- maintain migratory bird use;
- maintain stable water levels to promote aquatic vegetation;
- control rough fish populations.

These general habitat goals, together with additional input from State and Federal agency natural resource managers, were used to guide the development of specific project objectives. These objectives are presented in a subsequent section of this report. However, this project forms only one part of a much larger cooperative natural resource management effort on the river.

EXISTING CONDITIONS

PHYSICAL SETTING

The Trempealeau National Wildlife Refuge is located in Buffalo and Trempealeau Counties of Wisconsin in pool 6 of the Upper Mississippi River (see Plate 1). The Refuge lies in mid-pool on the left descending bank of the main channel (see Plate 2). The river valley varies from 3 to 6 miles wide and is bordered by forested bluffs rising 400 to 500 feet above the valley floor. The Refuge is separated from the Mississippi River by the Burlington Northern Railroad grade. The landward side the Refuge is bounded by State Trunk Highway (STH) 35 and dikes constructed to divert the Trempealeau River around the Refuge. The Trempealeau River was diverted to the east and barrier dikes constructed in the early 1900's when the area now covered by the Refuge was in private ownership.

The Refuge lies in the historic floodplain of the Upper Mississippi and Trempealeau Rivers. Elevations range from 644 feet to 680 feet NGVD, 1929. However, the railroad grade and perimeter dikes protect the Refuge from floods in excess of the 100-year event. Almost 90% of the Refuge is aquatic/wetland in nature. For planning purposes the Refuge has been divided into four general areas designated as pools A, B, C, and E (see Plate 3). Pool F shown on Plate 3 is currently in private ownership. Long-range plans for the Refuge include acquisition of this area.

WATER RESOURCES

The main channel of the river generally parallels the Burlington Northern Railroad which forms the southern boundary of the Refuge. Culverts and bridges in the railroad grade were closed in 1911. While the river does not flow through the Refuge, it may affect water levels in the Refuge to some degree via seepage, although data from gages located in the Refuge do not indicate a correlation between Refuge pool elevations and changes in the river levels. In addition, when the river is high, it is not possible to discharge water from the Refuge because of lower water levels in the Refuge. Floodwaters have directly entered the Refuge only once in the last 80 years when portions of the railroad grade washed out in the 1965 flood.

The Trempealeau River flows around the north and east sides of the Refuge. The river enters pool 6 of the Upper Mississippi River about 2 miles downstream from a Refuge water control structure. The major influence of the Trempealeau River is that when it is high, water can not be discharged from the Refuge via the existing water control structure. Seepage from the Trempealeau River may be a minor influence on the Refuge during high river flows. Some limited surface water enters the northwest side of the Refuge from the bluffs along Wisconsin State Highway #35. There are also 14 documented artesian wells of unknown capacity located within the Refuge. Based on measurements taken for similar wells in adjacent Perrot State Park, the contribution of the artesian wells to the system can be neglected.

GEOLOGY AND SOILS

Geology - The most significant geologic event explaining the nature of the Mississippi River in the vicinity of the project area occurred at the end of the Pleistocene glaciation approximately 10,000 years ago. During the retreat of the glaciers, tremendous volumes of glacial meltwater, primarily from the Red River Valley's Glacial Lake Agassiz, eroded the preglacial Minnesota and Mississippi River valleys. As meltwaters diminished, the deeply eroded river valleys aggraded substantially to about the present levels. Sediments composed of sand and gravel were deposited in the river valley, forming the basis for present Refuge soils. Since post-glacial times, a braided stream environment has dominated this reach of the Mississippi River, due to the river's low gradient and oversupply of sediment from its tributaries. Prior to impoundment of pool 6 in 1938, the broad floodplain of the river was characterized by this braided stream system that consisted of swampy depressions, sloughs, natural levees, islands, and shallow lakes. Since impoundment, a relatively thin veneer of silts, clays, or sands has been deposited over most of the river bottom within the pool.

Soils - Soils within the Refuge range from alluvial types in the wetlands to finely eroded sands on the steeper uplands. Varying depths of silt overlie sand and gravel sediments in the wetlands. Isolation of the Refuge from adjacent river floodwaters has reduced the degree of siltation compared to other Upper Mississippi River backwater areas. The 700-acre central upland portion of the Refuge is an area of rolling sand dunes formed from wind-blown material deposited during a former dry period.

Sixteen borings were taken in the aquatic areas of the Refuge in February/March 1991. In the pools A/B area of the Refuge, 12 borings indicated primarily very soft silty clays to a depth of at least 20 feet below the water surface. At greater depths, some fine to medium silty sands were encountered. In the area of pool C, similar soil characteristics were indicated, with more numerous seams of silty sands and more organic material. None of the upper deposits were of a suitable nature to use as fill for constructing dikes. The boring logs and locations are shown in appendix C.

Substrate Type - A survey of substrate type in pool A of the Refuge was conducted in the winter of 1990-1991 by the Corps of Engineers. Three locations within pool A were sampled and the substrate material was analyzed for particle size composition and organic matter content. A substrate type map of the area was not prepared. Most of the area has a silt substrate with organic sediments probably occurring in the older macrophyte beds.

Sediment Quality - As part of the substrate survey noted above, seven sediment samples were collected from potential borrow locations and subjected to bulk chemical analysis. These samples were collected from depths ranging from 5 to 20 feet. The bulk chemical analysis indicated that these sediments are free of cultural contamination such as pesticides, PCB's, and high levels of heavy metals (see appendix A). These results were expected from the deep lying sediments because they should not have been exposed to cultural contamination.

One surface sample was also collected and analyzed. The results showed negligible levels of cultural contamination. The Refuge has been isolated from the Mississippi and Trempealeau Rivers since 1911. It is expected that the surface sediments in the Refuge would be relatively free of contaminants because much of the industrial development in the region and the advent of agricultural chemicals occurred after this date.

NATURAL RESOURCES

Habitat Types and Distribution - Habitat within the Refuge can be classified into terrestrial and aquatic and further characterized by vegetation. The Refuge includes about 4,310 acres of marsh, open water and seasonally flooded areas, 590 acres of bottomland hardwoods, 400 acres of upland forest and shrublands, and 320 acres of grasslands.

Habitat Conditions - In general, the existing habitat conditions on the Trempealeau National Wildlife Refuge are considered to be very good, with the exception of pool A. Overall, the Refuge contains a diversity of high quality habitats that allows it to support abundant and diverse wildlife populations. The Refuge's physical separation from the Upper Mississippi and Trempealeau Rivers isolates the Refuge from the water quality and sedimentation problems found on many other Upper Mississippi River backwaters. Water quality on the Refuge is relatively good.

Pool A is a large lake area averaging about four feet deep. Turbid water conditions prevail due to wind driven wave action, and the feeding activity of rough fish. High turbidity with restricted light penetration limits submergent plant growth. Marsh plants such as cattail and bulrush are restricted to shallow protected bays along the north and west end of pool A. It receives relatively little use by migratory birds except during the early fall when large numbers of wood ducks congregate around the shoreline of Black Oak Island to feed on acorns. Fish eating birds including double-crested cormorants, ring-billed gulls, merganser, and great blue herons frequent the pool, feeding on schools of gizzard shad, bullheads, and other forage fish. It supports a limited fishery characterized by an overabundance of rough fish. Rough fish, a general lack of aquatic vegetation, shallow depths, and periodic winterkill conditions are the limiting factors on the fishery in pool A.

Pool B is a productive area on the Refuge. Shallower water depths permit the growth of emergent plants, floating leaf beds, and a variety of submergent aquatics. Diversity and interspersion of wetland and aquatic plants in pool B is excellent. Pool B supports the major portion of the fall migratory bird use on the Refuge.

Pool C contains more solid emergent marsh and stands of woody vegetation than pool B. It is less valuable to migratory birds than pool B. However, pool C provides habitat for a greater diversity of birds and mammals. The limiting factor on the value of pool C to waterfowl and furbearers is the relative lack of permanent surface water.

Pool E consists of prime marshes interspersed with old river channels and islands of bottomland forest. Wild rice occurs extensively in pool E. Pool E provides excellent habitat to a wide variety of wildlife.

Fish and Wildlife - The Trempealeau National Wildlife Refuge provides important nesting, resting, and feeding habitat for a host of migratory birds. Major breeding waterfowl use is by wood duck. Other breeding waterfowl include the blue-winged teal, mallard, hooded merganser, and Canada goose, in decreasing order of nesting density. The Refuge is an important resting and feeding area for waterfowl during migration. It currently receives about 750,000 use-days per year by migratory birds. A bird census conducted during the summer of 1981 recorded a total of 167 species of birds using the Refuge. Species sensitive to human disturbance on the Refuge include the black tern and the osprey, both of which nest on the Refuge.

The Refuge supports a resident deer herd of about 150 white-tailed deer. This number increases during the Wisconsin fall hunting season as hunting pressure on adjacent areas move deer onto the Refuge. The beaver and muskrat are the common furbearers on the Refuge. Other mammals known to occur on the Refuge include mink, raccoon, otter, striped skunk, weasels, red and gray fox, cottontail rabbits, gray and fox squirrels, and a variety of moles, mice, and shrews.

The Refuge supports a limited fishery resource dominated by rough fish. Shallow water and periodic winterkills are limiting factors. Bullhead, carp, and buffalo comprise the bulk of the fishery by weight. Eight species of more desirable fish are known to occur on the Refuge: black crappie, yellow perch, northern pike, largemouth bass, brown bullhead, bluegill, and white crappie.

Threatened and Endangered Species - Three Federally listed species occur in this portion of the Upper Mississippi River valley, the bald eagle (Haliaeetus leucocephalus), the peregrine falcon (Falco peregrinus), and the Higgins' eye pearly mussel (Lampsilis higginsi). It is extremely unlikely that the Higgins' eye would be found on the Refuge because of the lack of suitable habitat for this species. The peregrine falcon is an occasional visitor during migration. The bald eagle regularly uses the Refuge during migration and also nests on the Refuge. No other federally-listed endangered or threatened species or any species proposed to be listed are in the project area.

Three additional species classified by the State of Wisconsin as threatened are found on the Refuge. These are the osprey (Pandion haliaetus), wood turtle (Clemmys insculpta), Blanding's turtle (Emydoidea blandingi), yellow-crowned night heron (Nycticorax violaceous), red-shouldered hawk (Buteo lineatus), and Bell's vireo (Vireo bellii). Two osprey nests are located in the Refuge and others outside the Refuge on the riverward side of the railroad embankment. Other species of special concern are villous prairie clover (Petalostemon vellosum), western sand darter (Ammocrypta clara) mud darter (Etheostoma asprigene), pugnose minnow (Notropis emiliae), and black-crowned night heron (Nycticorax nycticorax).

Vegetation - Marsh and aquatic vegetation cover about 44% of the Refuge (see Plate 4). Primary species are cattail, sedge, bulrush, arrowhead, Phragmites, wild rice, American lotus, pickerelweed, water lily, pondweeds, waterweed, coontail, and water milfoil. Wetland shrub and wet meadows cover about 9% of the Refuge. Primary species are willow, cottonwood, red-osier dogwood, sedge, reed canary grass, and blue-joint grass.

Open water covers about 23% of the Refuge, mostly in pool A.

Bottomland forest covers about 11% of the Refuge (see Plate 5) and is dominated by silver maple, river birch, swamp white oak, elm, and black ash. Upland forest covers about 5% of the Refuge and is dominated by red oak, black locust, and ash with some scattered stands of pine. The upland shrub community covers about 2% of the Refuge, consisting primarily of black locust, oak, boxelder, ash, cherry, and dogwood.

Grassland covers about 6% of the Refuge with tame grasses such as bluegrass and brome grass predominant. Management efforts are focusing on encouraging the re-establishment of native species such as big and little bluestem, switch grass, Indian grass, side-oats grama, prairie junegrass, and green needlegrass.

Pool A is primarily open water with little or no aquatic vegetation, except for the northeastern corner of pool A behind Kiep's and Black Oak Islands, where aquatic vegetation is prevalent. There is a fringe of marsh and floating leaved plants along the northern and eastern edges of the pool.

Pool B contains a very diverse community of submersed, floating leaved, and emergent aquatic and marsh vegetation. The diversity and interspersion of vegetation in this pool is ideal to support a variety of wetland wildlife.

The lower half of pool C is primarily emergent marsh with some interspersion of bottomland forest and shrub growth. The upper half of the pool is predominantly bottomland forest in character. About 20 percent of the pool is open water during the summer (about 150 acres).

Pool E contains open and emergent marsh and bottomland forest/shrub habitats with a great deal of interspersion of vegetation types. This pool contains more "slough" type habitats than the other Refuge pools.

CULTURAL RESOURCES

In accordance with the National Historic Preservation Act of 1966, as amended, the National Register of Historic Places has been consulted. No sites listed on the Register are in the proposed project area, but one has been determined eligible for inclusion. A list of historic structures and archaeological sites that have been reported within or near the Refuge was provided by John Dobrovolny, Regional Historic Preservation Officer for the U.S. Fish and Wildlife Service. Several areas of the Refuge have been systematically surveyed for cultural remains. Other sites have been recorded through amateur collections and archival sources. Archaeological evidence from the Refuge indicates that humans have often occupied the higher ground over the past millennia; most of the cultural material recovered dates from between 500 B.C.-A.D. 1200 (Early-Late Woodland), but earlier material includes Late Archaic projectile points (from ca. 4-5,000 years ago), and a Clovis point (from Black Oak Island) that is about 10,000 years old. Twenty-

three archaeological sites have been identified within or near the Refuge boundaries, including 17 campsites/habitation sites and six burial mound groups. One archaeological site on Kiep's Island (47 TR 86), a multi-component Woodland Period habitation site with associated human burials, has been determined to be eligible for the National Register of Historic Places. Thirty-two sites have been reported within one mile of the Refuge. In addition, nine historic sites have been identified within the Refuge boundaries. All nine are homesteads built during the period 1880 to 1930. None are considered eligible for National Register nomination. Two individual grave sites dating to the late 19th or early 20th century have been reported north of the Refuge headquarters.

In September 1990, in accordance with recommendations by the Wisconsin State Historic Preservation Office (SHPO), an archaeologist with the St. Paul District conducted a Phase I Cultural Resources survey of land areas that would be affected by potential project construction. Examination of the southwest shore of Kiep's Island revealed that intact cultural deposits associated with 47 TR 86 probably extend at least 100m farther to the southeast than the previously defined site boundary. The archaeologist concluded that the four sites previously identified on the southwest shoreline of the island (by intensive survey and testing of the island conducted in 1983 for the U.S. Fish and Wildlife Service) should be regarded as a single analytic unit. Reconnaissance of Black Oak Island confirmed the presence of Woodland period occupations (ca. 250 B.C. - A.D. 1200) near the south end of the island; the probability is high that this area is also eligible for nomination to the National Register.

Testing of site 47 TR 150 in the area of the initially proposed Dike A near the wetland overlook station revealed the presence of intact Woodland (ca. A.D. 100-1200) and historic fur trade era (A.D. 1600-1850) strata, although part of the site has been disturbed by construction of the 1930's biological survey lodge that was demolished in 1979. The proposed location of Dike A has since been moved east to tie-in at the south end of Kiep's Island. This necessitated further cultural resources work in 1991 in order to evaluate the effect of the construction of the dike on the National Register-eligible resources of Kiep's Island. Heavy construction traffic across the island was of particular concern. The entire length of the road on Kiep's Island was tested. Cultural deposits are extensive and intact on essentially all high areas of the island, concentrated at a depth of 20-80 centimeters. Consultation and coordination with the Wisconsin SHPO and the Advisory Council on Historic Preservation resulted in a finding of No Adverse Effect of the project. However, the SHPO has stipulated that an evaluation of the effects of heavy traffic on the site be made, and has approved the St. Paul District's plan for such an evaluation. The evaluation plan is currently being coordinated with the Winnebago and the Wisconsin Great Lakes Intertribal Council.

Three prehistoric burial mound sites have been reported in the western part of the Refuge (Sections 4, 5, and 9), recorded on the basis of short descriptions made by archaeologists in the early 1900's. The exact location of these mound sites is uncertain. It is unusual to find mound sites in a floodplain setting; in fact, it is the opinion of Robert Boszhardt, Regional Archaeologist, that the location of the mounds was incorrectly reported in the 1900's, and that the mounds are actually located farther north on high ground. However, it is possible that cultural remains are still intact in the area of the Green Bay and Western railroad embankment. No attempt was made to relocate these sites during the 1990 survey.

RECREATION/AESTHETIC RESOURCES

Recreation on the Refuge primary consists of non-consumptive uses such as wildlife observation, hiking, biking, canoeing, and photography. The Refuge offers a 4.5-mile wildlife drive, a one-mile self-guided nature trail with interpretive panels, several miles of dikes and service roads for hiking, and snowshoeing and cross-country skiing throughout the Refuge. Some limited fishing, hunting, trapping, and picking of mushrooms, nuts, and wild fruits is permitted. Annual visits to the Refuge average about 20,000, with more than 60,000 visitors in 1991.

SOCIOECONOMIC RESOURCES

The nearest town, Trempealeau, has a population of 1,039 (1990 census). The city of Winona, Minnesota, directly across the Mississippi River from the Refuge (about 6 miles by road), has a population of over 25,000. The cities of La Crosse and Onalaska, Wisconsin, lie about 25 miles south of the Refuge. These cities have a combined population of more than 62,000. In addition, approximately 30,000 people live in small towns and rural areas within 25 miles of the Refuge. The lands immediately adjacent to the Refuge are either wooded or in agricultural use. Because it is located between the Trempealeau and Mississippi Rivers, the Refuge appears to be more isolated than it is.

FUTURE WITHOUT PROJECT CONDITIONS

EXISTING HABITAT DEFICIENCIES

Habitat deficiencies must be viewed in the context of the desired conditions or management goals of a particular area. What may be viewed as a deficiency for one species may be excellent habitat for another. Management goals for the Refuge vary by management area or pool. These management goals were discussed previously in this report.

Pool A - In general, the management goal for pool A is to improve its value as migratory habitat for diving ducks, and to establish and maintain a limited fishery in this portion of the Refuge. Lack of submerged aquatic vegetation in pool A limits its value as migratory habitat for waterfowl. The presence of rough fish, lack of water level control capabilities, and wind fetch all contribute to the lack of vegetation in this portion of the Refuge.

The lack of aquatic vegetation also limits the value of pool A as fish habitat. However, the primary limiting factor to establishing and maintaining a fishery in pool A is the lack of dissolved oxygen in the winter, which results in periodic winterkill. Dissolved oxygen data collected in the winter of 1990/91 and 1991/92 are included in appendix A, enclosure 1. The data indicate that during years with extensive snow cover, dissolved oxygen levels dropped to less than 2 ppm by January.

Pool B - Pool B currently provides excellent habitat for migratory birds. The management emphasis is to increase migratory bird use during migration and to increase dabbling duck production. There is a long-range concern that the lack of water control and the inability to control rough fish populations could limit the ability to maintain the high quality habitat in this pool in the future.

Pool C - Pool C provides moderate habitat for a variety of wildlife species. The primary management emphasis in lower pool C is to increase its use by dabbling ducks. Habitat value for migratory birds is limited by the lack of permanent water over much of this area. Encroachment of woody vegetation into the marsh portions of pool C is also gradually decreasing this area's value as migratory bird habitat.

Pool E - The diverse habitat types present in pool E provide excellent habitat for a wide variety of wildlife. Management emphasis is to maintain the traditional migratory bird use in this area. The extensive stands of wild rice result in high use of this area by migratory birds. Water level management capabilities are important in maintaining the current habitat conditions. Woody vegetation is expanding in portions of the pool and will result in a gradual decline in habitat value for migratory birds in this pool.

ESTIMATED FUTURE HABITAT TYPES AND DISTRIBUTION

The estimated future habitat conditions for the Trempealeau National Wildlife Refuge are based on the following major assumptions: (1) due to isolation from the Mississippi and Trempealeau Rivers, sedimentation will not have a significant effect on future conditions unless an extremely large flood would overtop the railroad embankment or Trempealeau River dike; (2) based on the observation of successional trends by Refuge personnel, ecological succession will proceed at a modest rate, primarily in the form of woody plant invasion of marshes; and (3) funds for capital improvements by the U.S. Fish and Wildlife Service in the form of new interior dikes, water control structures, and islands will not be available due to limited availability of construction funds in the refuge system nationwide as explained previously.

Pool A - Conditions in pool A are unlikely to change substantially in the future. Turbidity is expected to continue to limit aquatic and marsh plant growth in pool A. The factors limiting the fishery resource of pool A are also not expected to change.

Black Oak and Kiep's Islands will continue to erode and the area behind the islands will be subjected to increased wave energy. Significant archaeological resources present on these islands are also being threatened by this erosion. It is expected that these islands eventually would have to be stabilized to protect these cultural resources.

Pool B - Conditions over most of pool B are not expected to change significantly over the next 50 years. There may be temporal shifts in vegetation abundance from year to year, depending on temperature and precipitation. In the northwestern corner of pool B (covering about 450 acres), woody plant coverage is expected to increase from a current 10 per cent to 25 per cent over the next 50 years. The only readily evident factor threatening the habitat quality in pool B is rough fish activity. It is expected that the U.S. Fish and Wildlife Service would take action to control rough fish should they threaten the high quality habitat in pool B. Absent a project to maintain conditions in the pool, however, rough fish control measures are likely to be ineffective.

Pool C - Ecological succession is going to have an influence in pool C in the form of woody plant invasion of the marshes. The U.S. Fish and Wildlife Service will likely take some management actions to control this problem, but without water level control, management options will be limited. It is projected that woody plant invasion in the marsh portions of pool C will increase woody plant coverage from a current 15 per cent to 25 percent over the next 50 years.

Pool E - Ecological succession is expected to be the primary influence on habitat conditions in pool E. Management actions to control woody plant invasion will be limited because of a lack of water level control. It is projected that woody plant invasion in lower pool E will increase woody plant coverage from a current 30 per cent to 60 per cent over the next 50 years, while in upper pool E woody plant coverage will increase from 10 per cent to 25 percent.

Hydrology - Lacking any unforeseen change in the railroad embankment and the barrier dike, the water level regime in the Refuge will remain the same.

PLANNING OPPORTUNITIES

The principal purpose of plan formulation is to develop a plan that provides the best use, or combination of uses, of water and land resources to meet the project objectives. The plan formulation process must also consider the identified planning opportunities and constraints.

Planning opportunities are physical conditions, plans by others, and available resources considered in formulating alternative plans to address the management objectives for the project area. Characteristics of the study area are considered during the design of alternative plans to address the objectives. Whenever possible, existing physical conditions and material availability should be used to conserve non-renewable resources and in the design of project features.

Planning opportunities at Trempealeau National Wildlife Refuge primarily focus on the opportunity to increase habitat management capabilities through water level control. The planning opportunities available within the context of the Environmental Management Program are discussed for each pool.

(1) Pool A

The potential for habitat enhancement for pool A is high because this pool has significant habitat problems. Developing the ability to draw down pool A independently of the remainder of the Refuge would provide the opportunity to reduce water depths to encourage aquatic and marsh plant growth. In addition, drawdown could be used to induce winterkill of rough fish without adversely impacting the habitat values in the remainder of the Refuge.

The construction of islands in this lake-like pool would provide a means of reducing wind induced turbidity and encourage the growth of aquatic plants. Island construction would also provide the opportunity to increase habitat diversity in pool A. If material for the islands could come from pool A itself, it would also create deeper water habitat for fishery enhancement.

(2) Pool B

Planning opportunities in pool B are somewhat limited because of the excellent habitat already present in this pool. In addition, pool B lies in the middle of the Refuge, with water from pools C and E passing through it. This makes it more difficult to manage water levels in pool B independent of the other pools.

(3) Pool C

The primary planning opportunity in pool C is to develop the capability to independently retain water in the pool through the construction of a dike to separate pool C from pool B. An existing road and the remnants of an old railroad grade could be used to form a major portion of this dike.

The nearby Trempealeau River could provide a controllable source of water supply to augment water level control in pool C. A network of existing ditches in the pool area could have limited use in conveying water to various locations.

(4) Pool E

Planning opportunities in pool E focus on two areas. Pool E drains though a single opening in the Green Bay and Western Railroad grade. This offers the opportunity to control water levels in pool E though the construction of a water control structure in this opening. As with pool C, this would allow water to be independently retained in pool E for habitat management.

An abandoned roadway bisects pool E generally from east to west, designated as lower pool E (E1) on the south side and upper pool E (E2) on the north. Openings in the roadway do not permit independent water level control in pool E1 or pool E2. Construction of a dike along this old roadway offers the opportunity to divide pool E into two separate management units.

PLANNING CONSTRAINTS

HYDROLOGIC

Any structures must be designed with consideration of the hydrologic regime and water regulation of pool 6 and must not induce increased flood elevations of more than 0.01 feet during a 100-year recurrence interval flood event on the Mississippi and Trempealeau Rivers. Structures should be designed to withstand forces of water currents and wave action associated with a 50-year project life. In addition, project designs and operations must not induce increased ponding of water on private lands adjacent to the Refuge (particularly Pool F).

ENGINEERING

Any dredged material must be placed at an approved site or used beneficially. Construction access must be possible for normal construction equipment. Project features must be designed for a minimum 50-year life and operation and maintenance requirements must be minimized.

ECONOMIC

The cost of project features must be reasonable for the specific site when compared to the estimated habitat improvements. A proposed project has to be incorporated into the overall EMP funding limitations.

NATURAL RESOURCES

The primary natural resources constraint is that efforts to improve migratory birds, furbearer, and fishery habitat should not adversely impact on Refuge objectives of higher priority. For the Trempealeau National Wildlife Refuge these higher priority objectives include the maintenance and production of the protected and/or sensitive species, i.e., the peregrine falcon, bald eagle, double-crested cormorant, and osprey. In addition, adverse effects are to be avoided on the maintenance of natural areas and threatened prairie communities on the Refuge.

CULTURAL RESOURCES

Several pre-European sites could be affected by construction of a project. Sites on Kiep's Island would have to be avoided, protected from impact, or mitigated prior to construction.

Cultural resources concerns exist regarding disturbance of an access road leading to the Green Bay dike structure. Two burial mounds have been reported in this area but their exact locations are unknown. Aerial photographs from 1939 show a road leading directly to the structure in the Green Bay dike. Activities in this area should be confined to the existing road grade to avoid undisturbed areas that may contain mounds.

Other areas of the Refuge where construction could take place appear to pose no threat to known or potential cultural resources. However, any potential borrow sites on the Refuge would have to be investigated.

INSTITUTIONAL

The primary institutional constraint is that the project is located within the Trempealeau National Wildlife Refuge and, as such, must be compatible with the primary purposes of the Refuge and be consistent with the Refuge's management objectives.

LEGAL

The plan must comply with all Federal and State laws and regulations. Project features must be constructed on lands owned by the Federal government or the local sponsor or long-term easements must be obtained for use of private property.

RECREATION

Existing recreational access must be maintained.

PROJECT OBJECTIVES

The ultimate goal of the project is to preserve, restore, and enhance plant and animal habitat and to provide breeding, resting, and feeding habitat for migratory birds and marsh wildlife on the Refuge. A primary goal is to provide flexibility in controlling water levels in specific management units during various times of the year. Water management needs may vary from year to year, depending on yearly seasonal weather and habitat conditions. The benefits of water level control are not easily quantified because the benefits are dependent on what the Refuge manager determines necessary in any given year. During some years, additional water may be necessary to improve habitat conditions in a pool, while in other years, it may be desirable to lower pool elevations and expose more shoreline. The long term benefits stem from the ability to enhance habitat conditions in each management cell on the Refuge by independent water level management. 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. Based on the habitat goals for the Refuge, the following specific planning objectives were developed for each pool. Discussions of specific project objectives for the 50-year future period follow. The planning process was directed towards achieving these specific objectives, which are listed in general order of priority for each pool.

Pool A

- Establish emergent and submergent aquatic plant growth over 40 percent of pool A within 10 years following project implementation;

- Maintain 90 acres of existing islands (Kiep's and Black Oak Islands);

- Maintain a winter fish refuge with dissolved oxygen levels of 5 mg/l or greater.

Pool B

- Maintain 1600 acres of wetlands with a present ratio of 60 percent emergent vegetation/40 percent open water.

Pool C

- Provide 375 acres of flooded marsh (water depths of 12 to 18 inches) during the fall migration season;

- Limit woody plant invasion in the marsh portion of pool C to 40 acres.

Pool E (Upper)

- Provide 550 acres of flooded marsh (water depths of 12 to 18 inches) during the spring;

- Limit woody plant invasion to 20 acres.

Pool E (Lower)

- Limit woody plant invasion to 180 acres.

Based on design factors that affect project area habitats and future project performance assessment, the specific project objectives described above are summarized in table DPR-2.

TABLE DPR-2
Project Goals, Objectives, and Alternative Enhancement Features

POOL	PROJECT OBJECTIVE	POTENTIAL ENHANCEMENT ALTERNATIVE	UNIT OF MEASURE	ENHANCEMENT POTENTIAL Existing	Future w/o Project (2041)	Future With Project
A	Establish emergent & submergent veg.	Dike, draw down	acres	100	50	280
	Maintain existing islands.	Stabilize, protect	acres	90	70	90
	Maintain dissolved oxygen levels >5 mg/l.	Aerate, provide flow	mg/l	<5	<5	>5
B	Maintain existing wetland.	Dike, flow control, water supply	acres	1600	1200	1600
C	Provide flooded marsh.	Dike, water supply	acres	270	190	400
	Limit woody plant invasion.	Dike, water supply	acres	50	100	40
UPPER E	Provide flooded marsh.	Dike, water supply	acres	415	400	450
	Limit woody plant invasion.	Dike, water supply	acres	40	80	20
LOWER E	Limit woody plant invasion.	Dike, water supply	acres	200	280	180

PLAN FORMULATION

The principal purpose of plan formulation is to develop a plan that would provide the best use, or combination of uses, of water and land resources to meet the project objectives. Much discussion between the project proponents and designers centered around achieving the desired project objectives with the lowest first costs and minimal operation and maintenance requirements.

ALTERNATIVES CONSIDERED

The alternatives identified consist primarily of features for improved Refuge management that were identified during the development of the Refuge Master Plan in the early 1980's. In addition, the planning process identified some alternative methods of accomplishing the project objectives.

No Action

With this alternative, no project that would influence the Trempealeau National Wildlife Refuge would be implemented using Federal funds. A general decline in aquatic habitat would generally occur and the area of willow invasion would continue to increase. Specific details of future conditions with no action have been described in previous sections and they will not be repeated in this section. In particular, refer to the "Estimated Future Habitat Types and Distribution" section.

Pool A Alternatives

(1) Islands - Islands in pool A would reduce wind fetch in this large open pool. This could reduce erosion on Kiep's and Black Oak Islands. In addition, wave induced turbidity would be reduced, improving conditions for aquatic plant growth and subsequent fish habitat. The islands themselves would provide additional terrestrial waterfowl habitat.

(2) Dike - A dike would be constructed from the upland of the Refuge to the railroad dike to physically separate pools A and B. This would reduce wind fetch, allow water level manipulations, and provide a means to maintain a fishery in pool A.

(3) Pump Station - The only flow outlet for the entire Refuge is a gravity outlet located in pool A. High water periods on the Mississippi and/or Trempealeau Rivers limit the ability to discharge water from the Refuge. Construction of a pump station would provide this capability. Drawing down the water level would expose and consolidate sediments to promote the germination of seeds and subsequent growth of aquatic plants.

(4) Riprap Protection of Existing Islands - Kiep's and Black Oak Islands in pool A are experiencing significant erosion. Riprap is one possible solution to preventing further erosion.

(5) Mechanical Aeration - Mechanical aeration in the pool would provide adequate winter dissolved oxygen conditions for fish survival.

Pool B Alternatives

(1) Dike and Control Structure - Construction of a dike to physically separate pool A from pool B would allow independent water level management for each pool. The different habitat characteristics of the two pools make it highly desirable to manage them for different purposes, with separate water level management regimes.

(2) Pump Station - A direct means of maintaining existing water levels would be needed if water level manipulation of other pools on the Refuge is done. Water may need to be pumped from one pool to another or directly to the Mississippi River.

Pool C Alternatives

(1) A Dike between Pools C & B and Control Structure - Pool C would be physically separated from pool B through the construction of a dike that would make use of an existing road and partial dike. This would permit water level management control for pool C according to the habitat needs in that pool.

(2) A Dike in the Northwest Corner of Pool C - A small portion of pool C that currently does not provide optimal conditions for migratory birds would be physically separated from the rest of pool C. This would permit water level management of the area to provide habitat conditions more desirable to migratory birds. This alternative has been recently proposed by Ducks Unlimited, Inc. It will be called the "C2" alternative or "C2" pool.

(3) Water supply to raise the water level - Several options were considered:

a) Pump water from pool A to pool C;

b) Pump water from pool B to pool C;

c) Excavate a ditch from pool E to pool C;

d) Use groundwater, either from artesian wells or from drilled wells within pool C;

e) Gravity flow or pumping of water from the Trempealeau River into pool C or the C2 pool.

f) Pump water from pool C to the C2 pool.

Pool E Alternatives

(1) Green Bay Control Structure - Pool E currently drains through a single opening in the Green Bay and Western Railroad grade that separates pool E from the rest of the Refuge. Placing a water control structure in this opening would allow water level management control for pool E according to the habitat needs in that pool.

(2) Dike and Control Structure - Construction of a dike across pool E along the alignment of an abandoned roadway would allow water level management control for the upper portion of pool E.

(3) Wells - Drilling wells or tapping artesian wells to supply water to pool E would permit additional water level management capabilities.

(4) Water Diversion Structure - Water would be diverted from pool F to upper pool E at the location of the existing culvert through the road separating pools E and F.

(5) Pumping water from lower pool E to upper pool E.

ALTERNATIVES ELIMINATED FROM DETAILED EVALUATION

Pools A and B - All of the alternatives for pool A were evaluated in more detail. Pool B alternatives are common to whatever is evaluated for pool A, so pool B alternatives will not be discussed separately.

Pool C -

(a) pumping water from pool A to pool C (the pumping distance of more than a mile makes it uneconomical);
(b) excavating a ditch from pool E to pool C (it would significantly limit the operational opportunities for both pools because of the small hydraulic head difference, limited quantity of water, and the inability to operate the pools independently for habitat control and enhancement);
(c) using wells for water supply (unknown available quantities, possible adverse effects on the water table, and very costly to operate and maintain).

Pool E -

(a) the Green Bay Control Structure (it is not desired to manipulate lower pool E water levels because existing conditions are adequate and the structure would affect water levels in the privately owned pool F);
(b) using wells for water supply (same reasons as for pool C);
(c) a water diversion structure from pool F (operation would unacceptably affect water levels in pool F).

ALTERNATIVES CONSIDERED IN DETAIL

The following alternatives for accomplishing project objectives were analyzed in more detail:

1. Pool A - island construction; a dike to separate pools A and B; a pump station; protection of Kiep's and Black Oak Islands; aeration.

2. Pool C - a dike to separate pools C and B; water supplies; and the C2 alternative in the northwest corner of pool C.

3. Upper Pool E - a dike to divide upper and lower pool E; water supply.

A value engineering study was accomplished for the project and will be discussed in the following section of this report.

ALTERNATIVE EVALUATION

Alternative features for each pool were evaluated. The following discussion describes each alternative and analyzes the benefits that are possible for the individual pool. In terms of their benefits to migratory birds, the dikes that would form each pool are independent features. Habitat evaluation procedures (HEP) were used to evaluate the potential habitat benefits of each alternative. A detailed discussion of the habitat benefits that would be derived from the formation for each pool is presented in the habitat evaluation procedure discussion in appendix A. A summary of the costs and habitat benefits for each alternative is shown in table DPR-3. Details of the cost analysis are included in appendix F (Plan Formulation Data). An incremental analysis was conducted for the dike alternatives in order to identify the most cost-effective approach to meeting management goals for each pool. The incremental analysis is presented in a discussion following this section.

No Action - Habitat management and water levels in the Refuge would continue with limited operational capability. Willow encroachment in pools C and E would continue. Habitat conditions in pool B would deteriorate because the open water conditions and rough fish populations in pool A produce high turbidity. Management of migratory bird habitat would become more difficult throughout the Refuge as the habitat conditions continue to decline due to the loss of aquatic vegetation acreage. Kiep's Island would continue to erode, resulting in the loss of cultural resources and, eventually, the aquatic area behind the island would be subjected to the same open water effects as the rest of pool A. No project objectives would be met if this plan was selected, although continued management of the Refuge would address the problems to a small degree as conditions deteriorate. This plan would be selected only if no feasible action alternative could be found.

Pool A - The following is a discussion and evaluation of the alternatives for pool A. Alternative costs and habitat unit gains are summarized in table DPR-3. Detailed cost estimates and analyses are included in Appendix F.

(1) Islands - Two islands were proposed to be constructed in the 1,100-acre pool to break up wind-generated waves and reduce the associated turbidity levels, thereby allowing aquatic vegetation to become established. The islands would each be about 2,500 feet long with a 30-foot top width and extend about 4 feet above the normal pool elevation. The layout of the islands is shown on Plate 6. About 77,000 cubic yards of sandfill, 31,000 cubic yards of topsoil, and 4,500 cubic yards of rock riprap would be used to build the islands. About 5 acres of upland habitat would be created within the pool. It was desired to obtain the sandfill material for the islands from within the pool area, but soil borings in the area indicated that the existing in-place material would not be suitable for use (see Appendix C for soil boring information). Therefore, the sandfill would have to be obtained from an upland source or the vicinity of the main channel. Upland sources that were considered included: (1) an off-Refuge operating borrow pit about 11 miles away to the site (estimated cost of $14.00 per cubic yard); (2) proposed borrow areas on the Refuge (estimated cost of $6.20 per cubic yard); and (3) a channel maintenance dredged material placement site about 14 miles away from the island site (estimated cost of $10.60 per cubic yard). The use of material from the dredged material placement site was determined to be the

most acceptable upland source. The cost of using material from an operating borrow pit would include the cost of material from the pit, while there would be no cost for the material from the placement site. Although there would be no cost for material from a borrow area on the Refuge and the haul distance would be shorter, the cost of potential cultural resource investigations (estimated to be a minimum of $160,000) and the unknown constraints associated with excavation of the site would likely make the cost of using the material from the Refuge higher than hauling it from the placement site and would delay project implementation because of the time required for cultural resource investigations and possible mitigation. Pool depths of 4 feet or less would require dredging of access channels so that construction equipment and fill material could be moved mechanically to the island locations. Efforts would be made to stockpile this material dredged for access at an approved site and use it for island topsoil. Additional island topsoil would be obtained from bottom sediments within the pool adjacent to the islands.

Another option considered for island fill was to dredge sand from the vicinity of the main navigation channel outside the Refuge boundaries. The material would be hydraulically dredged and pumped via a pipeline through the railroad embankment directly to the island sites. No significant dredging in the pool would be needed for access because equipment to shape and finish the islands could be floated to the island sites in relatively shallow water. Topsoil would still be obtained from the pool adjacent to the islands. At about $5.80 a cubic yard, this option was found to be the most economical means of building the islands.

(2) Dike - The dike would result in the ability to improve habitat conditions in pool A and pool B by providing the capability to manipulate water levels in both of these pools. The degree and location of habitat change in pool A would be dependent on the location of the dike. The benefits to pool B would be the same for any of the pool A dike alternatives. It was initially proposed to locate the dike to separate pool A from pool B at the point where the maximum amount of deeper water acreage would be enclosed in one subimpoundment. It would connect the railroad embankment to the upland not far from the Refuge headquarters (see Plate 6). This would create a 1,100-acre pond for pool A. The dike would be 4,500 feet long, have a top elevation of 650 (4 feet above normal pool), and was initially proposed to have a top width of 20 feet. However, a value engineering study determined that a 15-foot top width would accomplish the intended purposes of providing a stable dike and access. About 90,000 cubic yards of fill would be required to construct the dike. The source of fill would be as described above (hydraulically dredged from outside the Refuge in the vicinity of the main navigation channel). The west side of the dike would include a 40-foot-wide berm and 23 rock groins spaced 180 feet apart extending 30 feet out from the dike to prevent erosion of the dike. The east side of the dike would be protected with an 18-inch-thick layer of rock riprap above the pool elevation of 646 and 27 inches below the water surface. A 12-foot-wide road surface would be placed on top of the dike using a 6-inch-thick layer of gravel. Typical riprap and sand berm cross-sections are shown on Plate 7. Islands would be constructed within pool A to break-up waves, providing calmer conditions in the pool. This alternative (including the proposed islands) is designated as A1 in table DPR-3.

After a value engineering study and further analysis, it was decided to locate the dike further east, creating a smaller but more manageable pool. It would connect to the railroad embankment on the south and to the east end of Kiep's Island on the north, creating a 700-acre pond for pool A (see Plate 6). The dike would be 4,000 feet long with the same design and and cross-section dimensions as described above. The reasons for relocating the dike included: (1) the length of dike is 500-feet shorter because the alignment would follow the shortest distance between existing landforms; (2) the smaller pool would be easier to physically manage (smaller volume of water and lower operational costs) with more predictable and reliable habitat enhancement results; (3) there would be less effect on the current high value habitat conditions that are to be maintained in pool B (the initially proposed location would have been constructed through a portion of the area desired to be maintained); and (4) the location would eliminate the need for islands to reduce wind fetch and break-up waves (the dike would accomplish the goal of reducing wind fetch and the associated wave action). A cost analysis was done for the two proposed locations of the dike. The results of the analysis are shown in table DPR-3. Alternative A1 reflects the initial location and alternative A4 is the easterly location. It was estimated that over $1 million in project costs would be saved by using the easterly dike location and eliminating the construction of islands. Annual operation and maintenance costs would also be less because of the smaller pool size and fewer project components.

The habitat benefits associated with the two different dike locations were evaluated using habitat evaluation procedures. The Wildlife Habitat Appraisal Guide (WHAG) method was used for the analysis. A diving duck migratory habitat model was developed and the habitat suitability index (HSI) for present and future without project condition was computed. The future HSI's without and with each of the pool alternatives (A1 and A4) were then computed and used to determine the average annual habitat units (AAHU) gained for each. Detailed discussions of the habitat analyses for the alternatives are included in Appendix A. For alternatives A1 and A4 the AAHU gains were calculated to be 336 and 272, respectively. In terms of cost per average annual habitat unit, the westerly dike alignment (A1) is $976 and the easterly dike alignment (A4) is $902. Therefore, the easterly location (A4) was selected as the preferred alignment.

After alternative A4 was identified as the preferred dike location, other cross-sectional design options were considered for the dike. These design alternatives would not affect the type or relative degree of habitat changes that would occur, only the construction and maintenance costs. Analyses included determination of the need for rock riprap or a sand berm design (see Plate 7). The riprap design cross-section would have a 15-foot-top width, 1 vertical on 3 horizontal side slopes, 18-inch-thickness of rock riprap above the water surface, and 27 inches below the water surface. The sandfill cross-section would have a 15-foot-top width, 1 vertical on 5 horizontal side slopes from elevation 650 to 648, a 40-foot-wide berm with 1 vertical on 2 horizontal side slopes, 6 inches of topsoil with seeding, and rock groins spaced 180 feet apart. Both designs include a 12-foot-wide by 6-inch-thick layer of gravel on the top of the dike so that vehicles could be driven on the dike for operation and maintenance. An initial cost analysis of the two designs indicated that the dike costs were highly dependent on the cost of sandfill and rock and that the difference in cost of the two designs may not be significant. The construction cost of the sand berm dike design was estimated to be $2,154,000 and the riprap dike design to be $2,200,000 (a cost difference of only about 2 percent). Costs for the sand berm/rock groin and rock riprap dikes are designated as alternatives A2 and A3, respectively,

in table DPR-3. It was decided that at this stage of design the dike with sand berm and rock groins on both sides would be used for the proposed design because of the uncertainty of unit costs, the estimated lower maintenance costs, and the possibility for sand fill costs to be less than currently estimated if additional sand could be dredged and stockpiled for use in other projects on the Refuge.

(3) Pump station - Several options were considered to draw down the water level in pool A. Portable electric and diesel pumps, siphons, and permanent pumps were investigated. Because of the relatively large pumping capacity required (22,000 gallons per minute), the analysis concluded that a permanent pump station would be the most efficient and operable option. The pump station would provide the capability for a 2-foot drawdown of pool A. The drawdown would serve several purposes including: (1) promoting germination of aquatic plants in the shallow fringe areas of the pool; (2) promoting aquatic plant growth in the remainder of the pool because of reduced turbidity and increased light penetration; and (3) providing the capability to eradicate rough fish by allowing most of the pool to freeze during the winter. The pump station would be capable of pumping water from pool A and/or pool B to the Mississippi River and allowing gravity flow from pool B to pool A. The station would be located in the pool A dike near the Burlington Northern Railroad embankment as shown on Plate 7. Additional discussion of the computation of pumping requirements is included in appendix B.

The project design provides the capability to lower the water level of pool A up to 2 feet. This was considered the minimum amount of drawdown required to generate a significant response in aquatic plant growth. A review of the habitat models also indicated that a 3-foot drawdown would not result in a quantifiable increase in habitat benefits over what would occur with a 2-foot drawdown. Based on this evaluation, it was not considered necessary to determine incremental cost estimates for alternative pumping capabilities.

(4) Riprap protection of existing islands - Kiep's Island and Black Oak Island are located in the pool A area of the Refuge (see Plate 6). Both the islands have experienced erosion.

An analysis of Black Oak Island using aerial photos from past years indicated that the island is eroding at some locations and accreting at others. It was decided that the erosion at Black Oak Island was not critical from a fish and wildlife habitat impact standpoint. Also, construction of a dike or islands to reduce wind fetch in pool A would slow the erosion because of reduced wave heights in the pool. Therefore, no protective measures were pursued.

Kiep's Island erosion is significant. If no protective measures were taken, the end of the island would be lost and a breach between the proposed dike and the remainder of the island would result. About 150 acres of pool A behind the island would be subjected to wave action from pool B and the manipulation of water levels in both pools A and B would not be possible, making the proposed project ineffective. Also, the loss of cultural resource artifacts would be significant. Therefore, riprap protection would be needed along a 900-foot length of Kiep's island from where existing rock protection has been placed to the east end of the island where the proposed dike would connect. Two methods of rock riprap protection were analyzed. One method would protect the bank in a conventional way by placing fill against the eroded bank, shaping it to a 1 vertical on 3 horizontal slope, laying geotextile fabric on the slope, and placing riprap on the slope 18 inches thick above the water surface and 27 inches thick below the water surface. The intent would be to disturb the existing bank as little as possible because of the abundance of cultural resource artifacts. Placement of material along the eroded bank would be done from the top of the bank. Little or no clearing would be done. The estimated construction cost of this riprap protection is about $282,000. The other option that was considered for protecting the bank was simply placing rockfill in the shape of a wedge at the toe of the eroded bank either by dumping rock from the top of the bank, by placing the rock on the ice during the winter, or by operating construction equipment on top of the rock wedge as it is constructed. A 3-foot-thick by 10-foot-wide layer of rock at the toe (either in the water or placed on the ice) would protect the toe of the eroded bank. The estimated construction cost of this rockfill option is about $53,000 and is the preferred method. A summary of the overall costs for the project using the conventional riprap and the rockfill options described above is shown in table DPR-3 as alternatives A5 and A6, respectively.

(5) Mechanical aeration - Construction of the dike to create the 700-acre pool A makes it feasible to consider the use of aeration to improve fish habitat in a portion of pool A. Because of the size of the Refuge and the current inability to effectively control rough fish populations, this feature would not be considered without the construction of a dike to create the 700-acre pool A. The pool size of alternative A6 would make it feasible to effectively control rough fish and establish a viable fishery. In addition, as the primary management emphasis of the Refuge is for migratory birds, construction of a dike would not be pursued solely to improve fish habitat. The management of pool A to increase aquatic vegetation for migratory birds, would provide secondary benefits by improving habitat conditions for fish. However, due to the relatively shallow depths of the pool, winterkill would still limit the potential to effectively develop a fishery in the pool. In order to establish and maintain a fishery in pool A, it is necessary to maintain winter dissolved oxygen levels greater than 5 mg/l in at least a small area of the pool. Several types of aeration systems are available including sub-surface air bubblers, mechanical surface aerators, and high volume water pumps. Available literature and preliminary contacts with aeration specialists indicated that the best system would be mechanical surface aerators because of the size and shallowness of the pool. Aerators would be placed in the deepest areas (about 5-6 feet) in the northwestern portion of the pool. Approximate locations are shown on Plate 6. The aerators would provide an open water area about 2 acres in size for alternative A6. This area would allow fish to gather during the winter months when dissolved oxygen concentrations in other areas of the pool are not adequate. This would make it possible to maintain a limited fishery in the

pool. Aeration equipment and installation costs are estimated to be about $80,000 for alternative A6. Habitat Evaluation Procedures (HEP-80) was used to evaluate the habitat benefits for largemouth bass and bluegill fish species because they represent the type of fishery that is planned for pool A. The U.S. Fish and Wildlife Service models for these species were used along with a St. Paul District model modification to evaluate winter habitat conditions. An average of the values obtained from the two species models was used as an overall fishery value for centrarchids. Currently, winter dissolved oxygen (DO) is the limiting factor on fish habitat value. If winter DO is eliminated as the limiting factor, the habitat suitability index for centrarchids would increase significantly for half of the year. Summer habitat conditions would improve slightly because of the increased amount of aquatic vegetation. The average annual habitat units gained by aeration of the pool was calculated and found to increase fish habitat in the pool by 260 AAHU's for alternative A6. This results in a cost of $52 per AAHU. The analysis is described in detail in Appendix A. The results are summarized in table DPR-3 under A6 as separable aeration costs. The results indicate that aeration would be a relatively low cost increment for the benefits obtained. Note that these fish benefits cannot be added directly to the migratory bird benefits obtained in the calculations above because of the differing species and objectives. Since alternative A6 would have to be in-place to gain the calculated benefits, the fish and migratory bird benefits can logically be kept separate.

Pool B - The dike and pump station proposed for pool A would also address the project objectives for pool B. The capability to pump from pool B to the Mississippi River, and to drain from pool B to pool A would permit the water level in pool B to be controlled and managed to maintain existing habitat conditions. Therefore, since the pump station is part of each alternative, no additional formulation or discussion of alternatives for pool B is needed.

Pool C - The following is a discussion and evaluation of the alternatives for pool C. Alternative costs and habitat benefits are summarized in table DPR-3.

(1) Dike and control structure - The dike would provide the capability to manipulate water levels in pool C to control the extent and type of vegetation in the pool. In order to physically separate pool C from pool B, an existing Refuge road (School Bus Point) would be used and a dike would be constructed along an abandoned railroad embankment and through a wet marsh area (see Plate 8). Alternative dike alignments were not considered because the proposed alignment is the shortest route between the two points of existing high ground. Total length of the new dike would be about 6,500 feet. The dike was proposed to be constructed to 4 feet above normal pool with a 20-foot top width and have side slopes of 1 vertical on 5 horizontal. A value engineering study resulted in reducing the top width to 15 feet as explained for the pool A dike. A typical dike cross-section is shown on Plate 9. A change in the height of the dike will be discussed later. About 3,000 feet of the dike to be constructed through the marsh would require placing the fill on filter fabric because of very poor foundation conditions. Material for topsoil on the dike would be obtained from the pool adjacent to the dike. A 12-foot-wide by 6-inch-thick layer of gravel would be placed on the top of the dike so that vehicles could be driven on the dike for operation and maintenance. Instead of using dredged material from near the navigation channel as in pool A, it was determined to be more efficient to haul sandfill for building the dike

from a channel maintenance material placement site south of Fountain City, Wisconsin, about 11 miles away. Using material dredged from an area near the Refuge (as for the pool A dike) would result in a pumping distance of 1-1/2 to 2-1/2 miles, possibly placing an additional dredge pipe through the railroad embankment, and difficult construction procedures because of the poor foundation conditions. Therefore, the borrow site near Fountain City was selected to evaluate the dike alternatives for pool C. The dike would be constructed by entering the northwest side of the Refuge along the School Bus Point road. Portions of that road on the west side of pool C may have to be raised slightly, but more detailed surveys would be necessary. Any raises would be less than 2 feet and only for short distances. About 3,500 feet of dike on the southeast side of pool C would be constructed along an existing abandoned railroad dike that now provides a poor quality road. A gated control structure consisting of a headwall and 30-inch pipe would be placed in the dike at the location shown on Plate 8 to permit drainage of pool C to pool B.

(2) Water supply - A dependable water supply to raise the water level of pool C would be needed to provide optimum management options. Alternative designs focused primarily on water supply strategies. The water supply alternatives that were evaluated were: (1) pumping water from pool B to pool C, (2) using water by gravity flow from the Trempealeau River, and (3) using a combination of the two.

It was determined that 9,000 gallons per minute would be needed to fill pool C in 15 days as desired. Additional discussion of the hydraulic analysis is included in Appendix B (Hydraulic Design). Diesel driven, hydraulic and submersible, electric, portable pumps were evaluated. It was found that diesel pumps would require daily monitoring and fueling, frequent maintenance, fuel storage facilities, and fuel delivery. The diesel pumps would also be relatively noisy. The electric pumps would require little maintenance and make little noise, but would require a new electric service and could have high demand charges. A present worth analysis of the pumps showed that the portable electric pumps would be the lowest cost considering equipment, operating, and maintenance costs. The analysis did not consider the additional problems of fuel storage, emissions, and daily attendance of the equipment. Therefore, two submersible electric pumps would be the preferred pumping equipment. The pumping analysis and additional details are shown in Appendix D (Mechanical and Electrical Design Summary).

Using water from the Trempealeau River was evaluated because the water would be carried to the pool by gravity, rather than being pumped. The Trempealeau River runs adjacent to the Refuge. The river was diverted in 1911 along the northern boundary of the Refuge by a dike. In the vicinity of pool C, the river is normally at least 6 feet higher than the normal pool C elevation. However, during spring flows and after intense rainfall in the watershed, high turbidity makes the river water quality poor compared to water within the Refuge. Therefore, it would not be desirable to use the river water to fill pool C at those times. However, it is estimated that the timing of filling pool C could be adjusted most years to correspond to normal flows on the Trempealeau River, making it possible to use the river water. For example, in 1991, the river water was estimated to be of adequate quality during the time when the pool would have been filled. This would likely be the case most years. Use of the Trempealeau River water would reduce the need to use the portable electric pumps to fill the pool. Pumps could be used to augment the river water supply, if desired, or during periods of high

turbidity to provide additional water level management capabilities. Monitoring of the water quality in the river would need to be done during filling operations. The gravity flow inlet structure would be the same design as the outlet structure, consisting of a gated headwall and 30-inch pipe located at the northern boundary of the Refuge. The location is shown on Plate 8. The water would discharge into an existing ditch system in pool C that would carry the water into the pool. A cost evaluation of each of the alternatives is shown in table DPR-3.

Habitat evaluation procedures were used to calculate the habitat benefits of the pool C alternatives. The mallard was selected as the evaluation species to use in the WHAG methodology because the primary management emphasis in pool C is to increase use of this area by dabbling ducks. The primary limiting factors are the amount of water present during key times of the year and the extent and types of vegetation in the pool. Creation of pool C would ensure that adequate water is present and provide the capability to manipulate water levels to control vegetation and prevent the encroachment of woody vegetation into the marsh. The 375-acre pool would provide a habitat gain of 49 AAHU's for the pool C alternatives that provide assured water level control capabilities (C1 and C2). This requires the use of pumps for all water supply (C1) or as backup for times when the Trempealeau River water could not be used (C2). If no pumps are provided by the alternative (C3), a 25-percent reduction in habitat benefits were assumed because of the times when it would not be possible to supply water to the pool. This results in a habitat gain of 37 AAHU's. The cost per AAHU for C1, C2, and C3 are shown on table DPR-3 as $2,133, $2,257, and $2,378, respectively.

An additional 2-foot raise in the dike to provide the capability to pond up to 4 feet of water in pool C (instead of 2 feet) was also evaluated. The cost evaluation is shown as alternative C4 in table DPR-3. Increases would be required for all the following project components: dike height; the number or size of pumps; the Trempealeau inlet structure; the number of outlet structures; and the pumping time for filling and keeping the pond filled. The estimated cost is shown in table DPR-3. However, it was determined during the evaluation that the ability to raise the water the additional 2 feet would not produce any appreciable gain in habitat quality. Therefore, only a minor increase in AAHU's was assumed for evaluation purposes. The cost per AAHU was computed to be $3,428.

(3) C2 dike alternative - Late in the formulation process for this study, the potential to develop a managed marsh unit was identified by Ducks Unlimited, Inc. This would be a dike constructed in the northwesterly corner of pool C to form a 220-acre pond where much of the existing ground is at or above the normal pool elevation of 646. This alternative is shown on Plate 8 as the C2 dike. The dike would be about 6,500 feet long and connect to the Green Bay and Western Railroad embankment on the west and the dike along the Trempealeau River on the north. The dike design and cross-section would be the same as proposed for pool C except the top elevation would be 652 (2 feet higher) because the existing ground is generally 2 feet higher. This would provide the capability to pond 4 feet of water at the dike. Water supply would be either gravity-fed from the Trempealeau River or pumped from the pool C area. A gated control structure consisting of a headwall and 30-inch pipe would be placed in the dike at the location shown on Plate 8 to permit drainage of the C2 pool to pool C. A cost evaluation of the with and without pump alternatives is shown in table DPR-3 as C2(1) and C2(2), respectively. Since the cost of the proposed development greatly exceeds the amount that

Ducks Unlimited Inc. can commit to a project, it is not being actively pursued by them or any other interests and is not likely in the future. However, Ducks Unlimited, Inc. did accomplish a topographic survey of the area that was used in the formulation of this alternative.

Habitat evaluation procedures were used to calculate the habitat benefits of the C2 pool alternatives. The mallard was selected as the evaluation species to use in the WHAG methodology because the primary management emphasis in the C2 pool is to provide feeding/resting areas for dabbling ducks. The primary limiting factors are the amount of water present during key times of the year and the extent and types of vegetation in the pool. Creation of the C2 pool would ensure that adequate water is present and provide the capability to manipulate water levels to control vegetation. When two portable pumps are included in the alternative (C2(1)), the 220-acre pool would provide a habitat gain of 98 AAHU's for the alternative. Assured water level control capabilities would be provided because the pumps would be used when the Trempealeau River water could not be used. During periods of high flow, the water from the Trempealeau River would not be usable because of high levels of suspended solids, nutrients, and possible chemicals. It is estimated that these conditions could occur at least 50 percent of the time that a water supply would be needed for pool C2. Therefore, if no pumps were provided (alternative C2(2)), a 50-percent reduction in habitat benefits was used because of the times when it would not be possible to adequately supply water to the pool. This results in a habitat gain of only 49 AAHU's. The cost per AAHU for C2(1) and C2(2) are shown on table DPR-3 as $893 and $1,331, respectively. It should be noted that implementation of the C2 pool alternative would not preclude implementation of a pool C alternative because the two actions would be independent.

Pool E - The following is a discussion and evaluation of the alternatives for pool E. Since it is unacceptable to increase water levels upstream of pool E because of private land, only alternatives to divide pool E were considered. Only one alignment was considered because the road remnant provides a structure upon which to build the dike. The only alternative dike design considered was the VE study proposal to reduce the top width of the dike.

(1) Dike and control structure - The dike would provide the capability to manipulate water levels in upper pool E to control the extent and type of vegetation in the pool. In order to physically separate upper and lower pool E, a dike would be constructed along an existing abandoned road in the Refuge (see Plate 10). Total length of the dike would be about 6,600 feet. The dike would begin at Lower Farm Road and end at the Green Bay and Western Railroad embankment. The dike would be constructed to 4 feet above normal pool (elevation 650) with a 15-foot top width and side slopes of 1 vertical on 5 horizontal. The dike design is the same as for pool C. A typical cross-section is shown on Plate 9. The height of the dike would allow the pool to be filled 2 feet above normal pool for habitat management. Material to topsoil the dike would be obtained from the pool adjacent to the dike. A 12-foot-wide by 6-inch-thick layer of gravel would be placed on the top of the dike so that vehicles could be driven on the dike for operation and maintenance. Sandfill for building the dike would be hauled about 8 miles from a channel maintenance dredged material placement site south of Fountain City, Wisconsin (same source as for the pool C and C2 dikes). The dike would be constructed by entering the Refuge from the northwest side, along Lower

Farm Road. It was determined during the formulation of the alternative that the ability to raise the water 2 feet was the optimum raise for habitat benefits. Increasing the water level more than 2 feet would not produce any appreciable gain in habitat quality and raising it less would not provide enough depth to control the encroachment of willows into the pool. Therefore, no other dike heights were proposed or evaluated. Only one alignment was evaluated because the proposed layout is the only alignment that makes use of an existing abandoned roadway. Any other alignment would require the use of more dike fill, have more impact on existing wetlands, and could encounter undesirable foundation conditions or disrupt existing flow conditions in pool E.

A gated control structure consisting of a headwall and 30-inch pipe would be placed in the dike at the location shown on Plate 10 to permit drainage of the upper pool to lower pool E.

(2) Water supply - A dependable water supply to raise the water level of pool E two feet would be needed to provide optimum management options. The two pump options that were evaluated were the same as for pool C and C2, diesel or electric pumps. The same present worth analysis applies to pool E because the required 9,000 gallon per minute pumping capability is the same as for pool C. Therefore, two portable, submersible, electric pumps would be the preferred pumping equipment, located as shown on Plate 10. Additional discussion of the hydraulic design is included in appendix B. A summary of the alternative costs is shown as E1 in table DPR-3.

Habitat evaluation procedures were used to calculate the habitat benefits of the pool E alternative. The mallard was selected as the evaluation species to use in the WHAG methodology because the primary management emphasis in pool E is to maintain and improve dabbling duck habitat. The primary limiting factors are the amount of water present during key times of the year and the extent and types of aquatic vegetation in the pool. The ability to pond additional water in pool E would ensure that adequate water is present and provide the capability to manipulate water levels to control vegetation as described for pool C. The 550-acre pool would provide a habitat gain of 103 AAHU's for the pool E alternative. This requires the use of pumps for all water supply. The cost per AAHU is $623 as shown on table DPR-3.

Alternative Summary - Table DPR-3 is a summary of the alternatives considered, costs associated with each alternative, and the habitat benefits gained expressed in Average Annual Habitat Units (AAHU). The cost per AAHU is also displayed. The costs shown were used for the preliminary evaluation and comparison of alternatives during the formulation of the project. These costs do not necessarily agree with the final costs of the alternative after further development of the selected plan described later in this report. A detailed cost breakdown is included in Appendix F.

TABLE DPR-3 – SUMMARY OF ALTERNATIVE COSTS & HABITAT BENEFITS

ALTERNATIVE–POOL A	A1	A2	A3	A4	A5	A6
Description	Initial sand berm/riprap dike; pumps; islands	Sand berm dike; pumps	Riprap dike; pumps	Sand berm/riprap dike; pumps	Sand berm dike; pumps; riprap Kiep's	Sand berm/riprap dike; pumps; rockfill Kiep's
Total Construction Cost	$2,932,000	$2,154,000	$2,200,000	$2,194,000	$2,435,000	$2,207,000
E&D	$586,000	$431,000	$440,000	$439,000	$487,000	$441,000
S&I	$176,000	$129,000	$132,000	$132,000	$146,000	$132,000
Total Project Cost	$3,694,000	$2,714,000	$2,772,000	$2,765,000	$3,068,000	$2,780,000
Ave Annual Construction Cost	$310,700	$228,200	$233,100	$232,500	$258,000	$233,800
Ave Annual O&M Cost	$17,200	$12,500	$13,100	$12,800	$8,000	$8,100
Total Annual Cost	$327,900	$240,700	$246,200	$245,300	$266,000	$241,900
AAHU gained	336	272	272	272	272	272
Cost per AAHU	$976	$885	$905	$902	$978	$889
						Separable aeration cost
					Construction Cost	$80,000
					E&D	$16,000
					S&I	$5,000
					Total aeration cost	$101,000
					Ave Annual Constr Cost	$8,500
					Ave Annual O&M Cost	$5,000
					Total Annual Cost	$13,500
					AAHU gain	260
					Cost per AAHU	$52

ALTERNATIVE–POOL C	C1	C2	C3	C4	C2(1)	C2(2)
Description	Sand dike; pumps; outlet	Sand dike; pumps; outlet; Trempeal inlet	Sand dike; outlet; Trempealeau inlet	Sand dike (+2); pumps; outlet; Tremp inlet	C2 sand dike; pumps; outlet; Tremp inlet	C2 sand dike; outlet; Trempealeau inlet
Total Construction Cost	$915,000	$967,000	$761,000	$1,489,000	$784,000	$577,000
E&D	$183,000	$193,000	$152,000	$298,000	$157,000	$115,000
S&I	$55,000	$58,000	$46,000	$89,000	$47,000	$35,000
Total Project Cost	$1,153,000	$1,218,000	$959,000	$1,876,000	$988,000	$727,000
Ave Annual Construction Cost	$97,000	$102,400	$80,600	$157,800	$83,100	$61,100
Ave Annual O&M Cost	$7,500	$8,200	$7,400	$13,600	$4,400	$4,100
Total Annual Cost	$104,500	$110,600	$88,000	$171,400	$87,500	$65,200
AAHU gained	49	49	37	50	98	49
Cost per AAHU	$2,133	$2,257	$2,378	$3,428	$893	$1,331

ALTERNATIVE – POOL E	E1
Description	Sand dike; pumps; outlet
Total Construction Cost	$566,000
E&D	$113,000
S&I	$34,000
Total Project Cost	$713,000
Ave Annual Construction Cost	$60,000
Ave Annual O&M Cost	$4,200
Total Annual Cost	$64,200
AAHU gained	103
Cost per AAHU	$623

ACRONYMS

O&M = Project operation and maintenance
E&D = Project engineering and design
S&I = Construction supervision and inspection
AAHU = Average annual habitat unit

INCREMENTAL ANALYSIS

In terms of benefits to migratory birds, the proposed pools are independent features. An incremental analysis was conducted for each alternative in order to identify the most cost effective approach to meeting the management goals for each pool. The incremental analysis for each pool is discussed below. Additional discussion of the incremental analysis for each pool is included in appendix A.

Pool A - The incremental analysis for pool A indicated that the easterly dike location (alternatives A2-A6) is the most effective location for the dike because this alignment is shorter than alternative A1 and it eliminates the need to construct islands. An analysis of various dike designs (alternatives A2, A3, and A4) found only minor differences in cost. Therefore, the sand berm/groin concept was selected because of probable additional habitat benefits associated with the design. Although Alternative A2 appears to be the most cost effective approach to meeting the migratory bird management goals of both pools A and B, it has a high risk of failure because of the potential loss of Kiep's Island through erosion and the subsequent inability to properly manage the pool. Alternative A6 would prevent this loss of pool management by maintaining the Kiep's Island barrier. Its cost per habitat unit is only slightly higher ($4/habitat unit) and also provides substantial cultural resource benefits. Because of the pool size, construction of alternative A6 would make it feasible to use aeration in the winter to improve fish habitat in pool A. The aeration equipment considered to be most effective for the size and depth of pool A would increase fish habitat in the pool four-fold at a cost of only $52/habitat unit.

Pool C - An incremental analysis of the pool C alternatives (C1-C4) indicates that alternative C1 (pumps and Trempealeau River inlet) is the most cost effective alternative. Supplying water solely from the Trempealeau River inlet (C3) would not be as effective because during certain times of the year it would not be desirable to draw water from the river due to water quality concerns. The alternative C4 (filling an additional 2 feet) was dropped from further evaluation for reasons discussed in the Alternative Evaluation section of this report.

The C2 pool alternative evaluation shows that the alternative C2(1) (with pumps) would be desirable from an annual cost per AAHU standpoint. Although a 25-percent reduction in construction cost is expected with C2(2), the 50-percent reduction in habitat benefits results in a significantly higher cost per AAHU.

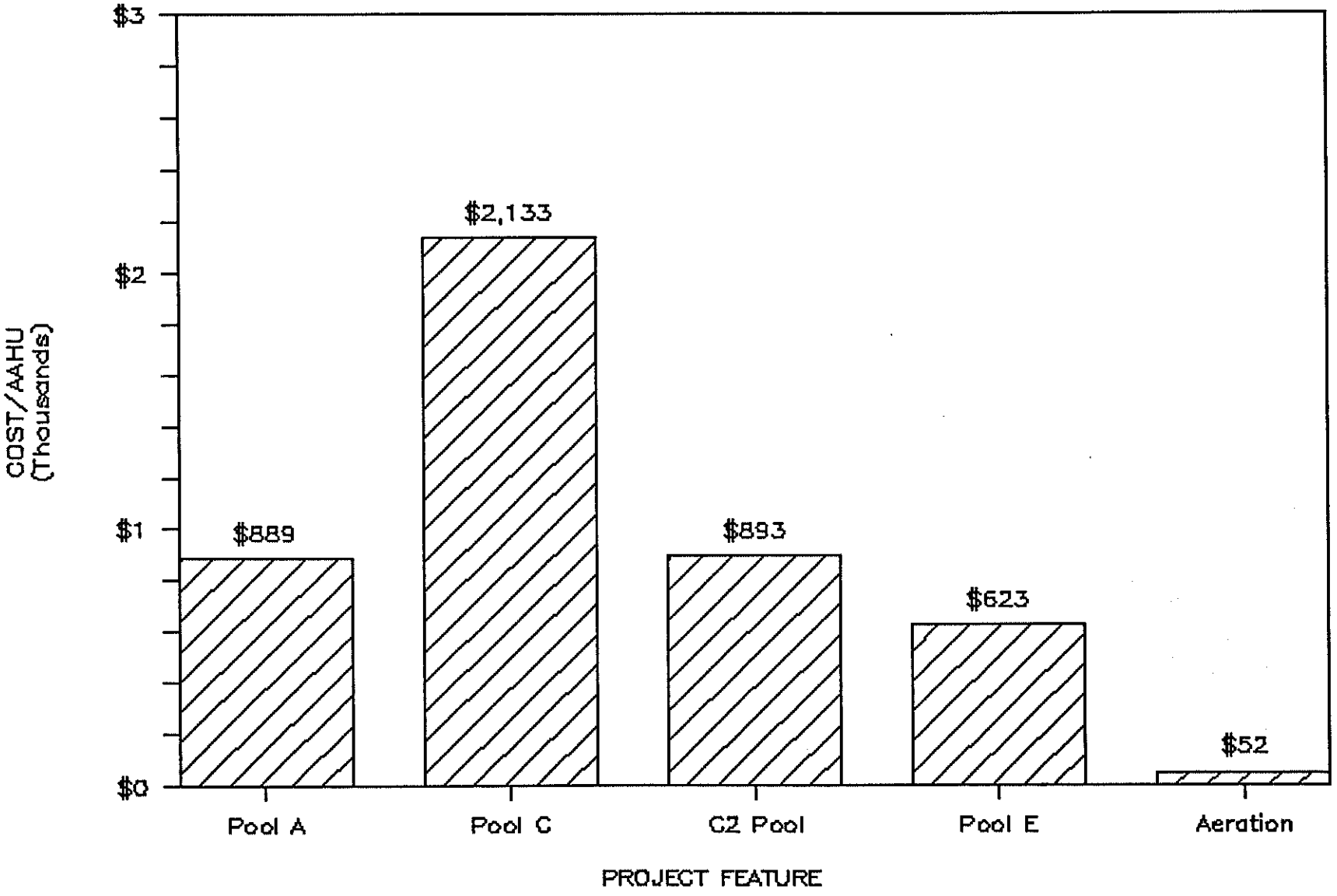
Pool E - No incremental analysis for this pool was done for the reasons previously stated in the Alternative Evaluation section of this report. Alternative E1 is the only alternative analyzed.

Summary - A comparison of the cost effectiveness for the preferred alternative for each of the four dikes and the separable aeration in pool A is shown in figure DPR-2. The analysis shows that on a cost per AAHU basis, the dike construction in pool E is the most cost effective ($623/AAHU), pool A is next most effective ($889/AAHU), the C2 pool is slightly more costly ($893/AAHU), and pool C is the least cost effective ($2,133/AAHU). Adding aeration to pool A would be very cost effective at $52/AAHU. A more detailed discussion of the incremental analyses is included in appendix A.

Figure DPR-2

TREMPEALEAU NWR

INCREMENTAL ANALYSIS



Because of the relatively high cost and limited increase in habitat benefits of the pool C dike, it should not be considered further unless there are other compelling reasons to pursue the development of pool C dike. Dikes A, C2, and E appear to be justified based on the reasonableness of costs and the resources being benefited. The enhancement and restoration of migratory bird habitat is very important to maintaining viable waterfowl populations along the migration corridor of the Upper Mississippi River.

Of the three dikes considered, construction of the pool A dike provides both migratory bird and fish habitat benefits. The construction of the dike would create a 700-acre management unit where it would be cost effective to control rough fish and to install aeration devices. These fishery benefits could not be achieved without the construction of the pool A dike.

SELECTED PLAN OF ACTION

Plan Description - The plan that best satisfies the immediate agency and public goals, habitat improvement objectives, and planning opportunities and constraints includes the following components:

(a) a dike from the eastern tip of Kiep's Island to the Burlington Northern railroad embankment to separate pools A and B (referred to as the pool A dike);

(b) a permanent pump station in the pool A dike to permit pumping from pool A and/or pool B to the Mississippi River, and gravity flow from pool B to pool A;

(c) rockfill protection along 900 feet of Kiep's Island;

(d) mechanical aeration in pool A;

(e) a dike to segregate the northwesterly portion of pool C (referred to as the C2 dike);

(f) a gravity flow gated inlet to the C2 pool from the Trempealeau River;

(h) a gravity flow gated outlet from the C2 pool to pool C;

(i) a dike to separate upper and lower pool E (referred to as the pool E dike);

(j) portable electric pumps to permit pumping from lower pool E to upper pool E and from pool C to the C2 pool, as necessary; and

(k) a gravity flow gated outlet from upper pool E to lower pool E.

The selected plan is shown on Plate 11. Typical cross-sections of the dikes are shown on Plate 12.

Pool A - The 4,000-foot-long dike would be located as shown on Plate 11 to separate pools A and B. A typical cross-section of the dike is shown on Plate 12. About 125,900 cubic yards of sand would be used to construct the dike to elevation 650 (4 feet above normal pool). The sand berm dike would have 19 rock groins on each side for a total of 38. The groins would be spaced 180 feet apart. The groin length would be 30 feet plus a 15-foot tie-in to the dike berm. The groins would have a top width of 2 feet with 1 vertical on 2 horizontal slopes. About 9,100 cubic yards of rock would be used for the groins. A typical section is shown on Plate 12. A 12-foot-wide road surface would be placed on top of the dike using a 6-inch-thick layer of gravel. A 200-foot-long emergency spillway at elevation 649 would be constructed to prevent failure of the dike system in case of excessive inflow from pool B because of heavy rainfall on the watershed. Geotextile reinforcement would be placed on the top and sides of the spillway with a gravel road on top and rock revetment on the downstream side. In pool A, dredging about 2 feet of material to a width of 15 feet along 5,000 linear feet of the dike would provide about 6,100 cubic yards of topsoil and create about 2 acres of additional deepwater habitat for fish. Using material from the adjacent pool area for topsoil on the dikes is intended to maximize the use of material from the immediate site.

Access for construction and operation and maintenance would be across Kiep's Island. A 15-foot-wide by 6-inch layer of gravel would be placed on the existing roadway alignment on Kiep's Island to protect cultural resource artifacts on the island from the effects of heavy equipment moving across the island. The existing causeway connecting the island to the rest of the Refuge would also be widened and graveled to accommodate the heavy equipment and improve safety. A landing for canoes and non-motorized boats would be constructed near the causeway for access to pool A because the existing boat access would only service pool B after dike A is in place. About 900 linear feet of Kiep's Island would be protected by constructing a rock wedge at the toe of the existing slope. About 1,400 cubic yards of rockfill would be used. It would be constructed by either dumping from the top of the bank, placing the rock on the ice along the shoreline in the winter, or by operating equipment on the top of the wedge as it is built. A typical cross-section of the protection is shown on Plate 12.

A permanent pump station would be constructed to provide the capability to lower the water level in pool A by 2 feet over a 20-day period. It would be designed to pump 22,000 gallons per minute and consists of two submersible electric pumps with a 28-inch discharge pipe. The station would be designed to allow pumping from pool A and/or pool B to the Mississippi River. The discharge pipe would be jacked through the Burlington Northern Railroad embankment. The pump station would be able to provide a 2-foot drawdown of pool A in no more than 20 days. Pump station details are shown on Plate 13. The pump station structure would also allow gravity flow from pool B to pool A. One cause of high turbidity in pool A and the resulting inhibited plant growth is rough fish activity. Reducing or eliminating rough fish populations is a secondary management goal. The pool A dike would inhibit migration of rough fish from pool B to pool A. However, an open culvert from pool B to pool A through the pump station would allow the rough fish access to pool A. Therefore, an additional feature was added to the pump station to further inhibit the migration of rough fish between the pools. A stoplog-controlled inflow crib immediately upstream of the inlet to the pump station in pool B was incorporated into the pump station design. It consists of four stoplog bays, five feet wide. The intent is to set the stoplogs to as high an elevation as possible so that the flow over the stoplogs will be as shallow as

possible. This will achieve the desired inflow while blocking the movement of fish as much as possible through the structure.

Winter aeration of pool A would be provided at 2 locations by placing 5 mechanical aerators at each location. The approximate locations are shown on Plate 11 and are in deeper areas of pool A. The aerators would be 3/4 horsepower electric units that would anchored just below the water surface to agitate the water and keep the surface from freezing. The aerators would be operated continuously from December through March. This will maintain adequate dissolved oxygen levels in these areas of the pool so that fish will survive the winter.

The main management goal in pool A is to promote aquatic plant growth through periodic drawdowns of the pool. The anticipated management plan would obtain a drawdown from mid-summer to mid-fall, since this is the period that provides the best opportunity for vegetation to become established. Normal pool water level is elevation 646. The typical operating condition for the pool would be for the gates in the pump station to be open to allow flow from pool B to pool A and the stoplog weirs to be set as high as possible without blocking exchange of water at the equilibrium elevation. Once a decision is made to draw down pool A, the following actions would take place: the gate at the existing Trempealeau River water control structure and the pump station gate to pool A would be closed; all stoplogs lowered into place at the crib; and the pump station activated. The drawdown of 2 feet would take between 2 and 3 weeks to complete. When the pool A elevation reaches 644, the pumping would cease. If, because of heavy rainfall and/or unexpectedly high inflows, pool A rises above elevation 644.5, pumping would start again to bring the water level down to elevation 644. Pool A would be maintained in this way for at least 2 to 3 months after drawdown is achieved. After this time, if no fish management goals are desired, the pool would be refilled by removing the appropriate number of stoplogs from the crib and opening the gate to pool A. It would take about one month for the pool A/pool B system to reach equilibrium. If the additional management goal to eliminate rough fish from pool A is desired, then the drawdown would remain in effect through the winter. Pool A would be refilled the following spring either with water from pool B or allowing it to rise gradually through the combination of precipitation, snowmelt, seepage, and inflow from springs. The choice would be made in the field at the time. Largemouth bass, black crappie, bluegill, northern pike, golden shiners, and yellow perch would be stocked into the restored pool from captured Refuge pool B fish and/or as they become available from the Genoa Fish Hatchery. The experience of the Refuge personnel will be a prime factor in operational decisions for optimum growth of vegetation and management of the fishery.

Pool C - The C2 pool would be created in the northwestern portion of pool C by constructing a 6,500-foot-long dike connected to the Green Bay and Western Railroad embankment on the west and the dike along the Trempealeau River on the north. The dike would be constructed to elevation 652 which would provide the capability to pond 4 feet of water in the C2 pool. The dike would have a 15-foot top width and side slopes of 1 vertical on 5 horizontal. A typical dike cross-section is shown on Plate 12. Material for topsoil on the dike would be obtained from existing material on the interior of the dike. A 12-foot-wide by 6-inch-thick layer of gravel would be placed on the top of the dike so that vehicles could be driven on the dike for operation and maintenance. Normal water supply would be gravity-fed from the Trempealeau River via a gated control structure consisting of a concrete headwall, slide gate, and 30-inch reinforced concrete pipe. However, electric power and

portable pumps would also be provided at the C2 pool so that water from pool C could be periodically supplied to the C2 pool when necessary. Two 4,500-gpm electric pumps would be used to provide a 4-foot increase in water level in pool C2 in 12 days. A concrete pad would be provided as a base for the pumps. A gated outlet control structure consisting of a headwall and 30-inch pipe (shown on Plate 14) would be placed in the dike at the location shown on Plate 11 to permit drainage of the C2 pool to pool C. A 200-foot-long emergency spillway at elevation 651 would be constructed to prevent failure of the dike system in the event that the inlet culvert from the Trempealeau River were inadvertently left open. Geotextile reinforcement with gravel on the top and rock revetment on the downstream side would be used. The C2 pool could be divided into smaller pools in the future, depending on the operational desires, costs, and habitat benefits obtainable. This could possibly be done by the Refuge with cooperation from Ducks Unlimited, Inc.

The operating plan for the C2 pool would be to initially fill it in the fall and hold the pool at elevation 650 for one growing season to set-back reed canary grass and willows. Water from the Trempealeau River would be used, with the option of using pumps if the river water quality is not adequate. The C2 pool could then be operated for one of three management options: (1) a spring resting and feeding area; (2) brood use; or (3) fall migration. To operate the pool for a spring resting and feeding area, an early spring pool elevation of 648 would be maintained. Gradually the pool would be dewatered over the summer to allow seed producing annual plants to grow and provide some habitat for fall migrating shorebirds. The following spring, the pool would be filled to elevation 650, making invertebrate and seed source available to migrating waterfowl. For brood use, elevations between 649 and 647 would be maintained, depending on the location of emergent aquatic vegetation that broods use for cover. To manage for fall migration, the pool would be dewatered in late fall to promote the growth of seed producing annual plants the next spring and summer. Then the pool would be flooded starting in late August to an elevation of 650. The management decisions for the various uses will be made by Refuge personnel, depending on weather conditions and the habitat conditions desired.

Pool E - A 6,600-foot-long dike would be constructed along an existing abandoned road in the Refuge (see Plate 11). The dike would begin at Upper Farm Road and end at the Green Bay and Western Railroad embankment. The dike would be constructed to 4 feet above normal pool (elevation 650) with a 15-foot top width and side slopes of 1 vertical on 5 horizontal. The dike design is similar to the C2 dike. A typical cross-section is shown on Plate 12. The height of the dike would allow the pool to be filled 2 feet above normal pool for habitat management. Material to place 6 inches of topsoil on the dike would be obtained from the pool adjacent to the dike. A 12-foot-wide by 6-inch-thick layer of gravel would be placed on the top of the dike so that vehicles could be driven on the dike for operation and maintenance. A 200-foot-long emergency spillway at elevation 649 would be constructed to prevent failure of the dike system in case of excessive inflow from lower pool E because of heavy rainfall on the watershed. Geotextile reinforcement would be placed on the top and sides with a gravel road on top and rock revetment on the downstream side. Two portable, submersible, electric 4,500-gpm pumps would be used to provide a 2-foot increase in water level up upper pool E in not more than 21 days. A concrete pad would be provided as a base for the pumps. A gated outlet control structure consisting of a headwall and 30-inch pipe (shown on Plate 14) would be placed in the dike at the location shown on Plate 11 to permit drainage of the upper pool to lower pool E.

Pool E would be managed for maximum habitat flexibility, depending on the specific goal in any one year. Once a decision is made to raise the pool, the outlet culvert would be closed and the portable pumps would be brought in to pump water from the lower pool E. The upper pool E would be raised to elevation 648, taking about 3 weeks. It would be maintained at that level for 2 to 3 months. When the management objectives have been met, the outlet culvert would be opened and the pool would reach equilibrium with the other pools in about 3 weeks.

Sources of Fill Material - Material to construct the pool A dike would be obtained from near the main navigation channel at about river mile 719.5. The exact location has not yet been determined, but it is known that adequate material is available in the vicinity. Material to construct the pools C2 and E dikes would be obtained from near the main channel or backwaters, from within pool A, from a dredged material placement site at river mile 732 near Fountain City, Wisconsin, or from a dredged material beneficial use site near Trempealeau. Additional soil investigations would be made to determine useable sites. The potential borrow sites are shown on Plate 15. Topsoil for the dikes would be excavated from the pools adjacent to the dikes. Rock riprap would be obtained from existing operating limestone quarries located near the Mississippi River valley in the vicinity of the Refuge.

Construction Methods

Pool A - Sand for the dike would be hydraulically dredged from the Mississippi River and deposited directly in place along the dike alignment. The dredge discharge pipe would be placed inside a pipe that would be jacked through the existing Burlington Northern Railroad embankment for the permanent pump station. The jacked pipe would eventually be the discharge pipe for the pump station. Material would be placed at the site of the pump station to pre-load the site prior to constructing the station. After appropriate settlement time, the site would be excavated, dewatered, and the pump station constructed. Riprap for the dike would be hauled by truck through the Refuge via Kiep's Island and placed along the dike using a clamshell crane. Gravel for the top of the dike would also be hauled by truck through the Refuge, placed directly on the top of the dike, and spread by grader. Topsoil for the dike would be obtained from the backwater adjacent to the dike using a clamshell, dragline, or backhoe and spread on the dike with a dozer. Three-phase, underground electric power would be run to the site for the pump station and aerators. Underground lines would be used in accordance with Refuge policy to prevent injury to the thousands of waterfowl that use the area. Markers would be placed in the pool so that the aerators could be installed at the desired locations in the fall by Refuge personnel. Anchors would be used to set the aerators.

Pool C - Several alternatives would be investigated to determine the exact source of material to construct the C2 dike. Possible methods include: dredging near the main channel or backwaters of the Mississippi River with placement directly on the dike alignment or stockpiling at a location on the Refuge and hauling by truck to the dike and spread by dozer; dredging from within pool A; or hauling by truck from beneficial use sites near Fountain City or Trempealeau, Wisconsin, and spreading by dozer. The actual method will be determined during the more detailed design stage. Gravel for the top of the dike would be hauled by truck, placed directly on the top of the dike, and spread by grader. Topsoil for the dike would be obtained from the

existing ground adjacent to the interior of the dike using a clamshell, dragline, or backhoe and spread on the dike with a dozer. Three-phase, underground electric power would be run to the site for use of the portable pumps.

Pool E - The dike would be constructed the same as described for the C2 dike, depending on the source of material. Three-phase, underground electric power would be run to the site for the portable pumps.

Project Support - The participants in the planning process provided written and verbal suggestions that were considered fully during plan development and selection. Their written comments and letters of support are included in attachments 4 and 5.

Project Accomplishments - The proposed project has been designed to meet or address the project objectives shown in table DPR-2.

Real Estate Requirements - Permanent easements need to be acquired for the proposed project where the dikes tie to the existing railroad embankments. The pool A dike and discharge pipe would involve Burlington Northern Railroad and the pool E dike would involve Green Bay and Western Railroad. The U.S. Fish and Wildlife Service has made an initial contact with the railroads and has received responses from the railroads. The Green Bay and Western Railroad is agreeable to the project as long as the proper lease agreement is executed. The USFWS would be responsible for the agreement and any fees. The Burlington Northern Railroad has requested additional information and assurances prior to their approval. Letters from the railroads are included in attachment 5. No other lands would be required since the project would be located on land owned and managed by the USFWS. Appropriate agreements would be made with the USFWS for the construction and operation and maintenance of the project.

ENVIRONMENTAL ASSESSMENT

An environmental assessment has been conducted for the proposed action, and a discussion of the impacts on habitat conditions follows. As specified by Section 122 of the 1970 Rivers and Harbors Act, the categories of impacts in the impact assessment matrix (table DPR-4) 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 was prepared (attachment 3). A separate Section 404(b)(1) evaluation was prepared for each pool since the actions are not dependent on each other. Application has been made to the State of Wisconsin regarding water quality certification under section 401 of the Clean Water Act. The Finding of No Significant Impact (attachment 2) will be signed after the public review period has elapsed, any issues have been resolved, and the water quality certification has been obtained. If the public review uncovers significant impacts, a revised NEPA document may be prepared.

Table DPR–4 – IMPACT ASSESSMENT MATRIX

NAME OF PARAMETER	MAGNITUDE OF PROBABLE IMPACT						
	← INCREASING BENEFICIAL IMPACT			NO APPRECIABLE EFFECT	INCREASING → ADVERSE IMPACT		
A. SOCIAL EFFECTS	SIGNIFICANT	SUBSTANTIAL	MINOR		MINOR	SUBSTANTIAL	SIGNIFICANT
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 & 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 Revenues				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 EFFECTS							
1. Historic Architectural Values				X			
2. Pre-Hist & Historic Archeological Values			X				

RELATIONSHIP TO ENVIRONMENTAL REQUIREMENTS

The proposed action would comply with all applicable Federal environmental laws, executive orders, and policies, and State and local laws and policies including the Clean Air Act, as amended; the Clean Water Act of 1977, as amended; the Endangered Species Act of 1973, as amended; the Land and Water Conservation Fund Act of 1965, as amended, the National Environmental Policy Act of 1969, as amended, the Fish and Wildlife Conservation Act of 1958, as amended, the National Wildlife Refuge System Administration Act; Executive Order 11988 - Floodplain Management; and Executive Order 11990 - Protection of Wetlands. The proposed action would not result in the conversion of farmland to non-agricultural uses. Therefore, the Farmland Protection Policy Act of 1981 does not apply to this project.

NATURAL RESOURCES

Habitat - The proposed actions would improve migratory bird habitat conditions on 3,470 acres of the Trempealeau National Wildlife Refuge. Of these acres, 700 acres in pool A would also have improved fish habitat conditions.

In order to better quantify habitat benefits of the proposed actions, the Wildlife Habitat Appraisal Guide (WHAG) was used to evaluate project effects. The WHAG methodology, developed by the Missouri Department of Conservation and the U.S. Soil Conservation Service, is a modification of the U.S. Fish and Wildlife Services' Habitat Evaluation Procedure (HEP). As in HEP, the WHAG methodology utilizes a Habitat Suitability Index (HSI) to rate habitat quality on a scale of 0 to 1 (1 being optimum). The HSI is multiplied by the number of acres of available habitat to obtain Habitat Units (HU's). One HU is defined as one acre of optimum habitat. By comparing existing HU's to HU's expected to be gained with the proposed action, the benefits can be quantified.

The mallard was selected as the evaluation species for portions of the evaluation since the goal of the Refuge is to improve habitat for dabbling ducks in some management units. Another key objective at the Refuge is to improve migratory habitat for diving ducks in specific management units. There were no available models for diving duck migratory habitat on the Upper Mississippi River, for either WHAG or HEP, so a model was developed.

The U.S. Fish and Wildlife Services' HEP was used to evaluate project effects for fish species because of the readily available fish species models associated with this methodology.

Table DPR-5 summarizes the habitat benefits that would accrue with the implementation of the selected project features for the Trempealeau National Wildlife Refuge. A detailed discussion of the habitat evaluation procedures conducted for this project is presented in appendix A.

Table DPR-5. Summary of HEP Analysis

PROJECT FEATURE	SPECIES BENEFITED	ACRES	FUTURE W/O PROJECT (AAHU's)	FUTURE WITH PROJECT (AAHU's)	AAHU's GAINED
Pool A Dike	Waterfowl	2,700	1,237	1,509	272
C2 Dike	Waterfowl	220	22	120	98
Pool E Dike	Waterfowl	550	193	296	103
Mechanical Aeration	Centrarchids	700	623	1,144	260*

*Full benefits achieved for only half of the year.

Habitat benefits for migratory birds would be derived from the ability to manipulate water levels in the various management units. In pool A, the ability to lower water levels for extended periods would greatly increase the growth and availability of important aquatic plants to migrating birds. In addition, the dike would reduce wind fetch for pool A thereby improving conditions for aquatic plant growth. The C2 dike would allow water level control in the C2 pool, providing the capability to control vegetational succession and improve the habitat quality in this management unit for migratory birds. The pool E dike would provide migratory bird habitat benefits in the same manner as those described for the C2 dike.

Substantial habitat benefits for fish would also be realized in a portion of pool A with the construction of the pool A dike. Present conditions in pool A do not allow for the establishment of a fishery in any portions of pool A. The dike would allow the capability to keep rough fish out of the lower 700 acres of this management unit. Coupled with the installation of mechanical aeration, and the increased aquatic vegetation that would become established with water level control, the opportunity to establish a viable fishery in lower pool A would be established. Construction of the pool A dike may have a negative impact on the fish habitat in pool B because it would reduce the acreage of deep water (greater than 4 feet) fish habitat available in pool B. However, this reduction of habitat in pool B is considered acceptable given the fish habitat gains in pool A due to aeration.

Impacts on terrestrial habitat would be negligible. Construction of the project would result in some short-term disturbance impacts resulting from vegetation clearing and earth moving. These impacts would be associated primarily with the construction of the C2 and pool E dikes.

Approximately 22 acres of wetland would be affected with the placement of fill material for the dikes and the protection at Kiep's Island. This loss in wetland habitat is considered to be an acceptable tradeoff in order to be able to effectively manage water levels in each of the management pools. The gain in habitat benefits that would result from the management activities will more than offset the losses that would occur with construction.

Riprap would come from established quarries in the area. Fill material for Dike A would be obtained by dredging in the main channel of Mississippi River in the immediate vicinity. Specific locations of the dredge cuts have not yet been determined. A mussel survey of the selected dredge areas will be completed during the preparation of plans and specifications. Fill material for constructing the C2 dike and Dike E would come from near the main channel or backwaters of the Mississippi River, pool A, or a dredged material beneficial use site near Fountain City or Trempealeau.

Water Quality - The proposed action would result in short-term decreases in water quality because of localized increases in turbidity during construction and/or dredging.

Endangered Species - No state listed or federally listed threatened or endangered species would be adversely affected by the project. As noted earlier, suitable habitat for the Higgins' eye pearly mussel is not present on the Refuge. The construction activities would not affect the suitability of the existing nesting sites for either bald eagles or ospreys on the Refuge. Critical habitat for the the state-listed wood turtle and the Blanding's turtle would not be affected by the proposed construction activities.

Air Quality - The proposed actions would have minor negative effects on air quality. Exhaust emissions from construction equipment would degrade air quality slightly for short periods. This temporary change in air quality could disturb people using adjacent areas of the Refuge, but the overall effect on people, vegetation, and wildlife would be negligible.

CULTURAL RESOURCES

Land areas that would be affected by the proposed construction include no historical or archaeological sites listed in the National Register. However, rich prehistoric cultural remains in the area include one site (47 TR 86) deemed eligible for inclusion in the National Register, and several others (47 TR 85, 114-116, and 150; and possibly the mound sites) with a high probability of eligibility.

Based on the archaeological survey of 1990 and consultation with the U.S. Fish and Wildlife Service Historic Regional Preservation Officer, the following evaluations can be made of areas to be affected by the various proposed project features:

-Riprap protection of Kiep's Island. Serious erosion of in situ cultural deposits has been noted in this area since 1981, and this stabilization would protect significant cultural resources. However, since the sites (including human burials) are already eroding out of the bank, the riprapping would be done in a manner that would not affect the site further. This would include avoiding cutting back the bank, grubbing tree roots, and activities on the top of the bank.

-Construction of dike A and access road on Kiep's Island. Most of the high ground (above El. 650 amsl) on Kiep's Island has been found to contain cultural material, probably related to the multi-component habitation and burial site at 47 TR 86. Since this site is eligible for the National Register of Historic Places, any activities that may affect the site would have to be coordinated through the Advisory Council. The proposed access road (currently existing as an unimproved track) crosses the site, and heavy use of the road could damage cultural materials through compaction. Before construction of the dike, the length of the road would have to be surfaced with 6 inches of gravel and then evaluated after construction. Burial of the power line for the aerators and pumping station would also have to be coordinated with the Advisory Council. Any bank modification for the dike tie-in could also affect cultural materials.

-Access road to Green Bay dike. This access road was apparently built between 1934 and 1938, just after the land was acquired for the Refuge (the road shows clearly on a 1938 aerial photograph). It is built to an elevation a couple of feet above the floodplain, and may have functioned in part as a dike. It was apparently constructed by sidecasting material from the pool, and thus the adjacent strips of land are disturbed. Additional sidecasting from the pool to provide topsoil for the dike will pose no threat to the cultural resources reported (but unlikely to exist) in Sections 4 and 5 of Trempealeau Township.

SOCIOECONOMIC FACTORS

The proposed project would have minimal or no impacts on the following Section 122 (1970 Rivers and Harbors Act) socioeconomic categories: transportation, public health and safety, community cohesion, community growth and development, business or home relocations, land use, property values, tax revenues, regional growth, employment, business activity, food supply, navigation, flooding effects, or energy resources.

Noise Pollution - The immediate vicinity around the project area would be temporarily disrupted by construction activities. Some disturbance may occur from noise and human activity, although these impacts are temporary, and adverse impacts to the general public would be short-term and insignificant.

Recreation and Aesthetic Values - The presence of construction equipment would have a temporary negative effect on aesthetic values in the area.

PROJECT REQUIREMENTS

OPERATION AND MAINTENANCE

After construction of the project, annual operation and maintenance (O&M) of the project would be the responsibility of the U.S. Fish and Wildlife Service (USFWS). Generally, it is anticipated that O&M requirements would include setting, operating, and maintaining pumps; refurbishing pumps on a periodic basis; repairing displaced rock from the dike A groins and the inlet and outlet structures; repairing minor erosion and maintaining vegetation on the dikes; setting and operating the aerators; lubrication of control structure gates; debris removal from pumping and control structures; maintenance of the gravel road surfaces on the dikes; monitoring water levels

within the Refuge for proper habitat management; inspection; and preparation of reports. An O&M manual detailing the specific requirements of the project would be prepared by the Corps during the plans and specifications phase. Development of the manual would be coordinated with the USFWS and Wisconsin Department of Natural Resources. Over the 50-year project life, the estimated average annual O&M cost for each pool is shown in table DPR-6. Total costs are rounded.

Table DPR-6 - Estimated Average Annual O&M Costs

	Average annual cost
Pool A	
Inspection and reports (1 mn-dy/yr @ $250/mn-dy)	$ 250
Rockfill replacement (ave. 6 CY/yr @ $60/CY)	360
Gravel replacement (ave. 7 CY/yr @ $40/CY)	280
Care of vegetation (2 mn-dy/yr @ $250/mn-dy)	500
Electric charge (pumps)	
(every 5 yr @ Pres Worth $40,745 to promote veg)	3,523
(every 15 yr @ Pres Worth $12,689 to kill rough fish)	1,097
Electric charge (aeration)	
(each yr except for fish kill)	767
Pump maintenance	
(each yr @ Pres Worth $12,157 to promote veg)	1,051
(every 15 yr @ Pres Worth $3,335 to kill rough fish)	288
Pump station maintenance (3 mn-dy/yr @ $250/mn-dy)	750
Aerator maintenance (each yr except for fish kill)	4,200
TOTAL ANNUAL O&M COST FOR POOL A	$13,100
Pool C (C2 pool)	
Inspection and reports (1 mn-dy/yr @ $250/mn-dy)	$ 250
Random fill (ave. 25 CY/yr @ $20/CY)	500
Rockfill replacement (ave. 2 CY/yr @ $70/CY)	140
Gravel replacement (ave. 5 CY/yr @ $35/CY)	175
Care of vegetation (2 mn-dy/yr @ $250/mn-dy)	500
Electric and maintenance charges (pumps)	866
Gate maintenance (2 mn-dy/yr @ $250/mn-dy)	500
Control structure operation (2 mn-dy/yr @ $250/mn-dy)	500
Debris removal (4 mn-dy/yr @ $250/mn-dy)	1,000
TOTAL ANNUAL O&M COST FOR POOL C (C2 pool)	$4,400
Pool E	
Inspection and reports (1 mn-dy/yr @ $250/mn-dy)	$ 250
Random fill (ave. 50 CY/yr @ $20/CY)	1,000
Rock replacement (ave. 1 CY/yr @ $70/CY)	70
Gravel replacement (ave. 7 CY/yr @ $37/CY)	260
Care of vegetation (2 mn-dy/yr @ $250/mn-dy)	500
Electric and maintenance charges (pumps)	1,165
Gate maintenance (1 mn-dy/yr @ $250/mn-dy)	250
Control structure operation (1 mn-dy/yr @ $250/mn-dy)	250
Debris removal (2 mn-dy/yr @ $250/mn-dy)	500
TOTAL ANNUAL O&M COST FOR POOL E	$4,200
TOTAL ANNUAL O&M COST FOR SELECTED PLAN	$21,700

COST ESTIMATE

A cost estimate for the project is shown in table DPR-7. This cost estimate differs from the estimate shown earlier in this report because it is based on more detailed project design and cost analyses after the plan formulation phase, especially relating to the pump station and outlet structures. Extensions are rounded to the nearest $100 and column totals to the nearest $1,000. A more detailed M-CASES estimate in the code of accounts format is included in appendix E.

Table DPR-7 - Cost Estimate for the Selected Plan

FEATURE	QUANTITY	UNIT PRICE	AMOUNT $	CONTINGENCY AMOUNT$	(%)	TOTAL AMOUNT $
Mobilization/demob	1	-	86,700	21,700	25	$ 108,000
POOL A						
Sandfill	125,900 CY	6.72	846,000	296,100	35	$1,142,100
Rockfill, groin	9,100 CY	36.44	331,600	82,900	25	414,500
Gravel, dike	900 CY	17.57	15,800	2,400	15	18,200
Gravel, road	310 CY	17.57	5,400	800	15	6,200
Riprap, road	75 CY	36.44	2,700	500	20	3,200
Rockfill, Kiep's	1,400 CY	30.59	42,800	8,600	20	51,400
Topsoil	6,100 CY	3.30	20,100	3,000	15	23,100
Seeding	7.6 AC	3255.00	24,700	3,700	15	28,400
Overflow spillway	200 LF	99.60	19,900	5,000	25	24,900
Boat ramp	1 JB	-	1,400	400	30	1,800
Pump station	1 JB	-	458,900	165,200	36	624,100
Electrical service	1 JB	-	280,000	42,000	15	322,000
Submersible pumps	2 EA	90000.00	180,000	18,000	10	198,000
Electrical & controls	1 EA	50000.00	50,000	5,000	10	55,000
Aeration	10 EA	1718.52	17,200	4,300	25	21,500
POOL A SUBTOTAL DIRECT CONSTRUCTION COSTS			2,297,000	638,000	-	2,935,000
POOL C (C2 pool)						
Sandfill	50,000 CY	4.91	245,500	85,900	35	$ 331,400
Gravel, dike	3,200 CY	17.57	56,200	8,400	15	64,600
Topsoil	7,000 CY	3.30	23,100	3,500	15	26,600
Seeding	10.3 AC	3255.50	33,500	5,000	15	38,500
Clearing, light	7.2 AC	2873.00	20,700	3,100	15	23,800
Overflow spillway	200 LF	56.44	11,300	2,800	25	14,100
Portable pumps	2 EA	25000.00	50,000	5,000	10	55,000
Portable pump pad	1 EA	22286.00	22,300	4,500	20	26,800
Electric service	1 JB	-	70,000	10,500	15	80,500
Outlet culvert	1 JB	-	83,500	28,400	34	111,900
Inlet culvert	1 JB	-	168,700	50,600	30	219,300
POOL C2 SUBTOTAL DIRECT CONSTRUCTION COSTS			785,000	208,000	-	993,000

Table DPR-7 - Cost Estimate for the Selected Plan (continued)

FEATURE	QUANTITY	UNIT PRICE	AMOUNT $	CONTINGENCY AMOUNT$	(%)	TOTAL AMOUNT $
POOL E						
Sandfill	44,700 CY	3.72	166,300	58,200	35	$ 224,500
Gravel, dike	1,500 CY	17.57	26,400	4,000	15	30,400
Topsoil	4,900 CY	3.28	16,100	2,400	15	18,500
Seeding	5.6 AC	3255.50	18,200	2,700	15	20,900
Clearing, med	4.0 AC	3332.38	13,300	2,000	15	15,300
Overflow spillway	200 LF	56.44	11,300	2,800	25	14,100
Portable pumps	2 EA	25000.00	50,000	5,000	10	55,000
Portable pump pad	1 EA	22286.00	22,300	4,500	20	26,800
Electric service	1 JB	-	70,000	10,500	15	80,500
Outlet culvert	1 JB	-	95,600	31,600	33	127,200
POOL E SUBTOTAL DIRECT CONSTRUCTION COSTS			489,000	124,000	-	613,000
SELECTED PLAN						
TOTAL DIRECT CONSTRUCTION COST			3,658,000	991,000		$4,649,000
ENGINEERING AND DESIGN			340,000	52,000		392,000
SUPERVISION & INSPECTION			273,000	74,000		347,000
TOTAL CONSTRUCTION COST FOR SELECTED PLAN			4,271,000	1,117,000		$5,388,000

Reasons for contingencies: (1) Quantity unknowns (based on available information); (2) Unit price unknowns; (3) Unknown site conditions; (4) Haul distance; (5) Production/duration uncertainties; and (6) Material cost factors.

NOTES:

(1) General design (planning) allocations have totaled about $341,000.

(2) Annualized first costs (based upon a 50-year economic life and an 8-1/4% discount rate) would amount to $453,100. With the addition of annual operation and maintenance costs, the total average annual costs are estimated to be $474,800. The cost for pool A assumes pumping material into place from the vicinity of the Mississippi River channel and costs for pools C2 and E assume hauling of dredged material from near Fountain City.

(3) The updated costs per average annual habitat units gained by implementation of the selected plan for pool A, pool C2, pool E, and aeration are $1,098, $1,057, $635, and $27, respectively.

(4) Performance evaluation costs are shown in table DPR-9.

PERFORMANCE EVALUATION

The principal types, purposes, and responsibilities of project monitoring and performance evaluation are shown in table DPR-8.

Table DPR-8
UMRS-EMP Monitoring and Performance Evaluation Matrix

Type of Activity	Purpose	Responsible Agency	Implementing Agency	Funding Source	Remarks
Sedimentation Problem Analysis	Sedimentation Research Strategy. /1	USFWS	USFWS (EMTC)	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 baseline for performance evaluation and inventory basic habitat conditions for project planning.	Corps of Engineers	Field stations or sponsors thru Cooperative Agreements, or Corps. /2	HREP	Over several years to reconcile perturbations. Project should be in "Active" portion of Spreadsheet.
Data Collection for Design	1. Identify project objectives. 2. Design of project. 3. Develop Performance Evaluation Plan.	Corps of Engineers	Corps of Engineers	HREP	
Performance Evaluation Monitoring	Determine success of projects.	Corps of Engineers	Field stations or sponsors thru Cooperative Agreements, sponsor thru O&M, /3 or Corps. /2	HREP	After construction.
Analysis of Biological Responses to Projects	1. Species abundance monitoring and internal UMRS cause-effect relationsips. Reevaluate design criteria assumptions.	Corps of Engineers	Corps/USFWS (EMTC)/Others	HREP	Biological Response Study tasks beyond scope of Performance Evaluation, Problem Analysis, and Trend Analysis.
	2. System-wide applicability of Level 1 results.	USFWS	USFWS(EMTC) (EMTC)/Others	LTRM	Problem Analysis and Trend Analysis studies of habitat projects.

1/ Refers to Sedimentation Research Strategy 1.2.1, Final Draft LTRM Operating Plan.

2/ 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.

3/ 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.

Post-construction plans to monitor the performance of the project were designed to directly measure the degree of attainment of project objectives. For each objective, an appropriate monitoring parameter was chosen. The parameter to be measured for each objective is shown in table DPR-9. Monitoring activities would be closely coordinated with any similar efforts by the Long Term Resource Monitoring program component and could be modified in the future based on field observations. Some limited, biological monitoring (fish and migratory bird response to water level manipulation) would likely be done by Refuge personnel as part of normal Refuge management activities. However, biological monitoring is not part of formal performance evaluation activities proposed for the project.

The U.S. Fish and Wildlife Service has established a network of staff gages on the Refuge and along the Trempealeau River. The purpose of this network is to obtain river and Refuge pool stage information in order to make operational decisions and to establish a regular record of conditions in and near the Refuge. Gages have been set at four locations on the Refuge and two locations along the Trempealeau River. Operation of the pools would require the use of these gages and is discussed in detail in appendix B. Gage locations may need to be changed, added to, or deleted after completion of the project and operations begin.

PROJECT IMPLEMENTATION

DIVISION OF PLAN RESPONSIBILITIES

The responsibilities for plan implementation and construction fall to the Corps of Engineers as the lead Federal agency. Acquisition of easements from the Burlington Northern Railroad, Green Bay and Western Railroad, and Dairyland Power Association for dike tie-ins and water diversion structure would be the responsibility of the U.S. Fish and Wildlife Service. Operation and maintenance (included minor repair and replacement) of the completed project would be the responsibility of the USFWS. Should rehabilitation of the project which exceeds the annual maintenance requirements be needed (as a result of a specific storm or flood event) the Federal share will be a responsibility of the Corps. Project performance evaluation and major rehabilitation would be the responsibility of the Corps of Engineers. Some project performance monitoring (field observations) would be accomplished by the USFWS during normal management efforts in the area. This will be more specifically coordinated and defined in the future O&M manual.

Table DPR-9 – Pre- and Post-construction Measurements

Goal	Project Objective	Enhancement Feature	Unit of Measure	Measurement Plan	Monitoring Interval	Projected Cost per Effort	Field Observations
Pool A							
Provide breeding, resting, and feeding habitat for migratory birds and establish a fishery	Establish emergent & submergent vegetation	Dike; pump station	acres	Vegetation survey (aerial photos to map vegetation)	Once pre- and 1, 3, and 10 yrs post-construction	$2,000	Vegetation and bird use
			feet	Monitor water level drawdown	Each year of drawdown	Included in O&M cost	
	Maintain existing islands	Dike; rockfill protection	feet	Measure Klep's shoreline from baseline and Black Oak from aerial photo	Once 0 and 10 yrs post-construction	$1,000	Erosion of bank
	Maintain dissolved oxygen levels >5 mg/l	Aeration	mg/l	Measure DO near aerators every 2 weeks during operation	Once pre- and 1 and 3 year post-construction	$2,500 (each operation)	Presence of fish
Pool B							
Provide breeding, resting, and feeding habitat for migratory birds	Maintain existing wetland water levels	Dike; pump station	feet	Monitor water levels	Each year	Included in Refuge mgmt activities	Vegetation and bird use
Pool C (C2)							
Provide breeding, resting, and feeding habitat for migratory birds	Provide flooded marsh	Dike; water supply inlet and pumps	feet	Monitor water levels	Each year	Included in O&M cost	Vegetation and bird use
	Limit woody vegetation	Dike; water supply inlet and pumps	acres	Use aerial photos to plot limits of woody veg.	Once pre- and 1, 3, and 10 yrs post-construction	$400	Willow encroachment
Pool E							
Provide breeding, resting, and feeding habitat for migratory birds	Provide flooded marsh	Dike; water supply pumps	feet	Monitor water levels	Each year	Included in O&M cost	Vegetation and bird use
	Limit woody vegetation	Dike; water supply pumps	acres	Use aerial photos to plot limits of woody veg.	Once pre- and 1, 3, and 10 yrs post-construction	$800	Willow encroachment

Average annual monitoring cost over the 50-year project life = $450

COST APPORTIONMENT

Construction - All project construction activities would be conducted on lands managed as part of the Trempealeau National Wildlife Refuge. Therefore, in accordance with Section 906(e)(3) of Public Law 99-662, the first costs for construction of the project would be 100-percent Federal and would be borne by the Corps of Engineers.

Operation and Maintenance - After construction of the project, annual management operations would be conducted by the U.S. Fish and Wildlife Service. A draft Memorandum of Agreement for operation and maintenance is included as attachment 6. The U.S. Fish and Wildlife Service would assume 100-percent of the operation and maintenance responsibilities in conformance with Section 107(b) of the Water Resources Development Act of 1992. A letter of intent from the U.S. Fish and Wildlife Service is included in attachment 4. Specific operation and maintenance features would be defined in a project O&M manual which would be prepared by the Corps and coordinated with the involved agencies during the plans and specifications phase.

Rehabilitation - Rehabilitation of the project cannot be accurately estimated. The U.S. Army Corps of Engineers will be responsible for 75 percent of the cost of rehabilitation work that is mutually agreed upon and determined necessary for the project or functional portion. The non-Federal sponsor is responsible for the remaining 25 percent of rehabilitation cost, in accordance with Section 906(e) of the Water Resources Development Act of 1986.

STEPS PRIOR TO PROJECT CONSTRUCTION

After submittal of the final report to higher authority, funds for preparing plans and specifications can be provided by the Office of the Chief of Engineers, prior to approval of the project by the Assistant Secretary of the Army (Civil Works). As described in this report, this work would include ground surveys, bathymetry in pool A, soil borings for final borrow site selection, final design of the dikes, pump station, and inlet and outlet control structures, and coordination with the railroads.

The current schedule is to begin final design work for preparing plans and specifications in February 1994. A construction contract would be advertised by the competitive bid process and is scheduled to be awarded in October 1994 and the work completed in September 1997.

RECOMMENDATIONS

I have weighed the accomplishments to be obtained from construction of this habitat improvement project against its cost and have considered the alternatives, impacts, and scope of the proposed project. In my judgment, the proposed project is a justified expenditure of Federal funds. I recommend that the Secretary of the Army approve this interior diking and water level control project at the Trempealeau National Wildlife Refuge in Trempealeau and Buffalo Counties, Wisconsin, for habitat rehabilitation and enhancement. The total estimated construction cost of the project is $5,388,000, which amount would be a 100-percent Federal cost according to Section 906(e)(3) of Public Law 99-662.

for Charles W Rogers MAJ, EN

James T. Scott
Colonel, Corps of Engineers
District Engineer

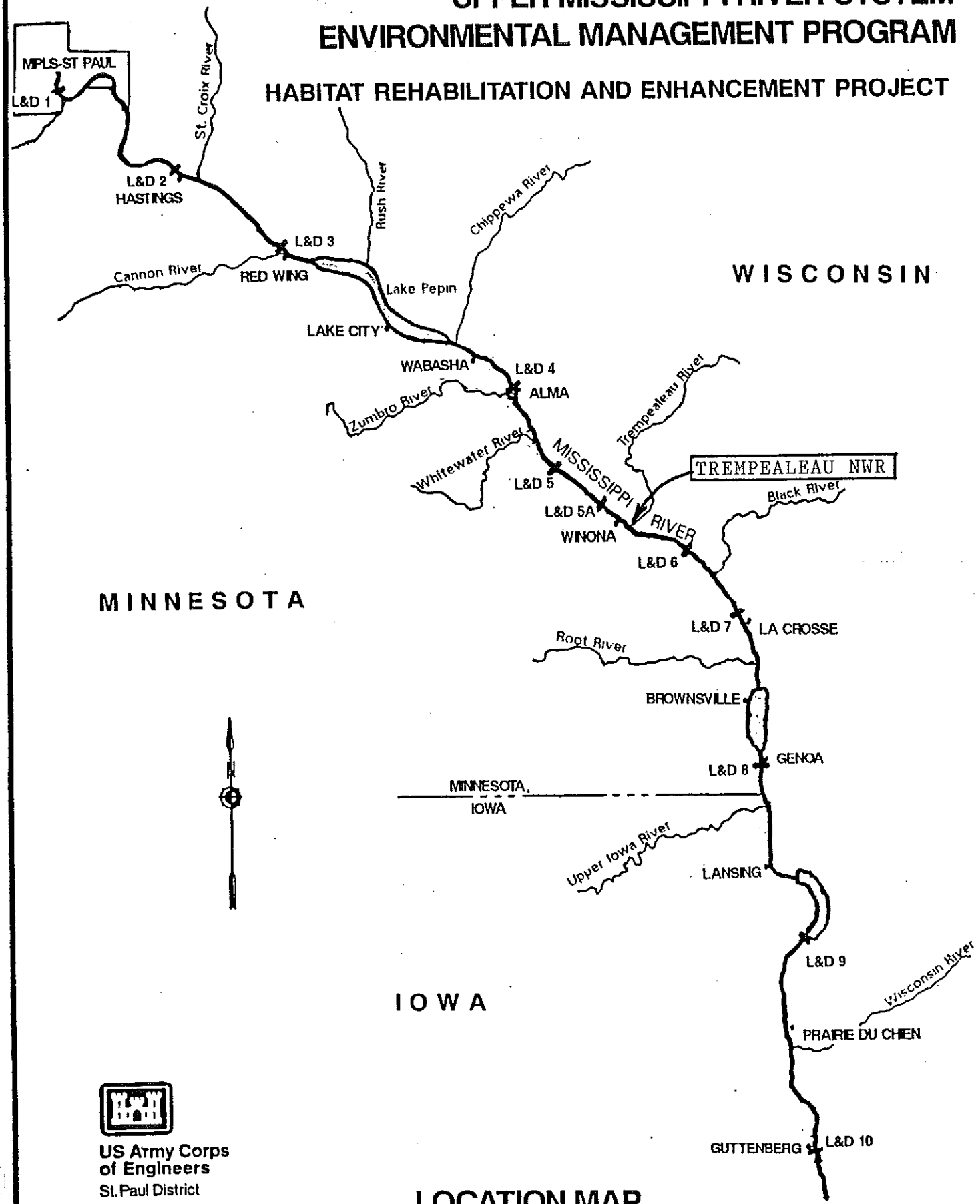
Attachments:
1. Plates:
   1 - Location Map
   2 - Refuge Map
   3 - Refuge Pools
   4 - Wetlands
   5 - Uplands and Bottomland Forest
   6 - Pool A Alternatives
   7 - Pool A - Typical Dike Cross-Sections
   8 - Pool C Alternatives
   9 - Typical Cross-Sections, Pools C & E Alternatives
  10 - Pool E Alternatives
  11 - Selected Plan
  12 - Typical Cross-Sections, Selected Plan
  13 - Pump Station
  14 - Gated Control Structure
  15 - Borrow Sites
2. Finding of No Significant Impact
3. Section 404(b)(1) Evaluation
4. Letter of Intent
5. Coordination
6. Draft MOA for O&M
7. Distribution List

Attachment 1

Plates

UPPER MISSISSIPPI RIVER SYSTEM ENVIRONMENTAL MANAGEMENT PROGRAM

HABITAT REHABILITATION AND ENHANCEMENT PROJECT



US Army Corps of Engineers
St. Paul District

LOCATION MAP

PLATE 1

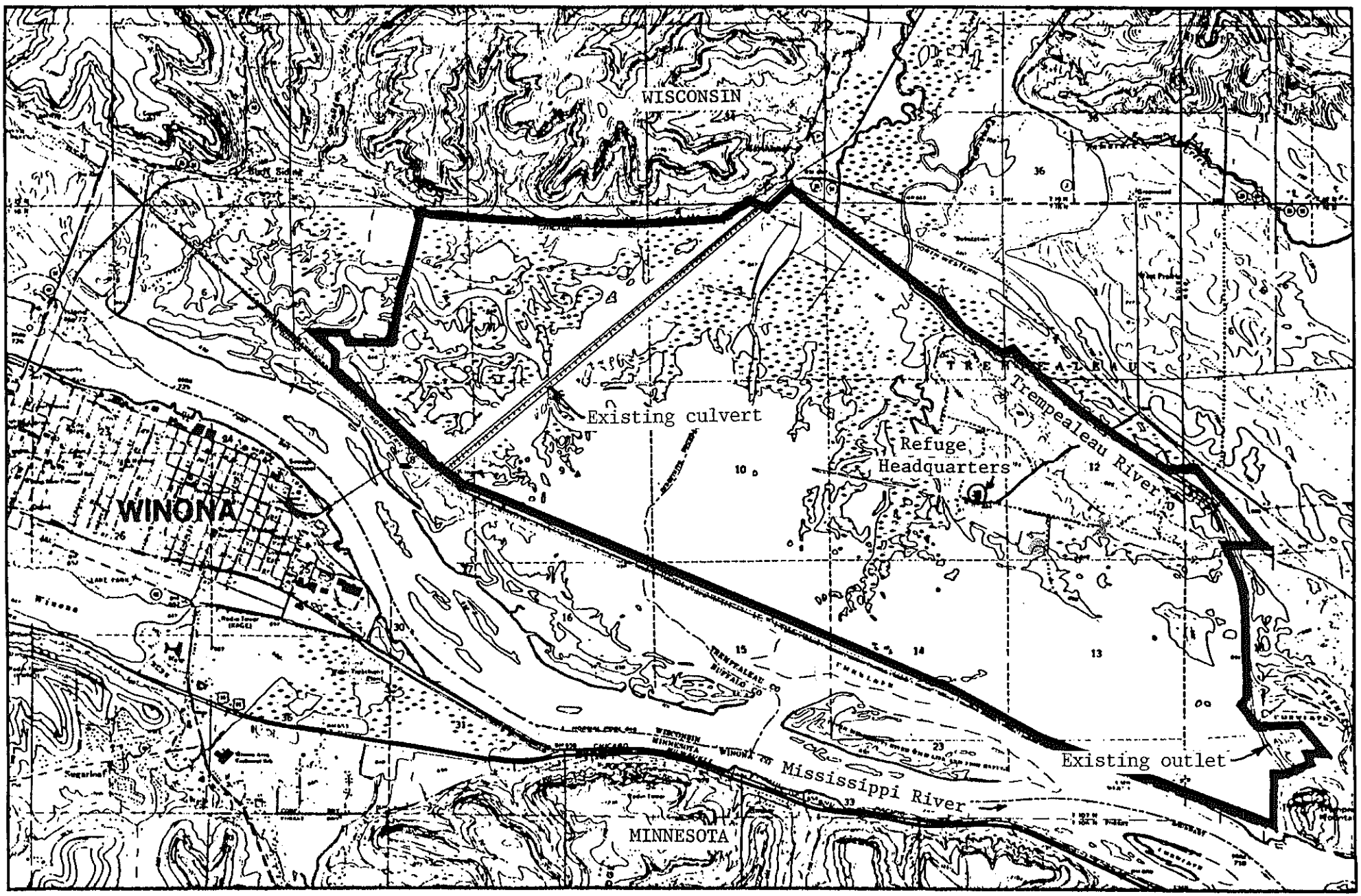


PLATE 2

TREMPEALEAU
NATIONAL WILDLIFE REFUGE

U.S. FISH AND WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

N

REFUGE MAP

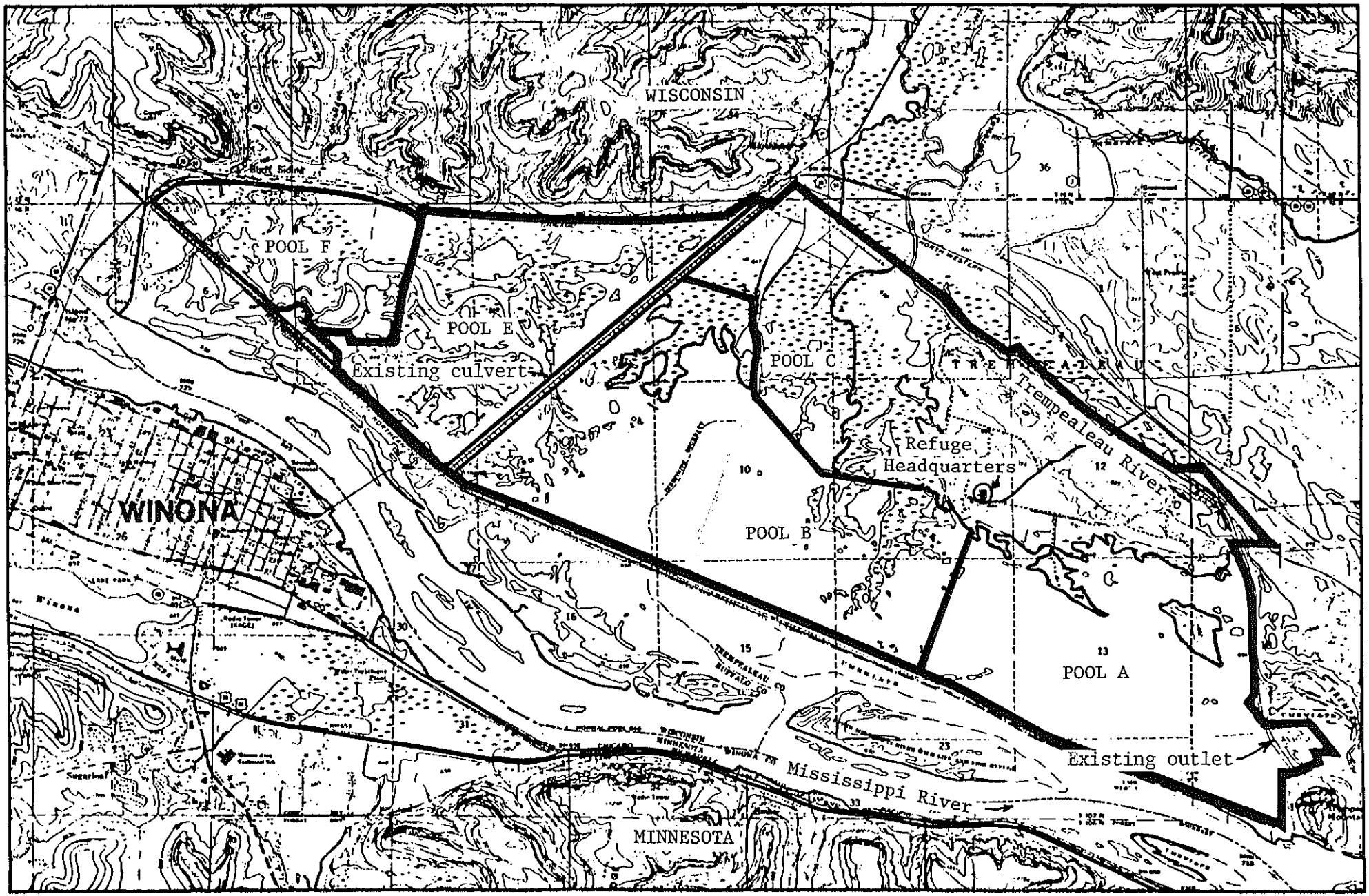


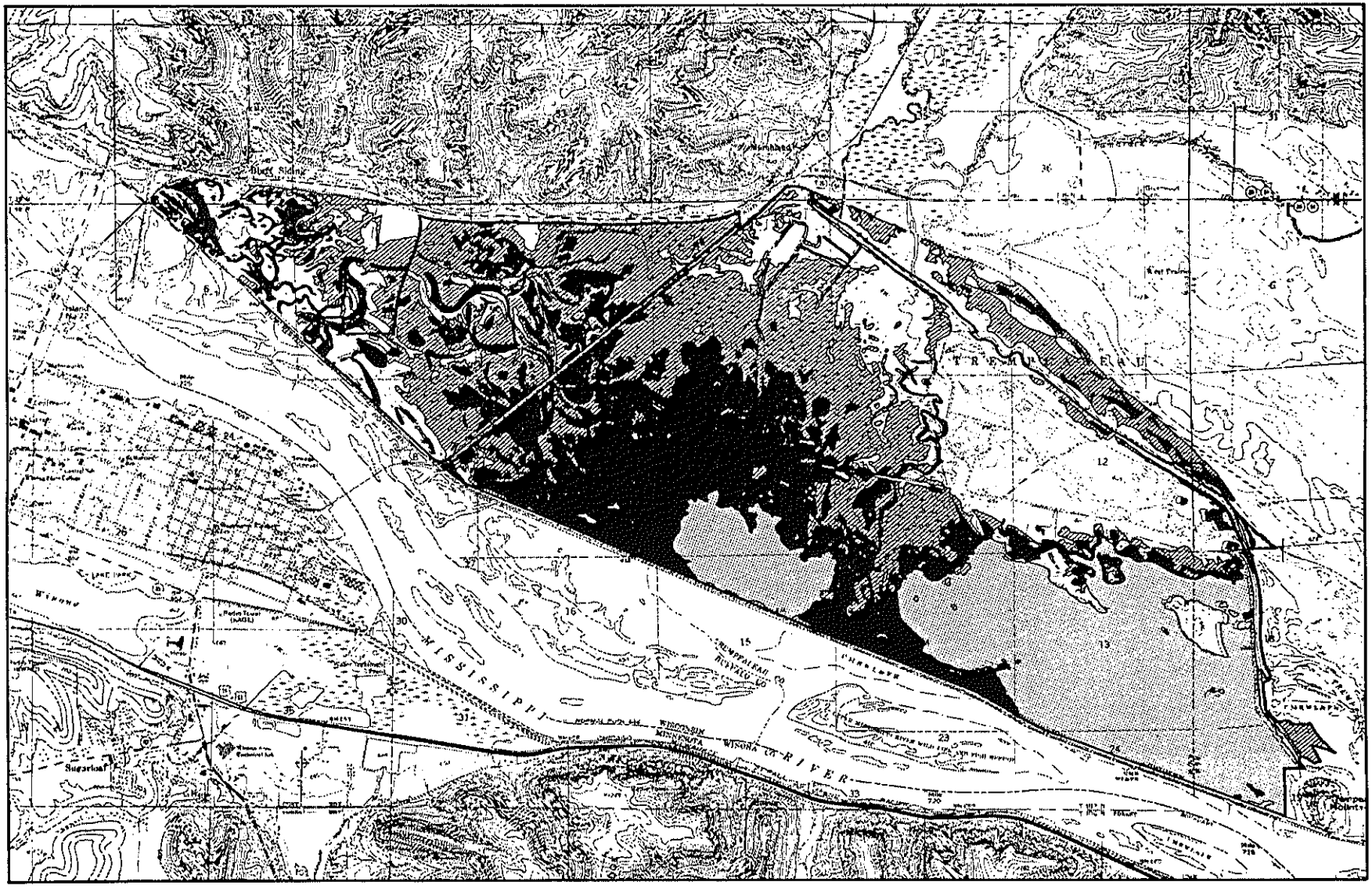
PLATE 3

TREMPEALEAU
NATIONAL WILDLIFE REFUGE

U.S. FISH AND WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

N

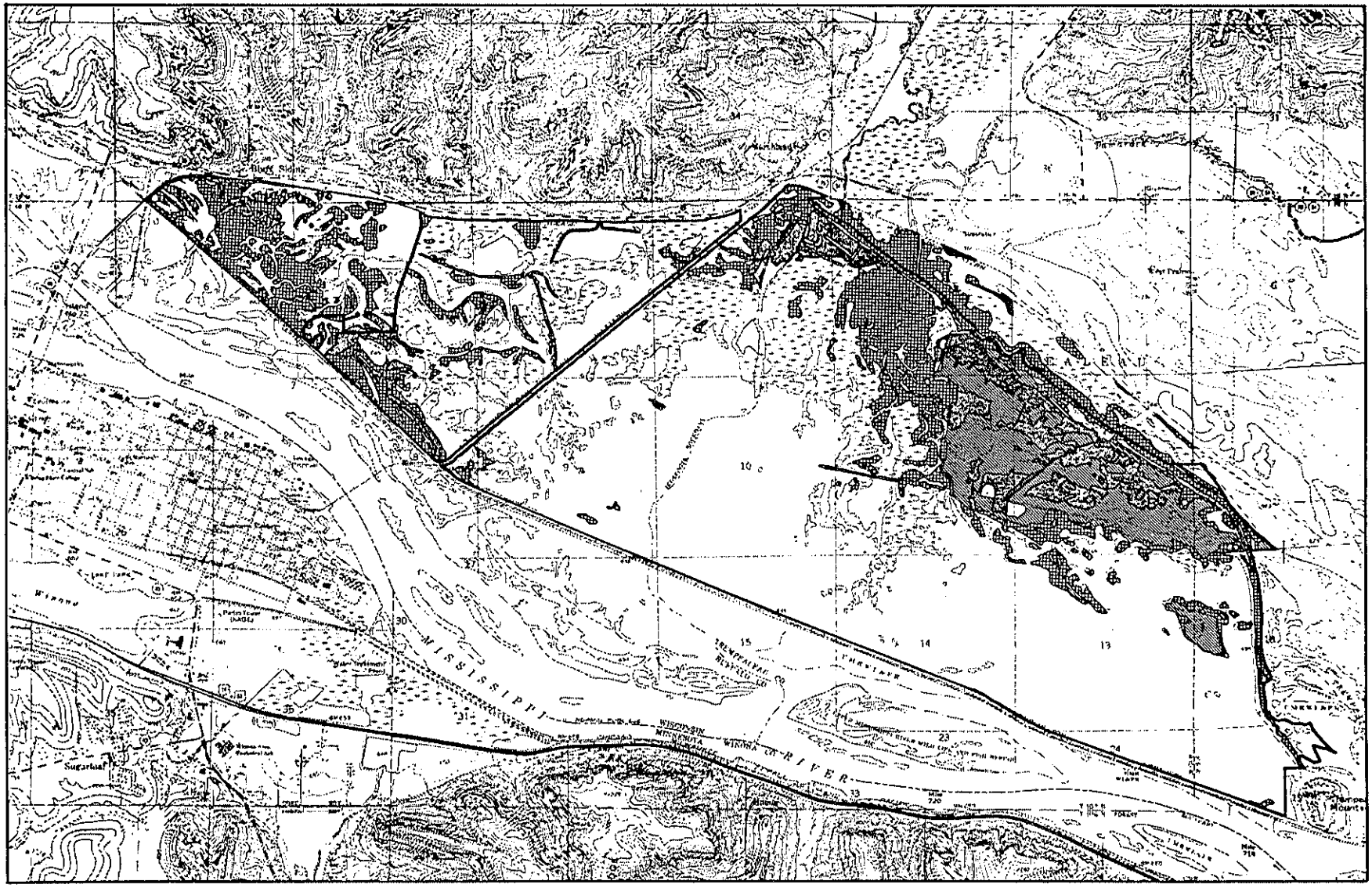
REFUGE POOLS



TREMPEALEAU
NATIONAL WILDLIFE REFUGE

U.S. FISH AND WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

PLATE 4



TREMPEALEAU
NATIONAL WILDLIFE REFUGE

U.S. FISH AND WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

PLATE 5

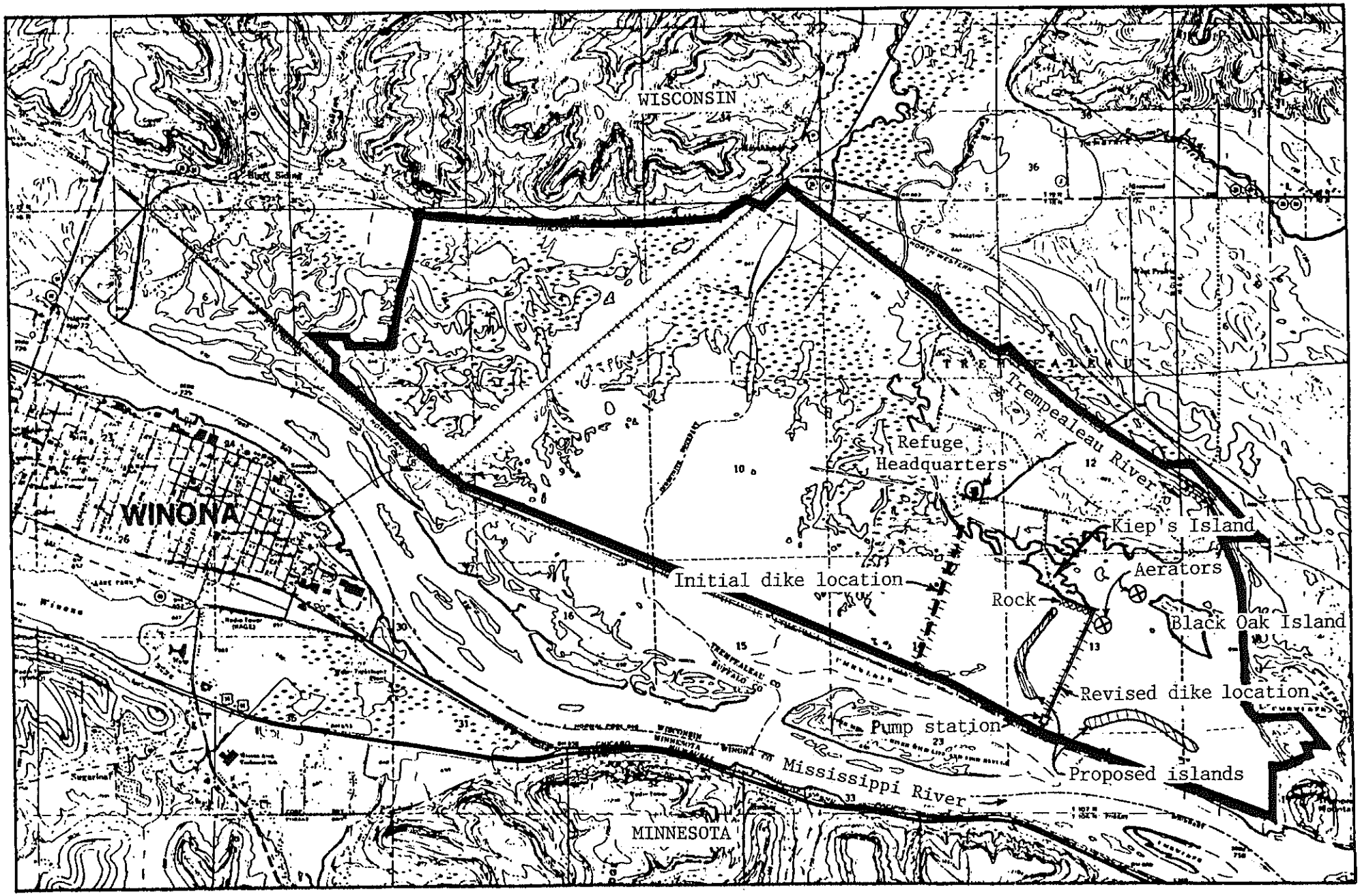


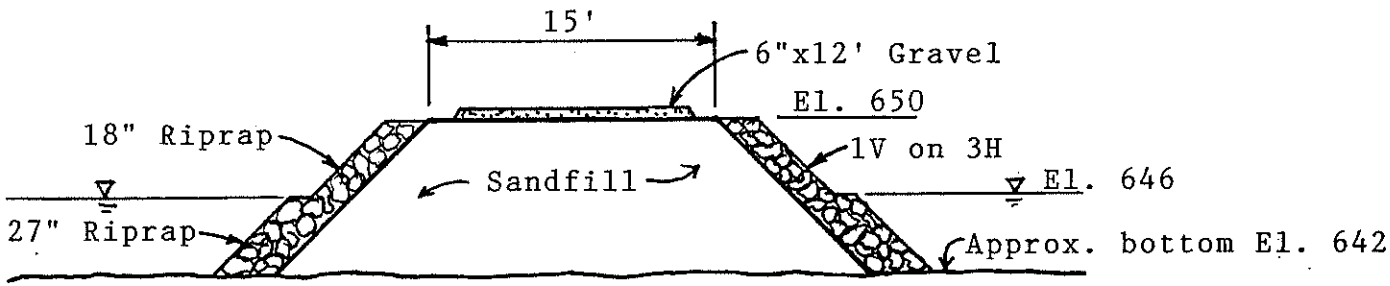
PLATE 6

TREMPEALEAU
NATIONAL WILDLIFE REFUGE

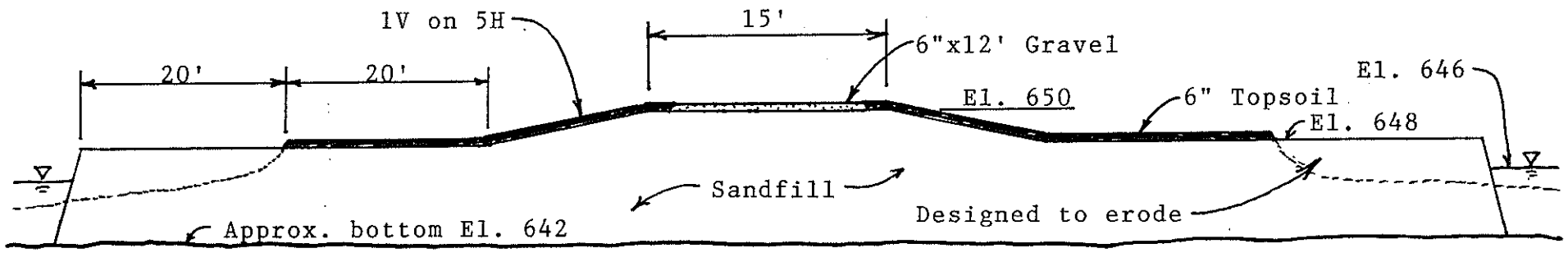
U.S. FISH AND WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

N

POOL A ALTERNATIVES



RIPRAP CROSS-SECTION



SAND BERM CROSS-SECTION

PLATE 7

POOL A - TYPICAL DIKE CROSS-SECTIONS
NO SCALE

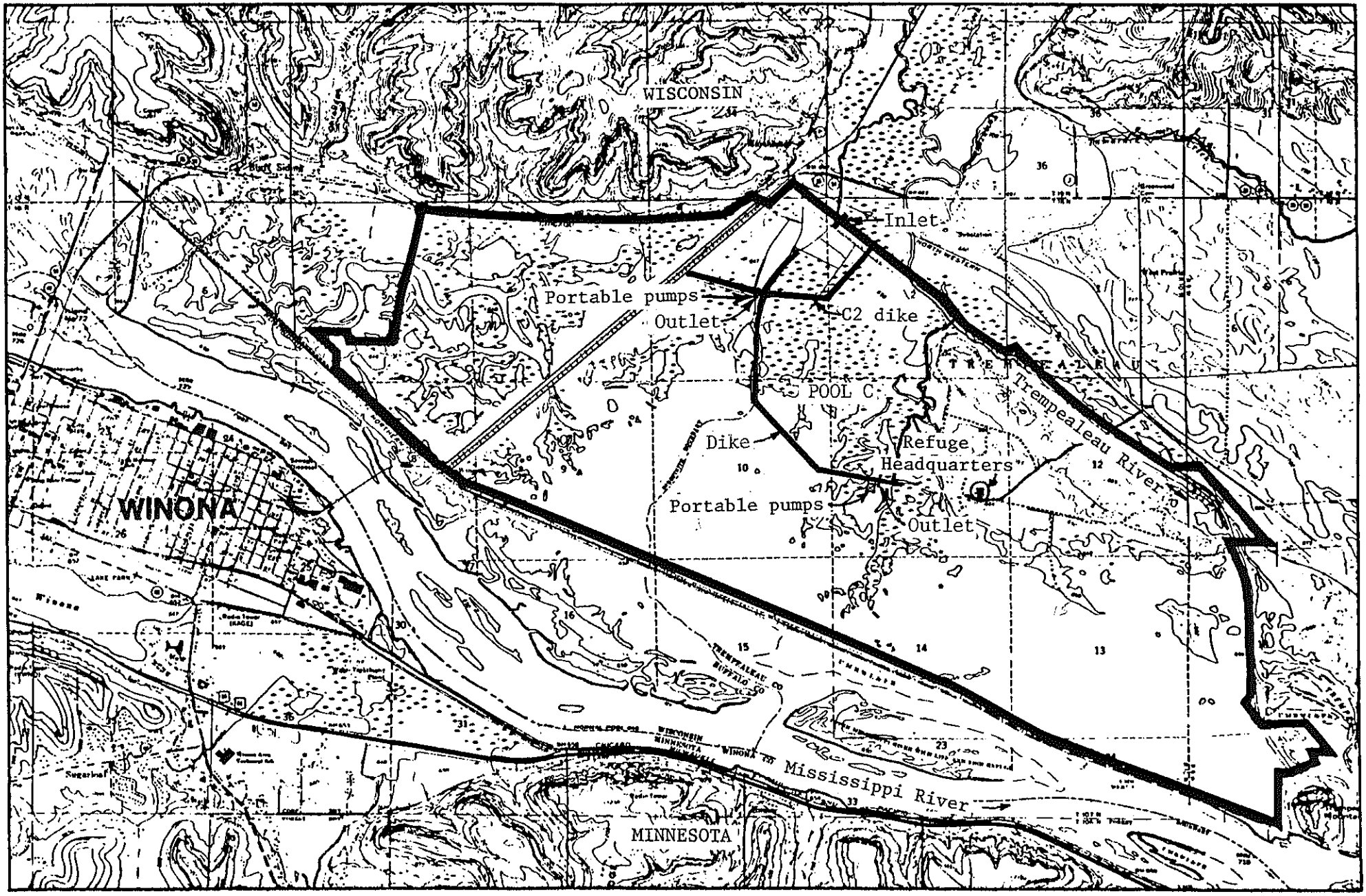


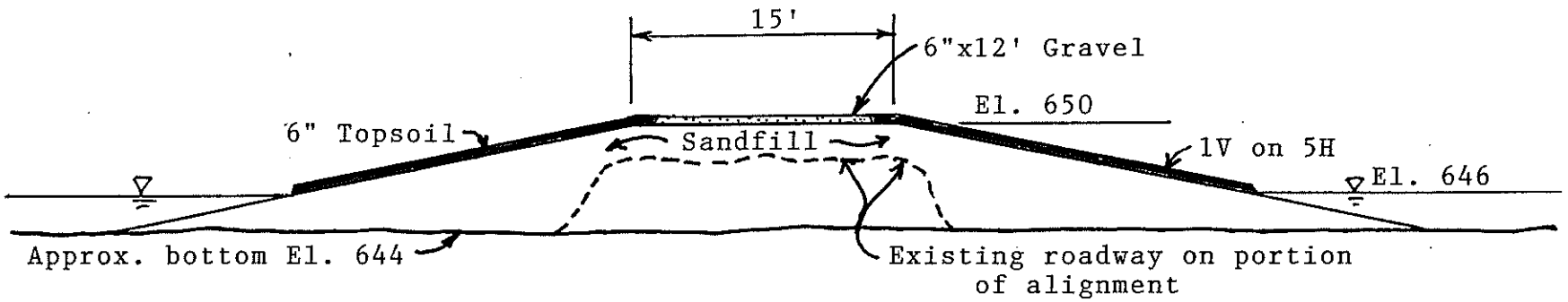
PLATE 8

TREMPEALEAU
NATIONAL WILDLIFE REFUGE

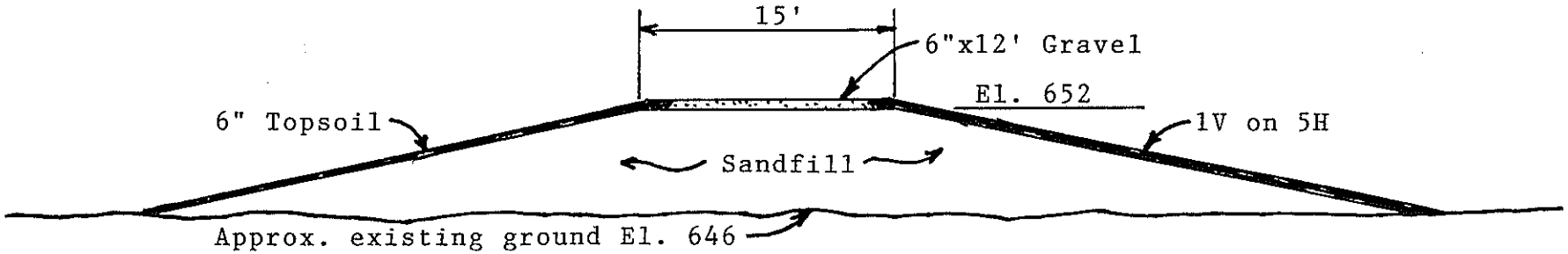
U.S. FISH AND WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

N

POOL C ALTERNATIVES



POOL C DIKE
and
POOL E DIKE



C2 DIKE

PLATE 9

TYPICAL CROSS-SECTIONS
POOLS C & E ALTERNATIVES
No Scale

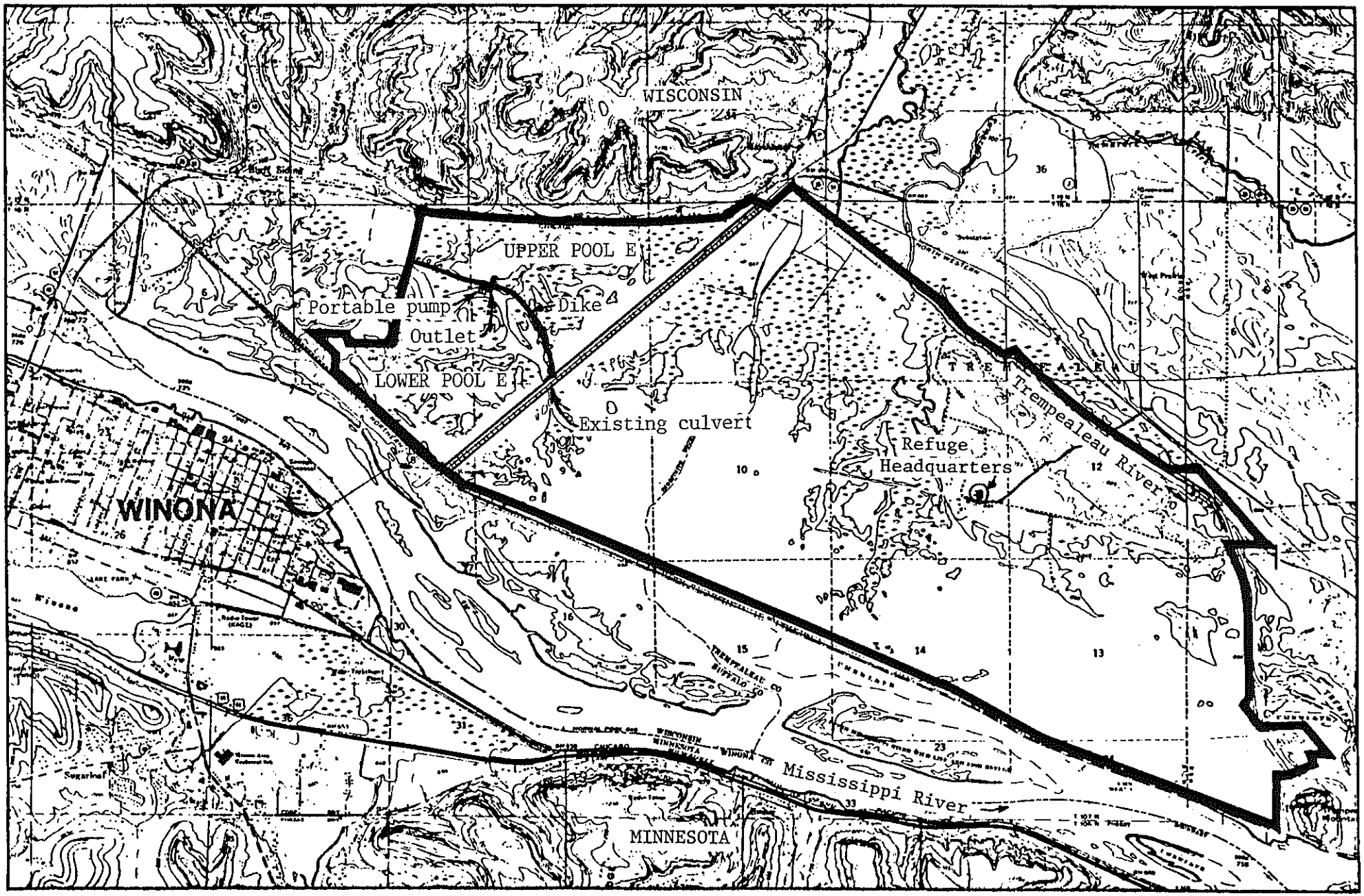


PLATE 10

TREMPEALEAU
NATIONAL WILDLIFE REFUGE

U.S. FISH AND WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

N

POOL E ALTERNATIVES

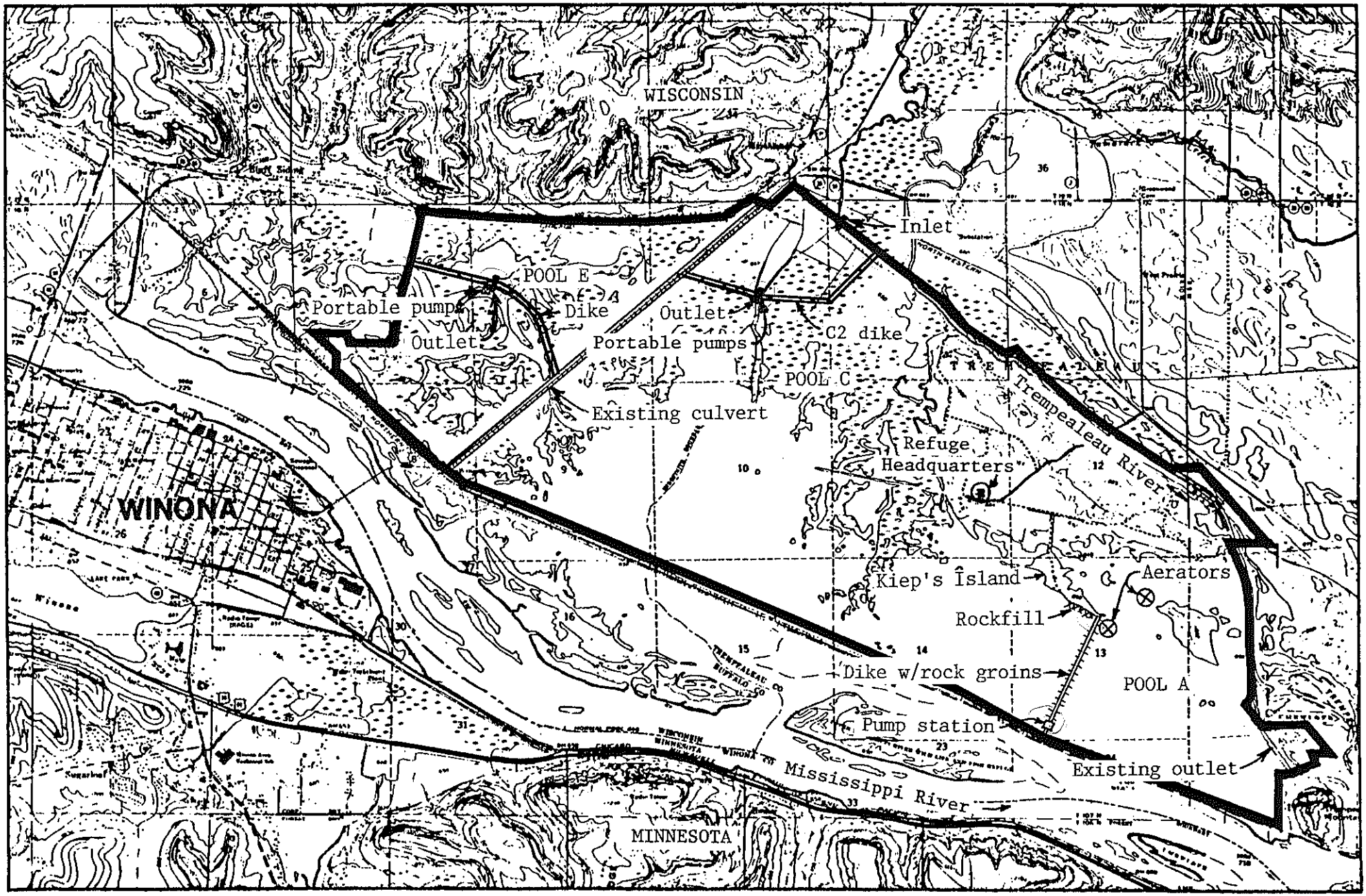


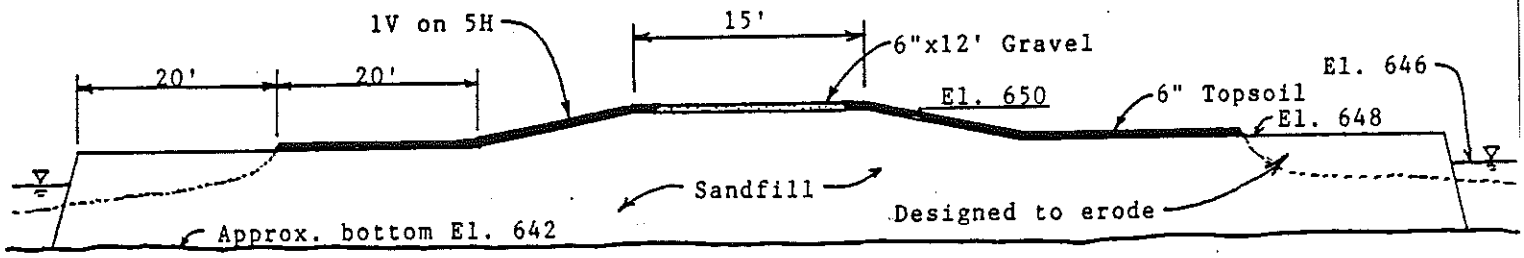
PLATE 11

TREMPEALEAU
NATIONAL WILDLIFE REFUGE

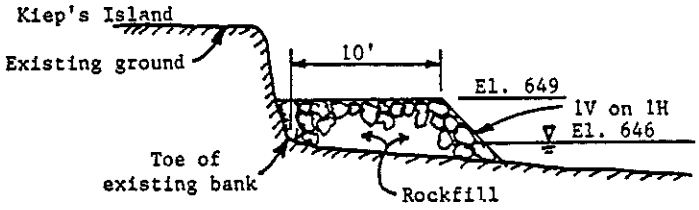
U.S. FISH AND WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

N

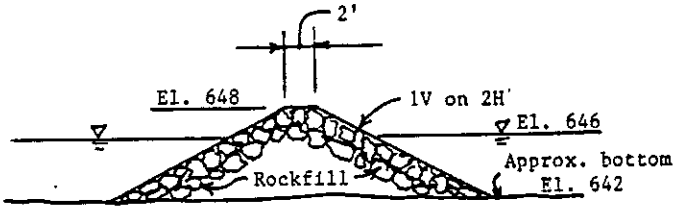
SELECTED PLAN



SAND BERM

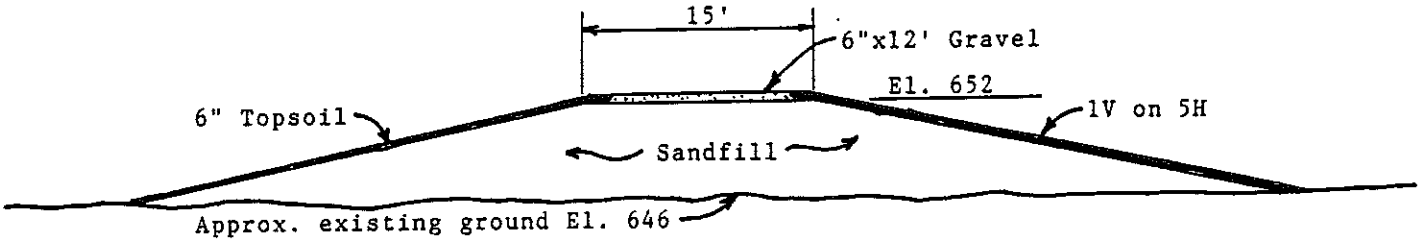


KIEP'S ISLAND BANK PROTECTION

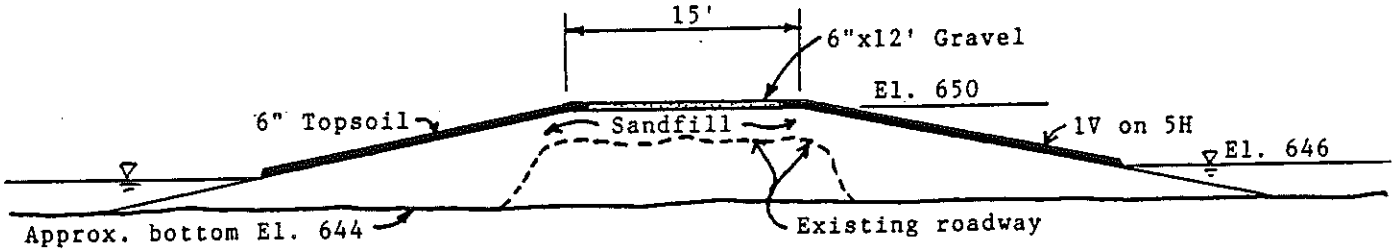


ROCK GROIN

POOL A DIKE



C2 DIKE

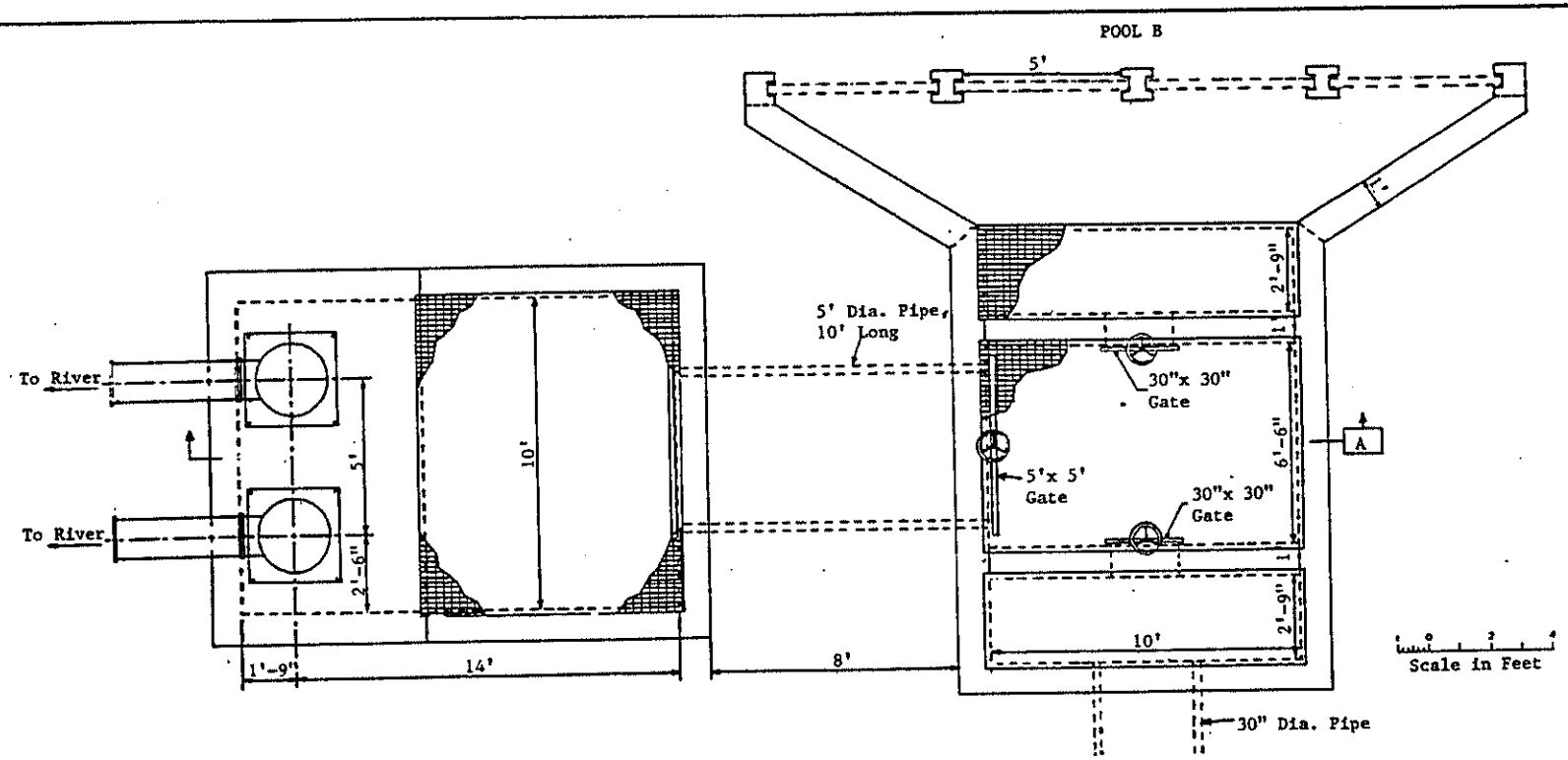


POOL E DIKE

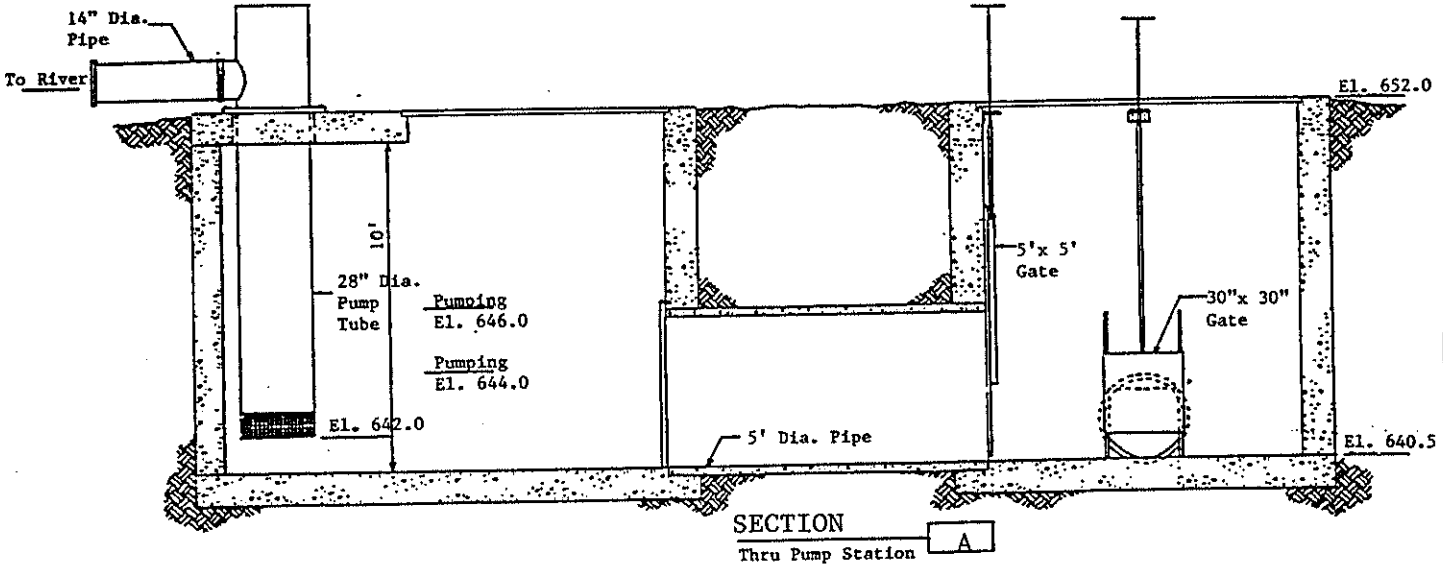
TYPICAL CROSS-SECTIONS
SELECTED PLAN

No Scale

PLATE 12



PLAN
Pump Station



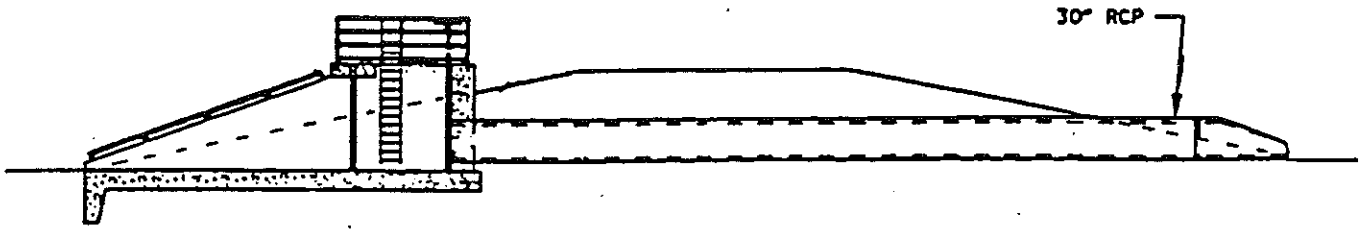
SECTION
Thru Pump Station A

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

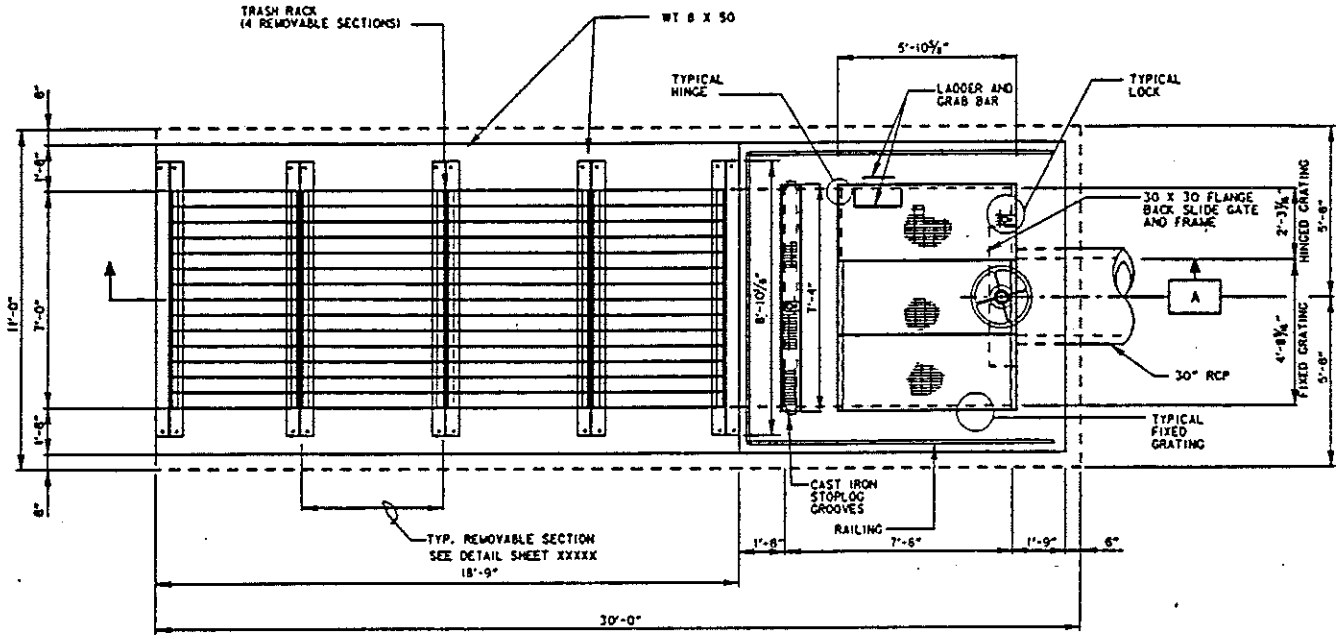
TREMPELEAU EMP

PUMP STATION

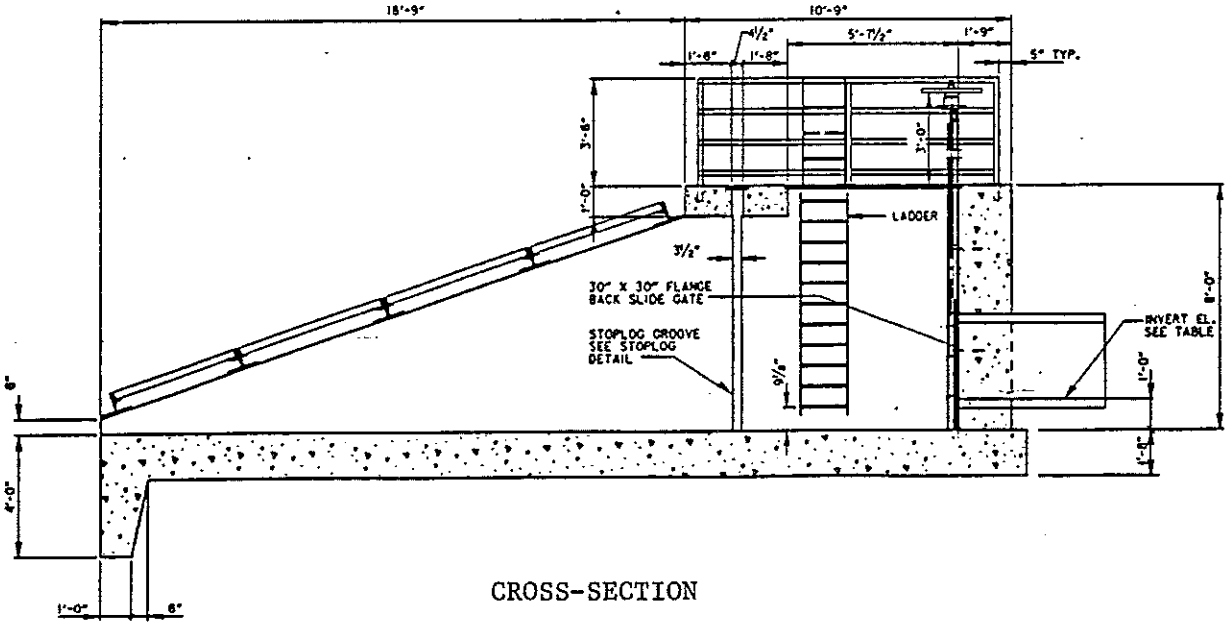
PLATE 13



PROFILE

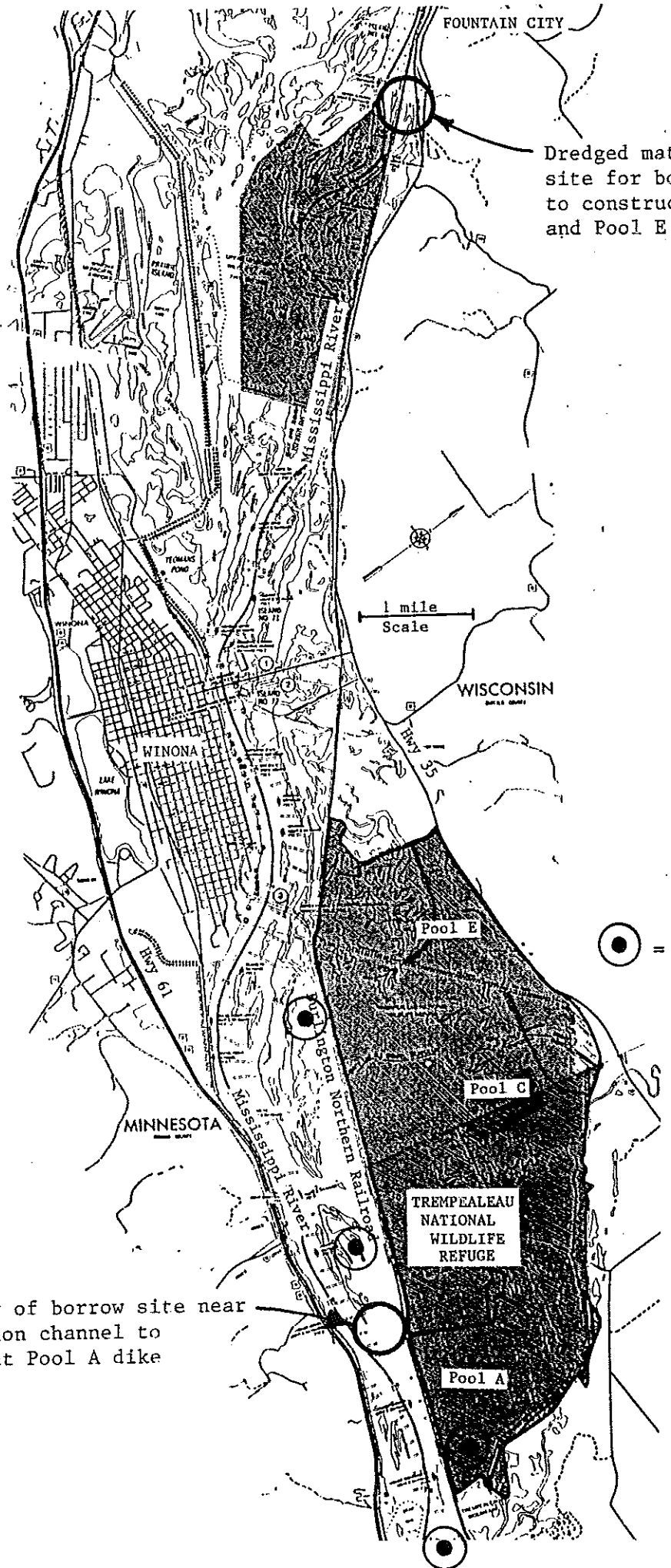


PLAN



CROSS-SECTION

GATED CONTROL STRUCTURE
(OUTLET AND INLET)



BORROW SITES

PLATE 15

Attachment 2

Finding of No Significant Impact

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
190 FIFTH STREET EAST
ST. PAUL, MINNESOTA 55101-1638

REPLY TO
ATTENTION OF

Planning Branch
Engineering and Planning 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.

TREMPEALEAU NATIONAL WILDLIFE REFUGE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
POOL 6, UPPER MISSISSIPPI RIVER
TREMPEALEAU AND BUFFALO COUNTIES, WISCONSIN

The proposed action involves the construction of three dikes, totaling about 17,000 linear feet, three water control structures, portable pumps and a permanent pump station, island stabilization, and an aeration system in one management pool. The purpose of the project is to improve breeding, resting and feeding habitat for migratory birds and marsh wildlife, and to improve fishery habitat on portions of the refuge. The project would improve marsh habitat on approximately 3,500 acres of the refuge by providing water level management capabilities and would improve fish habitat on about 700 acres. A description of the proposed action is contained in the alternatives section of the environmental assessment.

The finding of no significant impact is based on the following factors: (1) the proposed project would have beneficial impacts on wildlife and fishery resources; (2) the project would have minor beneficial impacts on the cultural environment; (3) the project would have no impacts on the social environment; (4) the project would have no impacts on the aesthetic/recreation environment; and (5) continued coordination will be maintained with the appropriate State and Federal agencies. The environmental effects of the proposed project are discussed in the environmental effects section of the environmental assessment.

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.

26 Jan 94
Date

for James T. Scott MAT, EN
Colonel, Corps of Engineers
District Engineer

Attachment 3

Section 404(b)(1) Evaluation

SECTION 404(b)(1) EVALUATION

DIKE A
TREMPEALEAU NATIONAL WILDLIFE REFUGE
TREMPEALEAU COUNTY, WISCONSIN

I. PROJECT DESCRIPTION

A. Location and Background - The Trempealeau National Wildlife refuge is a 5,900-acre area located in the Mississippi River floodplain on the Wisconsin side of the Mississippi River in pool 6 near Trempealeau, Wisconsin. The refuge is separated from the main channel of the Mississippi River by the Burlington Northern Railroad embankment and from the Trempealeau River by a barrier dike. The Refuge includes about 4,580 acres of marsh, open water and seasonally flooded areas, 630 acres of bottomland hardwoods, 400 acres of upland forest and shrublands, and 340 acres of grasslands. The proposed project is located in pool A of the refuge which is the most easterly of the pools in the refuge (See plates 1, 2 and 3 of the main report).

The Corps of Engineers is proposing to construct three dikes on the Trempealeau Wildlife Refuge. The general overall purpose of the project is to preserve, restore and enhance fish and wildlife habitat on the refuge by providing improved water management capabilities. Features of the overall project include dikes in pool A, pool C and pool E management units, pump stations, portable pumps, and a culvert for water supply from the Trempealeau River. Because each dike would be constructed for different management goals, may have different sources for fill material, and may be subject to design changes during detailed design studies, a separate 404 evaluation was prepared for each of the dikes. This evaluation is for the construction of the dike in pool A.

B. General Description - The proposed action involves the construction of a 4,000-foot dike, extending from the south end of Kieps Island to the railroad embankment. The dike would be about 4 feet above the normal water surface elevation with a 15 foot top width and 1V:5H side slopes to a 40-foot-wide berm that would be 2 feet above the water surface. The dike would be constructed of sand and would have 19 rock groins on each side of the dike. The groins would be spaced 180 feet apart. The groin length would be 30 feet plus a 15-foot tie-in to the dike berm. The groins would have a top width of 2 feet with 1V:2H slopes. About 900 feet of Kiep's Island would be protected with rockfill to maintain the integrity of the island for the dike tie-in. A permanent pump station would be constructed on the south end of the dike.

Construction of the dike would create a separate 700 acre management cell in pool A in which the water levels could be manipulated to increase the extent of aquatic vegetation for migratory birds. The dike would also allow some waterlevel manipulation in pool B, but to a lesser extent.

C. Authority and Purpose - This project would be constructed under authority of Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The purpose of the dike is to increase water management capabilities in pools A and B to improve habitat conditions for migratory birds, fish, and other wildlife. While the dike will allow the ponding of up to 1-2 additional feet of water in either pools A or B, the primary purpose is to facilitate the drawdown of pool A without effecting the remainder of the Refuge. Drawdown would be conducted during various times of the year, dependent upon the management plan for pool A in any given year.

D. General Description of Dredged and Fill Material

1. General Characteristics of the Material - The dike will be constructed of sand, dredged from near the main channel of the Mississippi River, and protected with rock groins.

2. Quantity of Material - The quantities of various fill materials are as follows: Sandfill - 125,900 cubic yards, Rockfill - 10,600 cubic yards, Topsoil - 6,100 cubic yards, Gravel - 1,200 cubic yards.

3. Source of the Material - The sand will be obtained by hydraulically dredging from near the main channel of the Mississippi River, rockfill and gravel from a local quarry, and topsoil from the pool adjacent to the dike.

E. Description of the Proposed Discharge Site

1. Location - The proposed fill would be located in the open lake-like portion of the Trempealeau National Wildlife Refuge. This open water area is located in the southwestern quarter of the Refuge.

2. Size - The area of the Refuge where the discharge would take place is a 1100-acre open water area that is relatively homogeneous in character.

3. Type of Site - The proposed discharge site is an open water site.

4. Types of Habitat - The habitat at the proposed discharge site is open water ranging from 1 to 5 feet deep with a silt/clay substrate. Aquatic vegetation is sparse to non-existent in this area.

5. Timing and Duration - The proposed discharge is expected to take place during the summer of 1995 or 1996, and would occur over a 3 month period.

F. Description of Disposal Method - The dike would be built from the Burlington Northern Railroad embankment out across the water until it reaches the other terminus at Kiep's Island. The sand would be hydraulically dredged from the Mississippi River and deposited directly in place along the dike alignment. Shaping of the material would be accomplished by dozer and/or other mechanical means. Rock groins would be placed with equipment working from the dike. Rockfill along the shore of Kiep's Island would be placed from the top of the bank, on the ice, or working on top of the rockfill.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations - The construction of the dike will cover approximately 12 acres of the existing bottom of pool A. Following completion, about 40 percent of the dike width would be below the surface of the water at normal pool elevations.

B. Water Circulation, Fluctuation, and Salinity Determinations

1. Water

a. Salinity - Not applicable.

b. Water Chemistry - The proposed discharge activities would have no impact on water chemistry.

c. Clarity - During construction of the dike there may be short term localized reductions in water clarity due to increases in turbidity. Over the long term the project is expected to result in some improvements in water clarity in pools A and B by reducing wind and rough fish induced turbidity.

d. Color - The proposed discharge activities would have no impact on water color.

e. Odor - The proposed discharge activities would have no impact on water odor.

f. Taste - The proposed discharge activities would have no impact on water taste.

g. Dissolved Gas Levels - The proposed discharge activities would have no impact on dissolved gas levels.

h. Nutrients - The proposed discharge activities would have no impact on nutrient levels.

i. Eutrophication -The proposed discharge activities would have no impact on eutrophication.

j. Temperature - The proposed discharge activities would have no impact on water temperature.

2. Current Patterns and Circulation

a. Current Patterns and Flow - There is a very slight current in the area of the proposed discharge. The dike would interrupt this current and further impound the water in the Refuge. Future current patterns and flows would be regulated by water management actions on the Refuge.

b. Velocity - The slight natural current that now exists would, for all practical purposes, cease. Future water management activities could induce a slight current in pools A and/or B depending on the management activity.

c. Stratification - The proposed discharge activities should have no impact on stratification.

d. Hydrologic Regime - The proposed discharge activities should have no impact on the hydrologic regime.

3. Normal Water Level Fluctuations - The proposed discharge activities would impact on water level fluctuations as the purpose of the project is to provide the capability to manage water levels in pools A and B of the Refuge. The dike would provide the ability to manage pool A $\pm$ 1.5 feet and pool B $\pm$ 1.0 foot.

4. Salinity Gradients - Not applicable.

C. Suspended Particulate/Turbidity Determinations - Construction of the dike would likely result in some temporary localized increases in turbidity as the sand is being deposited. Over the long term, the project should reduce turbidity in pools A and B by reducing wind and rough fish induced turbidity.

D. Contaminant Determination - Bulk chemical analysis for materials dredged in the main channel near Homer (RM 721) have been done periodically between 1974 and 1989. These tests, and others done in this portion of pool 6, indicate that sediments in this reach of the river are relatively uncontaminated. The proposed activities would have no appreciable effects on the location or levels of contaminants in the aquatic system.

E. Aquatic Ecosystem and Organisms Determinations

1. Effects on Plankton - The proposed actions would have no effect on plankton.

2. Effects on Benthos - Some minor losses of benthos would result during the placement of the materials of the dike as the proposed fill activity would affect about 12 acres of shallow water habitat. Theses losses would be offset with recolonization of riprapped areas on the dike.

3. Effects on Fish and Wildlife - The proposed activity would result in the direct conversion of 12 acres of shallow aquatic habitat to dike. This loss would have a negligible effect on the aquatic ecosystem of pools A and B. Overall, the project should have a substantial beneficial effect on the fish and wildlife resources of these pools by providing the capability for improved water management in both pools, increasing the quality of habitat for both fish and wildlife.

4. Effects on Aquatic Food Web - The proposed action would have no appreciable effect on the aquatic food web.

5. Effects on Special Aquatic Sites

a. Sanctuaries and Refuges - The project area is a National Wildlife Refuge. The proposed action would allow for more effective water level management on refuge lands to improve migratory bird habitat.

b. Wetlands, Mudflats and Vegetated Shallows - Approximately 12 acres of aquatic habitat would be lost with the placement of dike fill material. This tradeoff is considered acceptable for the capability to effectively manage water levels in pool A and Pool B.

6. Threatened and Endangered Species - The proposed activity would have no appreciable effect on State or Federally listed threatened or endangered species. The proposed activities would not affect the suitability of the existing nesting sites for either bald eagles or ospreys on the refuge. There is no suitable habitat for Higgin's eye pearly mussel on the refuge. Several mussel surveys have been conducted in lower pool 6 in conjunction with periodic maintenance dredging. It does not appear that the Higgin's eye pearly mussel would be affected by the proposed dredging from the main channel. The specific location for the dredging of sand for this project has not be identified. However, a mussel survey of the area to be dredged would be conducted prior to construction. Critical habitat for the State listed wood turtle and the Blanding's turtle would not be affected by the proposed construction activities.

7. Actions Taken to Minimize Impacts - Construction activities would be restricted during the fall and spring migration periods to minimize disturbance to waterfowl.

F. Proposed Disposal Site Determination

1. Mixing Zone Determination - No mixing zone was calculated because the sand used to construct the dike is not expected to move from the point of deposit.

2. Determination of Compliance with Applicable Water Quality Standards - The proposed fill activity is expected to comply with applicable state water quality standards. Water quality certification has been applied for from the State of Wisconsin and any imposed conditions would be complied with. Best management practices would be used to minimize the amount of suspended sediment in the effluent.

3. Potential Effects on Human Use Characteristics - The proposed fill activity would not have any adverse effect on human use of the project area.

G. Determination of Cumulative Effects on the Aquatic Ecosystem - The proposed action would be implemented in conjunction with the construction of two other dikes on the refuge. Cumulatively, all three dikes would result in the conversion of 22 acres of shallow aquatic habitat to dike. This conversion would have no appreciable affect on the aquatic ecosystem of the refuge. Their construction would provide the capability for effective management of water levels on the refuge to substantially improve habitat quality for fish and wildlife resources.

F. Determination of Secondary Effects on the Aquatic Ecosystem - No significant negative affects would result from the proposed project. The ability to manage water levels in pool A would result in long-term benefits to aquatic vegetation and water quality and related secondary benefits to fish and wildlife are expected.

III. FINDINGS OF COMPLIANCE

The proposed discharge of dredged material would comply with the Section 404 (b)(1) guidelines of the Clean Water Act. No significant adaptations to the Section 404(b)(1) guidelines were made for this evaluation. No alternatives were identified that would accomplish the purposes of the proposed dike that would not involve the deposition of fill. Alternative locations and sources of fill for the dike were considered with the selected location offering the best combination of engineering, economic, and environmental considerations. The environmental effects of constructing the dike in alternative locations would be nearly identical to those associated with the proposed location.

The proposed discharge of dredged material would comply with all State of Wisconsin water quality standards, Section 307 of the Clean Water Act, and the Endangered Species Act of 1973, as amended. The proposed action would have no adverse impacts on human health or welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, wildlife, and special aquatic sites. The life stages of aquatic organisms and other wildlife would not be adversely affected. No significant adverse effects on aquatic ecosystem diversity, productivity and stability, or on recreational, aesthetic, and economic values would occur.

On the basis of this evaluation, I specify that the proposed action complies with the requirements of the guidelines for discharge of dredged material.

for [signature] MAT, EN
James T. Scott
Colonel, Corps of Engineers
District Engineer

26 Jan 94
Date

SECTION 404(b)(1) EVALUATION

C2 DIKE
TREMPEALEAU NATIONAL WILDLIFE REFUGE
TREMPEALEAU COUNTY, WISCONSIN

I. PROJECT DESCRIPTION

A. Location and Background - The Trempealeau National Wildlife refuge is a 5,900-acre area located in the Mississippi River floodplain on the Wisconsin side of the Mississippi River in pool 6 near Trempealeau, Wisconsin. The refuge is separated from the main channel of the Mississippi River by the Burlington Northern Railroad embankment and from the Trempealeau River by a barrier dike. The Refuge includes about 4,580 acres of marsh, open water and seasonally flooded areas, 630 acres of bottomland hardwoods, 400 acres of upland forest and shrublands, and 340 acres of grasslands. The proposed project is located in pool C of the refuge which is an 800 acre area in the north central portion of the refuge (See plates 1, 2 and 3 of the main report).

The Corps of Engineers is proposing to construct three dikes on the Trempealeau Wildlife Refuge. The general overall purpose of the project is to preserve, restore and enhance fish and wildlife habitat on the refuge by providing improved water management capabilities. Features of the overall project include dikes in pool A, pool C and pool E management units, pump stations, portable pumps, and a culvert for water supply from the Trempealeau River. Because each dike would be constructed for different management goals, may have different sources for fill material, and may be subject to design changes during detailed design studies, a separate 404 evaluation was prepared for each of the dikes. This evaluation is for the construction of the dike in pool C.

B. General Description - The proposed action involves the construction of a 6,500-foot dike to separate a 220-acre area in the northwesterly portion of pool C from the management pool C. The dike would be about 6 feet above the normal water surface elevation with a 15 foot top width and 1V:5H side slopes. The dike would be constructed of sand and topsoiled and seeded. Topsoil for the dike would be obtained from existing material on the interior of the dike. A 100-foot, 30-inch diameter gated culvert would be placed through the dike that separates the Trempealeau River from the Refuge. The culvert would empty into an existing ditch system and would be used to supply water to the pool. A cofferdam would be required on the riverward side of the dike to install the culvert. Provisions would be made to place portable pumps at the site to fill the pond when water from the Trempealeau River cannot be used. A gated outlet culvert would be placed at a selected location on the dike.

Construction of the dike would create a separate 220-acre management cell (C2 pool) in pool C in which the water levels could be manipulated to control the type and extent of aquatic vegetation for migratory birds.

C. Authority and Purpose - This project would be constructed under authority of Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The purpose of the dike is to increase water management capabilities in pool C that will improve habitat conditions for migratory birds and other wildlife. The dike would allow the ponding of up to 4 feet of water in the pool and would allow Refuge managers to control water levels to enhance migratory bird food production, provide feeding habitat for migrating birds, and to control woody vegetation encroachment in this pool.

D. General Description of Dredged and Fill Material

1. General Characteristics of the Material - The dike will be constructed of sand, topsoiled and seeded.

2. Quantity of Material - The quantities of various fill materials are as follows: Sand fill - 50,000 cubic yards, Topsoil - 7,000 cubic yards, Gravel - 3,200 cubic yards, culverts (corrugated metal pipe) -200 linear feet. A final design for the cofferdam has not been selected. The cofferdam would be either constructed with about 200 cubic yards of random fill or about 1,000 square feet of sheet pile.

3. Source of the Material - The sand would be obtained by dredging near the main channel or backwaters of the Mississippi River, from within pool A, or from a dredged material beneficial use site near Fountain City or Trempealeau, Wisconsin, if no suitable river sources are available. Topsoil for the dike would be excavated from the pool adjacent to the dike. Random fill for the cofferdam would come from a designated location on the refuge or from the selected borrow site.

E. Description of the Proposed Discharge Site

1. Location - The proposed fill would be located in pool C of the Trempealeau National Wildlife Refuge.

2. Size - The area of the Refuge where the discharge would take place is a 1000-acre portion of the refuge that is primarily emergent marsh in character.

3. Type of Site - The proposed discharge site is a wetland site.

4. Types of Habitat - The habitat at the proposed discharge site is primarily emergent wetland that is approximately 90 percent emergent plants and 10 percent open water. Water depths during the growing season are generally in the range of 1/2 to 1 foot, with an interspersion of some deeper pockets and higher ground. Some vegetation characteristic of bottomland woods are present along the road.

5. Timing and Duration - The proposed discharge is expected to take place during the summer of 1995 or 1996, and would occur over a 3 month period.

F. Description of Disposal Method - The dike would be built by hydraulically dredging sand directly in-place or stockpiling the sand, trucking it to the site, and dumping it in-place. Shaping of the material would be done with a dozer and/or other mechanical means. Topsoil would most likely be obtained with a dragline working off the newly constructed dike. Cofferdams would be constructed with equipment working off the top of the existing dike.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations - The construction of the dike will cover approximately 11 acres of the pool C area. However, about half of the dike is located on existing ground that is above normal pool elevations. Sediment in the proposed fill area is primarily sand and silt. The cofferdam would affect about 1/4 of an acre of the Trempealeau River.

B. Water Circulation, Fluctuation, and Salinity Determinations

1. Water

a. Salinity - Not applicable.

b. Water Chemistry - The proposed discharge activities would have no impact on water chemistry.

c. Clarity - There would be no appreciable effects on water clarity. During construction of the dike, and the installation and removal of the cofferdams, there could be short term localized reductions in water clarity due to increases in turbidity.

d. Color - The proposed discharge activities would have no impact on water color.

e. Odor - The proposed discharge activities would have no impact on water odor.

f. Taste - The proposed discharge activities would have no impact on water taste.

g. Dissolved Gas Levels - The proposed discharge activities would have no impact on dissolved gas levels.

h. Nutrients - The proposed discharge activities would have no impact on nutrient levels.

i. Eutrophication -The proposed discharge activities would have no impact on eutrophication.

j. Temperature - The proposed discharge activities would have no impact on water temperature.

2. Current Patterns and Circulation

a. Current Patterns and Flow - The proposed action would have no impacts on current patterns or flow because there is essentially little or no current or flow in this portion of the refuge. A temporary change in current patterns would occur on the Trempealeau River because of the cofferdam.

b. Velocity - The proposed action would have no impact on water velocity.

c. Stratification - The proposed discharge activities should have no impact on stratification.

d. Hydrologic Regime - The proposed discharge activities should have no impact on the hydrologic regime.

3. Normal Water Level Fluctuations - The proposed discharge activities would impact on water level fluctuations as the purpose of the project is to provide the capability to manage water levels in a portion of pool C of the Refuge. The dike would provide the ability to pond an additional 4 feet of water in the 220-acre diked area of pool C.

4. Salinity Gradients - Not applicable.

5. Actions Taken to Minimize Impacts - No special actions would be taken to minimize impacts.

C. Suspended Particulate/Turbidity Determinations - Construction of the dike, and the installation and removal of the cofferdam, would likely result in some temporary localized increases in turbidity. Levels of turbidity would return to normal after construction.

D. Contaminant Determination - The fill would be sand, corrugated metal pipe, and either random fill or sheet pile for the cofferdams, and would not introduce contaminants into the aquatic system. The proposed activities would have no appreciable effects on the location or levels of contaminants in the aquatic system.

E. Aquatic Ecosystem and Organisms Determinations

1. Effects on Plankton - The proposed actions would have no effect on plankton.

2. Effects on Benthos - Some minor losses of benthos would result during the placement of the materials of the dike as the proposed fill activity would affect about 6 acres of shallow water habitat.

3. Effects on Fish and Wildlife - The proposed activity would result in the direct conversion of 6 acres of shallow aquatic habitat to dike. This loss would have a negligible effect on the aquatic ecosystem of pool C. Overall, the project should have a substantial beneficial effect on the fish and wildlife resources in this pool by providing the capability for improved water management, thereby increasing the quality of habitat for both fish and wildlife.

4. Effects on Aquatic Food Web - The proposed action would have no appreciable effect on the aquatic food web.

5. Effects on Special Aquatic Sites

a. Sanctuaries and Refuges - The project area is a National Wildlife Refuge. The proposed action would allow for more effective water level management on refuge lands to improve migratory bird habitat.

b. Wetlands, Mudflats and Vegetated Shallows - Approximately 6 acres of aquatic habitat would be lost with the placement of dike fill material. This tradeoff is considered acceptable for the capability to effectively manage water levels in a portion of pool C.

6. Threatened and Endangered Species - The proposed activity would have no appreciable effect on State or Federally listed threatened or endangered species. The proposed activities would not affect the suitability of the existing nesting sites for either bald eagles or ospreys on the refuge. There is no suitable habitat for Higgin's eye pearly mussel on the refuge. Critical habitat for the State listed wood turtle and the Blanding's turtle would not be affected by the proposed construction activities.

7. Actions Taken to Minimize Impacts - Construction activities would be restricted during the fall and spring migration periods to minimize disturbance to waterfowl.

F. Proposed Disposal Site Determination

1. Mixing Zone Determination - Not applicable. The material would not be dispersed.

2. Determination of Compliance with Applicable Water Quality Standards - The proposed fill activity is expected to comply with applicable state water quality standards. Water quality certification has been applied for from the State of Wisconsin and any imposed conditions would be complied with. Best management practices would be used to minimize the amount of suspended sediment in the effluent.

3. Potential Effects on Human Use Characteristics - The proposed fill activity would not have any adverse effect on human use of the project area.

G. Determination of Cumulative Effects on the Aquatic Ecosystem - The proposed action would be implemented in conjunction with the construction of two other dikes on the refuge. Cumulatively, all three dikes would result in the conversion of 22 acres of shallow aquatic habitat to dike. This conversion would have no appreciable affect on the aquatic ecosystem of the refuge. Their construction would provide the capability for effective management of water levels on the refuge to substantially improve habitat quality for fish and wildlife resources.

F. Determination of Secondary Effects on the Aquatic Ecosystem - No significant negative affects would result from the proposed project. The ability to manage water levels in a portion of pool C would result in long-term benefits to aquatic vegetation and water quality and related secondary benefits to fish and wildlife are expected.

III. FINDINGS OF COMPLIANCE

The proposed discharge of dredged material would comply with the Section 404 (b)(1) guidelines of the Clean Water Act. No significant adaptations to the Section 404(b)(1) guidelines were made for this evaluation. Other alternatives were identified that would accomplish the water level control of the entire pool C and involved the deposition of fill in pool C. The other alternatives considered used similar dike designs and sources of fill. They were not selected because they were higher cost and produced fewer overall habitat benefits.

The proposed discharge of dredged material would comply with all State of Wisconsin water quality standards, Section 307 of the Clean Water Act, and the Endangered Species Act of 1973, as amended. The proposed action would have no adverse impacts on human health or welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, wildlife, and special aquatic sites. The life stages of aquatic organisms and other wildlife would not be adversely affected. No significant adverse effects on aquatic ecosystem diversity, productivity and stability, or on recreational, aesthetic, and economic values would occur.

On the basis of this evaluation, I specify that the proposed action complies with the requirements of the guidelines for discharge of dredged material.

26 Jan 94
Date

for James T. Scott
Colonel, Corps of Engineers
District Engineer

SECTION 404(b)(1) EVALUATION

DIKE E
TREMPEALEAU NATIONAL WILDLIFE REFUGE
TREMPEALEAU COUNTY, WISCONSIN

I. PROJECT DESCRIPTION

A. Location and Background - The Trempealeau National Wildlife refuge is a 5,900-acre area located in the Mississippi River floodplain on the Wisconsin side of the Mississippi River in pool 6 near Trempealeau, Wisconsin. The refuge is separated from the main channel of the Mississippi River by the Burlington Northern Railroad embankment and from the Trempealeau River by a barrier dike. The Refuge includes about 4,580 acres of marsh, open water and seasonally flooded areas, 630 acres of bottomland hardwoods, 400 acres of upland forest and shrublands, and 340 acres of grasslands. The proposed project is located in pool E of the refuge which is a 1,150 acre area in the western portion of the refuge (See plates 1, 2 and 3 of the main report).

The Corps of Engineers is proposing to construct three dikes on the Trempealeau Wildlife Refuge. The general overall purpose of the project is to preserve, restore and enhance fish and wildlife habitat on the refuge by providing improved water management capabilities. Features of the overall project include dikes in pool A, pool C, and pool E management units, pump stations, portable pumps, and a culvert for water supply from the Trempealeau River. Because each dike is being constructed for different management goals, may have different sources for fill material, and may be subject to design changes during detailed design studies, a separate 404 evaluation is being prepared for each of the dikes. This evaluation is for the construction of the dike in pool E.

B. General Description - The proposed action involves the construction of a 6,600-foot dike to separate pool E into two separate subimpoundments. The dike would be about 4 feet above the normal water surface elevation with a 15 foot top width and 1V:5H side slopes. The dike would be constructed of sand and topsoiled and seeded. Most of the dike alignment follows a remnant roadway which would be raised about 2 feet. Topsoil for the dike would be obtained from pool E. Portable pumps and a gated outlet culvert would be placed at a selected location on the dike.

Construction of the dike would create separate management cells in pool E in which the water levels could be manipulated to control the type and extent of aquatic vegetation for migratory birds.

C. Authority and Purpose - This project would be constructed under authority of Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662). The purpose of the dike is to increase water management capabilities in pool E to improve habitat conditions for migratory birds and other wildlife. The dike would allow the ponding of up to 2 additional feet of water in pool E and would allow Refuge managers to control water levels to enhance migratory bird food production, provide feeding habitat for migrating birds, and to control woody vegetation encroachment in this pool.

D. General Description of Dredged and Fill Material

1. General Characteristics of the Material - The dike will be constructed of sand, topsoiled, and seeded.

2. Quantity of Material - The quantities of various fill materials are as follows: Sand fill - 44,700 cubic yards, Topsoil - 4,900 cubic yards, Gravel - 1,500 cubic yards, culvert (corrugated metal pipe) -100 linear feet.

3. Source of the Material - The sand would be obtained by dredging near the main channel or backwaters of the Mississippi River, from within pool A, or from a dredged material beneficial use site near Fountain City or Trempealeau, Wisconsin, if no suitable river sources are available. Topsoil for the dike would be excavated from the pool adjacent to the dike.

E. Description of the Proposed Discharge Site

1. Location - The proposed fill would be located in pool E of the Trempealeau National Wildlife Refuge.

2. Size - The area of the Refuge where the discharge would take place is a 1,150-acre portion of the refuge that is primarily emergent marsh in character.

3. Type of Site - The proposed discharge site is a wetland site.

4. Types of Habitat - The habitat at the proposed discharge site is a mix o emergent wetland, shrub wetland and bottomland forest. The remnant road is overgrown with trees and shrubs.

5. Timing and Duration - The proposed discharge is expected to take place during the summer of 1994 or 1995, and would occur over a 3 month period.

F. Description of Disposal Method - The dike would be built by hydraulically dredging sand directly in-place or stockpiling the sand, trucking it to the site, and dumping it in-place. Shaping of the material would be done with a dozer and/or other mechanical means. Topsoil would most likely be obtained with a dragline working off the newly constructed dike.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations - The construction of the dike will cover approximately 4 acres of the existing bottom of pool E. About 1/3 of the dike sideslopes would be under water at normal pool elevations. Sediment in the proposed fill area is primarily silt.

B. Water Circulation, Fluctuation, and Salinity Determinations

1. Water

a. Salinity - Not applicable.

b. Water Chemistry - The proposed discharge activities would have no impact on water chemistry.

c. Clarity - There would be no appreciable effects on water clarity. During construction of the dike there could be short term localized reductions in water clarity due to increases in turbidity.

d. Color - The proposed discharge activities would have no impact on water color.

e. Odor - The proposed discharge activities would have no impact on water odor.

f. Taste - The proposed discharge activities would have no impact on water taste.

g. Dissolved Gas Levels - The proposed discharge activities would have no impact on dissolved gas levels.

h. Nutrients - The proposed discharge activities would have no impact on nutrient levels.

i. Eutrophication -The proposed discharge activities would have no impact on eutrophication.

j. Temperature - The proposed discharge activities would have no impact on water temperature.

2. Current Patterns and Circulation

a. Current Patterns and Flow - The proposed action would have no impacts on current patterns or flow because there is essentially little or no current or flow in this portion of the refuge.

b. Velocity - The proposed action would have no impact on water velocity.

c. Stratification - The proposed discharge activities should have no impact on stratification.

d. Hydrologic Regime - The proposed discharge activities should have no impact on the hydrologic regime.

3. Normal Water Level Fluctuations - The proposed discharge activities would impact on water level fluctuations as the purpose of the project is to provide the capability to manage water levels in pool E of the Refuge. The dike would provide the ability to pond an additional 2 feet of water in pool E.

4. Salinity Gradients - Not applicable.

5. Actions Taken to Minimize Impacts - No special actions would be taken to minimize impacts.

C. Suspended Particulate/Turbidity Determinations - Construction of the dike would likely result in some temporary localized increases in turbidity. Levels of turbidity would return to normal after construction.

D. Contaminant Determination - The fill would be sand and corrugated metal pipe and would not introduce contaminants into the aquatic system. The proposed activities would have no appreciable effects on the location or levels of contaminants in the aquatic system.

E. Aquatic Ecosystem and Organisms Determinations

1. Effects on Plankton - The proposed actions would have no effect on plankton.

2. Effects on Benthos - Some minor losses of benthos would result during the placement of the materials of the dike as the proposed fill activity would affect about 6 acres of shallow water habitat.

3. Effects on Fish and Wildlife - The proposed activity would result in the direct conversion of 4 acres of shallow aquatic habitat to dike. This loss would have a negligible effect on the aquatic ecosystem of pool E. Overall, the project should have a substantial beneficial effect on the fish and wildlife resources in this pool by providing the capability for improved water management, thereby increasing the quality of habitat for both fish and wildlife.

4. Effects on Aquatic Food Web - The proposed action would have no appreciable effect on the aquatic food web.

5. Effects on Special Aquatic Sites

a. Sanctuaries and Refuges - The project area is a National Wildlife Refuge. The proposed action would allow for more effective water level management on refuge lands to improve migratory bird habitat.

b. Wetlands, Mudflats and Vegetated Shallows - Approximately 4 acres of aquatic habitat would be lost with the placement of dike fill material. This tradeoff is considered acceptable for the capability to effectively manage water levels in pool E.

6. Threatened and Endangered Species - The proposed activity would have no appreciable effect on State or Federally listed threatened or endangered species. The proposed activities would not affect the suitability of the existing nesting sites for either bald eagles or ospreys on the refuge. There is no suitable habitat for Higgin's eye pearly mussel on the refuge. Critical habitat for the State listed wood turtle and the Blanding's turtle would not be affected by the proposed construction activities.

7. Actions Taken to Minimize Impacts - Construction activities would be restricted during the fall and spring migration periods to minimize disturbance to waterfowl.

F. Proposed Disposal Site Determination

1. Mixing Zone Determination - Not applicable. The material would not be dispersed.

2. Determination of Compliance with Applicable Water Quality Standards - The proposed fill activity is expected to comply with applicable state water

quality standards. Water quality certification has been applied for from the State of Wisconsin and any imposed conditions would be complied with. Best management practices would be used to minimize the amount of suspended sediment in the effluent.

3. Potential Effects on Human Use Characteristics - The proposed fill activity would not have any adverse effect on human use of the project area.

G. Determination of Cumulative Effects on the Aquatic Ecosystem - The proposed action would be implemented in conjunction with the construction of two other dikes on the refuge. Cumulatively, all three dikes would result in the conversion of 22 acres of shallow aquatic habitat to dike. This conversion would have no appreciable affect on the aquatic ecosystem of the refuge. Their construction would provide the capability for effective management of water levels on the refuge to substantially improve habitat quality for fish and wildlife resources.

F. Determination of Secondary Effects on the Aquatic Ecosystem - No significant negative affects would result from the proposed project. The ability to manage water levels in pool C would result in long-term benefits to aquatic vegetation and water quality and related secondary benefits to fish and wildlife are expected.

III. FINDINGS OF COMPLIANCE

The proposed discharge of dredged material would comply with the Section 404 (b)(1) guidelines of the Clean Water Act. No significant adaptations to the Section 404(b)(1) guidelines were made for this evaluation. No alternatives were identified that would accomplish the purposes of the proposed dike that would not involve the deposition of fill. Alternative dike alignments were not considered because the road remnant provides a structure upon which to build the proposed dike. Other alternatives considered were different dike designs and sources of fill. They were not selected because they were more expensive.

The proposed discharge of dredged material would comply with all State of Wisconsin water quality standards, Section 307 of the Clean Water Act, and the Endangered Species Act of 1973, as amended. The proposed action would have no adverse impacts on human health or welfare, including municipal and private water supplies, recreational and commercial fishing, plankton, fish, wildlife, and special aquatic sites. The life stages of aquatic organisms and other wildlife would not be adversely affected. No significant adverse effects on aquatic ecosystem diversity, productivity and stability, or on recreational, aesthetic, and economic values would occur.

On the basis of this evaluation, I specify that the proposed action complies with the requirements of the guidelines for discharge of dredged material.

for James T. Scott HAT, EN
Colonel, Corps of Engineers
District Engineer

26 Jan 94
Date

Attachment 4

Letter of Intent

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/ARW-SS

DEC 16 1993

Colonel James T. Scott
District Engineer
Saint Paul District, US Army Corps of Engineers
Army Corps of Engineers Centre
190 Fifth Street East
Saint Paul, Minnesota 55101-1638

Dear Colonel Scott:

Based on the revised draft Definite Project Report/Environmental Assessment (SP-15), "Trempealeau National Wildlife Refuge Habitat Rehabilitation and Enhancement Project" dated August 1992; the U.S. Fish and Wildlife Service (Service) will assure operation and maintenance requirements of the project will be accomplished in accordance with Section 906(e) of the Water Resources Development Act of 1986. In accordance with the policies stated in the Fourth Annual Addendum, the Service will perform the operation and maintenance requirements for this project as listed on pages 50-51.

This project is located on Refuge lands. Therefore, the Service will complete its finding of no significant impact upon learning from you that the public review period produced no substantive changes in the Definite Project Report/ Environmental Assessment.

We look forward to continued cooperative efforts in developing habitat rehabilitation and enhancement projects under the Environmental Management Program.

Sincerely,

Marvin E. Moriarty
Acting Regional Director

Attachment 5

Coordination

WISCONSIN
DEPT. OF NATURAL RESOURCES

George E. Meyer
Secretary

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

101 South Webster Street
Box 7921
Madison, Wisconsin 53707
TELEPHONE 608-266-2621
TELEFAX 608-267-3579
TDD 608-267-6897

December 14, 1993

Colonel James T. Scott, District Engineer
St. Paul District, Corps of Engineers
190 Fifth Street East
St. Paul, MN 55101-1638

Dear Colonel Scott:

The Wisconsin Department of Natural Resources supports construction of the Trempealeau National Wildlife Refuge (NWR) Habitat Rehabilitation and Enhancement Project (HREP), Pool 6, Upper Mississippi River, Trempealeau and Buffalo Counties, Wisconsin.

Upon completion and final acceptance of the project by the Corps of Engineers and the Fish & Wildlife Service, the Wisconsin Department of Natural Resources will cooperate with the Fish & Wildlife Service to assure that operation and maintenance, and any mutually-agreed upon rehabilitation, will be accomplished in accordance with Section 906(e) of the Water Resources Development Act of 1986 and the current guidance contained in the Sixth Annual Addendum, May 1991, Appendix D, Section III.A.9 (pp. 21-22).

I look forward to completion of the Trempealeau National Wildlife Refuge Habitat Rehabilitation and Enhancement Project and the benefits it will provide to the Upper Mississippi River system.

Sincerely,

George

George E. Meyer
Secretary

c: Sam Marlar, Regional Director, UWFWS

WISCONSIN
DEPT. OF NATURAL RESOURCES
George E. Meyer
Secretary

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

3550 Mormon Coulee Road
State Office Building
La Crosse, WI 54601
TELEPHONE 608-785-9000
TELEFAX 608-785-9990

October 6, 1993

Colonel James T. Scott
St. Paul District, Corps of Engineers
180 Kellogg Boulevard East, Room 1421
St. Paul, MN 55101-1479

Dear Colonel Scott:

The Wisconsin Department of Natural Resources has completed review of the Definite Project Report/Environmental Assessment for the Trempealeau National Wildlife Refuge Habitat Rehabilitation and Enhancement Project, Pool 6, Upper Mississippi River, Trempealeau and Buffalo Counties, Wisconsin, dated August 1993. Following are our comments regarding this document.

DPR Main Report

Page DPR-12: Sediment Quality - Please include a copy of the bulk chemical analysis and the locations of the samples tested. This information should be referenced in this section and a copy of the results provided in the DPR appendixes.

Page DPR-13: Following the September 14, 1993, public meeting, we conducted a review of the state list of endangered and threatened species in response to comments made at the meeting. Natural Heritage Inventory records indicate the following species have occurred or presently occur on (or immediately adjacent to) the refuge:

Villous Prairie Clover (Petalostemon vellosum), Special Concern
Western Sand Darter (Ammocrypta clara), Special Concern
Mud Darter (Etheostoma asprigene), Special Concern
Pugnose Minnow (Notropis emiliae), Special Concern
Black-crowned Night Heron (Nycticorax nycticorax), Special Concern
Yellow-crowned Night Heron (Nycticorax violaceous), State Threatened
Red-shouldered Hawk (Buteo lineatus), State Threatened
Bell's Vireo (Vireo bellii), State Threatened

Please include these species in the section addressing endangered and threatened species.

Sources of Fill Material: Pages DPR-44, 45, 49. We do not concur that the only feasible source of material for Dike C2 and Dike E is the Fountain City Beneficial use site. We have made objections to identifying the beneficial use site as the only alternative for dikes C2 and E in our response (dated March 25, 1993) to the Preliminary Draft Trempealeau NWR DPR, dated January 1993. Our past experiences with waiting to identify alternative borrow sources during the Plans and Specs has prompted us to require that all alternative borrow sites be identified in the DPR and Section 404 evaluation and that borrow sites be selected prior to preparation of P&S. Since this is a habitat

OCT 0 3 1993

project, the dike material should create new habitat such as a dredged channel that would provide added depth to adjacent backwaters. We require that the potential source of fill material for Dikes C2 and E stated in the DPR include an option to obtain fill material from areas near the main channel and/or adjacent backwaters that would benefit fisheries habitat.

A preliminary investigation of the Mississippi River backwaters adjacent to and inside the Trempealeau NWR indicates there may be areas which contain suitable fill material for Dikes C2 and E. These areas are shown on Enclosure 1. We request that these areas be investigated by the COE to determine if the quantity and quality of the material is suitable for dike construction. This will require a particle size analysis and potentially a bulk chemical analysis.

We believe that it is feasible to utilize a backwater borrow site for construction of the C2 and E dikes. For example, the potential borrow site located within the interior of an island located at RM 717.5 LDB could be hydraulically pumped to a temporary disposal site inside the refuge. This material could then be trucked to Dikes C2 and E along existing refuge roads. Some of the advantages to using this method over using the Fountain City Beneficial site are: trucks hauling sand will not have to negotiate rail road crossings or travel public highways, hauling distance will be decreased, the refuge may choose to use the same borrow area and temporary containment site for obtaining material for a separate project to upgrade the refuge's exterior dike, and fisheries habitat in the Mississippi River could be improved.

Therefore, we request that the following sentence be incorporated into the appropriate sections when referring to potential sources of fill material for dikes C2 and E: "Fill material for Dike C2 (or E) will be obtained from sand dredged near the main channel or backwaters of the Mississippi River, from within Pool A, or from the Fountain City or Trempealeau Beneficial use site if no suitable River sources are available."

Attachment 3: Section 404 (b)(1) Evaluation. With regards to the additions of the above sentence into the DPR, paragraph D.3. (Source of the Material) and paragraph F (Description of Disposal Method) will need to be changed for Dike C2 and Dike E to reflect the addition of these alternative sites.

The following comments are in reference to the Trempealeau NWR HREP DPR APPENDIXES document:

Page A-3: The alignment of the C2 dike in figure 1 is different than the main report. Please make correction.

General comments:

We have had several conversations with your staff regarding the aeration of Pool A to improve winter fish habitat. We concur that the use of aerators will remove the one of main factors limiting the fisheries population on the Trempealeau NWR. While aeration will significantly improve fisheries habitat in Pool A, there is no mention of whether the fisheries population in Pool B will be impacted by dividing the present large pool into two separate pools. We speculate that there will be some decrease in habitat suitability for fish in Pool B since the dike will isolate fish from the deeper sections of the present pool (deep water areas of Pool A). Therefore, we request that the following sentences be added in the HEP Appendix and Main report regarding fisheries habitat benefits associated with construction of the dike: "Construction of the Pool A dike may have a negative impact on the fisheries habitat associated with Pool B. This impact would result from reducing the acreage of deep water habitat available to fish in Pool B (>4 feet). However, this

reduction of habitat in Pool B is considered acceptable given the fishery habitat gains in Pool A due to aeration."

We recommend that a bathymetric survey of Pool A be conducted prior to plans and specs to determine the best route for the Pool A Dike and best location for the aeration system. This bathymetric survey can also be used by refuge staff to guide them in water level management for Pool A.

We have determined that all of the water control structures will require a permit from the State of Wisconsin for the placement of a structure on the bed of a river. A permit will also be needed for diverting flow from the Trempealeau River. We will notify the Fish and Wildlife Service of these permit needs and the proper procedures for obtaining the permits.

We will provide our letter of support when we have been notified that our comments have been incorporated into the document or acceptable justification has been provided as to why these comments have not been included. We will provide water quality certification during preparation of plans and specs.

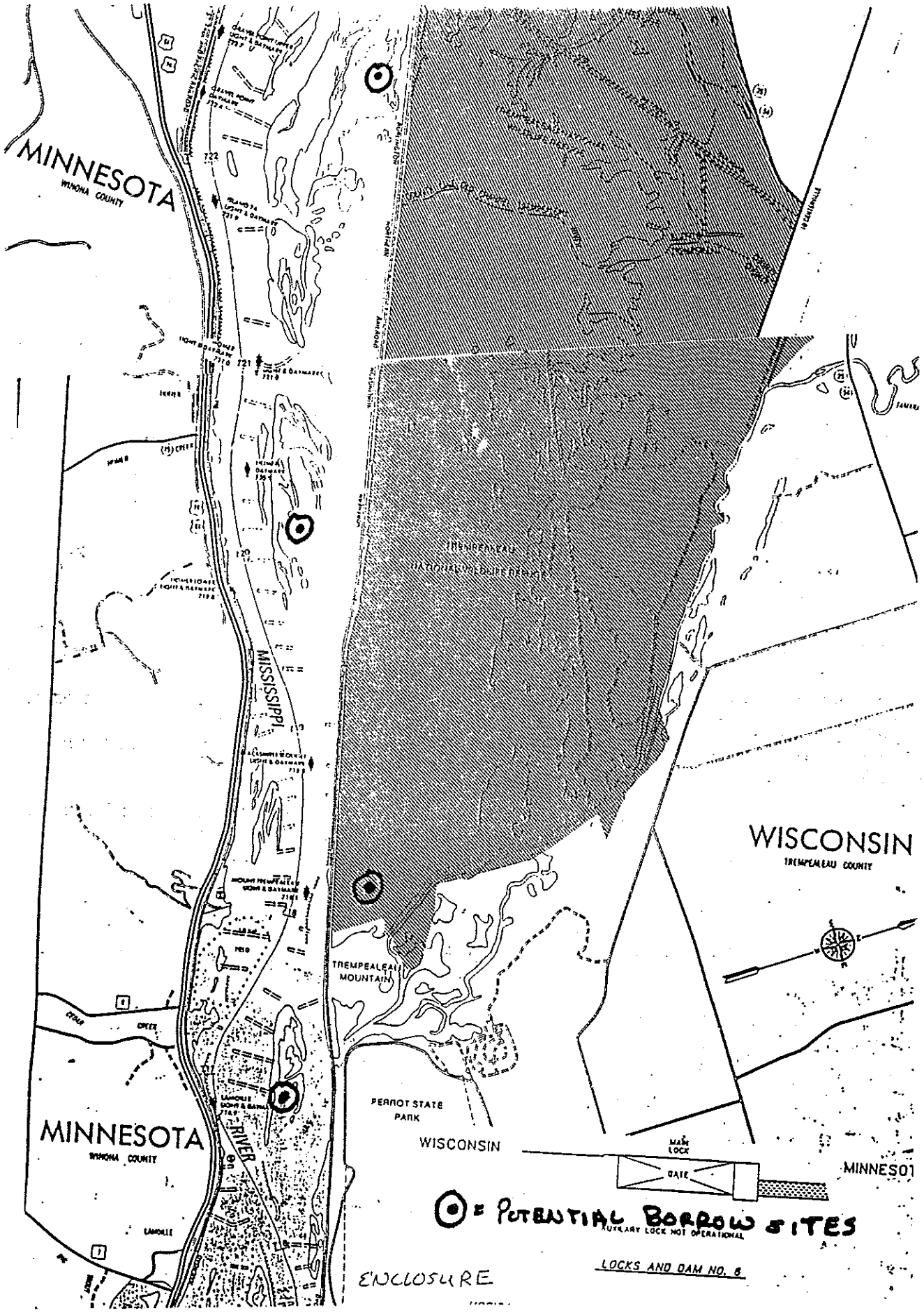
If you have any questions regarding our comments, you can contact me at (608) 785-9005.

Sincerely,

Jeffrey A. Janvrin
Mississippi River Habitat Specialist

Enclosure

c: Keith Beseke, FWS
Mike Davis, MN DNR
Pam Theil, Winona FRO
Rick Frietsche, Trempealeau NWR
Don Powell, COE
Randy Devendorf, COE
Ed Bourget, WDNR
Jim Talley, WDNR
Ron Benjamin, WDNR
Brian Brecka, WDNR
John Wetzel, WDNR
Terry Moe, WDNR
Gretchen Benjamin, WDNR


MINNESOTA
WINONA COUNTY
MISSISSIPPI
WISCONSIN
TREMPEALEAU COUNTY
TREMPEALEAU MOUNTAIN
PERROT STATE PARK
MINNESOTA
WINONA COUNTY
RIVER
WISCONSIN
MAIN LOCK
GATE
MINNESOT
= POTENTIAL BORROW SITES
AUXILIARY LOCK NOT OPERATIONAL
LOCKS AND DAM NO. 6

ENCLOSURE

Corps Responses to Wisconsin DNR Comments (10/6/93)
on the
Trempealeau NWR, WI
Draft DPR/EA

DPR-12 Comment - The results of the analysis have been placed in appendix A as requested.

DPR-13 Comment - The species listed were added to the "Threatened and Endangered Species" section of the report as requested.

Sources of Fill Material Comment - The draft report did indicate that other borrow sites would be investigated during more detailed design. However, the "Sources of Fill Material", "Construction Methods", and "Environmental Assessment" sections of the final report have been modified to include the suggested potential sites and plate 15 shows the sites.

Attachment 3 Comment - The Section 404(b)(1) Evaluations have been modified as requested.

Page A-3 Comment - The areas C1 and C2 shown in Figure 1 are not to be correlated with the C2 dike alignment. This figure was used to designate an evaluation segment or unit during the initial project formulation process, not to show dike alignment. The relationship of the C2 dike alignment to the pool C2 evaluation unit is explained in the 5th and 6th paragraphs on page A-8.

General comments - The requested statement about fish habitat in pool B has been added to the "Habitat" section of the Environmental Assessment.

A bathymetic survey of pool A will be one of the initial items of work scheduled when funds are received to prepare plans and specifications. The pool A dike and aerators would be located based on that information.

Statement about permits required has been noted for the future work efforts.

MINNESOTA-WISCONSIN BOUNDARY AREA COMMISSION
619 SECOND STREET, HUDSON, WISCONSIN 54016-1576
Serving Our Sponsor States on the St. Croix and Mississippi Rivers since 1965
Office Hours: 8 A.M. - 5 P.M. Monday-Friday
Minnesota Telephone (612) 436-7131
Wisconsin Telephone (715) 386-9444

September 14, 1993

Colonel James T. Scott
District Engineer
St. Paul District, Corps of Engineers
180 East Kellogg Blvd, room 1421
St. Paul, MN 55101-1479

ATTN: CENCS-PD-WR
Trempealeau National Wildlife Refuge
HREP, Pool 6, Upper Mississippi River

Dear Col. Scott:

On behalf of the Mississippi River Regional Committee of the Minnesota-Wisconsin Boundary Area Commission, I am writing to provide comments about the above referenced project located within the Trempealeau National Wildlife Refuge. Our committee reviewed the project public notice and staff report at our regular public meeting on September 9, 1993 and adopted the following specific comments:

1. The project consists of creating management pools by constructing three dikes totaling about 17,000 linear feet, three water control structures, a permanent pump station and portable pumps, island stabilization, and an aeration system in one management pool. The committee supports this design and urges the implementation of the project with consideration of the concerns expressed below.

2. The construction budget for this project, as shown in Table DPR-7, page DPR-53 of the Definite Project Report, is $3,637,000 plus an additional $945,000 for engineering, design, supervision and inspection, for a total cost of $4,582,000. Funding for this project will be 100% federal from the Environmental Management Program account. The committee is very concerned about recent documented lapse and diversion of EMP funds to non EMP projects and would urge the Corps to re-allocate lapsed or diverted funds for this project to enable the maximum benefits from the EMP funding.

3. There has been much discussion of late about the inability to fully commit funding for EMP projects due to lack of Corps support and resources to move projects efficiently through the engineering, design and construction phases. As a result the public and the river is not obtaining the maximum benefits from the EMP program as envisioned by those of us who worked so diligently for the passage of the Water Resources Development Act of 1986 and subsequent appropriations under the Act. Therefore, the committee strongly urges the Corps to provide the necessary engineering services to projects in the EMP to ensure full and complete funding obligations of the program for the future.

We appreciate the opportunity to comment on this project and are submitting these comments at the September 14, 1993 meeting in Trempealeau, Wisconsin, with copies to Congressman Gunderson, key agency staff, and our representatives to the Environmental Management Program Coordinating Committee.

Sincerely,

Dan McGuiness
Administrative Director

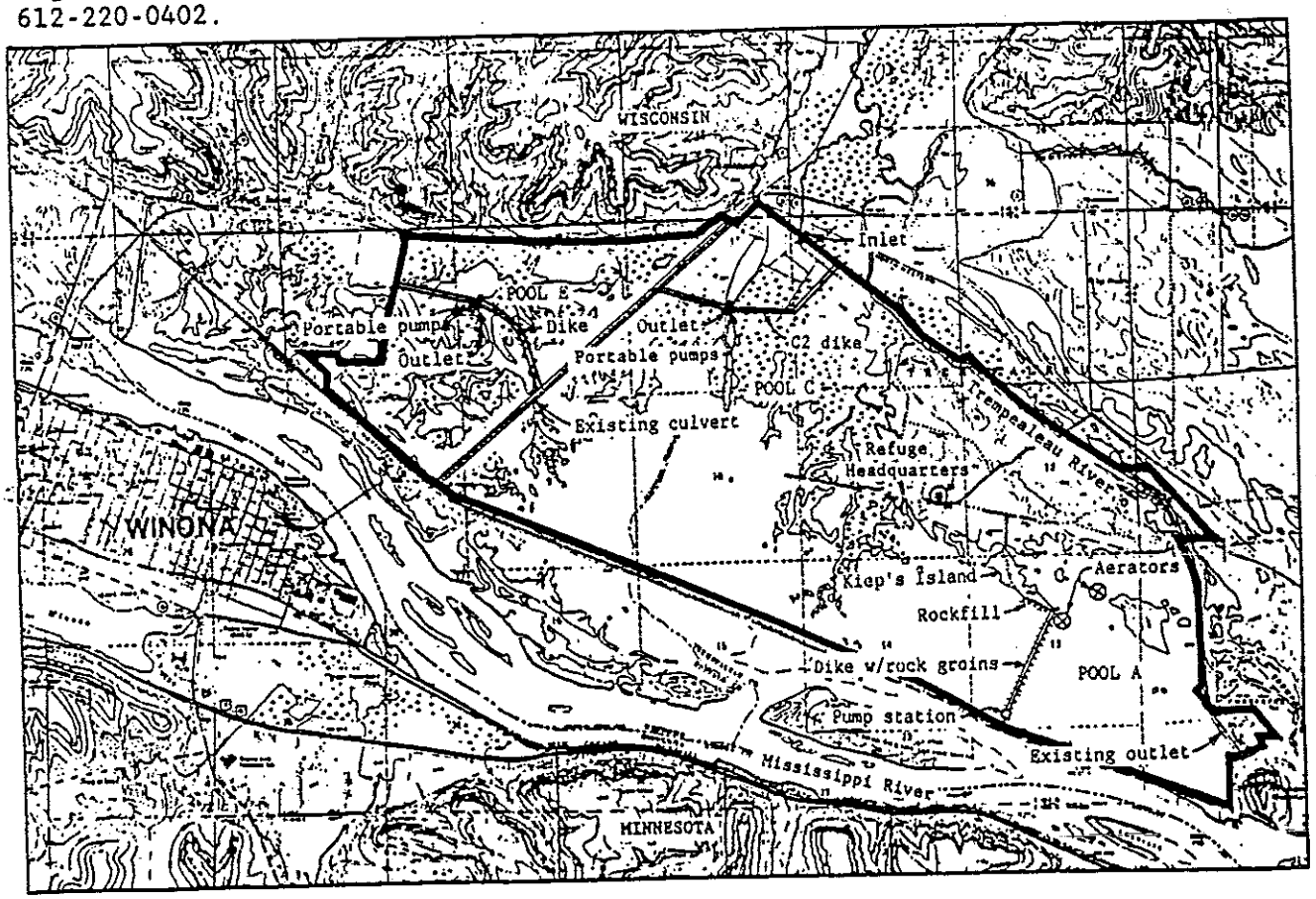
DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
180 E. KELLOGG BLVD., ROOM 1421
ST. PAUL, MINNESOTA 55101-1479

August 27, 1993

TREMPEALEAU NATIONAL WILDLIFE REFUGE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM

A public meeting to discuss a proposed habitat improvement project at the Trempealeau National Wildlife Refuge is scheduled for Tuesday, September 14, 1993, at 7:00 pm in the multi-purpose room of the Trempealeau Elementary School (4th & Grove Street) in Trempealeau, Wisconsin. This will be an opportunity to learn about the proposed project, ask questions, and provide your input. Representatives from the U.S. Corps of Engineers, U.S. Fish and Wildlife Service, and the Wisconsin Department of Natural Resources will be present. The Trempealeau habitat project is part of the Upper Mississippi River System Environmental Management Program. The purposes of the project are to provide the opportunity to control water levels in several areas of the Refuge in order to preserve, restore, and enhance a diversity of plant and animal communities and to provide breeding, resting, and feeding habitat for migratory birds and marsh wildlife. Fish habitat would also be improved on part of the Refuge. These goals would be accomplished by constructing dikes, water control structures, pumping facilities, and an aeration system.

We encourage you to attend the meeting and tell others who might like to provide input or hear about this project planned for the Trempealeau Refuge. If you are unable to attend the meeting, please send your comments to the District Engineer, ATTN: CENCS-PD-WR at the address above, or contact Mr. Don Powell at 612-220-0402.



TREMPEALEAU
NATIONAL WILDLIFE REFUGE

PROPOSED PLAN

RECORD OF ATTENDANCE

Trempealeau NWR Public Meeting at Trempealeau, WI September 14, 1993

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 (self, agency, etc)
ROBERT SIEKER	5305 MAIN FOUNTAIN CITY	MISS. RIVER COM.
Dale Cartyman	Trempelo	
Mr + Mrs Ken Burman	Kenosha Wi	
JOAN ALBERT	North Central Divn. Corps of Engineers 111 N. Canal, Chicago, IL 60606	
Schindler Ken, Doris + Daul	Trempealeau	
Nathan Kathir	COE, St Paul, MN ~~(Co-EW)~~	~~SE~~ Co-EW
Rob Drieslein	Winona ~~Bo~~	Winona Daily News
Bob Drieslein	R2 Trempelo, WI	USFWS
Robin Grawe	678 Sioux, Winona	MWBAC
Elaine Delaney	R#1 Trempealeau	
Carol Jefferson	RT3 Box 88 (Home) Winona MN 55987	Winona — Biology Dept STAFF Univ.
Doug Damberg	566 Sioux St. Winona	

RECORD OF ATTENDANCE

Trempealeau NWR Public Meeting at Trempealeau, WI — September 14, 1993

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 (self, agency, etc)
Judith E. Nelson	Lake Rd. Trempealeau	self
JEFF JANVRIN	WDNR LaCrosse WI 54601	WDNR
Pam Thiel	FWS Winona	US FWS
RAY FLOCK	COE, WINONA	COE
SARA SUMMERFELD	COE, [illegible]	COE
CLIFF INMAN	1405 No. LEXINGTON AVE. ARDEN HILLS MN 55126	BURLINGTON NORTHERN RR
Brian Brecka	Alma	WDNR
Dan McDonald	Tremp	TNWR
Thomas Hunter	Trempealeau	self
Steve Tapp	Fountain City, WI	Corps of Engineers
Scott Lee	Winona, MN	Trempealeau Elementary
SCOTT YESS	Winona, Mn.	USFWS

RECORD OF ATTENDANCE

Trempealeau NWR Public Meeting at Trempealeau, WI — September 14, 1993

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 (self, agency, etc)
Ambrose Schwartz	W228 State Rd	Self
Ron Benjamin	WDNR LAX	
Elanor Welch	Trempealeau	Resident
Eric Macbeth	619 Second St. Hudson WI 54016	MN-WI Boundary Area Commission
John Wetzel	3550 Mormon Coulee Rd LA Crosse 54601	WDNR
George J Richtman	Route 1 Box 1670 Trempealeau, WI	

TREMPEALEAU PUBLIC MEETING COMMENTS
September 14, 1993

Following is a summary of comments and questions received at the Trempealeau public meeting on September 14, 1993.

-Will artifacts on Keip's Island be protected by the plan? (Yes. Gravel will be laid down prior to hauling and the shoreline will be protected with rock.)

-What about Black Oak Island? (Dike A will reduce wave action that currently attacks the shoreline of the island.)

-What impact on woody vegetation will flooding of C2 have? (Purpose is to prevent encroachment of willows. Will impact on existing wooded area in the northern corner of the pool.)

-Will road into upper pool E be strengthened? Lower pool E should stay like it is. (Access road to upper pool E may need to be improved slightly and will be looked at further. Lower pool E will not be disturbed.)

-What will happen to existing outlet in pool A? (No changes will be made.)

-Will dike A cut off boat landing? (Yes. A new landing for non-motorized craft will be provided for pool A. Landing may be closed during migration.)

-Will project enhance camping at State Park? (Wildlife will be enhanced so public use of wildlife resources, such as sightseeing, bird watching, etc. will be enhanced).

-Congress said some funds should be used for recreation. What happened? (Low priority within administration.)

-FWS is not good at maintaining dikes.

-Take sand from Refuge to save 12 miles of trucking. (High costs for necessary cultural resource investigations would make more costly and require additional time. Proposed sites use material free of charge.)

-Get sand for pool C2 from river. (Will look at borrow sites in more detail during preparation of plans and specifications stage.)

-What is status of contacts with railroads? (Both railroads have been contacted and notified of potential project but no negotiations have taken place.)

-How assured is funding to build project? (Funds are scheduled and EMP has been receiving full funding in recent years.)

COMMENTS

Trempealeau National Wildlife Refuge Habitat Project 9/14/93

Name (optional) Pam Thiel

Pg 13 Fish & Wildlife

In the last paragraph, bullheads are noted as both a rough fish & a desirable sp. They can't be both. WI does not consider them a rough fish

Please leave this sheet at the meeting or mail your comments to:

Mr. Don Powell, CENCS-PD-WR
U.S. Corps of Engineers
180 Kellogg Blvd E, Rm 1421
St. Paul, MN 55101-1479

COMMENTS

Trempealeau National Wildlife Refuge Habitat Project 9/14/93

Name (optional) _____

My main concerns are:

A) During floods you maintain a much lower water level. Having your level 7-9 ft. lower, as you did during this Summer's flood, has quite an impact on your downstream neighbors. 5620 acres x 7-9 ft. equals how many gallons?!

B) The cost of this project. 4.6 million. If each household pays $2500 in property taxes, how many households would be needed to pay for this project? It makes you think, right. Of course compared to the space program, it's a drop in the bucket.

C) It seems pretty contrived. Aren't you a little concerned playing around with nature?

Please leave this sheet at the meeting or mail your comments to:

Mr. Don Powell, CENCS-PD-WR
U.S. Corps of Engineers
180 Kellogg Blvd E, Rm 1421
St. Paul, MN 55101-1479

COMMENTS

Trempealeau National Wildlife Refuge Habitat Project 9/14/93

Name (optional) Dale Cutgrow

I would strongly object to the use of wells to provide water,

Please leave this sheet at the meeting or mail your comments to:

Mr. Don Powell, CENCS-PD-WR
U.S. Corps of Engineers
180 Kellogg Blvd E, Rm 1421
St. Paul, MN 55101-1479

Sept 20, 1993

District Engineer,

Dear Sir:

We do not want to support the spending of 4½ Million on the Mississippi because we have a much smaller project that needs help. We have been unable to get a dike repaired on Black River 3 mi E. of Trempealeau which is letting Black River come through Tank Creek. The U.S.C.E. spent several hundred thousand this year to save the small Tank Creek bridge. If dike had been fixed the water would have gone through big bridge over Black River.

That water has killed thousands of trees and makes the "Great River Rd" a horrible sight with dead trees there. We can no longer use it for logs, lumber or firewood. Besides farmland crops are lost. All hunting or trapping is at a standstill because deer, squirrels etc won't live in the water. We can't even go duck hunting as the water is too deep to wade, even with waders. We can't use a boat as all the dead trees are down.

I know you are working on a Federal Project but also know the Wis D.N.R. and the Wis D.O.T.R. were there. The Wis D.N.R. would not let my neighbor go in on his own land + repair dike — Free of Charge — This dike I can trace back to more than 100 yrs old.

Would you please help us show them why we need to repair this. 80 Acres of this is a licensed fur farm.

I have contacted all Wis. authorities on this so I want only a response from you.

Was unable to attend meeting at Trempealeau last Tuesday as I had foot surgery a few days before.

Hope to hear some good news from you.

Sincerely

Dennice Ryder
R2 Box 51
Trempealeau, Wis
54661

Phone 608-534-7739

Winona Daily News
Winona, Minnesota — Wednesday, September 15, 1993
3 sections 50 cents

Refuge project

Proposals meet positive response at public hearing

By Rob Driesiein
Winona Daily News

TREMPEALEAU, Wis. — A proposed $4.5 million habitat improvement project on the Trempealeau National Wildlife Refuge met a favorable response during a public hearing Tuesday night.

Representatives from the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service and the Wisconsin Department of Natural Resources explained the project and answered questions from 40 area citizens attending the meeting at the Trempealeau Elementary School.

Through a series of dikes and pumping stations, the project will allow the refuge to better manage waterfowl and fish habitat, according to Corps of Engineers representative Don Powell.

The plan focuses on three areas of the refuge, Powell said.

On the east end, near Trempealeau Mountain, a dike system would create a 700-acre pool to establish emergent and submergent vegetation, maintain existing islands and maintain dissolved oxygen levels, he said.

Near the Marshland, Wis., access and the refuge's west end, additional dike systems would provide flooded marshes and limit woody plant invasion.

Carol Jefferson, a plant ecologist from Winona State University, asked if construction of a dike from Kiep's Island would affect plant communities on the island.

Powell and refuge manager Rick Frietsche said they are aware of the flora and construction plans will preserve it.

The dike system from Kiep's Island would connect to the Burlington-Northern Railroad tracks. No agreements have been struck between the railroad and the refuge yet, Powell said.

The dike would present a barrier to anglers using the refuge boat landing from reaching a 700-

►Please see REFUGE/7A

►Refuge

From page 1A

acre body of water at the eastern end of the refuge.

Refuge Manager Rick Frietsche said an additional access could be constructed so anglers could boat or canoe the area.

Trempealeau citizen George Richtman was concerned that new pumping stations would impact fishing.

The current gravity-fed water control structure on the east end of the refuge stimulates fish activity in the Trempealeau River and Bay. Richtman wondered if that would become obsolete.

Keith Beseke, Environmental Management Program coordinator, explained that the refuge would still use the gravity-fed structure because of its cost-effectiveness.

Frietsche and Powell said the project focuses on improving wildlife habitat, not recreation.

However, Frietsche said the public would benefit from improved wildlife-watching and fishing opportunities.

US Army Corps
of Engineers
St Paul District

Public Notice

Project: Trempealeau National Wildlife Refuge-Habitat Rehabilitation and Enhancement Project, Pool 6, Upper Mississippi River

Date:
August 16, 1993

In Reply Refer to:
Water Resources Study Branch
Planning Division

1. Project Location. The proposed project is located on the Trempealeau National Wildlife Refuge on the Wisconsin side of the Mississippi River in pool 6 near Trempealeau, Wisconsin. The Refuge is located in Trempealeau and Buffalo Counties and is separated from the main channel by the Burlington Northern Railroad embankment and from the Trempealeau River by a barrier dike. About 75 percent of the 5,620-acre Refuge is marsh, open water, and seasonally flooded areas. The remainder of the Refuge is bottomland hardwoods, upland forest and shrublands, and grasslands.

2. Project Authority. Section 1103 of the Water Resources Development Act of 1986 (Public Law 99-662) provides authorization and appropriations for an environmental management program for the Upper Mississippi River system that includes fish and wildlife habitat rehabilitation and enhancement. The proposed project would be funded and constructed under this authorization.

3. Project Purpose. The proposed project would provide the opportunity to control water levels in several areas of the Refuge in order to preserve, restore, and enhance a diversity of indigenous plant and animal communities and to provide breeding, resting, and feeding habitat for migratory birds and marsh wildlife. Fish habitat would also be improved on part of the Refuge.

4. Proposed Project. The selected plan of action would consist of creating management pools by constructing three dikes totaling about 17,000 linear feet, three water control structures, a permanent pump station and portable pumps, island stabilization, and an aeration system in one management pool. A 700-acre management pool would be created and a 22,000 gpm pump station would be constructed that would provide the capability to draw the pool down 2 feet to establish and promote the growth of aquatic vegetation. This pool would also be aerated at two areas during the winter to provide opportunity for improving fish habitat. A 220-acre management pool created in another part of the Refuge would be capable of ponding up to 4 feet of water using portable pumps to pump 9,000 gpm or an inlet from the Trempealeau River. The pool could be used for a spring resting and feeding area, brood use, or fall migration, depending on weather conditions and the type of habitat desired. A third management pool 550 acres in size would be created in the northern part of the Refuge that would be capable of providing a 2-foot increase in water level using portable pumps to pump 9,000 gpm. The raise in pool water level would provide a flooded marsh for migratory birds and also limit the encroachment of woody vegetation into the pool. An estimated 220,000 cubic

yards of sandfill to build the three dikes would be obtained by dredging from outside the Refuge near the main channel of the Mississippi River and from a placement site near Fountain City. The total direct construction cost of the project is estimated to be $3.6 million.

5. Permits/Coordination.

a. General. The proposed project has been coordinated with the U.S. Fish and Wildlife Service, the Wisconsin and Minnesota Departments of Natural Resources, and the Wisconsin State Historic Preservation Office.

b. State. The filling required for the proposed project is subject to regulation by the Wisconsin Department of Natural Resources in accordance with Section 401 and 404(t) of the Clean Water Act. A request for water quality certification will be made to the State of Wisconsin. A permit for diversion of water may also be needed and is being coordinated with the Wisconsin Department of Natural Resources.

c. Federal. An environmental assessment and Finding of No Significant Impact have been prepared in accordance with the requirements of the National Environmental Policy Act. The U.S. Fish and Wildlife Service was a cooperating agency throughout the process required by the Act. A Section 404(b)(1) evaluation has been prepared in compliance with the Clean Water Act of 1977.

6. Summary of Environmental Impacts.

a. General. Stated in Project Purpose Section.

b. Water Quality. The proposed project would have short-term construction related adverse effects due to the open water placement of sandfill at the dike sites and the possible minimal effluent return from fine material placed on the dike. This is expected to cause an increase in suspended particulates during construction. No increase in contaminants in the aquatic environment is expected from the proposed placement of closure fill. Long-term beneficial impacts on water clarity in the open water parts of the Refuge should occur because of the dike that would reduce wave action and the increase in aquatic plant growth.

c. Benthos. The dikes would result in minor adverse effects on the existing benthos in the Refuge. Minor losses of benthos would occur because the proposed dikes would affect about 21 acres of shallow water habitat. Dredging material from areas adjacent to the dikes for topsoil would result in the disturbance of an additional 3 acres of benthic habitat. These losses would be partially offset with the benthic recolonization of riprapped areas on the dikes and the colonization of the dredged areas by vegetation from the existing aquatic plant beds.

d. Fish. The creation of the 700-acre pool for migratory birds and aeration of the pool would improve fish habitat. Reducing the number and biomass of rough fish and stocking with fish such as largemouth bass, black crappie, and bluegill would improve the fishery. Dredging for topsoil would provide about 2 acres of additional deepwater fish habitat for such species as bluegill and largemouth bass. Project construction in other areas of the Refuge would have insignificant effects on fish.

e. Wildlife. The dikes would provide about 13 acres of terrestrial habitat for waterfowl and animals. Increased aquatic vegetation would provide habitat for aquatic furbearers and waterfowl.

f. Archaeological-Historical. No archaeological or historical sites listed on the National Register would be affected by the proposed project. However, sites deemed eligible or with a high probability of eligibility for inclusion on the National Register would be affected by haul or access routes for construction equipment. Coordination with the Advisory Council would be an ongoing activity prior to and during construction.

g. Noise Pollution, Air Quality. Minor noise and air quality impacts would occur during project construction but would be short-term. No significant adverse impacts to the general public should occur because the construction site is not in the immediate vicinity of any residences.

7. Applicable Federal Laws and Regulations.

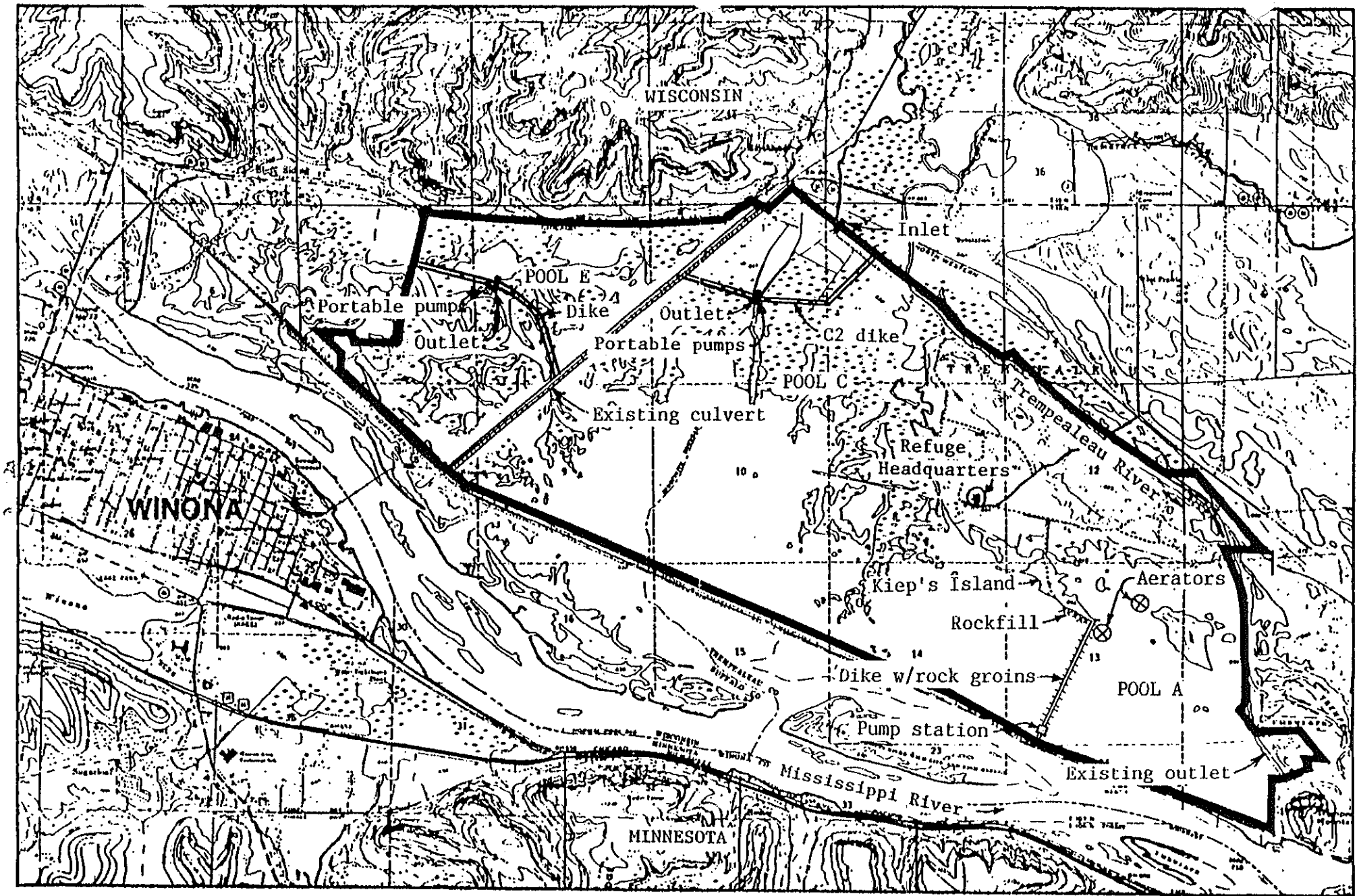
National Historic Preservation Act of 1966, as amended
Clean Air Act, as amended
Clean Water Act of 1977, as amended
National Environmental Policy Act of 1969, as amended
Fish and Wildlife Coordination Act of 1958, as amended
Endangered Species Act of 1973, as amended
National Wildlife Refuge System Administration Act
Land and Water Conservation Fund Act of 1965, as amended
Executive Order 11988, Floodplain Management, May 24, 1977
Executive Order 11990, Protection of Wetlands, May 24, 1977

8. Report. A Definite Project Report/Environmental Assessment is available to the public that describes the project and environmental impacts in detail. The report includes project drawings, a Finding of No Significant Impact, a Section 404(b)(1) evaluation, and letters of coordination with the U.S. Fish and Wildlife Service, the Wisconsin Department of Natural Resources, and the State Historical Society of Wisconsin. A copy of this report or additional information can be obtained by writing to the address below or contacting Mr. Don Powell at (612) 220-0402.

9. Request for a Public Hearing. Any person may request a public hearing on the project. The request must be submitted in writing to the District Engineer within 30 days of the date of this notice. The request must clearly set forth the interest that may be affected and how the interest may be affected by this activity. A public meeting to discuss the proposed project and respond to questions has been tentatively scheduled for September 14, 1993, in Trempealeau, Wisconsin. As soon as the date and location are firmly established, a notice will be sent to the interests receiving this public notice.

10. Public Comment Period. Interested parties are invited to submit to this office written facts, arguments, or objections to this project within 30 days of the date of this notice. These statements should bear upon the suitability of the location and the adequacy of the plans and should, if appropriate, suggest any changes deemed desirable. All statements, oral or written, will become part of the official project file and will be available for public examination. All replies should be addressed to the District Engineer, Corps of Engineers, St. Paul District, 180 Kellogg Blvd E, Rm 1421, St. Paul, Minnesota 55101-1479, ATTN: CENCS-PD-WR.

James T. Scott
Colonel, Corps of Engineers
District Engineer



TREMPEALEAU
NATIONAL WILDLIFE REFUGE

U.S. FISH AND WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

N

PROPOSED PLAN

Wisconsin Winnebago Business Committee

Governing Body of the Wisconsin Winnebago Nation

July 29, 1993

David Berwick
Department of the Army
St. Paul District, Corps of Engineers
Environmental Resources Branch
Planning Division

Dear Mr. Berwick:

We have reviewed your proposal for construction of a dike at Kiep's Island and also visited the listed sites. Our conclusion is that your plans should not affect the known cemetery thus, we have no objections.

Our only concern is that there should be no turn around area or road widening on the knoll in the vicinity of the cemetery. Since the extents of the burial ground are unknown, this would appear to be a wise precaution.

Please let me know if you have any further questions or concerns. I can be reached at the address listed below:

213 Sunnymeade Lane #1
Madison, WI 53713
(608) 255-2557

We would also be interested in obtaining a copy of the results of the excavations at the two test trenches.

Sincerely,

Larry A. Johns
Burial Sites Coordinator

cc: Ken Funmaker
He Ping

DEVELOPMENT DEPARTMENT: P.O. BOX 430, BLACK RIVER FALLS, WI 54615
PHONE: 1-800-722-8497 or 1-(715) 284-7443 FAX: 1-(715) 284-1712

United States Department of the Interior

IN REPLY REFER TO:

FISH AND WILDLIFE SERVICE
Upper Mississippi River Refuge Complex
51 East 4th Street
Winona,Minnesota 55987

April 22, 1993

Mr. Don Powell, Project Manager
Army Corps of Engineers
NCS-PD-WR
180 Kellogg Blvd. E., Room 1421
St. Paul, MN 55155

Dear Mr. Powell:

This letter provides some additional comments on the preliminary draft Definite Project Report for the Trempealeau Habitat Restoration and Enhancement Project to assist you in revising the fishery component of the document.

The purpose of the Pool A dike is to encourage the growth of submergent and emergent vegetation for migratory birds. Although Pool A will never be a world class fishery, we see an opportunity to increase the sport fishery in this pool with little additional cost compared to the benefits gained.

Turbidity is assumed to be the factor limiting growth of aquatic vegetation in the Pool A area. Bullheads and wave action contribute in a large part to the turbidity problems. The Pool A dike will break up the wind fetch that creates the wave action and provide the opportunity to isolate the fishery for management purposes. After the construction of the dike, Pool A will be drawn down to minimum pool elevations to expose bottom sediments to the beneficial effects of air and to winter kill the existing fishery. Aquatic vegetation along the exposed shoreline should be established by mid-summer following the drawdown and the pool will gradually be filled by seepage, springs and from either refuge pool or river sources. If river water is used for filling the pool the mid-summer timing would avoid attracting concentrations of rough fish. Largemouth bass, black crappie, bluegill, northern pike, golden shiners, and yellow perch will be stocked into the restored pool from captured refuge Pool B fish and/or as they become available from the Genoa Fish Hatchery. The Winona Fishery Resource Office (FRO) will coordinate the stocking program. Even if the bullhead problem is not completely controlled, the bullhead fishery will be improved by reducing the populations of stunted fish that the area currently holds. It is anticipated that the Pool A fishery will have to be restored every five to eight years. The condition of the aquatic vegetation may influence the interval of drawdowns also, but we do not anticipate a frequency greater than that noted above for fishery restoration.

Low levels of dissolved oxygen pose problems for the refuge fishery. The aeration system will provide a winter survival area for fish in Pool A.

Pool B has artesian wells and seeps along the railroad dike that provide a source of dissolved oxygen for fish in this pool during the winter. This pool is a significant source of food for piscivorous birds such as the black tern, osprey, cormorant, great egret, great blue heron and the bald eagle. Rough fish will not be controlled in Pool B unless we sustain significant loss of aquatic vegetation to turbidity caused by fish.

The Winona FRO has monitored the refuge fishery for the past two years and plan to gather information until the project is constructed (see attached memorandum). The FRO plans to follow this preconstruction monitoring with post-construction sampling.

Refuge staff collected dissolved oxygen levels at selected sites in the refuge pool during the winters of 90-91 and 91-92. Dan Wilcox has this data.

Moving the boat launching ramp to the Pool A side from its existing location should be included as a part of the EMP project. The A-B cross dike will isolate the existing landing. Water access for maintenance of the water control structure and the aeration system will be necessary.

If we can be of any further assistance, please feel free to contact us.

Sincerely,

Jim Fisher

James R. Fisher
Complex Manager

cc: R.Frietsche, Trempealeau NWR
G.Wege, St. Paul FO
P.Thiel, Winona FRO

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Fishery Assistance Office
51 East Fourth Street
Winona, Minnesota 55987

IN REPLY REFER TO:

April 12, 1993

Memorandum

To: Keith Beseke, Upper Mississippi River Refuge Headquarters, Winona MN

From: Scott Yess, Winona Fishery Resources Office, Winona, MN

Subject: Trempealeau Fishery

During the summer of 1991 and 1992 fishery surveys were conducted at Trempealeau NWR. The following is a survey of results of these surveys.

JULY 1991:

Black and brown bullheads dominated the catch in July followed by yellow perch and black crappie. Bullheads were approximately 8" average length while very few perch or black crappie were catchable size. Gizzard shad were the dominant forage species, however, golden shiner were also present. Additional species sampled included: northern pike, largemouth bass, carp, pumpkinseed sunfish, and bluegill. These species were present but numbers were low.

SEPTEMBER 1991:

Twenty two species were collected during September. The dominant species were similar to the July sampling period. White bass were also present in low numbers during this sampling month.

JULY 1992:

Species composition remained the same for July 1992, however, catchable sized black crappie and perch increased slightly. Shortnose gar numbers increased slightly also in 1992 making up 4% of the population. The following is a breakdown of the percent of the total catch by number.

Brown Bullhead	36%	Black Bullhead	20%
Yellow Perch	8%	Carp	8%
Black Crappie	6%	Shortnose Gar	4%
Gizzard Shad	4%	Bluegill	3%
Golden Shiner	3%	Northern Pike	.3%
Largemouth Bass	.3%		

Scott Yess

Corps Responses to Wisconsin DNR Comments (3/25/93)
on the
Trempealeau NWR, WI
Preliminary Draft DPR/EA

Fisheries Comments - In a drawdown of pool A, game fish will be impacted along with rough fish as noted. It will be necessary to stock fish in pool A after such a drawdown. FWS has stated that the fish will be obtained from pool B and/or as they become available from the Genoa Fish Hatchery.

A meeting between the FWS and WDNR fisheries personnel was held on May 17, 1993, to discuss the fisheries aspects of the proposed project and answer many of the concerns of the WDNR. A more detailed discussion of the operation of pool A has also been included in the report.

We do not concur that fisheries benefits are overestimated. As noted on page A-9 of the report, in order to more accurately reflect aquatic HU's gained, HU's were reduced by 1/2 to 260 AAHU's. This reflects an HSI of about .4 (slightly below average) and a .3 HSI gain from existing conditions of .1 HSI (70 AAHU's). If anything, the existing conditions may be slightly underestimated in quality. However, a detailed revaluation does not seem warranted. Aeration of pool A1 is rather inexpensive, and even if the habitat units gained were reduced by another 100 HU's, this feature would still be very cost effective.

Information on water quality and fisheries monitoring has been included in appendix A and attachment 5.

Access Comment - A landing for canoes and non-motorized boats will be added for access to pool A. The report has been modified to reflect this.

Pool E Comment - FWS goals are to manage water levels to maintain the existing habitat quality. FWS will monitor conditions in the pool during implementation of the operation plan.

DPR-31 Comments - The 10-year, 7-day discharge for the Trempealeau River at Dodge, Wisconsin, is 132 cfs. This can be directly applied to the reach around the Refuge because the watershed area downstream of Dodge is very small relative to the entire area of the Trempealeau River watershed. The design inflow for the culvert from the Trempealeau River into the C2 pool is 20 cfs. The longest period over which this culvert would operate is 12 days. Generally, operation of the pool would be avoided during a season for which very low flows and very low Refuge elevations are anticipated. This discussion has been included in appendix B.

There would be no exchange of water between the C2 pool and pool E.

DPR-40 & 41 Comment - The report and costs have been modified to reflect the use of underground electric service as suggested.

DPR-44 Comment - We recognize that sport fish are present in pools A and B. However, according to Refuge personnel, the quality of the fishery is limited due to excessive numbers of undesirable species and the winter DO conditions. Additional fisheries information has been included in the report.

DPR-45 Comment - We will work with Corps maintenance personnel and other agencies to locate other potential sources of fill material and to assure that enough material is available to satisfy the project requirements.

DPR-46 Comment - The FWS indicates that boating use on the refuge is minimal. Boating is restricted to non-motorized craft, mostly canoes. Access to pool B during periods of water drawdown in pool A would not be affected. An additional landing would be located near the causeway road to provide access to pool A. Therefore, there would be no appreciable effect on recreational boating.

DPR-48 Comment - It is not possible to be consistent with the cost estimates because they are done at different stages of project development. It is not reasonable to update costs used in the initial alternative evaluation, especially when the updating does not influence the alternative selection process. We have tried to note the updated information as it is presented in the report.

DPR-50 Comment - The table has been modified to be in accordance with the latest guidance of the EMP coordinating committee. A statement has been added in the report that no biological monitoring of the project would be funded under the habitat project component of the EMP. However, if other agencies wish to pursue biological monitoring as part of their management practices, they would be encouraged to do so.

General Comment - Designation of the pools can be somewhat confusing. We have tried to modify the report to reduce any confusion.

Appendix A Comments - As noted on pages A-5, A-7, A-10 and A-11, the diving duck model was used to quantify benefits in evaluation units A1 and A2. In addition to waterfowl benefits in pool A1, fisheries benefits were also evaluated to quantify the benefits derived from aeration.

Winter DO levels have been collected by FWS in 90/91 and 91/92. This information has been added to the report in appendix A.

The management objective for pool B is maintain the good quality waterfowl habitat that is currently present. Fisheries management in pool B is not a management objective for the refuge. The main concern in pool B is the effect rough fish populations have on aquatic vegetation in the pool.

Page A-9 Comment - The 520 HU's were shown in Table A-2 (page A-10) and are a total of the benefits derived from aeration (483) and construction of the dike (38). It was rounded to 520. Also see response to Fisheries Comments above.

Diving Duck Model Comments - The Diving Duck model was initially drafted for use on the Trempealeau project, but with the intent that it could be used for other areas on the river. The initial draft was reviewed by Eric Nelson, Rick Frietsche, Kathy Cheap, and Carl Korschgen of the FWS. Changes to the model were made based on their comments. Wisconsin DNR was invited to several planning meetings for this project in 1990 when this model was being developed, but did not attend. At the time, the model was reviewed by the project partners and was considered to be suitable for application to the Trempealeau EMP project. It is recognized that the model may be revised as it is applied to more projects. Comments concerning revision to the model will be considered in future versions of the model.

WISCONSIN
DEPT. OF NATURAL RESOURCES
George E. Meyer
Secretary

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

3550 Mormon Coulee Road
State Office Building
La Crosse, WI 54601
TELEPHONE 608-785-9000
TELEFAX 608-785-9990

March 25, 1993

St. Paul District, Corps of Engineers
Floodplain Management and Small Projects, Planning Division
ATTN: Mr. Don Powell
180 Kellogg Boulevard East, Room 1421
St. Paul, MN 55101-1479

Dear Mr. Powell:

This letter provides Wisconsin Department of Natural Resources' comments on the preliminary draft Definite Project Report/Environmental Assessment (DPR) for the Trempealeau National Wildlife Refuge Habitat Rehabilitation and Enhancement Project (Trempealeau NWR HREP), Pool 6 of the Upper Mississippi River, dated January, 1993. We will provide a letter stating our approval of the project and outlining our understanding of Wisconsin Department of Natural Resources' operation and maintenance responsibilities after completion of the final project report. Following are our comments on the Trempealeau NWR HREP DPR Main Report.

General Comments:

Fisheries

Throughout the document, references are made to the management objective of "fishery enhancement" in Pool A by creating deeper water habitat and installing an aeration system to prevent winterkill of fish. Another objective of the project is to develop the opportunity to draw down pool A independently of the remainder of the refuge to reduce water depths to encourage aquatic and marsh plants. It is also stated that this ability to drawdown pool A could be used to induce winterkill of roughfish. These 2 objectives for pool A seem to be contradictory. If a winterkill is used to control roughfish, won't the gamefish also be impacted?

Very little information is provided in the document relating to this apparent contradiction in objectives for pool A. The only reference we found regarding the proposed frequency of controlling roughfish populations through winterkill is found on page DPR-47 (once every 15 years). We recommend that a section be incorporated into the report clearly stating how Pool A will be managed to provide a balanced fishery while controlling roughfish if that is the desired outcome. Answers to the following questions will help clarify these management efforts: What type of information will be needed to determine if roughfish control is necessary? How will the pool be restocked with desirable species of fish after treatment? If the pool will need to be stocked after a treatment, where will the stocked fish come from and how much will it cost? Is once every 15 years sufficient for control of roughfish populations, or will it need to be done more often? If the pool is to be restocked after treatment, should the cost for stocking the pool be included in the estimated average annual O&M costs? We will be glad to assist in reviewing further fisheries objectives with FWS staff.

We commend the Refuge staff for wanting to improve fisheries resources and habitat within the Trempealeau NWR while still meeting the primary objective of managing the area for migratory birds and other wetland associated fauna. We believe this can be accomplished through the habitat enhancement practices proposed in the DPR. However, we are concerned that the area impacted and the habitat benefits gained by these enhancement efforts for fish habitat may be overestimated. Therefore, we request that the fisheries objectives be reviewed and habitat benefits reassessed.

We are aware that the Fish and Wildlife Service has conducted water quality and fisheries monitoring in the Trempealeau NWR. We recommend that this information be included in the DPR.

Access

The DPR does not mention if water access for maintenance will be provided into each of the pools to be created. We recommend that maintenance access be mentioned in the appropriate section of the DPR and on the maps. Presently, the public has boating access to what will become pools A and B. We recommend that this access be maintained.

Pool E

We are concerned with the possible management regime for Pool E. We recommend that the water level management strategies for this pool be carefully planned so that satisfactory woody vegetation control can be achieved while the current, excellent interspersion of emergents/submergents, including wild rice, not be detrimentally impacted.

DPR-31: Reference is made here and in other sections to using the Trempealeau River as a source of water for Pool C or the DU Pool. Based on the information presented in the DPR, a maximum of 9,000 gallons per minute will be pumped or diverted from the Trempealeau River to fill the DU pool (the selected alternative). Water from the DU pool may be used as a water source for Pool E. We suggest that the $Q_{7,10}$ flow of the Trempealeau River and a discussion of what impact this diversion of water will have on the Trempealeau River be included in the DPR. The Wisconsin Department of Natural Resources is still reviewing the need for a permit to divert this water. We will inform you whether a permit will be needed based on an analysis of the Trempealeau River flows and impacts on the resource.

DPR-40 & 41: We recommend that the use of overhead powerlines to provide electricity to the pumps be changed to buried powerlines. Buried powerlines would be desirable based on aesthetic and environmental concerns.

DPR-44: Second Paragraph. The statement "Present conditions in pool A do not allow for the establishment of a sport fishery in any portion of pool A..." is inaccurate. Sport fish are present in pool A and pool B. A more accurate description of the existing sport fishery can be based on the fisheries sampling conducted by the FWS. This section should be rewritten.

DPR-45: First Paragraph, Last Sentence. "Fill material for constructing the DU dike and pool E dike would come from a dredged material placement site." The dredged material placement site at Fountain City was mentioned elsewhere in the report as the fill material source. We recommend that alternative sites continue to be explored, such as the current work being done to determine if material adjacent to the dikes is suitable for construction. We question whether enough material will be available for construction of the DU and pool E dikes (approx. 94,700 cys needed) since the estimated total capacity of the beneficial use site is less than 70,000 cys. In addition, the Fountain City Beneficial Use Site is one of the highest demand sites on the Upper Mississippi river.

Beneficial use material is used by Winona, Buffalo County, the town of Fountain City and many contractors. More demand for this material is not needed. Since this is a habitat project, the dike material should create new habitat such as a dredged channel that would provide added depth to adjacent backwaters. We suggest that the potential source of fill material stated in the DPR include an option to obtain fill material from areas that would benefit fisheries habitat. We will contact your agency and the FWS later this year to investigate possible sites and determine the feasibility of obtaining material from a different location.

DPR-46: Socioeconomic Factors. Recreation and Aesthetic Values. Recreation by boaters may be impacted by the proposed drawdowns to promote growth of aquatic vegetation. This impact is not addressed in any portion of the DPR or EA. We suggest that this impact be discussed.

DPR-48: First Paragraph, Second Sentence. Cost Estimate. Although the reader is informed that costs presented here may differ from estimates shown earlier in the DPR, we suggest the cost estimates presented here and elsewhere in the DPR be consistent to avoid confusion.

DPR-50: Table DPR-7. This section implies that Performance Evaluation Monitoring and Analysis of Biological Responses to Projects will be conducted by EMTC as part of the Biological Response Study. No notification or coordination of this proposal has been given to the Wisconsin DNR. The Trempealeau NWR is a unique area that is not representative of the Upper Mississippi River and should not be selected as a site for the Biological Response Monitoring Studies conducted in the St. Paul District. The Wisconsin Department of Natural Resources does not support the selection of the Trempealeau NWR HREP as a site for inclusion in the biological response monitoring studies and will not support construction of this project if it is to be selected for environmental response monitoring using HREP funds. Reference in the DPR to the Trempealeau NWR HREP as a site for inclusion in the biological response monitoring studies should be eliminated.

The following comments are in reference to the Trempealeau NWR HREP DPR APPENDIXES document:

General comment: Discussion in the DPR and appendixes present the dike alignments for pool A as pool A1 and pool A2 and the alternatives using different construction methods as alternatives A1-A7. The use of similar abbreviations for these 2 different aspects of project planning sometimes makes it difficult to follow the discussion of the benefits of each alternative for someone unfamiliar with the area. Consider choosing different abbreviations for the dike and corresponding pool options and the different alternative construction methods for the dikes.

Appendix A - Habitat Evaluation Procedures: In the text, it appears that only the fisheries HEP model was applied to Pool A1 (page A-5) and the diving duck model was only used for Pool A2 (page A-7). We recommend the report include a discussion of habitat benefits (HSI) for all species in both pool A alternatives, if our interpretation of present text is correct.

Much of the benefits claimed for fisheries habitat improvement center around the elimination of low winter DO levels as a limiting factor. However, nowhere in the report can we find any reference to the present winter DO conditions on the refuge. Also, the success of the aeration system is dependent on the water depths and where the deeper sections of Pool A are located. This information would be very helpful in understanding how the calculated benefits for fisheries was accomplished. Please provide this information.

Another item that needs to be addressed is what impact the pool A dike will have on the fisheries resource in Pool B. If Pool B is fairly shallow, then doesn't the possibility exist that some fish utilizing pool B during the summer months move to the deeper sections of pool A for the winter? It

appears that the assumption has been made that there will be no impact on the fisheries resource in pool B by the construction of the dikes, roughfish control and drawdowns. However, no evidence or discussion is provided in the report to support or dismiss this hypothesis. Please provide a discussion on this topic.

Page A-9: Last Paragraph. The discussion here is confusing. How was the number "520" derived? As stated earlier, a bathymetric contour map of pool A would provide some insight into the amount of area that will be suitable habitat. Another factor that was not incorporated into the calculation of AAHU for fisheries benefits is the reduction in usable acreage during the drawdown periods to promote growth of aquatic vegetation. A drawdown of 2 feet in pool A (page DPR-28, Main report) could effectively reduce that amount of habitat available for fish. Page DPR-47 implies that pool A will have a drawdown once a year. The magnitude of the drawdown and duration is not mentioned. However, yearly drawdowns may impact the fisheries resource in pool A during the summer by causing DO problems, uncovering spawning beds and stranding fish. We recommend that these issues be addressed in the DPR.

Diving Duck Model: Mr. Randy Devendorf provided us with a copy of this model after we requested one during review of the Trempealeau DPR. We commend those that worked on the model for undertaking a much needed task for the river. However, we believe that a model that is to be used to calculate the benefits of HREP and other management efforts on the river should go through a more thorough review by the partner agencies and eventually be tested.

It appears that this model was developed solely for the purpose of using it for the Trempealeau NWR HREP. We applied this model to other areas of the river where historical use of diving ducks has occurred and suggest that the following environmental factors be included in the model.

1. The correspondences that accompanied the model document that consideration was given to include invertebrates as part of the model. We recommend that this topic be further discussed to determine if it can be incorporated into the model. Perhaps a review of the literature may reveal that there is some combination of water quality and sediment characteristics that relate to invertebrate densities.

2. We suggest that the water depth range be changed back to 18 inches to 6 feet.

3. Areas protected from adverse weather conditions (wind, waves, etc...) and disturbance appear to be very important on the open river. Islands and large stands of emergent vegetation can provide this protection. A category should be added to address this habitat requirement.

4. Possibly add a variable that incorporates knowledge on historical use of a site.

We appreciated the opportunity to provide comments on the Trempealeau NWR HREP draft DPR. If you have any questions regarding our comments, please give me a call at (608) 785-9005.

Sincerely,

Jeffrey A. Janvrin
Mississippi River Habitat Specialist

TREMPEALEAU NATIONAL WILDLIFE REFUGE
Established 1936

Compatibility Study
TREMPEALEAU REHABILITATION AND
ENHANCEMENT PROJECT

Establishing Authority

Lands comprising Trempealeau National Wildlife Refuge (NWR) have been acquired under two different authorities. Executive Order 7437, dated August 21, 1936 and the Refuge Recreation Act (16 U.S.C. 460k-460-4 as amended) are these authorities.

Purpose For Which Established

The refuge was established by Executive Order 7437 as "... a refuge and breeding ground for migratory birds and other wildlife." Subsequent land acquisition occurred under the authority of the Refuge Recreation Act for the purposes of "...(1) incidental fish and wildlife-orientated recreational development, (2) the protection of natural resources, (3) the conservation of endangered species or threatened species."

Description of Proposed Use

The proposal is a Habitat Rehabilitation and Enhancement project authorized by the Water Resource Development Act of 1986 (Pub. L. 99-662).

The proposal project consists of the construction of interior dikes and water control structure as outlined in goals and objectives of the Trempealeau NWR Master Plan, 1983. The project consists of the following components:

(a) a dike from the eastern tip of Kiep's Island to the Burlington Northern railroad embankment to separate pools A and B (referred to as the pool A dike);

(b) a permanent pumping station in the pool A dike to permit pumping from pool A into either pool B or the Mississippi River, pumping from pool B to either pool A or the Mississippi River, and gravity flow from pool B to pool A;

(c) rock fill protection along 900 feet of Kiep's Island;

(d) mechanical aeration in pool A;

(e) a dike to segregate the northwesterly portion of pool C (referred to as the DU dike);

(f) a gravity flow gated inlet to the DU pool from the Trempealeau River;

(h) a gravity flow gated outlet from the DU pool to pool C;

(i) a dike to separate upper and lower pool E (referred to as the pool E dike);

(j) a gravity flow gated outlet from upper pool E to lower pool E.

More details of the project, including maps and engineering drawings, are contained in the draft report entitled, "Upper Mississippi River System Environmental Management Program Definite Project Report With Integrated Environmental Assessment (SP-15) Trempealeau Habitat Rehabilitation and Enhancement, Pool 6, Upper Mississippi River, Trempealeau and Buffalo Counties, Wisconsin," prepared by the St. Paul District, Corps of Engineers.

Anticipated Impacts on Refuge Purposes

As a result of the project fish and wildlife populations should increase which will be a direct benefit toward maintaining and accomplishing refuge purposes. The above-mentioned report contains additional information on the project's impacts.

Justification

The proposed project works toward the accomplishment of the stated objectives of the refuge.

Determination

The proposed project is compatible with purposes for which the refuge was established.

Determined by: Richard A. Fritsche Date: 3/12/93

Reviewed by: James R. Fisher Date: 3/12/93

Reviewed by: Lisa Mandell Date: 3/16/93

SDH
Concurred by: _____ Date: 3/19/93

Marvin E. Moriarty
Director

Corps Responses to U.S. Fish and Wildlife Service Comments (3/8/93)
on the
Trempealeau NWR, WI
Preliminary Draft DPR/EA

Comment A - Further analysis of the Trempealeau River water quality and operational desires for the C2 pool indicated that pumps would be needed in order to adequately address the habitat objectives. Based on input from Refuge personnel and engineering expertise, the acceptability of using Trempealeau River water was reduced to 50 percent of the time. The habitat evaluation was revised accordingly. The portable pumping system needs to consist of only two pumps to fill the pool within the desired period of time of 2 weeks. The appropriate equipment would be provided to make the portable pumps mobile.

Comment B - After further analysis of the hydraulics of pool B, it is our opinion that a gravity outlet from pool B into the Mississippi River is both unnecessary and undesirable. The analyses of hypothetical operation using historic data show little impact on pool B of the planned pool A drawdown operation relative to what was actually observed in the years 1987-90. Since operation of pool A is periodic, it would be possible to plan the operation of the system around potentially difficult operating years when high water might be expected. A gravity outlet would involve high cost to install a sufficiently large culvert system and the capability to discharge when desired may not exist. There would be possible administrative difficulties with the railroad company because of the large size required for the structure. There also would be a real possibility that pollutants, rough fish, and undesirable exotics from the Mississippi River could enter pool B. Therefore, a gravity outlet will not be recommended. However, an alternate method of removing water from pool B to fill pool A has been developed that would reduce the number of rough fish moving into pool A. It involves placing a weir just above the inlet to the culvert into pool A at the pump station. It would inhibit the bottom dwelling rough fish from crossing into pool A when the culvert is open, but still allow sufficient flow into pool A.

Comment C - At a meeting with FWS the dike designs were discussed. Since cost was not an overriding factor, it was agreed that the sand berm/groin design would be preferred because of the more natural beach created for potential growth of emergent vegetation and resulting habitat benefits.

Comment D - Concur. Restrictions will be included.

Comment E - The report and costs for electrical service were modified to include underground installation because of the Refuge goal.

Comment 1 - The main report and appendix A have been modified to more adequately describe the analysis.

Comment 2 - Revised wording throughout the report as suggested.

Comment 3 - A more detailed description of pool C has been added to the report.

Comment 4 - Concur. O&M sections changed.

Comment 5 - Concur. References to pool D have been clarified or dropped from the report.

Comment 6 - Acreage figures have been corrected.

Comment 7 - Report has been revised by adding goal as suggested.

Comment 8 - Changes made to fishery resources as suggested.

Comment 9 - Change made to report to correct inaccurate statement.

Comment 10 - Change made to report to include reference to biological survey lodge.

Comment 11 - Concur. Paragraph has been rewritten.

Comment 12 - Discussions on pool B have been reworded to be consistent.

Comment 13 - Concur. The C2 dike is being coordinated with the Wisconsin SHPO.

Comment 14 - C2 dike has been added to the drawing.

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

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:

March 8, 1993

Col. Richard W. Craig
District Engineer
St. Paul District, Corps of Engineers
Attn: Don Powell, Project Manager
1421 U.S. Post Office and Custom House
St. Paul, MN 55101-1479

Dear Colonel Craig:

This provides U.S. Fish and Wildlife Service (Service) comments on the preliminary draft Definite Project Report (DPR) and Environmental Documentation (SP-15) for the Trempealeau National Wildlife Refuge Habitat Rehabilitation and Enhancement Project. In addition to providing benefits to the biological resources of the Upper Mississippi River, the project will assist our agencies in implementing the 1989 Cooperative Agreement regarding waterfowl habitat conservation opportunities. It will also provide a nationally significant contribution to the Upper Mississippi River and Great Lakes Joint Venture of which you are an active board member.

The project is being built on Federal lands managed as part of Trempealeau National Wildlife Refuge (NWR). Therefore a refuge compatibility determination and refuge approval is required before the project can be constructed. A compatibility determination for the selected alternative discussed in this draft report has been forwarded to our Regional Office. It will be forwarded to you under separate cover after it has been signed. Approval of the project will be formally provided by the Regional Director after completion of the final project report.

The Trempealeau NWR is a 5,617-acre refuge located in the Mississippi River floodplain in Pool 6 near Trempealeau, Wisconsin. Trempealeau NWR functions as a part of a system of areas closed to waterfowl hunting within the Mississippi Flyway. Closed areas are very important, not only for the food resources and wildlife habitat they provide, but especially for the sanctuary they provide during the waterfowl hunting season. The Trempealeau NWR is the only closed area on Pool 6 of the Upper Mississippi River during the waterfowl season. Unlike other closed areas on the river entry by power boaters for fishing and sightseeing is not permitted. This disturbs waterfowl and subjects them to hunting mortality outside the closed area. Any project which improves the water management capability or ultimately improves the food reserves within a closed area, especially a unique closed area such as Trempealeau NWR is extremely important.

The Trempealeau NWR has been isolated from the contamination and sedimentation that has affected the Upper Mississippi and Trempealeau River habitats by dikes that were built in 1911. This isolation has contributed to the unique diversity of aquatic habitats that provide food and shelter for a variety of wildlife species.

In 1988, the Service agreed to rebuild the dikes that were constructed (prior to government owership) in 1911 as a part of the Refuge Habitat Rehabilitation and Enhancement Project. Our letter to you in December of last year state our intentions to rehabilitate the lower diversion dike in Fiscal Year 1994. For these reasons, the Service continues to regard the scheduled construction of the interior dikes on Trempealeau NWR as one of its highest priority projects in the Environmental Program.

Following are some design modifications the Service feels are needed:

A. The statement that the Trempealeau River would be an acceptable water source for the DU Pool for 95% of the time underestimates the need for pumping capabilities at this pool. We need to have maximum flexibility for managing this pool and should not compromise the management of either this pool or Pool E for lack of a pump dedicated to the DU pool through this planning process. Therefore, a portable pumping system consisting of a minimum of three pumps will be necessary. We should also decide if a "portable" system is best, and if so, how that system can best serve the refuge operation staff (i.e. trailers, storage , hoisting, etc.).

B. The Service believes that a system to gravity discharge Pool B water to the Mississippi River is needed. Pool B water levels will need to be maintained during the removal operations (pumping) of Pool A. A gravity discharge system would also minimize the operation and maintenance cost of Pools B and E and the DU Pool.

C. During the Plan and Specification phase the planning team will have to study more closely the impacts of the dike construction on wetlands. The physical and biological factors relating to the dike "foot print" will have to be considered. Although these impacts cannot be reflected in our WHAG habitat analysis, they are real, and the micro-environment along the dike can be improved by the final design selected. As your excellent study of Dike A alternatives illustrates, the difference in cost is very small.

D. The final contract will probably include some restrictions to protect wildlife, the public, and physical facilities on the refuge. Again, your staff has been very helpful at preparing plan and specifications to reduce these concerns.

E. In the spring of 1992 the refuge met its goal of replacing all overhead utility lines serving refuge facilities with underground lines. Overhead lines are unnatural barriers to migrating birds and are hazardous obstacles, especially where morning fogs are frequent as they are on the refuge. The various structures proposed in this project are for the benefit of migrating birds. Burying the electric lines to these structures will ensure that migratory bird resources will not be adversely impacted.

The following editorial changes to this draft document are needed:

1. The Habitat Evaluation Procedure, Appendix A states: "The WHAG contains 12 species models for wetland cover types. The evaluation for Pools B, C and E was conducted using all applicable species because the U.S. Fish and Wildlife Service was interested, from a planning perspective, in determining potential project effects across the spectrum of wetland species. For quantification of potential project benefits and incremental analysis of project features, a single species was selected that would best reflect the project objectives for a particular pool."

   We agree that from an incremental analysis prospective, the single species analysis worked well, but the main text of the Definite Project Report should illustrate to the reader that the planning team did a holistic analysis.

2. The DPR continually focuses on waterfowl, again because that is what was primarily used in the incremental analysis. The Service's focus is more correctly stated in Objective 2, "To provide breeding, resting and feeding habitat for migratory birds and marsh wildlife." We suggest changing the word waterfowl in most places within the DPR to migratory birds.

3. The descriptions of the goals for Pool C are confused by the fact that the pool encompasses two different habitat types - marsh dominated by emergent aquatic plants, and a less wet area on the north end of the pool dominated by bottomland hardwoods. The thrust of this proposal was to enhance the bottomland hardwood area for migratory birds by flooding this area in the fall. Some benefits to marshbirds would accrue by setting back willow growth on the fringes of the marsh area. The idea of having an open water area in the marsh during peak growth of the emergent aquatic plants is not critical to dabbling duck use and should be de-emphasized in the report.

4. Sections of the DPR on Operation and Maintenance and Rehabilitation should be changed to reflect the new guidelines.

5. The discussion in the DPR on Pool D and F only confuse the reader. These alternatives were dropped during the Service's Master Plan/EIS effort back in the early 1980's.

6. Acreage figures on pages DPR 5 and 10 need to be modified. Please contact us for corrections.

7. Page 7 - Add to the fishery goal in Pool A - Reduce numbers and biomass by 50% while increasing numbers of northern pike, black crappie, largemouth bass, bluegill and yellow perch.

8. Page 11 - Fish and Wildlife Section in the paragraph on fishery resources. Add black crappie to the list of most common sport fish. Change the order to read black crappie, yellow perch and northern pike. Change order of non-game fish to bullhead, carp and buffalo.

9. Page 12 - Cultural Resources. The statement, "The Keip's Island is the only part of the refuge to have been surveyed," is in error. Actually the Service has surveyed 13 areas on the refuge.

10. Page 13 - Cultural Resources. The paragraph about site 47-TR-150 is misleading. Disturbance to the site in the area of the parking lot and overlook occurred as a result of the 1930's biological survey "lodge" that was demolished in 1979.

11. Page 15 - First paragraph, drop the last sentence.

12. Pool B discussion on Page 14, 15 and 24 are inconsistent. The open water area of Pool B will improve because of the cross dike Pool A/B construction.

13. Page 22 - Pool C Alternatives. The DU alternative or DU pool appears to have been introduced into the plan after cultural resources consultation was completed. Two known archeological sites in Section 3 are immediately north of the proposed dike alignment and four sites in Section 2 are east and southeast of the alignment. Terrain where the dike is to be located might not be conducive to prehistoric sites, but the Corps needs to inform the State Historic Preservation Officer of this change.

14. Plate B-3. Please add the DU dikes.

Based on information contained in the preliminary draft Definite Project Report/Environmental Assessment and the nature of the proposed project, its location, and the habitat requirements of the Federally threatened bald eagle (Haliaeetus leucocephalus), endangered peregrine falcon (Falco peregrinus), and endangered Higgins' eye pearly mussel (Lampsilis higginsi), we support your determination that the proposed project is not likely to adversely affect Federally-listed threatened or endangered species. Should this project be modified or new information indicates that listed species may be affected, consultation with the Service should be reinitiated.

Within Trempealeau NWR, improved habitat created by this EMP project will benefit a variety of wildlife species and will provide a gradation of water regimes as well as habitat types from which wildlife can select or relocate as the season and/or water levels fluctuate.

This report illustrates the cooperation evident between the U.S. Army Corps of Engineers and the Service. These efforts at working together on this project, as well as the Environmental Management Program as a whole, help ensure the success of mutual concerns for improvements on the Upper Mississippi River System.

Sincerely,

James R. Fisher

James R. Fisher
Complex Manager

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:

TAKE PRIDE IN AMERICA

FWS/ARW-SS

DEC 3 - 1992

Colonel Richard W. Craig
St. Paul District, Corps of Engineers
1421 U.S. Post Office and Custom House
St. Paul, Minnesota 55101-1479

Dear Colonel Craig:

The U.S. Fish and Wildlife Service (Service) continues to regard the scheduled construction of dikes on Trempealeau National Wildlife Refuge as a high priority project in the Environmental Management Program (EMP).

As the Service's part of this project, we plan to rehabilitate the lower barrier dike on the Trempealeau Refuge in Fiscal Year 1994. Our schedule calls for final plans and specifications to be completed by October 1993 with the bid opening for construction work on or about March 1994.

The Service and the Corps of Engineers (Corps) may be able to coordinate construction activities to minimize costs for inspection, mobilization, demobilization and the logistics of obtaining, moving and storing materials for these projects.

With this in mind, we would appreciate the status of the Corps' progress on the Trempealeau EMP project, and the schedule for completing the project. With your concurrence, the Service engineering staff can contact the Corps personnel assigned to this project to determine whether it is feasible to pursue cost savings through the coordination of activities.

If you need further information, or if we can be of assistance, please contact the Refuge Manager, Upper Mississippi National Wildlife and Fish Refuge at 507/452-4232.

Sincerely,

Marvin E. Moriarty
Acting Regional Director

GBW GREEN BAY AND WESTERN RAILROAD COMPANY
P.O. BOX 2507 • GREEN BAY, WI 54306-2507 • 414 / 497-5100

RECEIVED
OCT 2 1992
U.S. FISH & WILDLIFE SERVICE
Upper Miss. River NW&FR

TREMPEALEAU NWR
RECEIVED
OCT 2 1992
TREMPEALEAU, WISC.

September 29, 1992

Mr. James R. Fisher, Complex Manager
United States Dept. of the Interior
Fish & Wildlife Service
Upper Mississippi River Refuge Complex
51 E. Fourth St.
Winona, MN 55987

Re: Pend. 673
Wetland Site, Marshland

Dear Mr. Fisher:

Refer to your letter of Sept. 2, 1992, to Mr Robert Larsen.

Green Bay and Western Railroad Company is agreeable to the establishment of the wetland area you describe, subject to the following conditions:

1. You execute a standard lease to cover the area of encroachment on GBW's right-of-way. This will include an annual rental fee, plus insurance and other requirements.

2. The dike you construct must be at least 1,000 feet in length with a top elevation at least 3 feet below top of rail at our track's lowest point adjacent thereto. Your plans, as submitted, appear to conform to this requirement.

3. You will bear the cost and expense of repairing any damage to GBW's track and right-of-way resulting from your presence on our land.

I am enclosing two prints of GBW right-of-way map V53 covering the area where you propose to establish the wetlands.

If you wish to progress a lease, please return one print to me with the exact location of the dike indicated in red. Also show the limits of the wetlands encroachment upon our right-of-way.

If you have any questions, contact me at (414) 497-5131.

Respectfully,

J. E. Elmer, Manager,
Engineering Administration

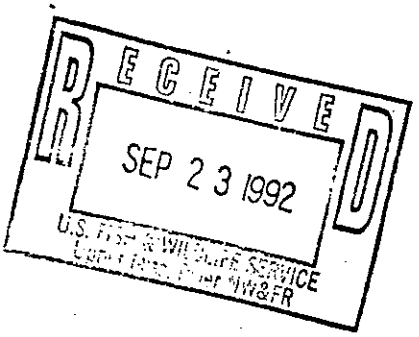
JEE:lc
enc. (2)
cc: Mr. Robert L. Meeks
Regional Operations Supervisor
Ducks Unlimited Inc.
6115 E. Main Ave.
Bismarck, ND 58501

BURLINGTON NORTHERN RAILROAD

ENGINEERING DEPARTMENT

Arden Hills District Office
4105 N. Lexington Ave, #300
Arden Hills, MN 55126

September 22, 1992



Mr. James R. Fisher
U. S. Dept. of the Interior
Fish and Wildlife Service
Upper Mississippi River Refuge Complex
51 East Fourth Street
Winona, MN 55987

Dear Mr. Fisher:

Mr. Mike Vietz forwarded your letter to him dated August 24, 1992, to my office. This letter regarded tieing your proposed dike into Burlington Northern's existing dike at our Milepost 320.64, near Trempealeau, WI.

After review by this office and Burlington Northern's Bridge Department, we will need additional information on this project in order to give you our concerns or approval. Request you provide a study or statement by a hydrologist that the proposed dike will have no deleterious effects on the Railroad's embankment.

We look forward to working with you on this project.

Yours truly,

C. D. Stack
Manager Engineering

Advisory Council On Historic Preservation

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

JUL 13 1992

Mr. Robert Whiting
Environmental Resources Branch
Department of the Army
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, MN 55101-1479

REF: Trempealeau Environmental Management Program Project
Trempealeau and Buffalo Counties, Wisconsin

Dear Mr. Whiting:

On July 8, 1992, the Council received your determination that the referenced project would have no adverse effect upon the Kiep's Island Site, a property eligible for listing on the National Register of Historic Places. Based upon the material which accompanied your determination, including the concurrence of the Wisconsin State Historic Preservation Office (SHPO), we see no reason for us to raise an objection provided that the conditions established by the SHPO are implemented.

If you have any questions, please contact Valerie DeCarlo at (202) 786-0505. Thank you for your cooperation.

Sincerely,

John L. Klima
Director, Eastern Office
of Project Review

State Historical Society of Wisconsin
Division of Historic Preservation
816 State Street • Madison, Wisconsin 53706-1488
☎ (608) 264-6500 • FAX (608) 264-6404

June 23, 1992

Mr. Robert Whiting
Environmental Resources Branch
Department of the Army
St. Paul District, Corps of Engineers
1135 U.S. Post Office & Custom House
St. Paul, MN 55101-1479

IN REPLY PLEASE REFER TO SHSW# 90-0338/TR

RE: Rehabilitation of Trempealeau Dike
ID: Cross Ref. 84-0074/TR

Dear Mr. Whiting:

We have had the opportunity to review the proposal for monitoring and site protection of the Kiep's Island Site set forth in your letter of June 3, 1992.

We find that these measures are compatible with those recommended in our letter of December 18, 1991 and with the stipulations agreed to in telephone conversations between Sissel Johannessen of the Corps and Jennifer Kolb, Archeologist of my staff. We believe that the project should now proceed as scheduled and the measures outlined in your June 3 letter should be implemented.

Thank you for your continuing cooperation in our review of this project. If there are any questions concerning this matter, please contact Gretchen Block of my staff at (608) 264-6505.

Sincerely,

Richard W. Dexter
Chief, Compliance Section
DIVISION OF HISTORIC PRESERVATION

RWD/GB/gb

cc: John Dobrovolny, FWS

REPLY TO
ATTENTION OF

June 3, 1992

Environmental Resources Branch
Planning Division

Mr. Richard W. Dexter
Chief, Compliance Section
Division of Historic Preservation
State Historical Society of Wisconsin
816 State Street
Madison, Wisconsin 53706

Dear Mr. Dexter:

We are writing in regard to the St. Paul District, Corps of Engineers, Environmental Management Program (EMP) Project at the Trempealeau National Wildlife Refuge, and its effect on the National Register-eligible archaeological site complex on Kiep's Island (your reference number 90-0338).

In previous correspondence with your office, we presented documentation for a finding of no adverse effect for the project. In a letter dated December 18, 1991, you concurred with this finding, with three stipulations. Two of these stipulations, concerning site erosion and testing of the dike tie-in, will be met by the following measures. One, the southwest shore of the island will be riprapped without bank modification, preventing further erosion of the site. Also, when the location of the dike tie-in has been selected, it will be tested by Corps archaeologists and the results coordinated with your office at that time.

The third stipulation concerned possible damage to the site complex from heavy equipment on the Kiep's Island road during dike construction. A mitigative measure to be included in the project specifications will be a 6-inch gravel road-bed, which will prevent surface damage and dissipate the stress on the underlying deposits. In addition, the compaction and effect of the heavy traffic on the archaeological materials will be monitored. The project described below will result in data bearing on the relative soil compaction at various depths with both light and heavy road use, as well as on the effects of the stress on artifacts buried at various depths. (It should be noted that penetrometer readings are not highly accurate or replicable, and will provide rough relative data only.)

Monitoring Proposal

1. Before heavy use of the road begins, Corps archaeologists will excavate two trenches at selected locations along the length of the road, perpendicular to the road and extending from the road center to a meter outside the road edge. These will be excavated in 10 centimeter (cm) levels, the soil from each level being screened and set aside separately. The trenches will be excavated down to culturally sterile soil (ca. 80-100 cm). At this time, penetrometer readings will be taken at 10 cm intervals in columns at a number of locations along the profile, both under and outside the road. These will serve several purposes: to see if decades of light traffic have compacted the deposits under the road to any observable degree (in contrast to those outside the road); to relate the degree of compaction to depth; and to serve as comparative data for the same readings taken after use of the road by heavy traffic.

2. The artifacts recovered from each 10 cm level will be recorded, described, quantified, and photographed at this time. The trenches will be lined with plastic mesh to mark their edges, and the soil and the artifacts from each 10 cm level will be replaced in the trenches in the same order that they were removed. Incorporated in alternate levels will be a number of modern artifacts (replicates of those used in a similar experiment by Mathewson et al. in the enclosed article).

3. After the use of the road by heavy equipment, the trenches will be reexcavated, the condition of the artifacts both prehistoric and modern will be noted, and the columns of penetrometer readings will be retaken at comparable levels. The relative compaction and effect on artifacts can thus be assessed.

We believe these measures to monitor and mitigate any possible effect of the Trempealeau EMP project on the valuable cultural resources of Kiep's Island fulfill your stipulations fully. We would be grateful to have your comments as soon as possible, so that the first step of the monitoring project can begin. If we can provide you with any further information, please call Corps staff archaeologist Sissel Johannessen (612 220 0263).

Sincerely,

Robert J. Whiting
Chief, Environmental Resources Branch
Planning Division

Enclosure

THE STATE HISTORICAL SOCIETY OF WISCONSIN

H. Nicholas Muller III, Director

816 State Street
Madison, Wisconsin 53706
608/262-3266

November 20, 1990

Mr. Robert J. Whiting
Chief, Environmental Resources Branch
St. Paul District, Corps of Engineers
1421 U.S. Post Office and Custom House
St. Paul, Minnesota 55101-1479

IN REPLY PLEASE REFER TO:
SHSW: #90-0338

RE: Rehabilitation of the Trempealeau Dike

Dear Mr. Whiting:

We have reviewed the draft cultural resource report entitled "Phase I Cultural Resources Investigation: Reconnaissance and Testing of EMP Project Areas in the Trempealeau National Wildlife Refuge, Trempealeau and Buffalo Counties, Wisconsin," by Randall M. Withrow.

We concur with the recommendation that all of the sites on Kipes Island be considered a single unit. The fact that additional pit features have been found to the southeast of TR-86 indicates that other parts of the island indeed have in-situ archeological deposits. We suggest that you prepare the documentation necessary for a new determination of eligibility that expands the previous area of significance from TR-86 to the entire island. Following this a plan to stabilize eroding banks on the island should be developed that would not harm existing archeological deposits, although obviously some data recovery may be necessary as in the case of the exposed pit features.

No systematic survey was conducted on Black Oak Island, but a shoreline investigation confirmed the presence of Tr-85. This site should be evaluated for eligibility for listing on the National Register of Historic Places, and, if eligible, plans made to protect the site. If there are any other shoreline areas of the island that have not yet been surveyed, we recommend that this be done as soon as possible as well.

As noted, Tr-150 will be directly affected by a new cross-dike and maintenance road south of the refuge headquarters. Tr-150 should be evaluated for listing on the National Register through preparation of Form 10-900, although it does appear that the site has been destroyed in the area of the wetland overlook and Biological Survey lodge location.

The report concludes that project activities in other areas will not affect known or potential resources. However, considering the fact that a 1000-acre impoundment will be created, the final report should contain specific explanations as to why the impoundment will not erode, submerge or otherwise affect both known and potential sites elsewhere in the project area.

We look forward to receiving the final report, as well as the documentation for determinations of eligibility on the various archeological sites noted above.

If you have any questions, please contact me at (608) 262-3417.

Sincerely,

Judy Patton

for Richard W. Dexter
Chief, Compliance Section
DIVISION OF HISTORIC PRESERVATION

RWD:lks
HPD\Whiting

THE STATE HISTORICAL SOCIETY OF WISCONSIN

H. Nicholas Muller III, Director

816 State Street
Madison, Wisconsin 53706
608/262-3266

May 4, 1990

Mr. Robert J. Whiting
Department of the Army
St. Paul District, Corps of Engineers
1421 U.S. Post Office and Custom House
St. Paul, Minnesota 55101-1479

IN REPLY PLEASE REFER TO:
SHSW: #90-0338

RE: Rehabilitation of Trempealeau Dike

Dear Mr. Whiting:

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.

There are no structures listed in the National Register of Historic Places located within the area of the proposed undertaking. Furthermore, we are not aware of any structures that may be eligible for the National Register in this area.

Eighteen known archeological sites are reported within the project boundaries, and 32 additional sites are reported within one mile. Archeological site TR-88 has been determined to be eligible for listing in the National Register of Historic Places.

We recommend that the project area be surveyed by a qualified archeologist to locate and relocate and evaluate archeological sites that may be affected by the undertaking. When the survey has been completed, two copies of the archeologist's report should be sent to our office for review and comment.

If there are any questions concerning this matter, please contact Judy Patton of my staff at (608) 262-2732.

Sincerely,

Richard W. Dexter
Chief, Compliance Section
DIVISION OF HISTORIC PRESERVATION

RWD:lks
cc: Dave Berwick, Corps
2796N/4

United States Department of the Interior

FISH AND WILDLIFE SERVICE
FEDERAL BUILDING, FORT SNELLING
TWIN CITIES, MINNESOTA 55111

TAKE PRIDE IN AMERICA

IN REPLY REFER TO:
FWS/ARW

JUN 2 1988

Colonel Joseph Briggs
District Engineer
U.S. Army Engineer District, St. Paul
1135 U.S. Post Office and Custom House
St. Paul, Minnesota 55101

Dear Colonel Briggs:

Since originally submitting fact sheets for the proposed Trempealeau projects in January, 1987, the Fish and Wildlife Service (Service) has coordinated with the State of Wisconsin and others in defining a project for accomplishment through the Upper Mississippi River System Environmental Management Program.

At a Channel Maintenance Forum Meeting in February, 1988, the Service and States agreed that the Service would accomplish the exterior levee rehabilitation portion of the project and that the interior work for wildlife habitat improvements would be recommended for Environmental Management Program inclusion.

The State of Wisconsin, at a recent Upper Mississippi River Basin Association Meeting, further endorsed and recommended that the project move forward in the Environmental Management Program processes.

It is our understanding that the St. Paul District will submit a fact sheet to the North Central Division for the necessary approvals. The fact sheet would be similar to the enclosed version which was updated in February, 1988, following the Channel Maintenance Meeting.

If you need further information or if we can be of assistance, please let us know.

Sincerely,

John Popowski
Regional Director

Enclosure

Attachment 6

Draft Memorandum of Agreement
for
Operation and Maintenance

DRAFT

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

AT THE

TREMPEALEAU NATIONAL WILDLIFE REFUGE

TREMPEALEAU AND BUFFALO COUNTIES, 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 Trempealeau National Wildlife Refuge (NWR) 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 Trempealeau NWR 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 Trempealeau NWR 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 on the Trempealeau NWR primarily through features that will permit water level manipulation in various areas of the Refuge. This would involve the construction of dikes, pump station, inlet and outlet structures, and an aeration system. The project would improve marsh habitat on approximately 3,500 acres of the Refuge by providing water level management capabilities and would improve fish habitat on about 700 acres.

IV. RESPONSIBILITIES

A. DOA is responsible for:

1. Construction: Construction of the project which consists of constructing three interior dikes totaling about 17,000 linear feet, one permanent pump station, one inlet and two outlet structures, an aeration system in one pool, stabilizing an existing island, and providing four portable pumps. Material to construct the dikes would be obtained outside the Refuge near the main navigation channel and from a dredged material placement site.

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 Definite Project Report 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, DOA will construct the Trempealeau NWR project as described in the Definite Project Report/Environmental Assessment, Trempealeau National Wildlife Refuge, Habitat Rehabilitation and Enhancement Project, dated January 1994, 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 DOA encounters potential delays related to construction of the project, DOA will promptly notify 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 three 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. 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 Definite Project Report/Environmental Assessment entitled "Trempealeau National Wildlife Refuge, Habitat Rehabilitation and Enhancement Project," dated January 1994, 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 no more than 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. Corps of Engineers, St. Paul District
Army Corps of Engineers Centre
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: _____
(signature)
JAMES T. SCOTT
Colonel, Corps of Engineers
St. Paul District

DATE: _____

THE U.S. FISH AND WILDLIFE SERVICE

BY: _____
(signature)
SAM MARLER
Regional Director
U.S. Fish and Wildlife Service

DATE: _____

Attachment 7

Distribution List

The Draft Definite Project Report/Environmental Assessment and/or Public Notice was sent to the following agencies and interests:

Congressional

Sen. Paul Wellstone (St. Paul)*
Sen. Dave Durenberger (Mpls)*
Rep. Tim Penny (Rochester)*
Sen. Feingold (Madison)*
Sen. Herbert Kohl (Madison)*
Rep. Steve Gunderson (Black Riv Falls)*

Federal

Department of Transportation (Chicago, Kansas City)*
Environmental Protection Agency (Chicago, Kansas City*)
U.S. Coast Guard (St. Louis)*
U.S. Fish and Wildlife Service (Onalaska - Delaney; Bloomington - Lewis*, Wege*; Winona - Fisher*, Beseke, Lennartson*; Fort Snelling - Marler*, Gibbons*, Dobrovolny*; Trempealeau Refuge - Frietsche; La Crosse - Korschgen*)
U.S. Geological Survey (St. Paul; Madison)*
National Park Service (Omaha)
Soil Conservation Service (Madison, St. Paul, Whitehall)*
Advisory Council on Historic Preservation (Wash DC)
Office of Environmental Compliance - DOE (Wash DC)*
Office of Environmental Project Review - DOI (Wash DC)
Corps of Engineers (LMS-Cotner; LMV-Arnold; NCD-Albert; NCR-Skalak; OCE-Howell*, Moeslein; Fountain City-Krumholz; LaCrescent-Otto*; La Crosse-Thomsen*; L&D 5A*; L&D 6*; St. Paul-Cin*, Devendorf, Face, Heide, M.Paulus, Hendrickson*, T.Paulus, Powell, Riedesel, Rodney, Smith*; Winona-Peterson*)

State of Wisconsin

Governor Tommy Thompson (Madison)*
Department of Administration (Madison)*
Department of Agriculture (Madison)*
Department of Health and Social Services (Madison)*
Department of Natural Resources (Madison - Meyer*; La Crosse - Janvrin, Moe; Eau Claire - Bourget; Black River Falls - Talley/Kohlmeyer*; Alma - Linderud*)
Department of Transportation (La Crosse)*
State Historic Preservation Officer (Madison - Dean, Dexter*)
State Archeologist (Madison)
Bureau of Water Reg & Zoning (Madison)*

State of Iowa

Department of Natural Resources (Des Moines - Szcodronski)

State of Minnesota

Department of Natural Resources (Lake City - Davis; St. Paul - Johnson; Winona - Gulden*)
Pollution Control Agency
Department of Administration*
Department of Transportation*
State Historic Preservation Officer
Department of Energy, Economics, and Development*
State Archeologist
State Planning Agency*
Water and Soil Resources Board*

*Public Notice Only

Local

Cochrane-Fntn Cty Rcrdr*
Fountain City Clerk*
Fountain City Post Office*
Winona Post Office*
Trempealeau Co Clerk*
Galesville Public Library
Trempealeau Hotel*
Perrot State Park*
Main Stream Cafe*
Trempealeau Mobil*
Town of Buffalo*
Arcadia News Leader*
Blair Press*
Winona Daily News*
Mathy Construction*
Alma Post Office*
Trempealeau Post Off*
Trempealeau Co Hiway*
Galesville Republican*
Citizens State Bank*
The Acorn*
Trempealeau Elementary*
Larry's Landing*
Winona Post/Shopper*
Whitehall Times*
Mathy Constr(Onalaska)*
Alma Public Library
Buffalo Co Cnsvtnist*
Buffalo Co Clerk*
Winona Public Library
Trempealeau Village Clerk*
Trempealeau Electric Coop
Bob's Beauty Bar*
Ed Sullivan's*
Ed's Conoco*
Sand Bar*
Trempealeau Cham Commerce*
Merrick State Park*

Other Interests

Upper Miss Riv Cons Com (Rock Isl)
Izaak Walton Lg (Stevens Point)*
National Audubon Society (Mpls)*
Dairyland Power Coop (La Crosse)*
Nature Conservancy (Mpls, Madison)*
WLSU, WKTY, WLXR Radio (La Crosse)*
Trempealeau Sportsman's Club*
Associated Conserv Clubs (Whitehall)*
Courier Press (Prairie du Chien)*
Wisc Winnebago Business Committee
Trempealeau Co Cable TV (Whitehall)*
Univ of Wisc-Biology (La Crosse)*
St Mary's College-Biology*
Sierra Club (Madison, Mpls)*
MN/WI Boundary Area Commission (Hudson)
Upper Miss River Basin Assoc (St.Paul)*
Ducks Unlimited (Bismarck, Mpls*, LaX*)
La Crosse Tribune*
WXOW, WKBT, WLAX TV (La Crosse)*
La Crosse Co Ext Office (La Crosse)*
Big River (Winona)*
Green Bay & Western Railroad
Burlington Northern Railroad
Winona Audubon*
Winona State-Biology*

Individuals

Willis Fernholz(Onalask)*
Harry Meinking(LaCrosse)*
Claude Deck(La Crosse)*
John Seiger(Trempealeau)*
Carl Stephan(St. Paul)
Orville Auseth(Trempeal)*
Archie Chase(Trempeal)*
Herman Eichman(Trempeal)*
Alvin Gilberg(Trempeal)*
Sanford Ilstrup(Trempeal*
Steve Kiedrowski(Tremp)*
Blake Nelson(Trempeal)*
Dan Peplinski(Trempeal)*
Grant Shorrel(Trempeal)*
Terry Uhl(Trempealeau)*
Kenneth Wilber(Trempeal)*
Pete Leavitt(Trempeal)*
Jeff Duncan(Trempealeau)*
Jim Forster(Menomonie)*
Lynda James(Trempealeau)*
Morgan McDonah(Trempeal)*
Bea Stellpflug(Trempeal)*
Ruth Lamke(Trempealeau)*
Bob Pohl(Winona)*
Curtis Morem(Cochrane)*
Fred Funk(Onalaska)*
Jack&George Blask(Genoa)*
George Walski(Galesville)*
Wendell Stephan(Trempeal)*
Jonathon Bald(Trempeal)*
Hubert Drugan(Trempeal)*
Phillip Foss(Trempealeau)*
Kenneth Hovell(Trempeal)*
Terry M. Johnson(Tremp)*
Forest Mason(Trempealeau)*
Gordon P. Olson(Trempeal)*
George Richtman(Trempeal)*
David Tranberg(Trempeal)*
Randy Van Vleet(Trempeal)*
John Zimmerman(Trempeal)*
Roger Czaplewski(Fount)*
Pam Eyden(Winona)*
Tom Hunter(Trempealeau)*
John Wilber(Genoa)*
Doris Schindler(Trempeal)*
Nate Vernon(Trempealeau)*
Scott Bestul(Lewiston)*
Scott Lee(Winona)
Kirsten Almo(Fountain)*
George Kletske(Cochr)*
John Weber(Alma)*
Eric Sorensen(Winona)*
Nancy Reynolds(Winona)*
JoAnne Riska(Winona)*
Dan Gray(Winona)*
Bill Green(Winona)*
Harvey Neilson(Tremp)*
Rebecca Barnes(Gales)*
Dianna Brown(Taylor)*
Ken&Sandy Burman(Keno)*
Dale Critman(Trempeal)*
Ralph Czaplewski(Foun)*
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US Army Corps
of Engineers
St. Paul District

UPPER MISSISSIPPI RIVER SYSTEM

ENVIRONMENTAL MANAGEMENT PROGRAM

DEFINITE PROJECT REPORT/

ENVIRONMENTAL ASSESSMENT (SP-15)

TREMPEALEAU NATIONAL WILDLIFE REFUGE

HABITAT REHABILITATION AND ENHANCEMENT PROJECT

POOL 6
UPPER MISSISSIPPI RIVER
TREMPEALEAU AND BUFFALO COUNTIES, WISCONSIN

APPENDIXES

JANUARY 1994

APPENDIXES

Appendix A - Habitat Evaluation Procedures

Appendix B - Hydraulic Design

Appendix C - Geotechnical Design

Appendix D - Mechanical and Electrical Design Summary

Appendix E - Detailed Cost Estimate

Appendix F - Plan Formulation Data

APPENDIX A

HABITAT EVALUATION PROCEDURES

HABITAT EVALUATION PROCEDURE USED FOR THE TREMPEALEAU NATIONAL WILDLIFE REFUGE HABITAT REHABILITATION AND ENHANCEMENT PROJECT

Habitat evaluation procedures (HEP) were used to evaluate the potential benefits of alternative habitat improvement features at the Trempealeau National Wildlife Refuge. Active participants included biologists from the St. Paul District, the Trempealeau National Wildlife Refuge, and the Upper Mississippi River Wildlife Refuge. Coordination was maintained with representatives of the Wisconsin Department of Natural Resources and the Minnesota Department of Natural Resources.

METHODS

METHODOLOGY

The Wildlife Habitat Appraisal Guide (WHAG) method was used to evaluate project effects and potential benefits for wildlife species. The WHAG was developed by the Missouri Department of Conservation and the U.S. Soil Conservation Service (MDC-SCS, 1990). This methodology has been used in the evaluation of habitat rehabilitation and enhancement projects (HREP) in the Rock Island and St. Louis Districts. This is the first application of this method in the St. Paul District. The WHAG was selected for use because the WHAG wetland species models appear well suited to the evaluation of the types of habitat modifications being considered at the Trempealeau National Wildlife Refuge (Refuge).

The U.S. Fish and Wildlife Service's 1980 version of Habitat Evaluation Procedures (HEP-80) was used to evaluate project effects and potential benefits for fish species because of the readily available fish species models associated with this methodology.

One of the major project objectives at the Refuge is to improve habitat migratory habitat for diving ducks. There were no available models for diving duck migratory habitat on the Upper Mississippi River so a model was developed specifically for this purpose (Devendorf, 1991).

EVALUATION SPECIES SELECTION

The WHAG contains 12 species models for wetland cover types. The evaluation for Pools B, C, and E was conducted using all applicable species because the U.S. Fish and Wildlife Service was interested, for a planning perspective, in determining potential project effects across the spectrum of wetland species. For quantification of potential project benefits and incremental analysis of project features, a single species was selected that would best reflect the project objectives for a particular pool.

For the evaluation of potential fishery impacts the largemouth bass (Micropterus salmoides), black crappie (Pomoxis nigromaculatus), and bluegill (Lepomis

macrochirus) were initially identified as the three species would most closely represent the type of fishery that the U.S. Fish and Wildlife Service would like to establish in Pool A. Following further review the largemouth bass and bluegill were selected as the evaluation species because they are a game and panfish that most represent the type of fishery that is planned for Pool A. The U.S. Fish and Wildlife Service models for these species (Stuber, et. al., 1982a; Stuber, et. al., 1982b) were used along with a St. Paul District model modification to evaluate winter habitat conditions (Palesh and Anderson, 1990).

DATA REQUIREMENTS

Because considerable information was already available for the Trempealeau National Wildlife Refuge, only limited additional data had to be collected for the WHAG evaluation. This consisted primarily of spot checks for specific pieces of information.

Winter dissolved oxygen data were collected to document the extent of winter dissolved oxygen depletion, both for the fishery evaluation and to document the extent of the problem for project planning purposes. The data (enclosure 1) indicated that during the years with extensive snow cover during the winter, DO levels dropped to less than 2 ppm by January.

EVALUATION UNITS

Based on the habitat conditions present in the various Trempealeau National Wildlife Refuge pools, the refuge was broken down into the following segments for the habitat evaluation. These units are shown on figure A-1.

Pool A - Pool A was initially evaluated as a single evaluation unit because the pool is relatively homogeneous in habitat type. When project planning resulted in locating a splitter dike across the pool as an alternative, it was subdivided for further evaluation purposes into pools A1 (700 acres) and A2 (400 acres).

Pool B1 - This is the major portion of pool B, approximately 1,600 acres in size. This area is primarily a mixture of marsh and shallow aquatic wetland habitats.

Pool B2 - This is the 450-acre northwestern corner of pool B. This area was separated out because it is more solid marsh in character with little or no open water over most of the growing season.

Pool C1 - Pool C1 is about 375 acres in size and is primarily marsh habitat.

Pool C2 - Pool C2 is about 425 acres in size. This unit was separated from pool C1 because it has considerable woody vegetation present in the form of both trees and brush. This area is a combination of marsh/grassland and bottomland hardwoods. the grassland area is primarily reed canary grass due to the predominately moist soil conditions.

Pool E1 - Pool E1 is about 550 acres in size, and was separated from pool E2 because one of the planning alternatives being considered is to separate pool E into two subunits via construction of a splitter dike.

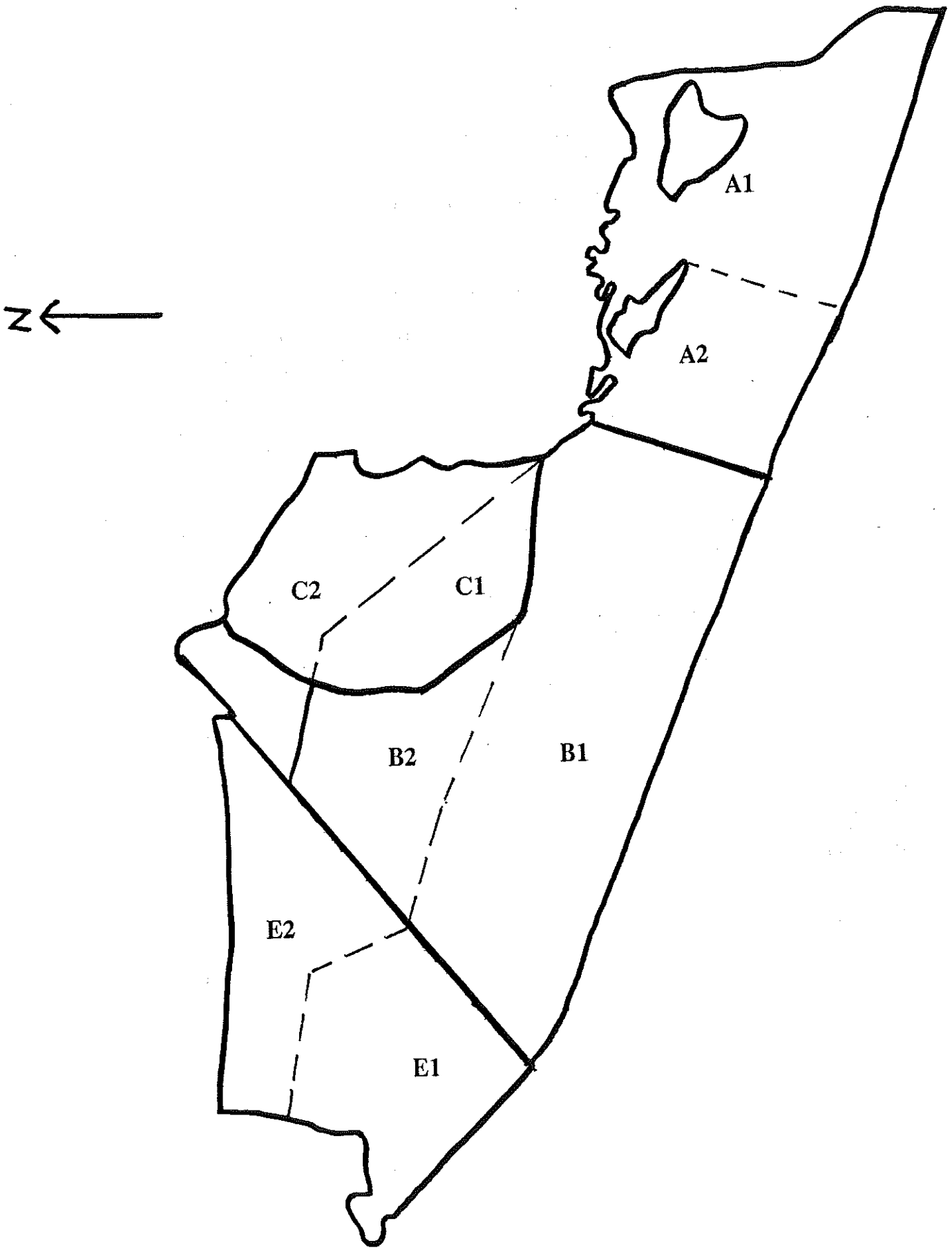


Figure 1. Trempealeau National Wildlife Refuge-Pools

Pool E2 - Pool E2 is about 600 acres in size.

FUTURE WITHOUT PROJECT CONDITIONS

The future without project habitat conditions assumed for the Trempealeau National Wildlife Refuge are discussed in the Definite Project Report and are briefly summarized below. Estimates on the succesional rate and encroachment of woody vegetation in the pools are based on observations of past trends by refuge personnel.

Pool A - Habitat conditions in pool A are not expected to change to any appreciable degree under the future without project condition.

Pool B1 - Habitat conditions in pool B1 are not expected to change to any appreciable degree under the future without project condition.

Pool B2 - Woody plants in the form of willow brush currently cover about 10 percent of pool B2. It is projected that under the future without project condition woody plant coverage will increase to about 25 percent over the next 50 years.

Pool C1 - Woody plants in the form of willow brush currently cover about 15 percent of pool C1. It is projected that under the future without project condition woody plant coverage will increase to about 25 percent over the next 50 years.

Pool C2 - Habitat conditions in pool C2 are not expected to change to any appreciable degree under the future without project condition.

Pool E1 - Woody plants in the form of trees and willow brush currently cover about 10 percent of pool E1. It is projected that under the future without project condition woody plant coverage will increase to about 25 percent over the next 50 years.

Pool E2 - Woody plants in the form of trees and willow brush currently cover about 30 percent of pool E2. It is projected that under the future without project condition woody plant coverage will increase to about 60 percent over the next 50 years.

EVALUATION AND HABITAT SUITABILITY INDEX RESULTS

Model matrixes and HSI calulations are presented in table A-1 and enclosure 2.

POOL A DIKE

The Pool A Dike would result in the ability to improve habitat conditions in pool A and pool B. The degree and location of habitat change in pool A would be dependent on the location of the dike. The location of the dike along Alignment 1 would create an 1,100 acre management pool in which water levels could be lowered up to 2 feet to stimulate aquatic plant growth. Barrier islands would need to be constructed to reduce wave action in the pool to increase water

clarity. Construction of the dike along Alignment 2 would create a 700 acre management pool (A1) in which water levels could be lowered. Barrier islands would not be required as the dike would function as a wave attenuater for the 400 acre management pool (A2). The creation of a 700 acre management pool would make it feasible to effectively control rough fish on a portion of the refuge and establish a viable game fish population. It was felt by refuge personnel that this may not be possible with an 1,100 acre management unit.

Habitat benefits would be realized in pool B irrespective of the location of dike A. Either alignment would provide the capability to pond additional water in pool B to control the extent and type of aquatic vegetation this 1600 acre management unit.

The habitat suitability determinations for the two dike A locations are summarized below.

Dike A Alignment 1 + Barrier Islands

POOL A -Pool A was evaluated using the diving duck migratory habitat model developed specifically for this project. The habitat suitability index (HSI) for the present and future without condition for using this model is .47. Pool A contains the physical characteristics to provide excellent diving duck migratory habitat in terms of size, water depths, and isolation. However, the primary limiting factor as recognized by Refuge managers and as reflected in the model is the lack of food resources in the form of submergent and emergent aquatic plants.

With this design, a 1,100 acre management pool would be created. The ability to lower water levels and reduce wave action in the pool would increase the amount of emergent and submergent vegetation in the pool. It is projected that with a 2 foot drawdown 15 percent of the pool would be exposed mudflats which would stimulate seed bank germination and emergent aquatic plant growth. It is expected that emergent aquatic vegetation would expand from less than 10 percent coverage of the pool to about 15 percent. About 55 percent of the pool would be between 0-2 feet during the growing season with improved water clarity. It is estimated that submergent aquatic plant coverage would increase from the existing 10 percent to somewhere between 30 and 50 percent. These conditions would increase the HSI value for diving duck migratory habitat in this pool to .74.

Dike A Alignment 2

Pool A1 - With this dike alignment a 700 acre management pool would be created. Habitat benefits for diving ducks in pool A1 would be essentially the same as described above for pool A.

The creation of a 700 acre management unit, with independent water control, also provides the opportunity to substantially improve fish habitat in this management unit. The presence of rough fish on the refuge, coupled with periodic winter kills has limited this possibility. It is felt that the 700 acre unit created with this alignment is an optimum size to control population levels of rough fish, and it creates a unit were winter aeration could be used to limit winter kills.

TABLE A-1: POOL A1 FISHERIES EVALUATION

BLUEGILL

VARIABLE	BASE SI	FW/O SI	FW SI
V3 - % cover	0.65	0.65	1.00
V4 - % littoral area	0.25	0.25	0.25
V5 - TDS	1.00	1.00	1.00
V6 - turbidity	1.00	1.00	1.00
V7 - pH	1.00	1.00	1.00
V8 - diss. oxygen	1.00	1.00	1.00
V10 - temp. (A)	0.80	0.80	0.80
V11 - temp (E)	1.00	1.00	1.00
V12 - temp (F)	1.00	1.00	1.00
V13 - temp (J)	0.90	0.90	0.90
V19 - drawdown	1.00	1.00	1.00
V20 - substrate	0.70	0.70	0.70
FOOD	0.87	0.87	1.00
COVER	0.34	0.34	0.40
WATER QUALITY	0.97	0.97	0.97
REPRODUCTION	0.89	0.89	0.89
SUMMER HSI	0.76	0.76	0.80

HSI=(Cf x Cc x Cwq^2 x Cr)^1/5
WHERE
Cf (food) = (V3 x V4 x V7)^1/3
Cc (cover) = (V3 x V4^2)^1/3
Cwq (water quality) = (V6+V7+2V8+2[(V10xV12xV13)^1/3]
Cr (reproduction) = (V11 xV19 x V20)^1/3

Va - cover	0.85	0.85	0.85
Vb - D.O.	0.10	0.10	1.00
Vc - temp	0.65	0.65	0.65
Vd - current	1.00	1.00	1.00
COVER	0.85	0.85	0.85
WATER QUALITY	0.10	0.10	0.88
OTHER	1.00	1.00	1.00
WINTER HSI	0.10	0.10	0.90

HSI = (Cw-c x Cw-wq x Co)^1/3
WHERE
Cw-c (winter cover) = Va
Cw-wq (winter water quality) = (2Vb + Vc)^1/3
Co (winter current) = Vd

OVERALL HSI	0.10	0.10	0.80

LARGEMOUTH BASS

VARIABLE	BASE SI	FW/O SI	FW SI
V2 - % > 6m	0.30	0.30	0.30
V3 - % cover (A,J)	0.40	0.40	0.80
V4 - % cover (F)	0.25	0.25	0.80
V5 -TDS	1.00	1.00	1.00
V6 - diss. oxygen	0.80	0.80	0.80
V7 - pH	1.00	1.00	1.00
V8 - temp (A,J)	1.00	1.00	1.00
V9 - temp (E)	1.00	1.00	1.00
V10 - temp (F)	1.00	1.00	1.00
V11 - sus. solids	0.70	0.70	1.00
V15 - substrate	0.80	0.80	0.80
V16 - water level (A,J)	0.90	0.90	1.00
V17 - water level (E)	0.95	0.95	0.95
V18 - water level (F)	1.00	1.00	1.00
FOOD	1.00	1.00	1.00
COVER	0.54	0.54	0.70
WATER QUALITY	0.90	0.90	0.94
REPRODUCTION	0.93	0.93	0.93
SUMMER HSI	0.82	0.82	0.89
WINTER HSI	0.10	0.10	1.00

SUMMER HSI = (Cf x Cc x Cwq x Cr)^1/4
WHERE
Cf (cover) = V5
Cc (Cover) = (V2 x [(V3+V2)/2] x V16 x V18)^1/4
Cwq (water quality) = (2V6+V7+2V8+V10+V11)/7
Cr (reproduction) = (V2 x V9 x V15 x V17)^1/4

WINTER HSI = Assumed to be the same as Bluegill

OVERALL HSI	0.10	0.10	0.89

An aquatic habitat evaluation was conducted using both the largemouth bass and the bluegill as evaluation species. The results are shown in table A-1. An average of the values obtained from the two species models were used as an overall fishery value for centrarchids.

At present winter dissolved oxygen is the limiting factor on the fish habitat value in pool A. Therefore the existing HSI is .10. If winter dissolved oxygen were eliminated as a limiting factor, the summer habitat conditions become the next limiting factor. Therefore, elimination winter dissolved oxygen as a limiting factor would increase the HSI for centrarchids from .10 to .79 ((.76+.82)/2).

Construction of the pool A dike would improve summer habitat conditions by increasing the amount of aquatic vegetation in the pool. This would increase the HSI from .79 to .85 ((.80+.89)/2).

Pool A2 - Pool A2 was evaluated using the diving duck migratory model. Under existing and future without conditions the HSI for pool A2 is .47.

With this dike alignment, water level control capabilities in pool A2 would be less than in pool A1, especially in terms of drawing this pool down to promote aquatic plant growth. However, with about 45 percent of this management unit with water depths of 3 feet or less, the wind blocking effect of the pool A dike should improve water clarity, allowing for a modest increase in submergent and emergent aquatic plant growth in this pool. It is estimated that emergent vegetation coverage would increase to slightly over 10 percent of the pool and submergent vegetation would increase from less than 10 percent coverage to slightly over 30 percent coverage of the pool. The HSI value for this pool is projected to increase to .56.

POOL B1

It was determined after reviewing the WHAG models that they were not sensitive enough to reflect the subtle habitat changes that could be achieved with ± 1-foot water level control in pool B1. It was decided that this water level control should conservatively result in a 10 percent increase in habitat quality. Since the primary objective in pool B1 is to improve conditions for dabbling ducks, the mallard was selected from the WHAG species models as the evaluation species for this pool. The HSI for existing conditions for the mallard is .45. Limiting factors are water depths during certain times of the year, percent open water and plant diversity. A 10 percent increase in habitat quality under with project conditions would raise the HSI to .50.

POOL B2

An evaluation of the effects of the alternative project features indicated that there would be no appreciable effect on habitat quality for waterfowl in pool B2.

POOL C DIKE

The pool C dike would provide the ability to manipulate water levels in pool C. Of primary importance is the ability to pond additional water in this pool to ensure flooded marsh conditions during critical times of the year and to control woody plant invasion into lower pool C (C1). Water supply to flood pool C would come from pumping from pool B or by drawing water from the Trempealeau River at certain times of the year. The mallard was selected as the evaluation species to use in the WHAG methodology, as the primary management emphasis in pool C is to increase use of this area by dabbling ducks.

POOL C1

The mallard model indicates that the HSI value for existing condition in pool C1 is .55. The primary limiting factors are the amount of water present in the marsh during certain times of the year and the extent and types of vegetation in the pool. It is estimated that woody vegetation will continue to encroach on certain areas of the marsh decreasing its value as waterfowl habitat. The future without project condition was estimated to be an HSI of .36.

Dike C will provide the ability to pond up to an additional 2 feet in this management unit. This will provide the capability to ensure that adequate water levels are provided during the certain times to provide enhanced waterfowl habitat. This feature would also provide the capability to use elevated water levels as a management tool to prevent the encroachment of woody vegetation into the marsh. Based on these factors, the HSI for the future with project condition was estimated to be .59.

POOL C2

An evaluation of the effects of Dike C indicated that this feature would have no appreciable effect on waterfowl habitat in pool C2.

Late in the project formulation process, the opportunity to develop a managed marsh unit in a portion of Pool C2 was identified. The potential for developing a managed marsh unit was identified by Duck Unlimited, Inc.. This alternative is designated the C2 dike.

The proposed feature would be located in the northwesterly corner of pool C2 and would consist of a 220 acre management unit. The managed marsh cell would be created by the construction of a 6,500-foot long dike which would tie into the Green Bay and Western railroad on the west and the dike along the Trempealeau river on the north. Water supply would be provided by drawing water from the Trempealeau River or by pumping from Pool C.

The mallard was selected as the evaluation species because the primary management emphasis in this unit would be to provide feeding/resting areas for dabbling ducks. The mallard model indicates the HSI value for the conditions in the area is .1. The area currently is a seasonally flooded marsh comprised primarily of reed canary grass and provides marginal habitat for waterfowl. The primary limiting factors are the amount of water during key times of the year and the type and extent of vegetation. It is estimated that conditions in the area will

change little if no feature is constructed. The future without condition was estimated to remain at an HSI of .1.

Construction of the dike with attendant water control features would ensure that desired water levels are present at key times of the year and would provide the capability to manipulate waters to control the type and extent of vegetation in this management unit. The HSI in this 220 acre unit would increase from .1 to .6.

If this feature were constructed without a pump, management capabilities would be substantially reduced. In certain years, it may not be desirable to draw water from the Trempealeau River because of water quality conditions. It is estimated by Refuge personnel that this would occur approximately 50 percent of the time. Therefore, the HSI for this alternative was reduced 50 percent from .6 to .3.

POOL E DIKE

The pool E dike would create two separate management cells in which water levels could be manipulated to control the type and extent of aquatic vegetation for waterfowl habitat. The mallard was selected as the evaluation species to use as the management emphasis for this pool is to maintain and improve dabbling duck habitat.

POOL E1

An evaluation of the effects of the alternative project features determined that there would be no appreciable effect on pool E1.

POOL E2

The mallard model indicates that the existing HSI value for pool E2 is .35. The primary limiting factors are the amount of water in certain portions of the marsh during certain times of the year and the extent and type of aquatic vegetation that is present in the pool. Construction of the dike would result in habitat benefits similar to those described for pool C1. The HSI value for the with project condition is estimated to be .56.

HABITAT UNIT CALCULATIONS

The values used to determine habitat unit gains for the various project features are shown in table A-2. For the future with project conditions (except for mechanical aeration) it was assumed that project benefits would not be fully realized until 10 years after project implementation. Most of the benefits are tied to vegetative responses and it is projected that it would take approximately 10 years for these responses to fully develop.

The HEP calculation procedure overestimates the benefits derived from the elimination of winter D.O.. Aeration in lower pool A will provide the opportunity to establish an overwintering fish population by creating areas of refuge as the D.O. levels sag during the winter. The majority of the lake will not provide

TABLE A–2. HABITAT UNIT CALCULATIONS – TREMPEALEAU NWR

FEATURE	EVALUATION SPECIES	POOL	ACRES	FUTURE WITHOUT TY0	FUTURE WITHOUT TY1	FUTURE WITHOUT TY50	FUTURE WITHOUT AAHU	FUTURE WITH TY0	FUTURE WITH TY1	FUTURE WITH TY10	FUTURE WITH TY50	FUTURE WITH AAHU	AAHU GAIN
Pool A Dike Alignment 1	Diving Ducks	A	1100	.47	.47	.47	517	.47	.47	.74	.74	781	264
Pool A Dike Alignment 2	Diving Ducks Diving Ducks	A1 A2	700 400	.47 .47	.47 .47	.47 .47	329 188	.47 .47	.47 .47	.74 .56	.74 .56	497 220	168 32
Pool A Dike All Alignments	Mallard	B	1600	.45	.45	.45	720	.45	.45	.50	.50	792	72
Pool C Dike	Mallard	C1	375	.55	.55	.36	171	.55	.55	.59	.59	220	49
C2 Dike With Pumps	Mallard	C2	220	.10	.10	.10	22	.10	.10	.60	.60	120	98
C2 Dike Without Pumps	Mallard	C2	220	.10	.10	.10	22	AAHU GAINS REDUCED BY HALF DUE TO INABILITY TO REACH MANAGEMENT GOALS 50 PERCENT OF THE TIME					49
Pool E Dike	Mallard	E2	550	.35	.35	.35	193	.35	.35	.56	.56	296	103
Pool A Dike	AQUATIC BENEFITS												
Mech. Aeration	Centrarchids	A1	700	.10	.10	.10	70	.10	.79	.79	.79	553	483
Pool A Dike	Centrarchids	A1	700	AAHU WITH AERATION			553	.10	.79	.85	.85	591	38
											TOTAL AQUATIC		521

suitable habitat as acceptable D.O. levels will be limited to the area of influence of the aerators. It is not possible at this time to determine what the area of influence will be, but it will probably be in the range of 20 to 60 acres. In order to more accurately reflect the aquatic HU's gained, it is assumed that the entire 700 acres in lower pool A will be near the estimated HSI for only half of the year. Therefore the aquatic HU's gained with aeration and pool control is half that reflected in the HU calculations, or 520/2 = 260 Average Annual Habitat Units.

INCREMENTAL ANALYSIS

In terms of their benefits to waterfowl, the proposed dikes are independent features. An incremental analysis was conducted for each dike alternative considered in order to identify the most cost effective approach to meeting management goals for each pool. The incremental analysis for each dike is discussed below.

POOL A DIKE

The pool A dike would result in the ability to improve habitat conditions in pool A and pool B by providing the capability to manipulate water levels in both these pools. The degree and location of habitat change in pool A would be dependent on the location, while the benefits to pool B would be the same for any of the pool A dike alternatives. The alternatives considered included dike alignments, dike design, and the type grade of rock (rock fill or riprap) to use for bank protection. Six alternatives were considered and a detailed description of each alternative is presented in the Alternatives section of the main report.

Initial alternative evaluation focused on the location of the proposed dike. Two dike alignments were considered (Alignment 1 and Alignment 2). The same general dike design was used to compare cost of the two alignments. After alignment 2 was identified as the preferred dike location, several design options were considered. These design alternatives would not the affect the type or amount of habitat changes that would occur. The only difference of these design alternatives is cost.

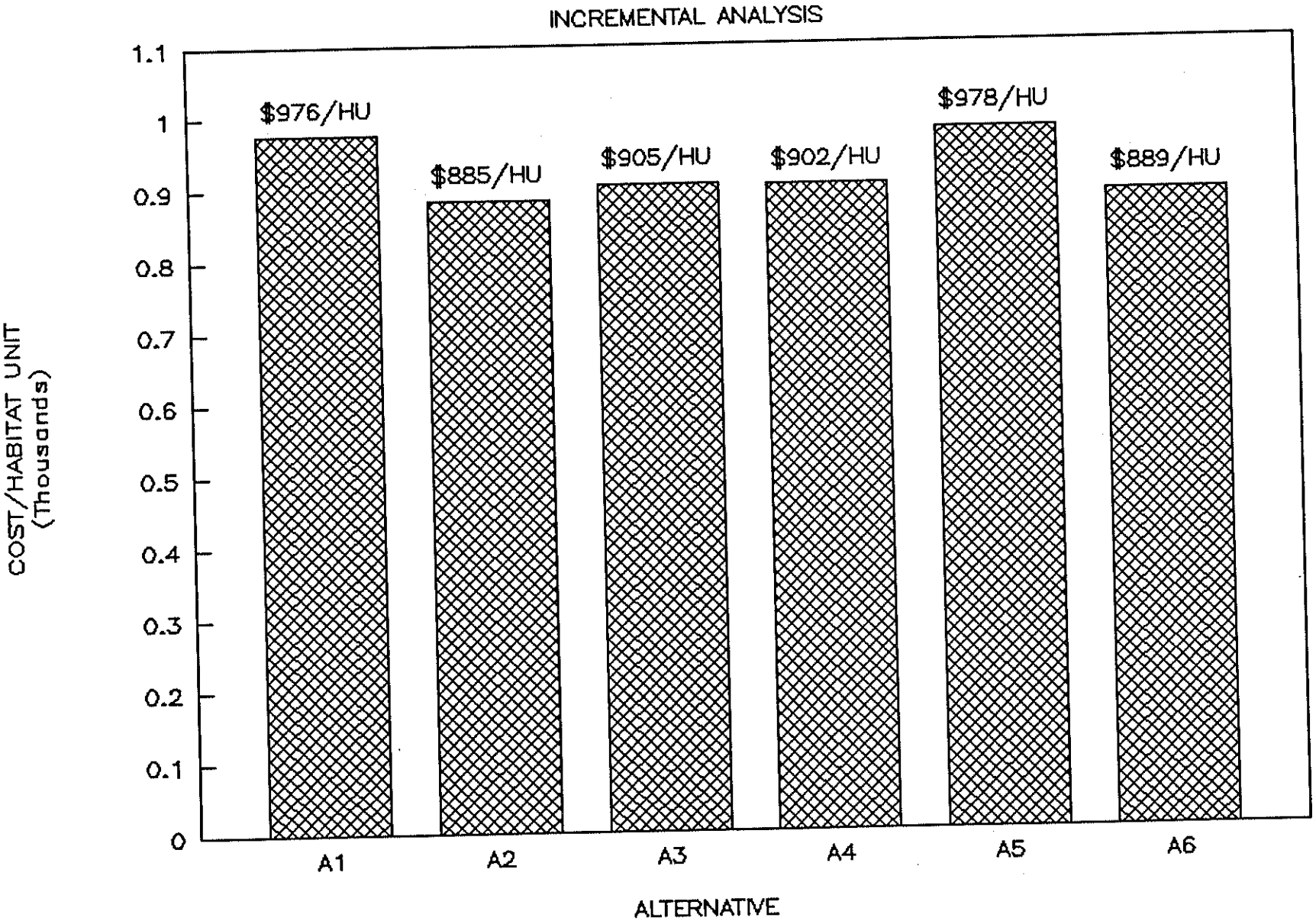
The project design assumes the capability to lower the water level of lower pool A up to 2 feet. This was considered the minimum amount of drawdown required to generate a significant response in aquatic plant growth. A review of the habitat models also indicated that a three foot drawdown would not result in a quantifiable increase in habitat benefits over what would occur with a 2 foot drawdown. Based on this evaluation, it was not considered necessary to determine cost estimates for alternative pumping capabilities.

Table A-3 is a summary of the alternatives considered, cost associated with each alternative, and the habitat benefits gained (Average Annual Habitat Units) and is displayed in figure A-2. The incremental analysis shows that dike Alignment 2 (Alternatives A2-A6) is the most effective location for the dike because this alignment is shorter and it eliminates the need to construct islands to reduce wind fetch. Alternative A2 appears to be the most cost effective approach to meeting the waterfowl management goals of both pools A and B at $885/HU. This alternative, however, has a high risk of failure, as concentrated wave action

TABLE A-3. SUMMARY OF ALTERNATIVES FOR DIKE A

ALTERNATIVE	ALTERNATIVE DESCRIPTION	TOTAL CONSTRUCTION COST	AVERAGE ANNUAL COST (INCLUDES O&M)	AAHU	COST/AAHU
A1	Alignment 1 Sand Dike, Pumps, Islands	$3,694,000	$327,900	336	$976/HU
A2	Alignment 2 Sand Dike, Pumps	$2,714,000	$240,700	272	$885/HU
A3	Alignment 2 Riprap Dike, Pumps	$2,772,000	$246,200	272	$905/HU
A4	Alignment 2 Sand/riprap Dike, Pumps	$2,765,000	$245,300	272	$902/HU
A5	Sand Dike, Pumps, Is. Riprap	$3,068,000	$266,000	272	$978/HU
A6	Sand/Riprap Dike, Pumps Is. Rockfill	$2,780,000	$241,900	272	$889/HU
A7	Aeration	$101,000	$13,600	260	$52/HU

FIGURE A–2: DIKE A ALTERNATIVES



where the dike ties into Kiep's Island could result in shoreline erosion causing significant adverse impacts to a cultural resources site and the loss of the ability to properly operate the project. The selected alternative (A6) is only slightly more costly at $889/HU and would ensure that induced erosion on Keip's Island would not occur.

Construction of the dike makes it feasible to consider the use of aeration to improve fish habitat in a portion of pool A. Because of the size of the refuge and the current inability to effectively control rough fish populations, this feature would not be considered without the construction of a dike in pool A. In addition, as the primary management emphasis of the Refuge is for waterfowl, the dikes would not be pursued solely to improve fishery habitat. The management of pool A to increase aquatic vegetation for waterfowl, would provide secondary benefits by improving habitat conditions for fish. However, due to the relatively shallow depths of the pool, winter kill would still limit the potential to effectively develop a game fish population in the pool. Aeration of the pool over winter would remove this limiting factor. The type of aeration equipment used was selected based on the design that was considered to be most effective for a pool of this size and depth. This feature would increase fish habitat in lower pool A almost 400 percent at a cost of only $52/HU.

POOL C DIKE

Pool C dike would provide the capability to manipulate water levels in pool C to control the extent and type of vegetation in the pool. Alternative dike alignments were not considered because the proposed alignment is the shortest route between the two closest points of high ground. Alternative designs focused primarily on water supply strategies, either by pumping from pool B, by gravity inlet from the Trempealeau River or a combination of the two.

An additional 2 foot raise in the dike to allow the ability to pond up to 4 feet of water in pool C was considered. It was determined that the ability to raise the water an additional 2 would not result any appreciable gain in habitat quality. Therefore, this alternative was dropped from further consideration.

Table A-4 is a summary of the alternatives considered for pool C and is displayed in figure A-3. An incremental analysis indicates that alternative C1 is the most cost effective alternative. Supplying water solely from the Trempealeau River inlet was not as effective, because during certain times of the year it would not be desirable to draw water from the river because of water quality concerns. This approach decreases management flexibility and it has been determined that with Alternative C3, management objectives would be met only 75 percent of the time. Therefore, the habitat unit gain for pool C was reduced by 25 percent for this alternative.

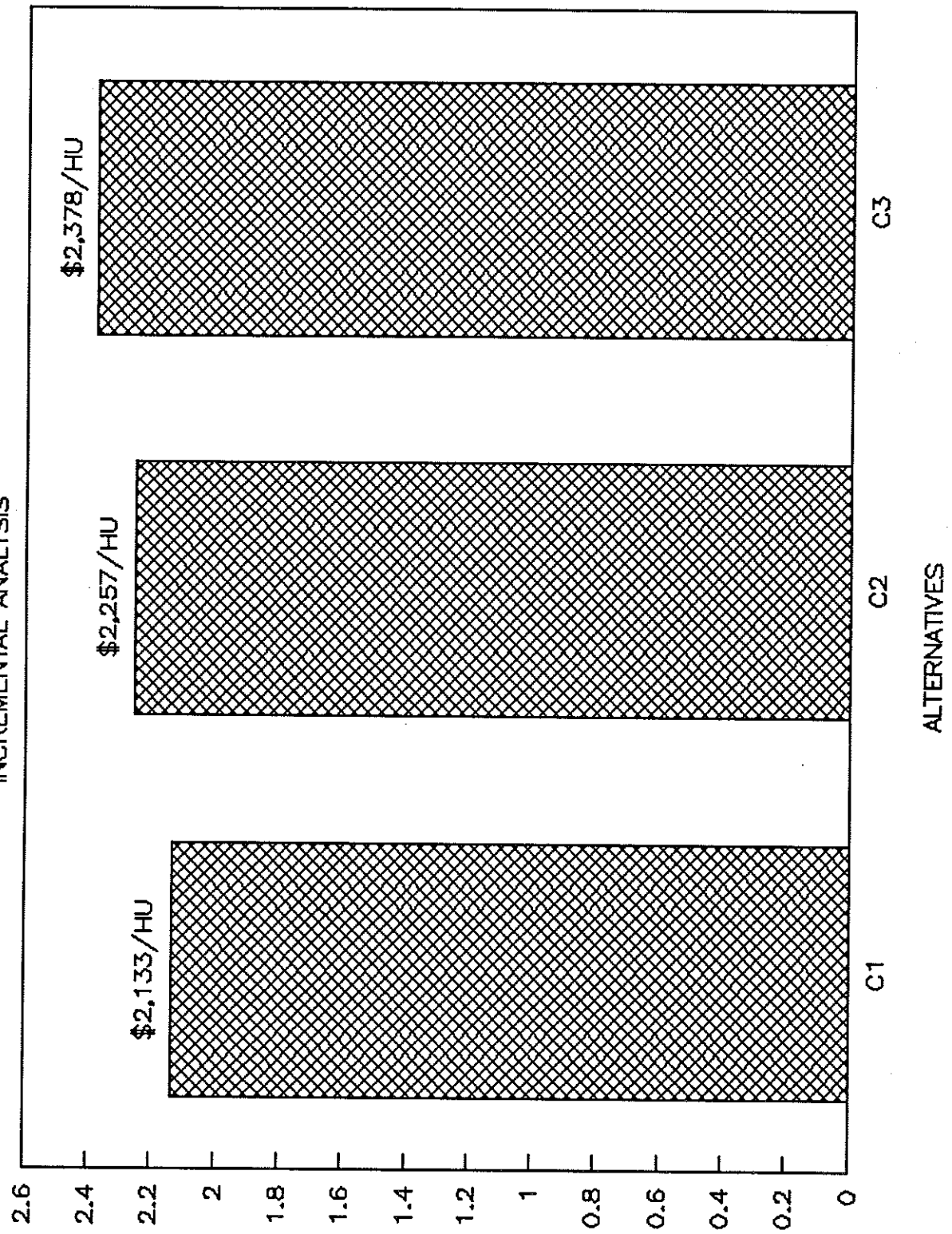
POOL C - C2 DIKE

The proposed C2 dike would provide the capability to manipulate water levels in a portion of the management unit referred to as pool C2. The feature would include approximately 6,500 feet of dike and would allow water level control on approximately 220 acres. Water supply would come primarily from gravity flow inlet from the Trempealeau River, supplemented with pumping from pool C to

TABLE A-4. SUMMARY OF ALTERNATIVES FOR DIKE C

ALTERNATIVE	ALTERNATIVE DESCRIPTION	TOTAL CONSTRUCTION COST	AVERAGE ANNUAL COST (INCLUDES O&M)	AAHU	COST/HU
C1	Sand Dike, Pumps, Outlet	$1,153,000	$104,500	49	$2,133/HU
C2	Sand Dike, Pumps, Outlet, Tremp. Inlet	$1,218,000	$110,600	49	$2,257/HU
C3	Sand Dike, Tremp. Inlet	$959,000	$88,000	37	$2,378/HU

FIGURE A-3: DIKE C ALTERNATIVES



provide water during those times when it would not be suitable to draw water from the Trempealeau River. An alternate design did not include the ability to pump from pool C. Refuge personnel have indicated that without pumping capability, management objectives of this managed marsh unit could not be met 50 percent of the time and the habitat unit gains were adjusted accordingly.

Table A-5 is a summary of the two alternatives considered for the C2 Dike and is displayed in figure A-4. The analysis indicates that without the pumps, the cost per habitat unit is substantially higher. The incremental cost of installing the pumps is $455/HU and brings the overall cost of the C2-1 alternative down to $893/HU.

POOL E DIKE

Pool E dike would provide the capability to manipulate water levels in pool E to control the extent and type of vegetation in the pool. No alternative alignments were considered because the road remnant provides a structure upon which to build the dike. The only alternative design considered was to reduce the topwidth of the dike.

PROJECT FEATURES COMPARISON

A comparison of the cost effectiveness of the four dikes and aeration of lower pool A is shown in figure A-5. The analysis shows that on a Cost/Habitat Unit basis, Dike E is the most cost effective of the four dikes , Pool C2 Dike and Dike A are slightly more costly and Dike C is the least cost effective. Overall the relative cost of the dikes E, C2 and A do not differ significantly, ranging from $623/HU to $889/HU. Dike C is substantially more costly at $2,133/HU. Because of the relatively high cost of this feature, coupled with the limited increase in habitat benefits, it is recommended that the Pool C dike feature be deleted from the proposed project.

The cost per habitat unit of dikes E, C2 and A are justified based on the reasonableness of the costs and the importance of the resource being benefitted. The Trempealeau National Wildlife Refuge is one of the few areas isolated from the flows of the Mississippi River and the Trempealeau River. As a result the water quality and habitat conditions on this refuge, especially for migratory birds, have remained very high. The importance of this area to migratory species will increase as navigation on the river increases. The proposed features would provide the capability to maintain and improve habitat quality in this important area. The construction of the proposed features will contribute to the goals of the North American Waterfowl Management Plan. The enhancement and restoration of waterfowl habitat, especially along the migration corridors such as the Mississippi River, is of key importance to maintaining viable waterfowl populations.

Of the remaining three dikes being considered, Dike A is the most preferred feature to construct because of the two types of habitat benefits that can be realized with its construction. Construction of this feature, and attendant water level management, would not only result in waterfowl habitat benefits, but also would provide the opportunity to substantially improve fish habitat in lower pool A. The construction of the dike would create a 700 acre management unit

TABLE A-5. SUMMARY OF ALTERNATIVES FOR C2 DIKE

ALTERNATIVE	ALTERNATIVE DESCRIPTION	TOTAL CONSTRUCTION COST	AVERAGE ANNUAL COST (INCLUDES O&M)	AAHU	COST/HU
C2-1	Dike, Pump, Outlet, Tremp. Inlet	$988,000	$87,500	98	$893/HU
C2-2	Dike, Outlet, Tremp. Inlet	$727,000	$65,200	49	$1331/HU

FIGURE A–4: C2 DIKE ALTERNATIVES

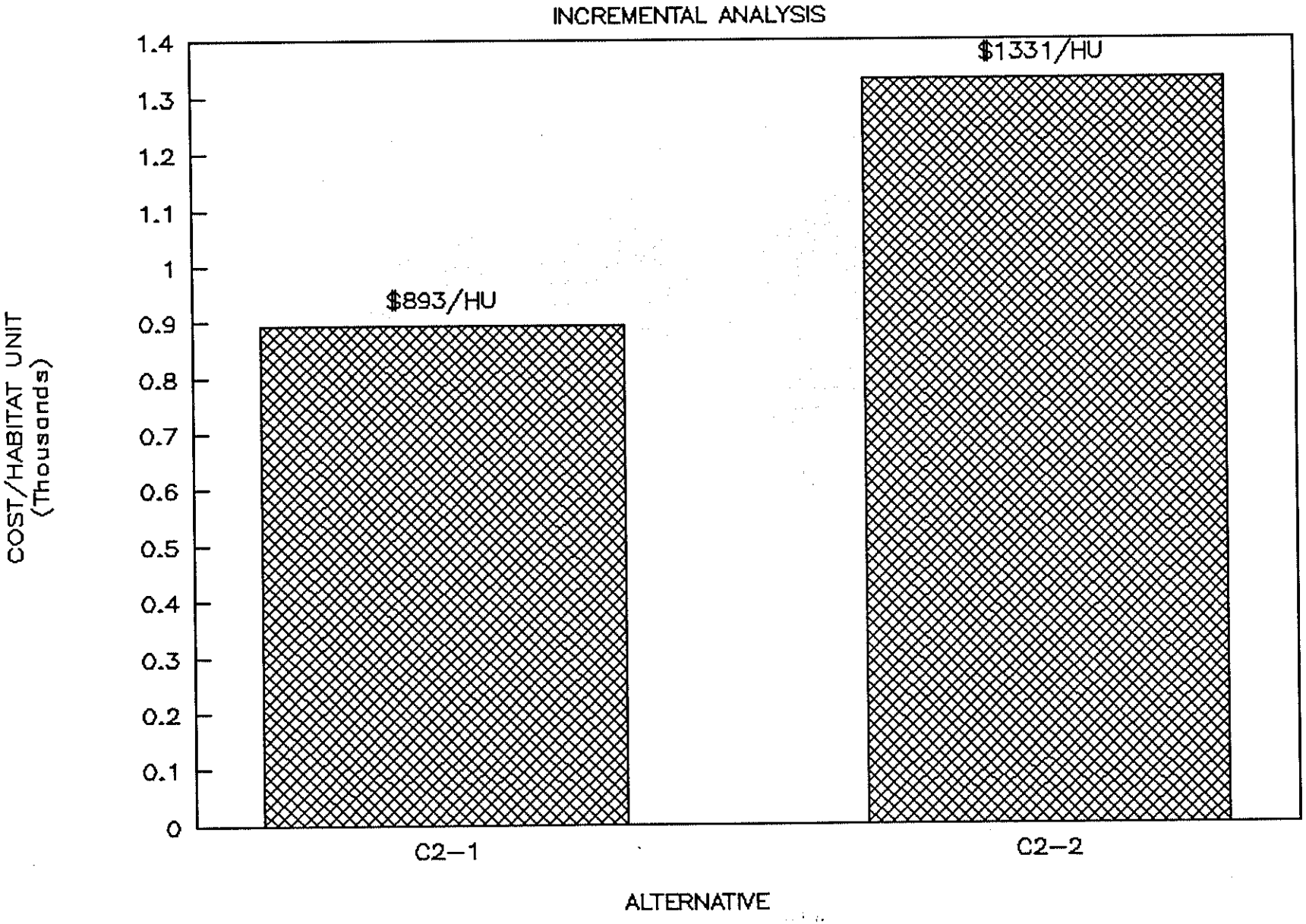
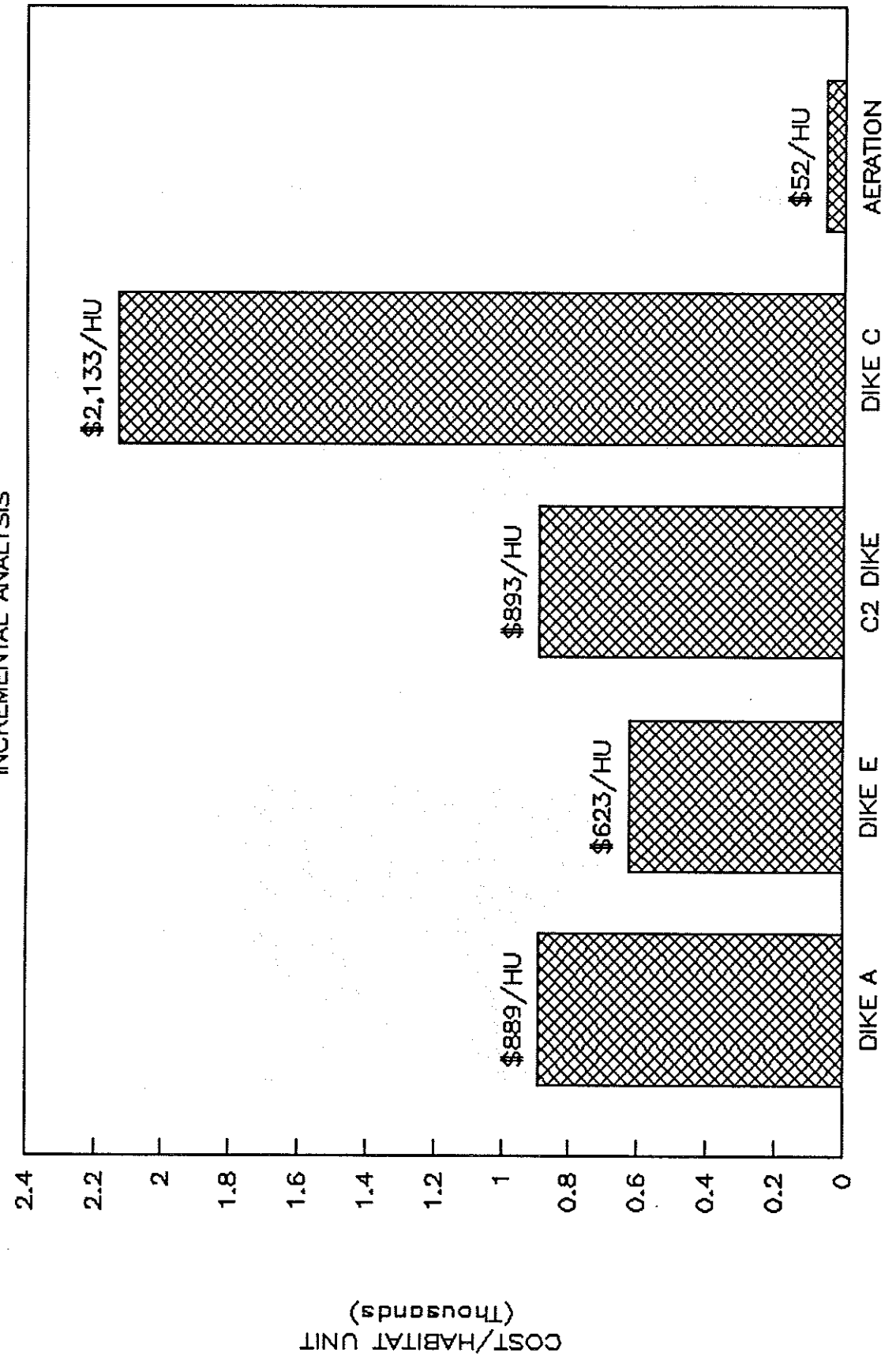


FIGURE A-5: TREMPEALEAU EMP

INCREMENTAL ANALYSIS



where it would be cost effective to control rough fish and to install aeration devices. At $52/HU to achieve fishery benefits, the aeration of this management unit is the most cost effective of all project features. These fishery benefits could not be achieved without the construction of Dike A.

REFERENCES

Devendorf, Randall D.. 1991. Diving duck migratory habitat model. St. Paul District, Corps of Engineers. Unpublished.

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Stuber, R.J., G. Gebhart, and O.E. Maughan. 1982a. Habitat suitability index models: Bluegill. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.8. 26 pp.

Stuber, R.J., G. Gebhart, and O.E. Maughan. 1982a. Habitat suitability index models: Largemouth bass. U.S.D.I. Fish and Wildlife Service. FWS/OBS-82/10.16. 32 pp.

ENCLOSURE 1

TREMPEALEAU NATIONAL WILDLIFE REFUGE

D.O DATA

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Trempealeau National Wildlife Refuge
Route 1, Box 326
Trempealeau, Wisconsin 54661

IN REPLY REFER TO:

March 13, 1992

Dan Wilcox
Biologist
U.S. Army Engineering District, St. Paul
1421 U.S. Post Office and Custom House
Saint Paul, Minnesota 55101-1479

Dear Mr. Wilcox:

I am enclosing data on dissolved oxygen (D.O.) levels from ten sampling dates at the Trempealeau National Wildlife Refuge this winter. The sampling locations were derived from the map we sent you last year. We eliminated sites 2A, 4A and 6A. If you need another map let us know. All measurements were made with a Y.S.I. meter. If you have any questions please call me at 608-539-2311.

Sincerely,

Dan Amundson

Daniel Amundson
Fish and Wildlife Biologist

- Note: Minimal Snow Cover on ice Dec. 91, Jan, Feb of 92 -
- Not a severe D.O. Drop as in previous year w/23" of Snow cover -
RAW

A-E1-2

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

PROJECT AREA	Trempealeau	% CLOUD COVER	100 16° F
DATE	12/3/91	DISCHARGE (cfs)	
FIELD CREW	Daniel Amundson Dan McDonah Rick Frietsche	POOL ELEVATION (ft)	

LOCATION DESCRIPTIONS

LOCATION	TIME	ICE (cm)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
1	10:45 am	16	90 cm	30 cm	17 ?	0.8	17 seems high
2	11:44	27	195	40	12.9	0.1	
3	11:56	17	175	45	13.2	1.5	
4	12:17	16	140	55	12.8	2.0	
5	11:31	26	170	40	14.8	0.1	
6	12:05	18	180	45	13.5	1.0	
7	12:35	20	140	50	4.8	2.9	

COMMENTS, OBSERVATIONS

TPL 91-4

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

PROJECT AREA	Tremp.	% CLOUD COVER	20%
DATE	12/10/91	DISCHARGE (cfs)	
FIELD CREW	Daniel Amundson Dan McDonah	POOL ELEVATION (ft)	

LOCATION DESCRIPTIONS

LOCATION	TIME	ICE (cm)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
1	8:30 am	17	same	45	11.6	2.0	
5	9:11	30	" "	45	13.0	1.2	
2	11:12	30	" "	45	12.0	1.0	
3	11:30	20	" "	45	13.2	1.2	
6	12:00	20	" " 120"	45	7.3	3.0	new site
7	12:13	24	same	45	5.05	1.3	

COMMENTS, OBSERVATIONS

Unable to locate site 4 and 6. Picked a spot close to suspected site 6 location.

TPL 91-4

A-E1-4

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

PROJECT AREA	Tremp.
DATE	12/17/ 91
FIELD CREW	Dan Amundson Dan McDohan

% CLOUD COVER	95
DISCHARGE (cfs)	
POOL ELEVATION (ft)	

LOCATION DESCRIPTIONS

LOCATION	TIME	ICE (cm)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
1	9:21	25	same	45	11.4	1.0	
5	10:11	35	"	55	12.3	1.0	
2	10:20	35	"	45	8.3	1.0	
3	10:41	23	"	45	8.0	2.0	
6	11:05	26	120	45	10.7	3.0	
7	11:25	28	"	45	6.6	2.0	

COMMENTS, OBSERVATIONS

TPL 91-4

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

PROJECT AREA	Tremp.	% CLOUD COVER	100
DATE	12/30/91	DISCHARGE (cfs)	
FIELD CREW	Dan Amundson Dan McDonah	POOL ELEVATION (ft)	

LOCATION DESCRIPTIONS

LOCATION	TIME	ICE (cm)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
1	10:47am	27	same	40	3.6	1.0	
5	11:41	36	"	40	9.4	0.1	
2	11:50	37	"	50	7.6	0.9	
3	12:05	27	"	50	5.7	2.0	
6	12.21	27	180	40	5.0	1.0	
4	12:36	24	140	45	6.0	1.8	
7	12:48	30	"	40	5.0	1.0	

COMMENTS, OBSERVATIONS

Relocated sites 4 and 6 original.

TPL 91-4

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

PROJECT AREA	Tremp.	% CLOUD COVER	100
DATE	1/7/92	DISCHARGE (cfs)	
FIELD CREW	Dan Amundsom Dan McDonah	POOL ELEVATION (ft)	

LOCATION DESCRIPTIONS

LOCATION	TIME	ICE (cm)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
1	12:45	26	same	45	2.7	1.8	
5	1:00	35	"	55	5.05	3.0	
2	1:15	35	"	55	6.0	2.2	
3	1:30	26	"	55	9.2	2.1	
6	1:40	26	"	55	8.2	2.9	
4	1:55	24	"	55	8.2	3.0	
7	2:05	26	"	55	3.2	1.0	

COMMENTS, OBSERVATIONS

TPL 91-4

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

PROJECT AREA	Tremp.	% CLOUD COVER	20
DATE	1/14/92	DISCHARGE (cfs)	
FIELD CREW	Dan Amundson Dan McDonah	POOL ELEVATION (ft)	

LOCATION DESCRIPTIONS

LOCATION	TIME	ICE (cm)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
1	12:06	30	same	45	6.2	2	
5	11:48	34	"	45	6.5	1.8	
2	11:35	35	"	45	7.2	2.6	
3	11:13	26	"	45	7.0	3.0	
6	11:00	28	"	45	5.0	1.0	
4	10:40	26	"	45	6.4	3.0	
7	10:15	30	"	45	3.62	2.0	

COMMENTS, OBSERVATIONS

TPL 91-4

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

PROJECT AREA	Tremp.	% CLOUD COVER	50
DATE	1/21/92	DISCHARGE (cfs)	
FIELD CREW	Dan Amundson Dan McDonah	POOL ELEVATION (ft)	

LOCATION DESCRIPTIONS

LOCATION	TIME	ICE (cm)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
1	11:21	38	same	40	8.6	1.0	
5	11:38	42	"	40	6.8	1.2	
2	11:52	40	"	45	7.2	0.9	
3	12:05	32	"	50	7.8	2.2	
6	12:20	32	"	50	2.8	1.8	
4	12:35	34	"	50	7.4	2.2	
7	12:46	32	"	50	2.8	1.2	

COMMENTS, OBSERVATIONS

TPL 91-4

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

page___of___

PROJECT AREA	Tremp.	% CLOUD COVER	100
DATE	1/28/92	DISCHARGE (cfs)	
FIELD CREW	Dan Amundson Dan McDohan	POOL ELEVATION (ft)	

LOCATION DESCRIPTIONS

LOCATION	TIME	ICE (cm)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
1	11:00am	35	same	45	9.3	0.9	
5	11:26	41	same	45	8.8	0.8	
2	11:43	45	"	45	7.0	1.0	
3	11:56	33	"	55	6.8	4.0?	
6	12:12	35	"	55	3.6	2.0	
4	12:26	32	"	55	5.8	3.9	
7	12:45	38	"	55	7.0	1.0	

COMMENTS, OBSERVATIONS

TPL 91-4

A-E1-10

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

PROJECT AREA	Tremp.	% CLOUD COVER	100
DATE	2/14/92	DISCHARGE (cfs)	
FIELD CREW	Dan Amundson Dan McDonah	POOL ELEVATION (ft)	

LOCATION DESCRIPTIONS

Access limited by melting ice

LOCATION	TIME	ICE (cm)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
1	10:48	33	same	50	11.0	2.0	no air boat
5	11:08	42	same	55	4.2	3.0	
2	11:24	42	"	60	3.0	3.0	
3	11:56	31	"	60	5.6	4.0	
7	1:15	40	"	65	8.3	2.8	

COMMENTS, OBSERVATIONS

TPL 91-4

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

page____of____

PROJECT AREA	Tremp.	% CLOUD COVER	100
DATE	2/21/92	DISCHARGE (cfs)	
FIELD CREW	Dan Amundson Dan McDonah	POOL ELEVATION (ft)	

LOCATION DESCRIPTIONS

Access was limited by melting ice

LOCATION	TIME	ICE (cm)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
1	8:41am	34	same	55	6.2	2.2	
5	9:15	42	"	65	3.2	2.2	
2	9:33	42	"	65	2.7	3.2	
3	10:07	32	"	65	4.5	3.8	

COMMENTS, OBSERVATIONS

TPL 91-4

A-E1-12

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Trempealeau National Wildlife Refuge
Route 1, Box 326
Trempealeau, Wisconsin 54661

IN REPLY REFER TO:

November 5, 1991

Dan Wilcox
Biologist
U.S. Army Engineering District, St. Paul
1421 U.S. Post Office and Custom House
Saint Paul, Minnesota 55101-1479

Dear Mr. Wilcox:

I am enclosing data on dissolved oxygen (D.O.) levels from three sampling dates at the Trempealeau National Wildlife Refuge last winter. I have also included a map which indicates sampling locations. Data collected on 12/19/90 and 1/9/91 represents D.O. readings using a Hydrolab. Data from 1/31/91 was collected with a Y.S.I. meter. The accuracy of the data collected on 1/9/91 is questionable. We feel the Hydrolab was not functioning properly during this sampling. This year we hope to do all sampling with a Y.S.I. meter. I hope this data is helpful. If you have any questions please call 608-539-2311.

Sincerely,

Dan Amundson

Daniel Amundson
Fish and Wildlife
Biologist

* NOTE - 23" of SNOW COVER ON ICE IN DECEMBER 90- RAD

A-E1-13

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

PROJECT AREA	Trempealeau NWR	% CLOUD COVER	100
DATE	12/19/90	DISCHARGE (cfs)	N/A
FIELD CREW	Dan Amundson Rick Frietsche	POOL ELEVATION (ft)	644

LOCATION DESCRIPTIONS

Main Pool Trempealeau National Wildlife Refuge

LOCATION	TIME	ICE (cm) (in.)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
Site 1	9:30	3	-	-	10.2	3	
2		5	-	-	12.6	2.2	
3		5	-	-	11.5	2.2	
4		5	-	-	11.8	2.3	
5		4	-	-	12.0	2.3	
6		6	-	-	9.8	2.2	
7		6	-	-	13.7	2.5	

COMMENTS, OBSERVATIONS

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

PROJECT AREA	Trempealeau NWR	% CLOUD COVER	clear
DATE	1/9/91	DISCHARGE (cfs)	N/A
FIELD CREW	Dan Amundson Rick Frietsche	POOL ELEVATION (ft)	644

LOCATION DESCRIPTIONS

Main Pool Trempealeau National Wildlife Refuge

LOCATION	TIME	ICE (cm)	WATER DEPTH	SAMPLE DEPTH	D.O. (mg/l)	TEMP. (C)	REMARKS
Site 1	10:30	25	90	-	1.6→ 0	1.6	
2		28	180	-	1.6→ 0	1.4	
5		28	140	-	1.6 → 0	1.3	
3		42	157	-	1.6 → 0	1.3	
6		33	140	-	1.6 → 0	0.7	
4		42	135	-	1.6 → 0	1.5	
7		41	130	-	2.6	1.5	
culvert		32	230	-	1.6	1.5	

COMMENTS, OBSERVATIONS

TREMPEALEAU NATIONAL WILDLIFE REFUGE

WATER QUALITY DATA FORM
WINTER HREP MONITORING

PROJECT AREA	Trempealeau NWR	% CLOUD COVER	40%
DATE	1/31/91	DISCHARGE (cfs)	N/A
FIELD CREW	Dan Amundson Rick Frietsche	POOL ELEVATION (ft)	644

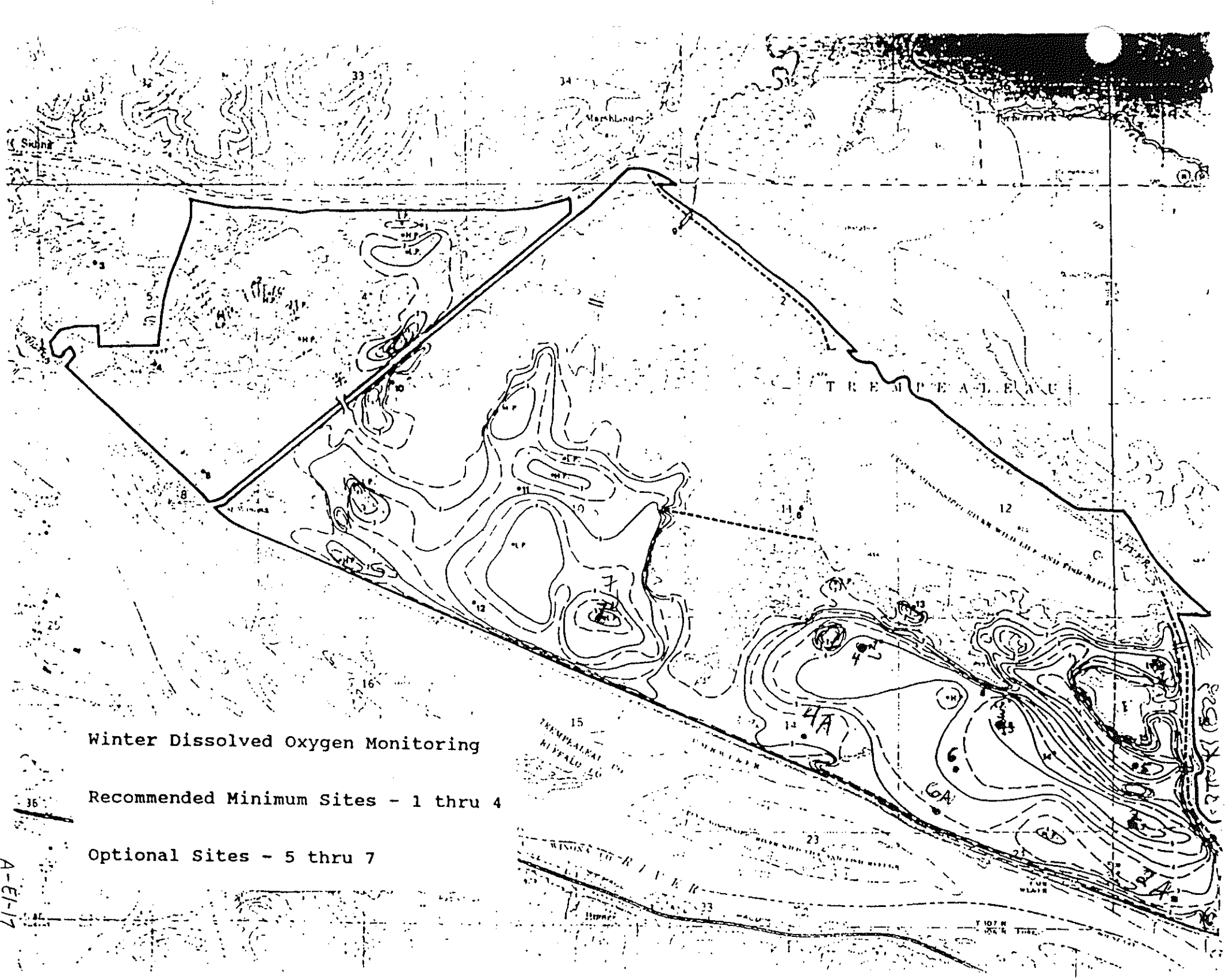
LOCATION DESCRIPTIONS

Main Pool Trempealeau National Wildlife Refuge

LOCATION	TIME	ICE (cm)(ft)	WATER DEPTH	SAMPLE DEPTH (ft)	D.O. (mg/l)	water TEMP. (C)	REMARKS
Site 1	2:11 pm	1.5	3.5	2.0	0.41	0.5	
2	2:30	1.0	-	2.0	0.38	0.5	
2A	2:45	2.0	3.5	2.0	0.45	0.2	
6A	3:05	2.0	3.5	2.0	0.3	0.3	
4A	3:20	2.0	2.5	2.0	0.47	0.2	
7	3:40	2.0	3.0	2.0	0.25	0.3	
5	4:00	1.5	-	2.0	0.35	0.5	
6	4:20	2.0	-	2.0	0.3	0.2	
3	4:30	2.5	4.0	3.0	0.35	1.0	
4	4:41	2.5	-	3.0	0.24	0.5	

COMMENTS, OBSERVATIONS

A-FI-K



Winter Dissolved Oxygen Monitoring

Recommended Minimum Sites - 1 thru 4

Optional Sites - 5 thru 7

ENCLOSURE 2

TREMPEALEAU NATIONAL WILDLIFE REFUGE

HABITAT REHABILITATION AND ENHANCEMENT PROJECT

HSI CALCULATIONS

Pool A1

DIVING DUCK MODEL
TREMPEALEAU NATIONAL WILDLIFE REFUGE
HREP PROJECT

1) Size of Water Body

a.	Less than 100 acres	1
b.	100 to 200 acres	5
c.	200 to 500 acres	7
d.	Greater than 500 acres	(10)

2) Water Depth - Percent of Area 18" to 4'

a.	Less than 10 percent	1
b.	10 to 40 percent	3
c.	40 to 70 percent	(5)
d.	Greater than 70 percent	* (10) *

3) Percent Submergent Vegetation Cover

a.	Less than 10 percent	(1)
b.	10 to 30 percent	3
c.	30 to 50 percent	* (6) *
d.	Greater than 50 percent	10

4) Species of Submergent Vegetation Present
(Key species: wild celery, sago pondweed, and other pondweeds)

a.	None of key species present or less than 10 percent of aquatic bed	1
b.	At least one key species covers 10 to 30 percent of aquatic bed (add one point if more than one key species present)	(3)
c.	At least one key species covers 30 to 60 percent of aquatic bed (add one point if more than one key species present)	6
d.	Greater than 60 percent of aquatic bed is comprised of key food species	10

5) Percent Emergent Vegetation Cover

a.	Less than 10 percent or greater than 50 percent	(1)
b.	10 to 20 percent or 30 to 50 percent	5
c.	20 to 30 percent	* (10) *

- Existing Conditions = ○
- Future w/o Project = Existing Conditions or ○*
- Future w/Project = Existing Conditions or *○*

6) Species of Emergent Vegetation Present
(Key species: arrowhead (S. rigida), soft-stem bulrush, wild rice)

a.	None of key species present or less than 10 percent of aquatic bed	1
b.	At least one key species covers 10 to 30 percent of aquatic bed (add one point if more than one key species present)	(3)
c.	At least one key species covers 30 to 60 percent of aquatic bed (add one point if more than one key species present)	6
d.	Greater than 60 percent of aquatic bed is comprised of key food species	10

7) Disturbance

a.	Access uncontrolled	1
b.	No hunting activity occurs or closed to hunting only	5
c.	No human activity occurs or closed to human entry	(10)

TOTAL ____

MAXIMUM POSSIBLE TOTAL 70

HSI ____

EXISTING & Future w/O = 33/70 = .47

FUTURE w/Project = 52/70 = .74

* These values would Also apply to Pool A calculations with the Alignment 1 alternative

Pool A2

DIVING DUCK MODEL
TREMPEALEAU NATIONAL WILDLIFE REFUGE
HREP PROJECT

1) Size of Water Body

a.	Less than 100 acres	1
b.	100 to 200 acres	5
c.	200 to 500 acres	* (7) *
d.	Greater than 500 acres	(10)

2) Water Depth - Percent of Area 18" to 4'

a.	Less than 10 percent	1
b.	10 to 40 percent	3
c.	40 to 70 percent	(5)
d.	Greater than 70 percent	10

3) Percent Submergent Vegetation Cover

a.	Less than 10 percent	(1)
b.	10 to 30 percent	3
c.	30 to 50 percent	* (6) *
d.	Greater than 50 percent	10

4) Species of Submergent Vegetation Present
(Key species: wild celery, sago pondweed, and other pondweeds)

a.	None of key species present or less than 10 percent of aquatic bed	1
b.	At least one key species covers 10 to 30 percent of aquatic bed (add one point if more than one key species present)	(3)
c.	At least one key species covers 30 to 60 percent of aquatic bed (add one point if more than one key species present)	6
d.	Greater than 60 percent of aquatic bed is comprised of key food species	10

5) Percent Emergent Vegetation Cover

a.	Less than 10 percent or greater than 50 percent	(1)
b.	10 to 20 percent or 30 to 50 percent	* (5) *
c.	20 to 30 percent	10

- Existing Conditions = ○
- Future w/o Project = Existing Conditions or ○*
- Future w/ Project = Existing Conditions or *○*

Pool A-2

6) Species of Emergent Vegetation Present
(Key species: arrowhead (S. rigida), soft-stem bulrush, wild rice)

a. None of key species present or less than 10 percent of aquatic bed	1
b. At least one key species covers 10 to 30 percent of aquatic bed (add one point if more than one key species present)	(3)
c. At least one key species covers 30 to 60 percent of aquatic bed (add one point if more than one key species present)	6
d. Greater than 60 percent of aquatic bed is comprised of key food species	10

7) Disturbance

a. Access uncontrolled	1
b. No hunting activity occurs or closed to hunting only	5
c. No human activity occurs or closed to human entry	(10)

TOTAL	____
MAXIMUM POSSIBLE TOTAL	70
HSI	____

Existing & Future w/o = 33/70 = .47
Future w/project = 39/70 = .56

Wetland Species Characteristic Matrix

Wildlife Area: Pool B

~~Date:~~

Habitat Type: N

CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
1. Percent Nonforest Wetlands in 2 Mile Wide Circle	N												
1. >75%				10	10	10	10				10		
2. 50 - 75%				8	8	8	8				8		
3. 25 - 50%				6	6	6	6				6		
4. 10 - 25%				4	4	4	4				4		
5. <10%				1	1	1	1				1		
2. Percent Nonforest Wetlands and Lakes or Reservoirs in 2 Mile Wide Circle	N,C,G												
1. >75%			10										
2. 50 - 75%			8										
3. 25 - 50%			6										
4. 10 - 25%			4										
5. <10%			LF										
3. Percent Bottomland Hardwoods and Nonforest Wetlands in 2 Mile Wide Circle	N,B,C												
1. >75%		10						10	10	10			
2. 50 - 75%		8						8	8	8			
3. 25 - 50%		6						6	6	6			
4. 10 - 25%		4						4	4	4			
5. <10%		LF						1	1	1			
4. Fall Winter Water Conditions	N,B,C												
1. Water present annually (predictable & water levels controlled		10	10										
2. Water present most years with occasional lapse & water levels controlled		7	7										
3. Water present 1 out of 3 years (opportunistic) & water levels controlled		4	4										
4. Water unpredictable; dry during fall and winter; or no control when present		LF	LF										
5. Fall-Winter Flood Conditions (food plant availability)	N,B	M	M										
1. Food plants unaffected		10	10										
2. Reduced 1 - 25% (Multiply index by .75)		8	8										
3. Reduced 25 - 50% (Multiply index by .50)		6	6										
4. Reduced 50 - 75% (Multiply index by .25)		4	4										
5. Reduced >75% (Multiply index by .25)		1	1										
6. Water Depth 4" - 18" Fall - Winter	N,B,C												
1. >90%		10	10										
2. 75 - 90%		8	8										
3. 50-75%		6	6										
4. 25 - 50%		4	4										
5. <25%		1	1										
7. Water Depth <4" During May	N												
1. >90%					10						LF		
2. 75 - 90%					8						2		
3. 25 - 75%					6						4		
4. 1 - 25%					4						7		
5. ZERO or all >4" Deep					1						10		
8. Water Depth 4 - 18" By August	N												
1. >75%				1	10	1	10				10		
2. 50 - 75%				7	7	7	7				7		
3. 25 - 50%				10	4	10	4				4		
4. <25%				4	1	4	1				1		
9. Permanent Water Entire Year	N				M								
1. >90%					10								
2. 75 - 90% (Multiply index by .90)					8								
3. 50 - 75% (Multiply index by .75)					6								
4. 25 - 50% (Multiply index by .50)					4								
5. <25% (Multiply index by .25)					1								
10. Percent Emergent Vegetation Within 2 yds. of Water	N												
1. >75% of emer. veg. within 2 yd. of water			10								10		
2. 50-75% of emer. veg. within 2 yd. of water			7								7		
3. 25-50% of emer. veg. within 2 yd. of water			4								4		
4. <25% of emer. veg. within 2 yd. of water			1								1		

- Existing Conditions = ○
- Future w/o Project = Existing Conditions or ○*
- Future w/ Project = Existing Conditions or *○*

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
11.	Woody Invasion	N												
	1. <10%				10		5	6	1					
	2. 10 - 25%				8		4	8	6					
	3. 25 - 50%				6		3	10	8					
	4. 50 - 75%				4		2	4	10					
	5. >75%				1		1	1	4					
12.	Emergent Vegetation Coverage	N,B												
	1. >90%				6	LF			1					
	2. 75 - 90%				10	2			2					
	3. 50 - 75%				8	4			4					
	4. 25 - 50%				4	6			10					
	5. 10 - 25%				2	8			7					
	6. <10%				LF	10			1					
13.	Cattail and Bulrush Coverage	N												
	1. >75%						10	LF				8		
	2. 50 - 75%						8	2				10		
	3. 25 - 50%						6	4				6		
	4. 10 - 25%						4	7				4		
	5. <10%						1	10				LF		
14.	Wetland Size	N,B												
	1. >200 acres				10	10	10	10	10			10		
	2. 100 - 200 acres				10	8	8	8	10			10		
	3. 50 - 100 acres				8	6	6	6	10			8		
	4. 25 - 50 acres				6	4	4	4	10			6		
	5. 5 - 25 acres				4	1	2	2	5			4		
	6. <5 acres				LF	LF	1	1	LF			LF		
15.	Wetland Edge	N,B												
	1. >75% Bottomland H. - % adj. to water								10					
	2. 50-75% Nonforest w.-% woody or adj. to								8					
	3. 25 - 50% bottomland hardwoods								6					
	4. 10 - 25%								4					
	5. <10%								1					
16.	Water Regime	N												
	1. Gradual drying with >75% water remaining by Aug. 1				4	4	8	2	10			8		
	2. Gradual drying with 50 - 75% water remaining by Aug. 1				6	6	6	6	6			6		
	3. Gradual drying with 25 - 50% water remaining by Aug. 1				10	10	4	10	4			4		
	4. Gradual drying with <25% water remaining by Aug. 1				8	8	2	8	2			2		
	5. Stable water				2	4	10	4	10			10		
	6. Rapid drying; or no water after June 1				LF	LF	LF	LF	LF			LF		
17.	Important Food Plant Coverage	N,B	M	M										
	1. >75%		10	10										
	2. 50 - 75% (Multiply index by .75)		8	8										
	3. 25 - 50% (Multiply index by .50)		6	6										
	4. 10 - 25% (Multiply index by .25)		4	4										
	5. <10% (Multiply index by .25)		1	1										
18.	Plant Diversity	N,B												
	1. >7		5	5										
	2. 4 - 7		3	3										
	3. <4		1	1										
19.	Persistent Emergent and Woody Vegetation Coverage	N												
	1. 5 - 15%													
	2. [illegible]													
	3. 25 - 50%		4	4										
	4. <5% or >50%		2	2										
			1	1										

N. A

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
20.	Substrate - Surface Water Interspersion	N												
	1. Substrate interspersed with shallow water					10								
	2. Shallow water occurring as one or few pools					1								
21.	Percent Open Water	N												
	1. <10%		5	5		10						6		
	2. 10 - 25%		3	3		8						10		
	3. 25 - 50%		1	1		6						8		
	4. 50 - 90%		1	1		4						4		
	5. >90%		1	1		1						1		
22.	Winter Water Depth (Oct. - March)	N												
	1. 15 - 24"						10							
	2. 10 - 15" or 24 - 30"						7							
	3. 6 - 10" or 30 - 36"						4							
	4. <6" or >36"						1							
23.	Sedge Canopy Coverage	N												
	1. >90%							8						
	2. 75 - 90%							10						
	3. 50 - 75%							6						
	4. 25 - 50%							4						
	5. 1 - 25%							2						
	6. Zero							LF						
24.	Wetland Substrate	N												
	1. Muddy					5								
	2. Sandy					3								
	3. Gravel					1								
25.	Percent Soil Waterlogged Substrate During May	N												
	1. >90% of substrate waterlogged					10								
	2. 75 - 90% of substrate waterlogged					8								
	3. 50 - 75% of substrate waterlogged					6								
	4. 25 - 50% of substrate waterlogged					4								
	5. <25% of substrate waterlogged					1								
26.	Percent Exposed Wetland Substrate and 1-4" Shallow Water Covered by Vegetation May-June	N												
	1. <10%					10								
	2. 10 - 25%					8								
	3. 25 - 50%					6								
	4. 50 - 75%					4								
	5. 75 - 90%					2								
	6. >90%					LF								
27.	Percent Channel with Aquatic Vegetation	B												
	1. >10%									10	10			
	2. 5 - 10%									7	7			
	3. [illegible]									4	4			
	4. None; or 1/4 mi. from center stand									1	1			
28.	Average Water Fluctuation in Channel	B												
	1. Bank full <3 times per year										10			
	2. Bank full [illegible]										7			
	3. Bank full 5-7 times per year										4			
	4. Bank full >7 times per year; or >1/4 mile from channel										1			
29.	Cropfield Management	C												
	1. No fall tillage		10	10										
	2. Winter Wheat		2	10										
	3. Chisel plowing		0	8										
	4. Chopped, Baled, grazed			6										
	5. Fall disc		4	4										
	6. Fall moldboard		1	1										

NA

NA

NA

Pol 67 B

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
30.	Cropping Practice	C												
	1. >50 unharvested		10	10										
	2. 25-50% harvested		7	7										
	3. 10 [illegible]		4	4										
	4. <10% unharvested		1	1										
31.	Crop Rotation	C												
	1. SG - RC - L			5										
	2. [illegible]			3										
	3. Continuous SG or RC			1										
32.	Field Size (% w/in 660' Woodland or Treeline)	C,G												
	1. <25%			10										
	2. 25 - 50%			6										
	3. [illegible]			3										
	4. >75%			1										
33.	Grassland Composition	G												
	1. Bluegrass, clover, alfalfa			10										
	2. Timothy, orchardgrass or mixed CSG			5										
	3. Pasture of RSG			1										
34.	Average Height Herbaceous Vegetation (Fall)	G												
	1. <6"			10										
	2. >6"													
35.	Woodland Tree Species	B												
	1. >50% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash		1							8	10			
	2. 25 - 50% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash		4							10	8			
	3. [illegible]													
	sycamore, willow, maple, ash; or <25% pin oak (or other small acorns)		6							1	6			
	4. 25 - 50% pin oak (or other small acorns)		8							4	4			
	5. >50% pin oak (or other small) acorns)		10							6	1			
36.	Permanent Water Within Woodland	B												
	1. >25%		1						10	10				10
	2. 10 - 25%		3						7	7				7
	3. 5 - 10%		5						4	4				4
	4. [illegible]								2	2				2
	5. Zero		2						1	1				1
37.	Forest Openings (<2 ac. in size)	B												
	1. 15 - 30% scattered		1						10	10	5			
	2. 15 - 30% one or few		3						7	7	4			
	3. [illegible]								4	4	3			
	4. <5% or >30%		1						1	1	1			
38.	Woodland Size Class	B												
	1. Sawtimber - open canopy		10						4	10	4		10	10
	2. Sawtimber - close canopy		8						1	8	1		10	10
	3. Pole with 25-50% sawtimber		6						10	6	6		8	7
	4. [illegible]		4						8	4	8		2	2
	5. Regeneration								8	LF	10		LF	LF
	6. Pole		1						6	2	6		4	4
39.	Percent Canopy From Old Growth (>16" dbh)	B												
	1. >25%									10	1			
	2. 10 - 25%									8	4			
	3. 5 - 10%													
	4. [illegible]									4	8			
	5. Zero									1	10			

Appl 68 B

A-E2-9

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
40.	Woodland Overstory Canopy Height (feet)	B												
	1. >80'												10	10
	2. 65-80'												7	7
	3. 40-65'												4	4
	4. <40'												1	1
41.	Percent Subcanopy Closure	B												
	1. >75%												10	1
	2. 50-75%												7	4
	3. 25-50%												4	10
	4. <25%												1	7
42.	Woodland (Stand) Size													
	1. <25%												10	10
	2. 25-50%												7	7
	3. 50-75%												4	4
	4. >75%												1	1
43.	Percent Forest Canopy Adjacent to or Over Permanent Water	B												M
	1. >25%													10
	2. 10-25%													7
	3. 5-10%													4
	4. <5%													1
44.	Number of Snags Trees per Acre	B												
	1. >4													10
	2. 3-4									5				7
	3. 1-2									3				4
	4. <1									1				1
45.	Number of Cavity Trees Per Acre	B												
	1. >9								10					10
	2. 3 - 9								7					7
	3. 1 - 3								4					4
	4. None								IF					1
46.	Stems per Square Yard of Shrub and Tree Regeneration >3 Feet Tall													
	1. >3									1	10		10	1
	2. 1-3									3	7		7	4
	3. .5-1									5	4		4	10
	4. <.5									2	1		1	7
47.	Percent Woodland Within 660' of Permanent Water	B							M	M	M			
	1. >75%								10	10	10		10	10
	2. 50 - 75% (Multiply Index by .75)								7	7	7		7	7
	3. 25 - 50% (Multiply Index by .50)								4	4	4		4	4
	4. <25% (Multiply Index by .25)								1	1	1		1	1
48.	Distance to Nearest Forest Wetland, Oxbow or Slough	B,C,G												
	1. <250' water predictable		10	10					10	10	10			
	2. 250'-1/8 mi. water predictable		10	10					10	10	5			
	3. 1/8-1 mi. water predictable		10	10					1	1	1			
	4. <250' water predictable 1 of 3 years		5	5					5	5	3			
	5. 250'-1/8 mi. water predictable 1 of 3 yrs.		5	5					5	5	2			
	6. 1/8-1 mi. water predictable 1 of 3 yrs.		5	5					1	1	1			
	7. >1 mi.; or <1 mi. water unpredictable		1	1					1	1	1			
49.	Distance to Bottomland Hardwoods	N,C												
	1. <1/4 mi. water predictable		10						5					
	2. 1/4-1/2 mi. water predictable		10						3					
	3. 1/2-1 mi. water predictable		8						1					
	4. <1/4 mi. water predictable 1 of 3 yrs.		6						5					
	5. 1/4-1/2 mi. water predictable 1 of 3 yrs.		6						3					
	6. 1/2-1 mi. water predictable 1 of 3 yrs.		4						1					
	7. >1 mi.; or <1 mi. water unpredictable		1						1					

N/A

Pool 69 B.

A-E2-10

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
50.	Distance to Cropland	N,B,G												
	1. <1/4 mi., unharvested or partially unharvested and water predictable		10	10										
	2. 1/4-1/2 mi. unharvested or partially unharvested and water predictable		8	8										
	3. 1/2-1 mi. unharvested or partially unharvested and water predictable		6	6										
	4. <1/4 mi., unharvested or partially unharvested and water predictable 1 of 3 years; or adjacent, unflooded with residues undisturbed		5	5										
	5. 1/4-1/2 mi. unharvested or partially unharvested and water predictable 1 of 3 years; or 1/4-1/2 mi. unflooded with residues and undisturbed		4	4										
	6. 1/2-1 mi. unharvested or partially unharvested and water predictable 1 of 3 yrs; or 1/2-1 mi. unflooded with residues undisturbed; or winter wheat		2	2										
	7. >1 mi. to any cropfield; or <1 mi. unflooded cropfield with residues disced or plowed		1	1										
51.	Distance to Grassland	N,C												
	1. <1/2 mi. with winter height <6" and field size >40 acres			10										
	2. 1/2-1 mi. with winter height <6" and field size >40 acres			7										
	3. <1 mi. with winter height <6" and field size <40 acres			4										
	4. >1 mi. to any grassland with winter height <6"; or grassland with winter height>6"			1										
52.	Distance to Stream or River (permanent flow or pools)	N,B												
	1. <1/4 mi.								10					
	2. 1/4 - 1/2 mi.								5					
	3. >1/2 mi.								1					
53.	Distance to Major River, Lake or Reservoir >100 Acres	N,C,G												
	1. <1 miles Missouri, Mississippi,			10										
	2. 1 - 5 miles Grand, St. Francis			7										
	3. 5 - 10 miles			4										
	4. >10 miles			1										
54.	Distance to FALL Canada Goose Concentration Area	N,C,G		M										
	1. <4 miles			10										
	2. 4 - 10 miles (Multiply Index by .75)			7										
	3. 10-25 miles (Multiply Index by .50)			4										
	4. >25 miles (Multiply Index by .25)			1										

NA

NA

Wetland Species Characteristic Matrix

	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
Total	48	57	60	39	63	49	50			63		
Maximum Possible	80	80	70	85	85	70	85			80		
HTSI	.60	.71	.86	.16	.74	.70	.59			.79		
Multiplier	.75	.75										
Revised HTSI	.45	.53										

N	85	105	70	85	85	70	85			80		
B	105						100	110	95		60	100
C	70	105										
P		80										

Abbreviations

C = cropfield, G = grassland, N = nonforest wetland, B = bottomland hardwoods,
LF = limiting factor, score Habitat Type Suitability Index (HTSI) as .1 if characteristic scores .1.
M = multiplier. Multiply HTSI by the appropriate value to calculate revised HTSI. Use lowest value if 2 multiplier values apply.

Limiting Factors	Character Number
Mallard - If Percent in Bottomland Hardwood and Nonforest Wetland or Fall Winter Water Conditions score 1, HTSI = .1.	3,4
Canada goose - If Percent in Nonforest Wetland or Fall Winter Water Conditions score 1, HTSI = .1.	2,4
Iesser yellowlegs - If Wetland Size, Water Regime or Percent Wetland Substrate score 1, HTSI = .1.	14,16,26
Green-backed heron - If Wetland Size Water or Regime HTSI = .1.	14,66
Wood duck - If Woodland Size Class or Number of Tree Cavities score 1, HTSI = .1.	38,45
Least bittern - If Emergent Vegetation Coverage, Wetland Size, or Water Regime Score 1, HTSI = .1.	12,14,16
American Coot - If Cattail and Bulrush Coverage, Wetland Size or Water Regime Score 1, HTSI = .1.	13,14,16
King Rail - If Sedge Canopy Coverage or Water Regime Score 1, HTSI = .1 Score 1, HTSI = .1.	23,16
Northern Parula - If Woodland Size Class	40
Prothonotary Warbler - If Woodland Size Class	40

Multiplier	
Mallard - Important Food Plant Coverage (Nonforest wetland)	17
Fall-Winter Flood Conditions	5
Canada goose - Distance to Major Canada Goose Winter Area	54
Important Food Plant Coverage (Nonforest wetland)	17
Fall-Winter Flood Conditions	5
Muskrat - Percent Permanent Water Entire Year	9
Wood duck - Percent Woodland Within 660' of Permanent Water	47
Beaver - Percent Woodland Within 660' of Permanent Water	47
Green-backed Heron - Percent Woodland Within 660' of Permanent Water	47
Prothonotary Warbler - Percent Forest Canopy Adjacent to or Over Permanent Water	43

ater Fowl Habitat Conditions w/ Pool A Dike - 3/89

- A slight increase in habitat quality due to managed water levels. - Allows ability to manipulate water levels to control vegetation, or to drawdown to manage for invertebrates - This would result in a 10% - 20% increase in Habitat Quality - HSI Future with - increase to .50 -

	Existing	Future w/o	Future w/project
mallard	.45	.45	.5

Pool A B

Wetland Species Characteristic Matrix

Wildlife Area: Pool C1

Date: _____

Habitat Type: N

CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
1. Percent Nonforest Wetlands in 2 Mile Wide Circle	N												
1. >75%				10	10	10	10				10		
2. 50 - 75%				8	8	8	8				8		
3. 25 - 50%				6	6	6	6				6		
4. 10 - 25%				4	4	4	4				4		
5. <10%				1	1	1	1				1		
2. Percent Nonforest Wetlands and Lakes or Reservoirs in 2 Mile Wide Circle	N,C,G												
1. >75%			10										
2. 50 - 75%			8										
3. 25 - 50%			6										
4. 10 - 25%			4										
5. <10%			LF										
3. Percent Bottomland Hardwoods and Nonforest Wetlands in 2 Mile Wide Circle	N,B,C												
1. >75%		10						10	10	10			
2. 50 - 75%		8						8	8	8			
3. 25 - 50%		6						6	6	6			
4. 10 - 25%		4						4	4	4			
5. <10%		LF						1	1	1			
4. Fall Winter Water Conditions	N,B,C												
1. Water present annually (predictable & water levels controlled		10	10										
2. Water present most years with occasional lapse & water levels controlled		7	7										
3. Water present 1 out of 3 years (opportunistic) & water levels controlled		4	4										
4. Water unpredictable; dry during fall and winter; or no control when present		LF	LF										
5. Fall-Winter Flood Conditions (food plant availability)	N,B	M	M										
1. Food plants unaffected		10	10										
2. Reduced 1 - 25% (Multiply index by .75)		8	8										
3. Reduced 25 - 50% (Multiply index by .50)		6	6										
4. Reduced 50 - 75% (Multiply index by .25)		[illegible]	[illegible]										
5. Reduced >75% (Multiply index by .25)		1	1										
6. Water Depth 4" - 18" Fall - Winter	N,B,C												
1. >90%		10	10										
2. 75 - 90%		8	8										
3. 50-75%		6	6										
4. 25 - 50%		4	4										
5. <25%		1	1										
7. Water Depth <4" During May	N												
1. >90%					10						IF		
2. 75 - 90%					8						2		
3. 25 - 75%					6						4		
4. 1 - 25%					4						7		
5. ZERO or all >4" Deep					1						10		
8. Water Depth 4 - 18" By August	N												
1. >75%		*		1		10	1	10			10		*
2. 50 - 75%				7		7	7	7			7		
3. 25 - 50%				10		4	10	4			4		
4. <25%				4		1	4	1			1		
9. Permanent Water Entire Year	N					M							
1. >90%						10							
2. 75 - 90% (Multiply index by .90)						8							
3. 50 - 75% (Multiply index by .75)						6							
4. 25 - 50% (Multiply index by .50)						4							
5. <25% (Multiply index by .25)						1							
10. Percent Emergent Vegetation Within 2 yds. of Water	N												
1. >75% of emer. veg. within 2 yd. of water				10							10		
2. 50-75% of emer. veg. within 2 yd. of water				7							7		
3. 25-50% of emer. veg. within 2 yd. of water			*	4							4		*
4. <25% of emer. veg. within 2 yd. of water				1							1		

- Existing Conditions = ⬭
- Future w/o Project = Existing Conditions or ⬭*
- Future w/ Project = Existing Condition or *⬭*

Pool 69 C1

A-E2-13

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
11.	Woody Invasion	N												
	1. <10%				10		5	6	1					
	2. 10 - 25%				8		4	8	6					
	3. 25 - 50%				6		3	10	8					
	4. 50 - 75%				4		2	4	10					
	5. >75%				1		1	1	4					
12.	Emergent Vegetation Coverage	N,B												
	1. >90%				6	LF			1					
	2. 75 - 90%				10	2			2					
	3. 50 - 75%				8	4			4					
	4. 25 - 50%				4	6			10					
	5. 10 - 25%				2	8			7					
	6. <10%				LF	10			1					
13.	Cattail and Bulrush Coverage	N												
	1. >75%						10	LF			8			
	2. 50 - 75%						8	2			10			
	3. 25 - 50%						6	4			6			
	4. 10 - 25%						4	7			4			
	5. <10%						1	10			LF			
14.	Wetland Size	N,B												
	1. >200 acres				10	10	10	10	10		10			
	2. 100 - 200 acres				10	8	8	8	10		10			
	3. 50 - 100 acres				8	6	6	6	10		8			
	4. 25 - 50 acres				6	4	4	4	10		6			
	5. 5 - 25 acres				4	1	2	2	5		4			
	6. <5 acres				LF	LF	1	1	LF		LF			
15.	Wetland Edge	N,B												
	1. >75% Bottomland H. - % adj. to water								10					
	2. 50-75% Nonforest w.-% woody or adj. to								8					
	3. 25 - 50% bottomland hardwoods								6					
	4. 10 - 25%								4					
	5. <10%								1					
16.	Water Regime	N												
	1. Gradual drying with >75% water remaining by Aug. 1				4	4	8	2	10		8			
	2. Gradual drying with 50 - 75% water remaining by Aug. 1				6	6	6	6	6		6			
	3. Gradual drying with 25 - 50% water remaining by Aug. 1				10	10	4	10	4		4			
	4. Gradual drying with <25% water remaining by Aug. 1				8	8	2	8	2		2			
	5. Stable water				2	4	10	4	10		10			
	6. Rapid drying; or no water after June 1				LF	LF	LF	LF	LF		LF			
17.	Important Food Plant Coverage	N,B	M	M										
	1. >75%		10	10										
	2. 50 - 75% (Multiply index by .75)		8	8										
	3. 25 - 50% (Multiply index by .50)		6	6										
	4. 10 - 25% (Multiply index by .25)		4	4										
	5. <10% (Multiply index by .25)		1	1										
18.	Plant Diversity	N,B												
	1. >7		5	5										
	2. 4 - 7		3	3										
	3. <4		1	1										
19.	Persistent Emergent and Woody Vegetation Coverage	N												
	1. 5 - 15%			5										
	2. 15 - 25%			4										
	3. [illegible]			2										
	4. <5% or >50%		1	1										

N A

Pool 66 <1

A-E2-14

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
20.	Substrate - Surface Water Interspersion	N												
	1. Substrate interspersed with shallow water					10								
	2. Shallow water occurring as one or few pools					1								
21.	Percent Open Water	N												
	1. <10%		5	5			10					6		
	2. 10 - 25%		3	3			8					10		
	3. 25 - 50%		1	1			6					8		
	4. 50 - 90%		1	1			4					4		
	5. >90%		1	1			1					1		
22.	Winter Water Depth (Oct. - March)	N												
	1. 15 - 24"						10							
	2. 10 - 15" or 24 - 30"						7							
	3. 6 - 10" or 30 - 36"						4							
	4. <6" or >36"						1							
23.	Sedge Canopy Coverage	N												
	1. >90%							8						
	2. 75 - 90%							10						
	3. 50 - 75%							6						
	4. 25 - 50%							4						
	5. 1 - 25%							2						
	6. Zero							LF						
24.	Wetland Substrate	N												
	1. Mucky					5								
	2. Sandy					3								
	3. Gravel					1								
25.	Percent Soil Waterlogged Substrate During May	N												
	1. >90% of substrate waterlogged					10								
	2. 75 - 90% of substrate waterlogged					8								
	3. 50 - 75% of substrate waterlogged					6								
	4. 25 - 50% of substrate waterlogged					4								
	5. <25% of substrate waterlogged					1								
26.	Percent Exposed Wetland Substrate and 1-4" Shallow Water Covered by Vegetation May-June	N												
	1. <10%					10								
	2. 10 - 25%					8								
	3. 25 - 50%					6								
	4. 50 - 75%					4								
	5. 75 - 90%					2								
	6. >90%					LF								
27.	Percent Channel with Aquatic Vegetation	B												
	1. >10%									10	10			
	2. 5 - 10%									7	7			
	3. 1 - [illegible]									[illegible]	[illegible]			
	4. None; or 1/4 mi. from center stand									1	1			
28.	Average Water Fluctuation in Channel	B												
	1. Bank full <3 times per year										10			
	2. Bank full 3-5 times per year										7			
	3. Bank full [illegible] times per year										[illegible]			
	4. Bank full >7 times per year; or >1/4 mile from [illegible]										1			
29.	Cropfield Management	C												
	1. No fall tillage		10	10										
	2. Winter Wheat		2	10										
	3. Chisel plowing		8	8										
	4. Chopped [illegible]		6	6										
	5. Fall disc		4	4										
	6. Fall moldboard		1	1										

NA

NA

NA

Pool 67 C1

A-E2-15

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
30.	Cropping Practice	C												
	1. >50 unharvested		10	10										
	2. 25-50% harvested		7	7										
	3. 10 - 25% unharvested		4	4										
	4. <10% unharvested		1	1										
31.	Crop Rotation	C												
	1. SG - RC - C			5										
	2. SG - RC or idle some years			3										
	3. Continuous SG or RC			1										
32.	Field Size (% w/in 660' Woodland or Treeline)	C,G												
	1. <25%			10										
	2. 25 - 50%			6										
	3. 50 - 75%			3										
	4. >75%			1										
33.	Grassland Composition	G												
	1. Bluegrass, clover, alfalfa			10										
	2. Timothy, orchardgrass or mixed CSG			5										
	3. Fescue or WSG			1										
34.	Average Height Herbaceous Vegetation (Fall)	G												
	1. <6"			10										
	2. >6"			1										
35.	Woodland Tree Species	B												
	1. >50% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash		1							8	10			
	2. 25 - 50% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash		4							10	8			
	3. >25% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash; or <25% pin oak (or other small acorns)		6							1	6			
	4. 25 - 50% pin oak (or other small acorns)		8							4	4			
	5. >50% pin oak (or other small acorns)		10							6	1			
36.	Permanent Water Within Woodland	B												
	1. >25%		1						10	10				10
	2. 10 - 25%		3						7	7				7
	3. 5 - 10%		5						4	4				4
	4. 1 - 5%		3						2	2				2
	5. Zero		2						1	1				1
37.	Forest Openings (<2 ac. in size)													
	1. 15 - 30% scattered		1						10	10	5			
	2. 15 - 30% one or few		3						7	7	4			
	3. 5 - 15%		5						4	4				
	4. <5% or >30%		1						1	1	1			
38.	Woodland Size Class	B												
	1. Sawtimber - open canopy		10						4	10	4	10	10	
	2. Sawtimber - close canopy		8							8	1	10	10	
	3. Pole with 25-50% sawtimber		6						10	6	6	7	7	
	4. Regeneration with 25-50% sawtimber		4						8	4	8	2	2	
	5. Regeneration		1						8	LF	10	LF	LF	
	6. Pole		1						6	2	6	4	4	
39.	Percent Canopy From Old Growth (>16" dbh)	B												
	1. >25%									10	1			
	2. 10 - 25%									8	4			
	3. 5 - 10%									6	6			
	4. 1 - 5%									4	8			
	5. Zero									1	10			

Pool 68-C1

A-E2-16

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
40.	Woodland Overstory Canopy Height (feet)	B												
	1. >80'												10	10
	2. 65-80'												7	7
	3. 40-65'												4	4
	4. <40'												1	1
41.	Percent Subcanopy Closure	B												
	1. >75%												10	1
	2. 50-75%												7	4
	3. 25-50%												4	10
	4. <25%												1	7
42.	Woodland (Stand) Size													
	1. <25%												10	10
	2. 25-50%												7	7
	3. 50-75%												4	4
	4. >75%												1	1
43.	Percent Forest Canopy Adjacent to or Over Permanent Water													M
	1. >25%													10
	2. 10-25%													7
	3. 5-10%													4
	4. <5%													1
44.	Number of Snags Trees per Acre	B												
	1. >4									5				10
	2. 3									5				7
	3. 2									3				4
	4. <1									1				1
45.	Number of Cavity Trees Per Acre	B												
	1. >9									10				10
	2. 3 - 9									7				7
	3. 1 - 3									4				4
	4. None									LF				1
46.	Stems per Square Yard of Shrub and Tree Regeneration >3 Feet Tall													
	1. >3									1	10			1
	2. 1-3									3	7			4
	3. .5-1									5	4			10
	4. <.5									2	1			7
47.	Percent Woodland Within 660' of Permanent Water	B							M	M	M			
	1. >75%								10	10	10		10	10
	2. 50 - 75% (Multiply Index by .75)								7	7	7		7	7
	3. 25 - 50% (Multiply Index by .50)								4	4	4		4	4
	4. <25% (Multiply Index by .25)								1	1	1		1	1
48.	Distance to Nonforest Wetland, Oxbow or Slough	B,C,G												
	1. <250' water predictable		10	10						10	10			
	2. 250'-1/8 mi. water predictable		10	10						10	5			
	3. 1/8-1 mi. water predictable		10	10						1	1			
	4. <250' water predictable 1 of 3 years		5	5						5	3			
	5. 250'-1/8 mi. water predictable 1 of 3 yrs.		5	5						5	2			
	6. 1/8-1 mi. water predictable 1 of 3 yrs.		5	5						1	1			
	7. >1 mi.; or <1 mi. water unpredictable		1	1						1	1			
49.	Distance to Bottomland Hardwoods	N,C												
	1. <1/4 mi. water predictable		10							5				
	2. 1/4-1/2 mi. water predictable		10							3				
	3. 1/2-1 mi. water predictable		8							1				
	4. <1/4 mi. water predictable 1 of 3 yrs.		6							5				
	5. 1/4-1/2 mi. water predictable 1 of 3 yrs.		6							3				
	6. 1/2-1 mi. water predictable 1 of 3 yrs.		4							1				
	7. >1 mi.; or <1 mi. water unpredictable		1							1				

N.A.

Pool 69 C1

A-E2-17

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
50.	Distance to Cropland	N,B,G												
	1. <1/4 mi., unharvested or partially unharvested and water predictable		10	10										
	2. 1/4-1/2 mi. unharvested or partially unharvested and water predictable		8	8										
	3. 1/2-1 mi. unharvested or partially unharvested and water predictable		6	6										
	4. <1/4 mi., unharvested or partially unharvested and water predictable 1 of 3 years; or adjacent, unflooded with residues undisturbed		5	5										
	5. 1/4-1/2 mi. unharvested or partially unharvested and water predictable 1 of 3 years; or 1/4-1/2 mi. unflooded with residues and undisturbed		4	4										
	6. 1/2-1 mi. unharvested or partially unharvested and water predictable 1 of 3 yrs; or 1/2-1 mi. unflooded with residues undisturbed; or winter wheat		2	2										
	7. >1 mi. to any cropfield; or <1 mi. unflooded cropfield with residues disced or plowed		1	1										
51.	Distance to Grassland	N,C												
	1. <1/2 mi. with winter height <6" and field size >40 acres			10										
	2. 1/2-1 mi. with winter height <6" and field size >40 acres			7										
	3. <1 mi. with winter height <6" and field size <40 acres			4										
	4. >1 mi. to any grassland with winter height <6"; or grassland with winter height>6"			1										
52.	Distance to Stream or River (permanent flow or pools)	N,B												
	1. <1/4 mi.								10					
	2. 1/4 - 1/2 mi.								5					
	3. >1/2 mi.								1					
53.	Distance to Major River, Lake or Reservoir >100 Acres	N,C,G												
	1. <1 miles Missouri, Mississippi,			10										
	2. 1 - 5 miles Grand, St. Francis			7										
	3. 5 - 10 miles			4										
	4. >10 miles			1										
54.	Distance to FALL Canada Goose Concentration Area	N,C,G		M										
	1. <4 miles			10										
	2. 4 - 10 miles (Multiply Index by .75)			7										
	3. 10 - 25 miles (Multiply Index by .50)			4										
	4. >25 miles (Multiply Index by .25)			1										

Pool 7θ c l

Wetland Species Characteristic Matrix

	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
Total Maximum Possible	80	80	70	85	85	70	85			80		
HTSI												
Multiplier												
Revised HTSI												
N	80	105	70	85	85	70	85			80		
B	105						100	110	95		60	100
C	70	105										
P		80										

Abbreviations

C = cropfield, G = grassland, N = nonforest wetland, B = bottomland hardwoods,
LF = limiting factor, score Habitat Type Suitability Index (HTSI) as .1 if characteristic scores .1.
M = multiplier. Multiply HTSI by the appropriate value to calculate revised HTSI. Use lowest value if 2 multiplier values apply.

Limiting Factors	Character Number
Mallard - If Percent in Bottomland Hardwood and Nonforest Wetland or Fall Winter Water Conditions score 1, HTSI = .1.	3,4
Canada goose - If Percent in Nonforest Wetland or Fall Winter Water Conditions score 1, HTSI = .1.	2,4
Lesser yellowlegs - If Wetland Size, Water Regime or Percent Wetland Substrate score 1, HTSI = .1.	14,16,26
Green-backed heron - If Wetland Size Water or Regime HTSI = .1.	14,66
Wood duck - If Woodland Size Class or Number of Tree Cavities score 1, HTSI = .1.	38,45
Least bittern - If Emergent Vegetation Coverage, Wetland Size, or Water Regime Score 1, HTSI = .1.	12,14,16
American Coot - If Cattail and Bulrush Coverage, Wetland Size or Water Regime Score 1, HTSI = .1.	13,14,16
King Rail - If Sedge Canopy Coverage or Water Regime Score 1, HTSI = .1 Score 1, HTSI = .1.	23,16
Northern Parula - If Woodland Size Class	40
Prothonotary Warbler - If Woodland Size Class	40

Multiplier	
Mallard - Important Food Plant Coverage (Nonforest wetland)	17
Fall-Winter Flood Conditions	5
Canada goose - Distance to Major Canada Goose Winter Area	54
Important Food Plant Coverage (Nonforest wetland)	17
Fall-Winter Flood Conditions	5
Muskrat - Percent Permanent Water Entire Year	9
Wood duck - Percent Woodland Within 660' of Permanent Water	47
Beaver - Percent Woodland Within 660' of Permanent Water	47
Green-backed Heron - Percent Woodland Within 660' of Permanent Water	47
Prothonotary Warbler - Percent Forest Canopy Adjacent to or Over Permanent Water	43

	PRESENT		FWO		FW	
	PTS	HSI	PTS	HSI	PTS	HSI
Mallard	59	.55	57	.36	63	.59
C. Goose	56	.53	54	.34	60	.56
L. Bittern	49	.70	49	.70	47	.67
L. Yellowlegs		.10		.10		.10
Muskrat	67	.79	67	.79	70	.82
King Rail	49	.70	49	.70	46	.66
G-B Heron	50	.59	50	.59	55	.65
A. Coot	50	.63	50	.63	56	.70

3/89

Wetland Species Characteristic Matrix

Wildlife Area: Pool E2

Date: _____

Habitat Type: N

CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
1. Percent Nonforest Wetlands in 2 Mile Wide Circle	N												
1. >75%				10	10	10	10				10		
2. 50 - 75%				8	8	8	8				8		
3. 25 - 50%				6	6	6	6				6		
4. 10 - 25%				4	4	4	4				4		
5. <10%				1	1	1	1				1		
2. Percent Nonforest Wetlands and Lakes or Reservoirs in 2 Mile Wide Circle	N,C,G												
1. >75%			10										
2. 50 - 75%			8										
3. 25 - 50%			6										
4. 10 - 25%			4										
5. <10%			LF										
3. Percent Bottomland Hardwoods and Nonforest Wetlands in 2 Mile Wide Circle	N,B,C												
1. >75%		10						10	10	10			
2. 50 - 75%		8						8	8	8			
3. 25 - 50%		6						6	6	6			
4. 10 - 25%		4						4	4	4			
5. <10%		LF						1	1	1			
4. Fall Winter Water Conditions	N,B,C												
1. Water present annually (predictable & water levels controlled		10	10										
2. Water present most years with occasional lapse & water levels controlled		7	7										
3. Water present 1 out of 3 years (opportunistic) & water levels controlled		4	4										
4. Water unpredictable; dry during fall and winter; or no control when present		LF	LF										
5. Fall-Winter Flood Conditions (food plant availability)	N,B	M	M										
1. Food plants unaffected		10	10										
2. Reduced 1 - 25% (Multiply index by .75)		8	8										
3. Reduced 25 - 50% (Multiply index by .50)		6	6										
4. Reduced 50 - 75% (Multiply index by .25)		4	4										
5. Reduced >75% (Multiply index by .25)		1	1										
6. Water Depth 4" - 18" Fall - Winter	N,B,C												
1. >90%		10	10										
2. 75 - 90%		8	8										
3. 50-75%		6	6										
4. 25 - 50%		4	4										
5. <25%		1	1										
7. Water Depth <4" During May	N												
1. >90%					10						LF		
2. 75 - 90%					8						2		
3. 25 - 75%					6						4		
4. 1 - 25%					4						7		
5. ZERO or all >4" Deep					1						10		
8. Water Depth 4 - 18" By August	N												
1. >75%				1		10	1	10			10		
2. 50 - 75%				7		7	7	7			7		
3. 25 - 50%				10		4	10	4			4		
4. <25%				4		1	4	1			1		
9. Permanent Water Entire Year	N					M							
1. >90%						10							
2. 75 - 90% (Multiply index by .90)						8							
3. 50 - 75% (Multiply index by .75)						6							
4. 25 - 50% (Multiply index by .50)						4							
5. <25% (Multiply index by .25)						1							
10. Percent Emergent Vegetation Within 2 yds. of Water	N												
1. >75% of emer. veg. within 2 yd. of water				10							10		
2. 50-75% of emer. veg. within 2 yd. of water				7							7		
3. 25-50% of emer. veg. within 2 yd. of water				4							4		
4. <25% of emer. veg. within 2 yd. of water													

- Existing Conditions = ○
- Future w/o Project = Existing Conditions or ○*
- Future w/ Project = Existing Conditions or *○*

Pool ~~65~~ E2

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
11.	Woody Invasion	N												
	1. <10%				10		5	6	1					
	2. 10 - 25%				8		4	8	6					
	3. 25 - 50%				8		3	10	8					
	4. 50 - 75%				4		2	4	10					
	5. >75%				1		1	1	4					
12.	Emergent Vegetation Coverage	N,B												
	1. >90%				6	LF			1					
	2. 75 - 90%				10	2			2					
	3. 50 - 75%				8	4			4					
	4. 25 - 50%				4	6			10					
	5. 10 - 25%				2	8			7					
	6. <10%				LF	10			1					
13.	Cattail and Bulrush Coverage	N												
	1. >75%						10	LF				8		
	2. 50 - 75%						8	2				10		
	3. 25 - 50%						6	4				6		
	4. 10 - 25%						4	7				4		
	5. <10%						1	10				LF		
14.	Wetland Size	N,B												
	1. >200 acres				10	10	10	10	10			10		
	2. 100 - 200 acres				10	8	8	8	10			10		
	3. 50 - 100 acres				8	6	6	6	10			8		
	4. 25 - 50 acres				6	4	4	4	10			6		
	5. 5 - 25 acres				4	1	2	2	5			4		
	6. <5 acres				LF	LF	1	1	LF			LF		
15.	Wetland Edge	N,B												
	1. >75% Bottomland H. - % adj. to water								10					
	2. 50-75% Nonforest w.-% woody or adj. to								8					
	3. 25 - 50% bottomland hardwoods								6					
	4. 10 - 25%								4					
	5. <10%								1					
16.	Water Regime	N												
	1. Gradual drying with >75% water remaining by Aug. 1				4	4	8	2	10			8		
	2. Gradual drying with 50 - 75% water remaining by Aug. 1				6	6	6	6	6			6		
	3. Gradual drying with 25 - 50% water remaining by Aug. 1				10	10	4	10	4			4		
	4. Gradual drying with <25% water remaining by Aug. 1				8	8	2	8	2			2		
	5. Stable water				2	4	10	4	10			10		
	6. Rapid drying; or no water after June 1				LF	LF	LF	LF	LF			LF		
17.	Important Food Plant Coverage	N,B	M	M										
	1. >75%		10	10										
	2. 50 - 75% (Multiply index by .75)		8	8										
	3. 25 - 50% (Multiply index by .50)		6	6										
	4. 10 - 25% (Multiply index by .25)		4	4										
	5. <10% (Multiply index by .25)		1	1										
18.	Plant Diversity	N,B												
	1. >7		5	5										
	2. 4 - 7		3	3										
	3. <4		1	1										
19.	Persistent Emergent and Woody Vegetation Coverage													
	1. 5 - 15%		5	5										
	2. [illegible]		[illegible]	[illegible]										
	3. 25 - 50%		2	2										
	4. <5% or >50%		1	1										

N.A.

Pro1 ~~66~~ E2

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
20.	Substrate - Surface Water Interspersion	N												
	1. Substrate interspersed with shallow water					10								
	2. Shallow water occurring as one or few pools					1								
21.	Percent Open Water	N												
	1. <10%		5	5		10						6		
	2. 10 - 25%		3	3		8						10		
	3. 25 - 50%		1	1		6						8		
	4. 50 - 90%		1	1		4						4		
	5. >90%		1	1		1						1		
22.	Winter Water Depth (Oct. - March)	N												
	1. 15 - 24"						10							
	2. 10 - 15" or 24 - 30"						7							
	3. 6 - 10" or 30 - 36"						4							
	4. <6" or >36"						1							
23.	Sedge Canopy Coverage	N												
	1. >90%							8						
	2. 75 - 90%							10						
	3. 50 - 75%							6						
	4. 25 - 50%							4						
	5. 1 - 25%							2						
	6. Zero							LF						
24.	Wetland Substrate	N												
	1. Mucky					5								
	2. Sandy					3								
	3. Gravel					1								
25.	Percent Soil Waterlogged Substrate During May	N												
	1. >90% of substrate waterlogged					10								
	2. 75 - 90% of substrate waterlogged					8								
	3. 50 - 75% of substrate waterlogged					6								
	4. 25 - 50% of substrate waterlogged					4								
	5. <25% of substrate waterlogged					1								
26.	Percent Exposed Wetland Substrate and 1-4" Shallow Water Covered by Vegetation May-June	N												
	1. <10%					10								
	2. 10 - 25%					8								
	3. 25 - 50%					6								
	4. 50 - 75%					4								
	5. 75 - 90%					2								
	6. >90%					LF								
27.	Percent Channel with Aquatic Vegetation	B												
	1. >10%								10	10				
	2. 5 - 10%								7	7				
	3. 1 - 5%								4	4				
	4. None; or 1/4 mi. from cen[illegible] stand								1					
28.	Average Water Fluctuation in Channel	B												
	1. Bank full <3 times per year										10			
	2. Bank full 3-5 times per year										7			
	3. Bank full 5-7 times per year										4			
	4. Bank full >7 times per year; or >1/4 mi. from channel										1			
29.	Cropfield Management	C												
	1. No fall tillage		10	10										
	2. Winter wheat		2	10										
	3. Chisel plowing		8	8										
	4. Chopped, baled, grazed		6	6										
	5. Fall disc			4										
	6. Fall moldboard		1	1										

NA

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
30.	Cropping Practice	C												
	1. >50 unharvested		10	10										
	2. 25-50% harvested		7	7										
	3. 10 - 25% unharvested		4	4										
	4. <10% unharvested		1	1										
31.	Crop Rotation	C												
	1. SG & RC - L			5										
	2. SG - RC; or idle some years			3										
	3. Continuous SG or RC			1										
32.	Field Size (% w/in 660' Woodland or Treeline)	C,G												
	1. <25%			10										
	2. 25 - 50%			6										
	3. 50 - 75%			3										
	4. >75%			1										
33.	Grassland Composition	G												
	1. Bluegrass, clover, alfalfa			10										
	2. Timothy, orchardgrass or mixed CSG			5										
	3. Fescue or WSG			1										
34.	Average Height Herbaceous Vegetation (Fall)	G												
	1. <6"			10										
	2. >6"			1										
35.	Woodland Tree Species	B												
	1. >50% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash		1							8	10			
	2. 25 - 50% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash		4							10	8			
	3. <25% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash or <25% pin oak (or other small acorns)		6							1	6			
	4. 25 - 50% pin oak (or other small acorns)		8							4	4			
	5. >50% pin oak (or other small acorns)		10							6	1			
36.	Permanent Water Within Woodland	B												
	1. >25%		1						10	10				10
	2. 10 - 25%		3						7	7				7
	3. 5 - 10%		5						4	4				4
	4. 1 - 5%		3						2	2				2
	5. Zero		2						1	1				1
37.	Forest Openings (<2 ac. in size)	B												
	1. 15 - 30% scattered		1						10	10	5			
	2. 15 - 30% one or few		3						7	7	4			
	3. 5 - 15%		5						4	4	3			
	4. <5% or >30%		1						1	1				
38.	Woodland Size Class	B												
	1. Sawtimber - open canopy		10						4	10	4	10	10	
	2. Sawtimber - close canopy		8						1	8	1	10	10	
	3. Pole with 25-50% sawtimber		6						1	6	6	7	7	
	4. Regeneration with 25-50% sawtimber		4						8	4	8	2	2	
	5. Regeneration		1						8	LF	10	LF	LF	
	6. Pole		1						6	2	6	4	4	
39.	Percent Canopy From Old Growth (>16" dbh)	B												
	1. >25%									10	1			
	2. 10 - 25%									8	4			
	3. 5 - 10%									6	6			
	4. 1 - 5%									4	8			
	5. Zero									1	10			

Pool ~~68~~ E2

A-E2-23

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
40.	Woodland Overstory Canopy Height (feet)	B												
	1. >80'												10	10
	2. 65-80'												7	7
	3. 40-65'												4	4
	4. <40'												1	1
41.	Percent Subcanopy Closure	B												
	1. >75%												10	1
	2. 50-75%												7	4
	3. 25-50%												4	10
	4. <25%												1	7
42.	Woodland (Stand) Size													
	1. <25%												10	10
	2. 25-50%												7	7
	3. 50-75%												4	4
	4. >75%												1	1
43.	Percent Forest Canopy Adjacent to or Over Permanent Water	B												M
	1. >25%													10
	2. 10-25%													7
	3. 5-10%													4
	4. <5%													1
44.	Number of Snags Trees per Acre	B												
	1. >4									5				10
	2. 3-4									5				7
	3. 1-2									3				4
	4. <1									1				1
45.	Number of Cavity Trees Per Acre	B												
	1. >9									10				10
	2. 3 - 9									7				7
	3. 1 - 3									4				4
	4. None									LF				1
46.	Stems per Square Yard of Shrub and Tree Regeneration >3 Feet Tall													
	1. >3									1	10			1
	2. 1-3									3	7			4
	3. .5-1									5	4		4	10
	4. <.5									2	1		1	7
47.	Percent Woodland Within 660' of Permanent Water	B							M	M	M			
	1. >75%								10	10	10		10	10
	2. 50 - 75% (Multiply Index by .75)								7	7	7		7	7
	3. 25 - 50% (Multiply Index by .50)								4	4	4		4	4
	4. <25% (Multiply Index by .25)								1	1	1		1	1
48.	Distance to Nonforest Wetland, Oxbow or Slough	B,C,G												
	1. <250' water predictable		10	10					10	10	10			
	2. 250'-1/8 mi. water predictable		10	10					10	10	5			
	3. 1/8-1 mi. water predictable		10	10					1	1	1			
	4. <250' water predictable 1 of 3 years		5	5					5	5	3			
	5. 250'-1/8 mi. water predictable 1 of 3 yrs.		5	5					5	5	2			
	6. 1/8-1 mi. water predictable 1 of 3 yrs.		5	5					1	1	1			
	7. >1 mi.; or <1 mi. water unpredictable		1	1					1	1	1			
49.	Distance to Bottomland Hardwoods	N,C												
	1. <1/4 mi. water predictable		10						5					
	2. 1/4-1/2 mi. water predictable		10						3					
	3. 1/2-1 mi. water predictable		8						1					
	4. <1/4 mi. water predictable 1 of 3 yrs.		6						5					
	5. 1/4-1/2 mi. water predictable 1 of 3 yrs.		6						3					
	6. 1/2-1 mi. water predictable 1 of 3 yrs.		4						1					
	7. >1 mi.; or <1 mi. water unpredictable		1						1					

N.A.

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
50.	Distance to Cropland	N,B,G												
	1. <1/4 mi., unharvested or partially unharvested and water predictable		10	10										
	2. 1/4-1/2 mi. unharvested or partially unharvested and water predictable		8	8										
	3. 1/2-1 mi. unharvested or partially unharvested and water predictable		6	6										
	4. <1/4 mi., unharvested or partially unharvested and water predictable 1 of 3 years; or adjacent, unflooded with residues undisturbed		5	5										
	5. 1/4-1/2 mi. unharvested or partially unharvested and water predictable 1 of 3 years; or 1/4-1/2 mi. unflooded with residues and undisturbed		4	4										
	6. 1/2-1 mi. unharvested or partially unharvested and water predictable 1 of 3 yrs; or 1/2-1 mi. unflooded with residues undisturbed; or winter wheat		2	2										
	7. >1 mi. to any cropfield; or <1 mi. unflooded cropfield with residues disced or plowed		1	1										
51.	Distance to Grassland	N,C												
	1. <1/2 mi. with winter height <6" and field size >40 acres			10										
	2. 1/2-1 mi. with winter height <6" and field size >40 acres			7										
	3. <1 mi. with winter height <6" and field size <40 acres			4										
	4. >1 mi. to any grassland with winter height <6"; or grassland with winter height>6"			1										
52.	Distance to Stream or River (permanent flow or pools)	N,B												
	1. <1/4 mi.								10					
	2. 1/4 - 1/2 mi.								5					
	3. >1/2 mi.								1					
53.	Distance to Major River, Lake or Reservoir >100 Acres	N,C,G												
	1. <1 miles Missouri, Mississippi,			10										
	2. 1 - 5 miles Grand, St. Francis			7										
	3. 5 - 10 miles			4										
	4. >10 miles			1										
54.	Distance to FALL Canada Goose Concentration Area	N,C,G		M										
	1. <4 miles			10										
	2. 4 - 10 miles (Multiply Index by .75)			7										
	3. 10 - 25 miles (Multiply Index by .50)													
	4. >25 miles (Multiply Index by .25)			1										

N.A.

N.A

Pool 70 E2

Wetland Species Characteristic Matrix

	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
Total												
Maximum Possible												
HTSI												
Multiplier												
Revised HTSI												
N	~~95~~ ~~105~~	70	85	85	70	85			80			
B	105						100	110	95		60	100
C	70	105										
P		80										

Abbreviations

C = cropfield, G = grassland, N = nonforest wetland, B = bottomland hardwoods,
LF - limiting factor, score Habitat Type Suitability Index (HTSI) as .1 if characteristic scores .1.
M = multiplier. Multiply HTSI by the appropriate value to calculate revised HTSI. Use lowest value if 2 multiplier values apply.

Limiting Factors

	Character Number
Mallard - If Percent in Bottomland Hardwood and Nonforest Wetland or Fall Winter Water Conditions score 1, HTSI = .1.	3,4
Canada goose - If Percent in Nonforest Wetland or Fall Winter Water Conditions score 1, HTSI = .1.	2,4
lesser yellowlegs - If Wetland Size, Water Regime or Percent Wetland Substrate score 1, HTSI = .1.	14,16,26
Green-backed heron - If Wetland Size Water or Regime HTSI = .1.	14,66
Wood duck - If Woodland Size Class or Number of Tree Cavities score 1, HTSI = .1.	38,45
Least bittern - If Emergent Vegetation Coverage, Wetland Size, or Water Regime Score 1, HTSI = .1.	12,14,16
American Coot - If Cattail and Bulrush Coverage, Wetland Size or Water Regime Score 1, HTSI = .1.	13,14,16
King Rail - If Sedge Canopy Coverage or Water Regime Score 1, HTSI = .1 Score 1, HTSI = .1.	23,16
Northern Parula - If Woodland Size Class	40
Prothonotary Warbler - If Woodland Size Class	40

Multiplier

Mallard - Important Food Plant Coverage (Nonforest wetland)	17
Fall-Winter Flood Conditions	5
Canada goose - Distance to Major Canada Goose Winter Area	54
Important Food Plant Coverage (Nonforest wetland)	17
Fall-Winter Flood Conditions	5
Muskrat - Percent Permanent Water Entire Year	9
Wood duck - Percent Woodland Within 660' of Permanent Water	47
Beaver - Percent Woodland Within 660' of Permanent Water	47
Green-backed Heron - Percent Woodland Within 660' of Permanent Water	47
Prothonotary Warbler - Percent Forest Canopy Adjacent to or Over Permanent Water	43

	PRESENT		IWO		FW	
	PTS	HSI	PTS	HSI	PTS	HSI
MALLARD	56	.35	56	.35	60	.56
C. GOOSE	55	.34	55	.34	59	.55
L. Bittern	49	.70	45	.64	57	.73
L. Yellowlegs		.10		.10		.10
Muskrat	67	.71	64	.68	68	.72
King Rail	46	.66	57	.73	41	.59
G-B HERON	43	.51	47	.55	46	.54
A. COOT	52	.65	50	.63	56	.70

3/89

Pool - E2

Wetland Species Characteristic Matrix

Wildlife Area: Pool C-2

Date: _____

Habitat Type: N

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
1.	Percent Nonforest Wetlands in 2 Mile Wide Circle	N												
	1. >75%				10	10	10	10				10		
	2. 50 - 75%				8	8	8	8				8		
	3. 25 - 50%				6	6	6	6				6		
	4. 10 - 25%				4	4	4	4				4		
	5. <10%				1	1	1	1				1		
2.	Percent Nonforest Wetlands and Lakes or Reservoirs in 2 Mile Wide Circle	C,G												
	1. >75%			10										
	2. 50 - 75%			8										
	3. 25 - 50%			6										
	4. 10 - 25%			4										
	5. <10%			LF										
3.	Percent Bottomland Hardwoods and Nonforest Wetlands in 2 Mile Wide Circle	N,B,C												
	1. >75%		10						10	10	10			
	2. 50 - 75%		8						8	8	8			
	3. 25 - 50%		6						6	6	6			
	4. 10 - 25%		4						4	4	4			
	5. <10%		LF						1	1	1			
4.	Fall Winter Water Conditions	N,B,C												
	1. Water present annually (predictable & water levels controlled		10	10										
	2. Water present most years with occasional lapse & water levels controlled		7	7										
	3. Water present 1 out of 3 years (opportunistic) & water levels controlled		4	4										
	4. Water unpredictable; dry during fall and winter; or no control when present		LF	LF										
5.	Fall-Winter Flood Conditions (food plant availability)	N,B	M	M										
	1. Food plants unaffected		10	10										
	2. Reduced 1 - 25% (Multiply index by .75)		8	8										
	3. Reduced 25 - 50% (Multiply index by .50)		6	6										
	4. Reduced 50 - 75% (Multiply index by .25)		4	4										
	5. Reduced >75% (Multiply index by .25)		1	1										
6.	Water Depth 4" - 18" Fall - Winter	N,B,C												
	1. >90%		10	10										
	2. 75 - 90%		8	8										
	3. 50-75%		6	6										
	4. 25 - 50%		4	4										
	5. <25%		1	1										
7.	Water Depth <4" During May	N												
	1. >90%					10						LF		
	2. 75 - 90%					8						2		
	3. 25 - 75%					6						4		
	4. 1 - 25%					4						7		
	5. ZERO or all >4" Deep					1						10		
8.	Water Depth 4 - 18" By August	N												
	1. >75%			1			10		10			10		
	2. 50 - 75%			7			7	7	7			7		
	3. 25 - 50%			10			4	10	4			4		
	4. <25%			4			1	4	1			1		
9.	Permanent Water Entire Year						M							
	1. >90%						10							
	2. 75 - 90% (Multiply index by .90)						8							
	3. 50 - 75% (Multiply index by .75)						6							
	4. [illegible] (Multiply index by .50)						4							
	5. <25% (Multiply index by .25)						1							
10.	Percent Emergent Vegetation Within 2 yds. of Water	N												
	1. >75% of emer. veg. within 2 yd. of water			10								10		
	2. 50-75% of emer. veg. within 2 yd. of water			7								7		
	3. 25-50% of emer. veg. within 2 yd. of water			4								4		
	4. <25% of emer. veg. within 2 yd. of water			1								1		

N.A

N.A

- EXISTING CONDITIONS = O
- FUTURE W/O PROJECT = EXISTING CONDITIONS
- FUTURE W/PROJECT = EXISTING CONDITIONS or ★O★

Pool ~~65~~ C-2

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
(11)	Woody Invasion	N												
	1. <10%				10		5	6	1					
	2. 10 - 25%				8		4	8	6					
	3. 25 - 50%				6		3	10	8					
	4. 50 - 75%				4		2	4	10					
	5. >75%				1		1	1	4					
(12)	Emergent Vegetation Coverage	N,B												
	1. >90%				6	LF			1					
	2. 75 - 90%				10	2			2					
	3. 50 - 75%				8	4			4					
	4. 25 - 50%				4	6			10					
	5. 10 - 25%				2	8			7					
	6. <10%				LF	10			1					
13.	Cattail and Bulrush Coverage	N												
	1. >75%						10	LF				8		
	2. 50 - 75%						8	2				10		
	3. [illegible]			N.A										
	4. 10 - 25%						4	7				4		
	5. <10%						1	10				LF		
(14)	Wetland Size	N,B												
	1. >200 acres				10	10	10	10	10			10		
	2. 100 - 200 acres				10	8	8	8	10			10		
	3. 50 - 100 acres				8	6	6	6	10			8		
	4. 25 - 50 acres				6	4	4	4	10			6		
	5. 5 - 25 acres				4	1	2	2	5			4		
	6. <5 acres				LF	LF	1	1	LF			LF		
(15)	Wetland Edge	N,B												
	1. >75% Bottomland H. - % adj. to water								10					
	2. 50-75% Nonforest w.-% woody or adj. to								8					
	3. 25 - 50% bottomland hardwoods								6					
	4. 10 - 25%								4					
	5. <10%								1					
(16)	Water Regime	N												
	1. Gradual drying with >75% water remaining by Aug. 1				4	4	8	2	10			8		
	2. Gradual drying with 50 - 75% water remaining by Aug. 1				6	6	6	6	6			6		
	3. Gradual drying with 25 - 50% water remaining by Aug. 1				10	10	4	10	4			4		
	4. Gradual drying with <25% water remaining by Aug. 1				8	8	2	8	2			2		
	5. Stable water				2	4	0	10	10			10		
	6. Rapid drying; or no water after June 1				LF	LF	LF	LF	LF			LF		
(17)	Important Food Plant Coverage	N,B	M	M										
	1. >75%		10	10										
	2. 50 - 75% (Multiply index by .75)		8	8										
	3. 25 - 50% (Multiply index by .50)		6	6										
	4. 10 - 25% (Multiply index by .25)		4	4										
	5. <10% (Multiply index by .25)		1	1										
(18)	Plant Diversity	N,B												
	1. >7		5	5										
	2. 4 - 7		3	3										
	3. <4		1	1										
(19)	Persistent Emergent and Woody Vegetation Coverage	N												
	1. 5 - 15%		5	5										
	2. 15 - 25%		4	4										
	3. 25 - 50%		2	2										
	4. <5% or >50%		1	1										

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
20.	Substrate - Surface Water Interspersion	N												
	1. Substrate interspersed with shallow water					10								
	2. Shallow water occurring as one or few pools					1								
21.	Percent Open Water	N												
	1. <10%		5	5			10					6		
	2. 10 - 25%		3	3			8					10		
	3. 25 - 50%		1	1			6					8		
	4. 50 - 90%		1	1			4					4		
	5. >90%		1	1			1					1		
22.	Winter Water Depth (Oct. - March)	N												
	1. 15 - 24"						10							
	2. 10 - 15" or 24 - 30"						7							
	3. 6 - 10" or 30 - 36"						4							
	4. <6" or >36"						1							
23.	Sedge Canopy Coverage	N												
	1. >90%							8						
	2. 75 - 90%							10						
	3. 50 - 75%							6						
	4. 25 - 50%							4						
	5. < 25%							2						
	6. Zero							LF						
24.	Wetland Substrate	N												
	1. Muddy					5								
	2. Sandy					3								
	3. Gravel					1								
25.	Percent Soil Waterlogged Substrate During May	N												
	1. >90% of substrate waterlogged					10								
	2. 75 - 90% of substrate waterlogged					8								
	3. 50 - 75% of substrate waterlogged					6								
	4. 25 - 50% of substrate waterlogged					4								
	5. <25% of substrate waterlogged					1								
26.	Percent Exposed Wetland Substrate and 1-4" Shallow Water Covered by Vegetation May-June	N												
	1. <10%					10								
	2. 10 - 25%					8								
	3. 25 - 50%					6								
	4. 50 - 75%					4								
	5. 75 - 90%					2								
	6. >90%					LF								
27.	Percent Channel with Aquatic Vegetation	B												
	1. >10%									10	10			
	2. 5 - 10%									7	7			
	3. 1 - 5%									4	4			
	4. None; or 1/4 mi. from center stand									1	1			
28.	Average Water Fluctuation in Channel	B												
	1. Bank full <3 times per year										10			
	2. Bank full 3-5 times per year										7			
	3. Bank full 5-7 times per year										4			
	4. Bank full >7 times per year; or >1/4 mile from channel										1			
29.	Cropfield Management	C												
	1. No-till tillage		10	10										
	2. Winter Wheat		2	10										
	3. Chisel plowing		8	8										
	4. Chopped, baled, grazed		6	6										
	5. Fall disc		4	4										
	6. Fall moldboard		1	1										

N. A.

N. A.

Pool 8T C-2

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
30.	Cropping Practice	C												
	1. >50 unharvested		10	10										
	2. 25-50% harvested		7	7										
	3. 10 - 25% unharvested		4	4										
	4. <10% unharvested		1	1										
31.	Crop Rotation	C												
	1. SG & RC - L			5										
	2. SG - RC; or idle some years			3										
	3. Continuous SG or RC			1										
32.	Field Size (% w/in 660' Woodland or Treeline)	C,G												
	1. <25%			10										
	2. 25 - 50%			6										
	3. 50 - 75%			3										
	4. >75%			1										
33.	Grassland Composition	G												
	1. Bluegrass, clover, alfalfa			10										
	2. Timothy, orchardgrass or mixed CSG			5										
	3. Fescue or WSG			1										
34.	Average Height Herbaceous Vegetation (Fall)	G												
	1. <6"			10										
	2. >6"			1										
35.	Woodland Tree Species	B												
	1. >50% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash		1							8	10			
	2. 25 - 50% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash		4							10	8			
	3. <25% trees as elm, walnut, cottonwood, sycamore, willow, maple, ash; or >25% pin oak (or other small acorns)		6							1	6			
	4. 25 - 50% pin oak (or other small acorns)		8							4	4			
	5. >50% pin oak (or other small acorns)		10							6	1			
36.	Permanent Water Within Woodland	B												
	1. >25%		1					10	10					10
	2. 10 - 25%		3					7	7					7
	3. 5 - 10%		5					4	4					4
	4. 1 - 5%		3					2	2					2
	5. Zero		2					1	1					1
37.	Forest Openings (<2 ac. in size)	B												
	1. 15 - 30% scattered		1					10	10	5				
	2. 15 - 30% one or few		3					7	7	4				
	3. 5 - 15%		5					4	4	3				
	4. <5% or >30%		1					1	1	1				
38.	Woodland Size Class	B												
	1. Sawtimber - open canopy		10					4	10	4		10	10	
	2. Sawtimber - close canopy		8					1	8	1		10	10	
	3. Pole with 25-50% sawtimber		6					10	6	8		7	7	
	4. Regeneration with 25-50% sawtimber		4					8	4	8		2	2	
	5. Regeneration		1					8	2	10		LF	LF	
	6. Pole		1					6	2	6		4	4	
39.	Percent Canopy From Old Growth (>16" dbh)	B												
	1. >25%									10	1			
	2. 10 - 25%									8	4			
	3. 5 - 10%									6	6			
	4. 1 - 5%									4	8			
	5. Zero									1	10			

Pool 68 C-2

A-E2-30

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
40.	Woodland Overstory Canopy Height (feet)	B												
	1. >80'												10	10
	2. 65-80'												7	7
	3. 40-65'												4	4
	4. <40'												1	1
41.	Percent Subcanopy Closure	B												
	1. >75%												10	1
	2. 50-75%												7	4
	3. 25-50%												4	10
	4. <25%												1	7
42.	Woodland (Stand) Size													
	1. <25%												10	10
	2. 25-50%												7	7
	3. 50-75%												4	4
	4. >75%												1	1
43.	Percent Forest Canopy Adjacent to or Over Permanent Water	B												M
	1. >25%													10
	2. 10-25%													7
	3. 5-10%													4
	4. <5%													1
44.	Number of Snags Trees per Acre	B												
	1. >5									5				10
	2. 3-4									5				7
	3. 1-2									3				4
	4. <1									1				1
45.	Number of Cavity Trees Per Acre	B												
	1. >9									10				10
	2. 3 - 9									7				7
	3. 1 - 3									4				4
	4. None									LF				1
46.	Stems per Square Yard of Shrub and Tree Regeneration >3 Feet Tall													
	1. >3									1	10		10	1
	2. 1-3									3	7		7	4
	3. .5-1									5	4		4	10
	4. <.5									2	1		1	7
47.	Percent Woodland Within 660' of Permanent Water	B								M	M	M		
	1. >75%									10	10	10	10	10
	2. 50 - 75% (Multiply Index by .75)									7	7	7	7	7
	3. 25 - 50% (Multiply Index by .50)									4	4	4	4	4
	4. <25% (Multiply Index by .25)									1	1	1	1	1
48.	Distance to Nonforest Wetland, Oxbow or Slough	B,C,G												
	1. <250' water predictable		10	10						10	10	10		
	2. 250'-1/8 mi. water predictable		10	10						10	10	5		
	3. 1/8-1 mi. water predictable		10	10						1	1	1		
	4. <250' water predictable 1 of 3 years		5	5						5	5	3		
	5. 250'-1/8 mi. water predictable 1 of 3 yrs.		5	5						5	5	2		
	6. 1/8-1 mi. water predictable 1 of 3 yrs.		5	5						1	1	1		
	7. >1 mi.; or <1 mi. water unpredictable		1	1						1	1	1		
49.	Distance to Bottomland Hardwoods	N,C												
	1. <1/4 mi. water predictable		10							5				
	2. 1/4-1/2 mi. water predictable		10							1				
	3. 1/2-1 mi. water predictable		8							1				
	4. <1/4 mi. water predictable 1 of 3 yrs.		6							5				
	5. 1/4-1/2 mi. water predictable 1 of 3 yrs.		6							3				
	6. 1/2-1 mi. water predictable 1 of 3 yrs.		4							1				
	7. >1 mi.; or <1 mi. water unpredictable		1							1				

N-A-

~~69~~ Pool C-2

A-E2-31

Wetland Species Characteristic Matrix

	CHARACTERISTIC	Habitat Type	Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
50.	Distance to Cropland	N,B,G												
	1. <1/4 mi., unharvested or partially unharvested and water predictable		10	10										
	2. 1/4-1/2 mi. unharvested or partially unharvested and water predictable		8	8										
	3. 1/2-1 mi. unharvested or partially unharvested and water predictable		6	6										
	4. <1/4 mi., unharvested or partially unharvested and water predictable 1 of 3 years; or adjacent, unflooded with residues undisturbed		5	5										
	5. 1/4-1/2 mi. unharvested or partially unharvested and water predictable 1 of 3 years; or 1/4-1/2 mi. unflooded with residues and undisturbed		4	4										
	6. 1/2-1 mi. unharvested or partially unharvested and water predictable 1 of 3 yrs; or 1/2-1 mi. unflooded with residues undisturbed; or winter wheat		2	2										
	7. >1 mi. to any cropfield; or <1 mi. unflooded cropfield with residues disced or plowed		1	1										
51.	Distance to Grassland	N,C												
	1. <1/2 mi. with winter height <6" and field size >40 acres			10										
	2. 1/2-1 mi. with winter height <6" and field size >40 acres			7										
	3. <1/2 mi. with winter height <6" and field size <40 acres			4										
	4. >1 mi. to any grassland with winter height <6"; or grassland with winter height>6"			1										
52.	Distance to Stream or River (permanent flow or pools)	N,B												
	1. <1/4 mi.								10					
	2. 1/4 - 1/2 mi.								5					
	3. >1/2 mi.								1					
53.	Distance to Major River, Lake or Reservoir >100 Acres	N,C,G												
	1. <1 miles Missouri, Mississippi,			10										
	2. 1 - 5 miles Grand, St. Francis			7										
	3. 5 - 10 miles			4										
	4. >10 miles			1										
54.	Distance to FALL Canada Goose Concentration Area	N,C,G												
	1. <4 miles			10										
	2. 4 - 10 miles (Multiply Index by .75)			7										
	3. 10 - 25 miles (Multiply Index by .50)			4										
	4. >25 miles (Multiply Index by .25)			1										

N.A.

N.A.

Pool-C2

Wetland Species Characteristic Matrix

		Mallard	Canada Goose	Least Bittern	Lesser Yellowlegs	Muskrat	King Rail	Green-backed Heron	Wood Duck	Beaver	American Coot	Northern Parula	Prothonotary Warbler
Total													
Maximum Possible													
HTSI													
Multiplier													
Revised HTSI		SEE PRINTOUTS											
	N	85	105	70	85	85	70	85			80		
	B	105						100	110	95		60	100
	C	70	105										
	P		80										

Abbreviations

C = cropfield, G = grassland, N = nonforest wetland, B = bottomland hardwoods,
LF = limiting factor, score Habitat Type Suitability Index (HTSI) as .1 if characteristic scores .1.
M = multiplier. Multiply HTSI by the appropriate value to calculate revised HTSI. Use lowest value if 2 multiplier values apply.

Limiting Factors	Character Number
Mallard - If Percent in Bottomland Hardwood and Nonforest Wetland or Fall Winter Water Conditions score 1, HTSI = .1.	3,4
Canada goose - If Percent in Nonforest Wetland or Fall Winter Water Conditions score 1, HTSI = .1.	2,4
Lesser yellowlegs - If Wetland Size, Water Regime or Percent Wetland Substrate score 1, HTSI = .1.	14,16,26
Green-backed heron - If Wetland Size Water or Regime HTSI = .1.	14,66
Wood duck - If Woodland Size Class or Number of Tree Cavities score 1, HTSI = .1.	38,45
Least bittern - If Emergent Vegetation Coverage, Wetland Size, or Water Regime Score 1, HTSI = .1.	12,14,16
American Coot - If Cattail and Bulrush Coverage, Wetland Size or Water Regime Score 1, HTSI = .1.	13,14,16
King Rail - If Sedge Canopy Coverage or Water Regime Score 1, HTSI = .1 Score 1, HTSI = .1.	23,16
Northern Parula - If Woodland Size Class	40
Prothonotary Warbler - If Woodland Size Class	40

Multiplier

Mallard - Important Food Plant Coverage (Nonforest wetland)	17
Fall-Winter Flood Conditions	5
Canada goose - Distance to Major Canada Goose Winter Area	54
Important Food Plant Coverage (Nonforest wetland)	17
Fall-Winter Flood Conditions	5
Muskrat - Percent Permanent Water Entire Year	9
Wood duck - Percent Woodland Within 660' of Permanent Water	47
Beaver - Percent Woodland Within 660' of Permanent Water	47
Green-backed Heron - Percent Woodland Within 660' of Permanent Water	47
Prothonotary Warbler - Percent Forest Canopy Adjacent to or Over Permanent Water	43

3/89

MISSOURI DEPARTMENT OF CONSERVATION

WILDLIFE HABITAT APPRAISAL GUIDE

ABITAT TYPE ABREVIATIONS

1	N	NONFOREST WETLAND
2	B	BOTTOMLAND HARDWOODS-WETLAND
3	C	CROPLAND-WETLAND

SPECIES ABREVIATIONS

1	MALL	MALLARD	3	YLEG	LESSER YELLOWLEGS
2	BITT	LEAST BITTERN	4	HERO	GREEN-BACKED HERON

PROJECT NAME POOLC2 EVALUATION

MATRIX NAME POOLC2 A MATRIX THAT YOUR CREATED OR MODIFIED
DATA FILE NAME PLC2

PLANNING CONDITION PRES & Future w/o DATE FIELD WORK 22 DEC 92
TODAYS DATE 06-28-1993

SAMPLE SITE HABITAT INDEXES

HIS DATA SET CONTAINS:
1 NONFOREST WETLAND SAMPLE SITES
) BOTTOMLAND HARDWOODS-WETLAND SAMPLE SITES
) CROPLAND-WETLAND SAMPLE SITES

AVERAGE HABITAT INDEXES BY HABITAT TYPE

\B	MALL	BITT	YLEG	HERO
	.1	.67	.6	.72

A-E2-34

Pool C-2

MISSOURI DEPARTMENT OF CONSERVATION

WILDLIFE HABITAT APPRAISAL GUIDE

ITAT TYPE ABREVIATIONS

1	N	NONFOREST WETLAND
2	B	BOTTOMLAND HARDWOODS-WETLAND
3	C	CROPLAND-WETLAND

SPECIES ABREVIATIONS

1	MALL	MALLARD	3	YLEG	LESSER YELLOWLEGS
2	BITT	LEAST BITTERN	4	HERO	GREEN-BACKED HERON

PROJECT NAME POOLC2 EVALUATION

MATRIX NAME POOLC2 A MATRIX THAT YOUR CREATED OR MODIFIED
DATA FILE NAME FUTPLC2

PLANNING CONDITION FUTURE WITH PROJECT DATE FIELD WORK 22 DEC 92
TODAYS DATE 06-28-1993

SAMPLE SITE HABITAT INDEXES

THIS DATA SET CONTAINS:
1 NONFOREST WETLAND SAMPLE SITES
0 BOTTOMLAND HARDWOODS-WETLAND SAMPLE SITES
0 CROPLAND-WETLAND SAMPLE SITES

AVERAGE HABITAT INDEXES BY HABITAT TYPE

HAB	MALL	BITT	YLEG	HERO
N	.62	.7	.59	.73
B				
C				

Pool C-2

A-E2-35

May 17, 1991

MEMO TO: See Distribution

SUBJECT: Sediment Testing - Trempealeau National Wildlife Refuge
HREP Project

1. On February 28, 1991, we collected sediment samples for bulk chemical testing from the Trempealeau NWR. The boring crew was taking borings and we collected samples from potential sources of sand borrow. It took about a five foot segment from the split spoon sampler to get enough material for one composite sample for all the analysis we were running.

2. The locations for the samples are shown on the attached sheet and map.

3. The sample results are enclosed. If you desire the backup lab sheets and QA/QC data let me know and I will send you a copy of that material also.

4. As would be expected from material that is deeply buried the sediments look pretty clean. Even sample #4 which was a near surface muck sample is relatively clean.

5. We could not collect additional fine material samples from near the surface because the material was generally to loose to stay in the split spoon sampler being used by the boring crew. If and when we identify areas where we may be dredging up fines we can collect further samples if need be using a ponar or a hand-held tublar sampler.

6. If you have any questions please give me a call at (612) 220-0266.

Gary Palesh

Enclosures

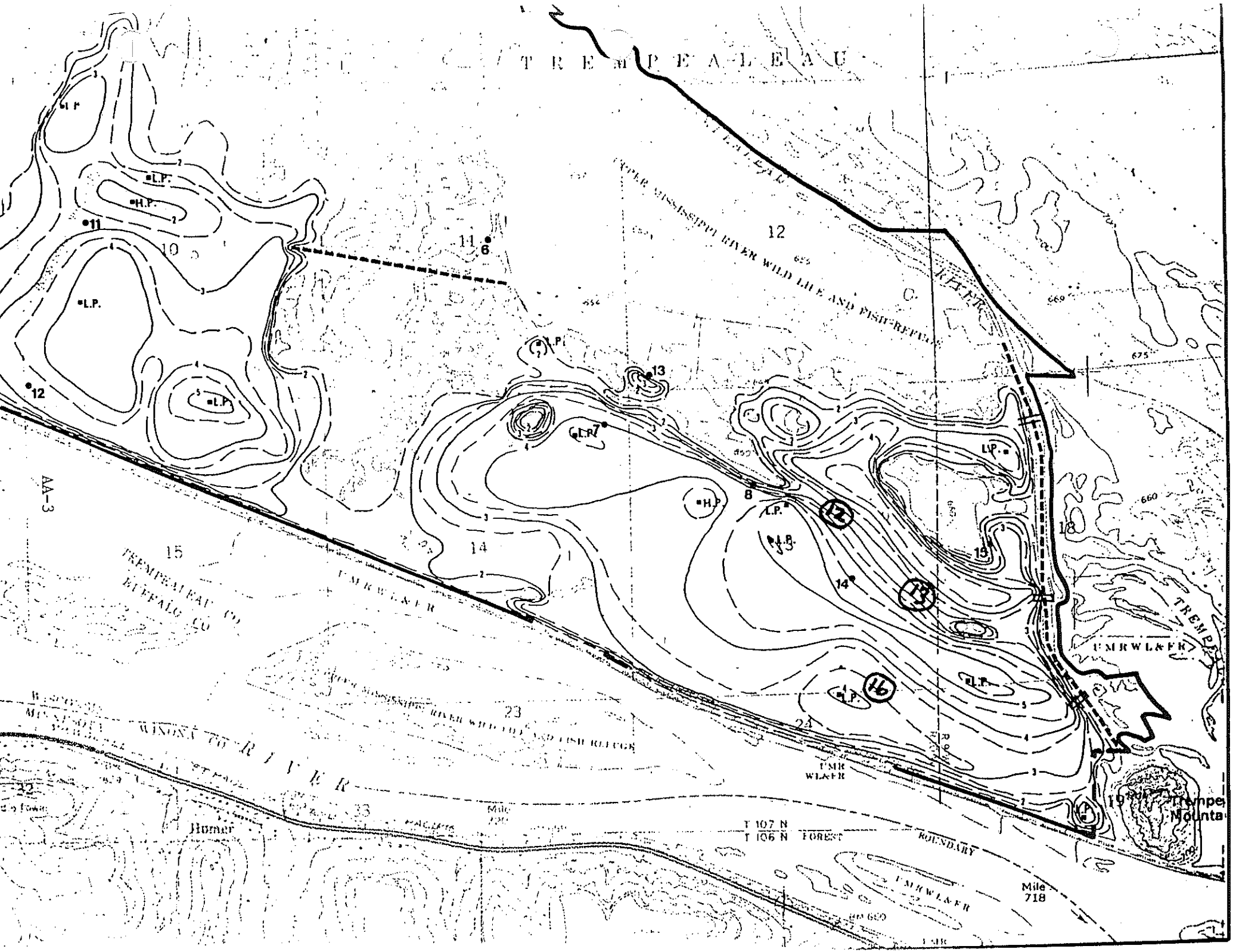
Distribution:

Keith Beseke
Rick Frietche
John Sullivan

TREMPEALEAU NWR
LOCATION OF SEDIMENT SAMPLES
2/28/91

SAMPLE #	BORING LOCATION	SAMPLE DEPTH*
1	12	2' - 5'
2	12	7' - 12'
3	12	12' - 17'
4	13	0 - 2'
5	13	4' - 9'
6	13	9' - 14'
7	16	5' - 10'
8	16	15' - 19'

* depth from the sediment water interface


TREMPEALEAU
UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE
TREMPEALEAU CO
BUFFALO CO
WINONA CO
RIVER
UMRWL&FR
Homer
T 107 N
T 106 N
FOREST
BOUNDARY
Mile 718
Trempe
Mounta
L.P.
H.P.
10
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8

pace INCORPORATED
THE ASSURANCE OF QUALITY

REPORT OF LABORATORY ANALYSIS

St. Paul Corps of Engineering
1421 USPO & Custom House
St. Paul, MN 55101-9808

April 05, 1991
PACE Project Number: 910301510

Attn: Mr. Gary Palesh

Trempealeall NWR

Parameter	Units	MDL	Tremp-1	DATE AND TIME ANALYZED	
PACE Sample Number:			10 0084379		
Date Collected:			02/28/91		
Date Received:			03/01/91		
SUBCONTRACT ANALYSIS					
INDIVIDUAL PARAMETERS					
Moisture	%	0.01	24	03/05/91	:
Particle Size Sieve No.200 (passing)	%	1.0	2.9	03/05/91	:
Total Organic Carbon	mg/kg	580	1100 (SC)	04/02/91	:
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Arsenic	mg/kg	1	ND	03/15/91	14:40
Cadmium	mg/kg	0.60	ND	03/16/91	13:33
Chromium	mg/kg	1.0	5.5	03/16/91	13:33
Copper	mg/kg	0.50	3.1	03/16/91	13:33
Cyanide, Total	mg/kg	0.5	ND	03/05/91	13:00
Lead	mg/kg	4.5	ND	03/16/91	13:33
Manganese	mg/kg	0.20	160	03/16/91	13:33
Mercury	mg/kg	0.02	ND	03/22/91	10:30
Nickel	mg/kg	2.1	3.7	03/16/91	13:33
Nitrogen, Ammonia	mg/kg	20	98	03/05/91	15:00
Selenium	mg/kg	0.5	ND	03/13/91	09:05
Solids, Percent Total	%	0.1	75	03/04/91	10:30
Solids, Percent Volatile	%	0.01	2.4	03/06/91	06:30
Zinc	mg/kg	0.60	14	03/16/91	13:33
ORGANIC ANALYSIS					
ORGANOCHLORINE PESTICIDES AND PCBS-8080					
Date Analyzed			03/14/91		
Aldrin	mg/kg	0.002	ND	03/14/91	:
a-BHC	mg/kg	0.002	ND	03/14/91	:

MDL Method Detection Limit
ND Not detected at or above the MDL.
SC Interregional work is verified by the laboratory managers in the region in which the work was performed.

1710 Douglas Drive North
Minneapolis, MN 55422
TEL: 612-544-5543
FAX: 612-525-3377

Offices Serving: Minneapolis, Minnesota; Tampa, Florida; Iowa City, Iowa; San Francisco, California; Kansas City, Missouri; Los Angeles, California; Charlotte, North Carolina; Asheville, North Carolina; New York, New York; Pittsburgh, Pennsylvania

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THE ASSURANCE OF QUALITY

REPORT OF LABORATORY ANALYSIS

Mr. Gary Palesh
Page 2

April 05, 1991
PACE Project Number: 910301510

Trempealeall NWR

PACE Sample Number:			10 0084379	
Date Collected:			02/28/91	
Date Received:			03/01/91	
Parameter	Units	MDL	Tremp-1	DATE AND TIME ANALYZED
ORGANIC ANALYSIS				
ORGANOCHLORINE PESTICIDES AND PCBS-8080				
b-BHC	mg/kg	0.004	ND	03/14/91 :
g-BHC (Lindane)	mg/kg	0.002	ND	03/14/91 :
d-BHC	mg/kg	0.005	ND	03/14/91 :
Chlordane (tech)	mg/kg	0.10	ND	03/14/91 :
4,4'-DDD	mg/kg	0.013	ND	03/14/91 :
4,4'-DDE	mg/kg	0.006	ND	03/14/91 :
4,4'-DDT	mg/kg	0.009	ND	03/14/91 :
Dieldrin	mg/kg	0.004	ND	03/14/91 :
Endosulfan I	mg/kg	0.002	ND	03/14/91 :
Endosulfan II	mg/kg	0.005	ND	03/14/91 :
Endosulfan Sulfate	mg/kg	0.032	ND	03/14/91 :
Endrin	mg/kg	0.013	ND	03/14/91 :
Endrin aldehyde	mg/kg	0.20	ND	03/14/91 :
Heptachlor	mg/kg	0.002	ND	03/14/91 :
Heptachlor epoxide	mg/kg	0.002	ND	03/14/91 :
Methoxychlor	mg/kg	0.052	ND	03/14/91 :
Toxaphene	mg/kg	0.30	ND	03/14/91 :
PCB-1016	mg/kg	0.030	ND	03/14/91 :
PCB-1221	mg/kg	0.030	ND	03/14/91 :
PCB-1232	mg/kg	0.030	ND	03/14/91 :
PCB-1242	mg/kg	0.030	ND	03/14/91 :
PCB-1248	mg/kg	0.030	ND	03/14/91 :
PCB-1254	mg/kg	0.030	ND	03/14/91 :
PCB-1260	mg/kg	0.030	ND	03/14/91 :

MDL Method Detection Limit
ND Not detected at or above the MDL.

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Mr. Gary Palesh
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April 05, 1991
PACE Project Number: 910301510

Trempealeall NWR

Parameter	Units	MDL	Tremp-2	DATE AND TIME ANALYZED	
PACE Sample Number:			10 0084387		
Date Collected:			02/28/91		
Date Received:			03/01/91		
SUBCONTRACT ANALYSIS					
INDIVIDUAL PARAMETERS					
Moisture	%	0.01	24	03/05/91	:
Particle Size Sieve No.200 (passing)	%	1.0	4.4	03/05/91	:
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Arsenic	mg/kg	1	ND	03/15/91	14:40
Cadmium	mg/kg	0.60	ND	03/16/91	13:33
Chromium	mg/kg	1.0	4.3	03/16/91	13:33
Copper	mg/kg	0.50	2.3	03/16/91	13:33
Cyanide, Total	mg/kg	0.5	ND	03/05/91	13:00
Lead	mg/kg	4.5	ND	03/16/91	13:33
Manganese	mg/kg	0.20	55	03/16/91	13:33
Mercury	mg/kg	0.02	ND	03/22/91	10:30
Nickel	mg/kg	2.1	2.8	03/16/91	13:33
Nitrogen, Ammonia	mg/kg	20	150	03/05/91	15:00
Selenium	mg/kg	0.5	ND	03/13/91	09:05
Solids, Percent Total	%	0.1	79	03/04/91	10:30
Solids, Percent Volatile	%	0.01	0.48	03/06/91	06:30
Zinc	mg/kg	0.60	9.2	03/16/91	13:33
ORGANIC ANALYSIS					
ORGANOCHLORINE PESTICIDES AND PCBS-8080					
Date Analyzed			03/14/91		
Aldrin	mg/kg	0.002	ND	03/14/91	:
a-BHC	mg/kg	0.002	ND	03/14/91	:
b-BHC	mg/kg	0.004	ND	03/14/91	:
g-BHC (Lindane)	mg/kg	0.002	ND	03/14/91	:
d-BHC	mg/kg	0.005	ND	03/14/91	:
Chlordane (tech)	mg/kg	0.10	ND	03/14/91	:

MDL Method Detection Limit
ND Not detected at or above the MDL.

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April 05, 1991
PACE Project Number: 910301510

Trempealeall NWR

Parameter	Units	MDL	Tremp-2	DATE AND TIME ANALYZED
PACE Sample Number:			10 0084387	
Date Collected:			02/28/91	
Date Received:			03/01/91	
ORGANIC ANALYSIS				
ORGANOCHLORINE PESTICIDES AND PCBS-8080				
4,4'-DDD	mg/kg	0.013	ND	03/14/91 :
4,4'-DDE	mg/kg	0.006	ND	03/14/91 :
4,4'-DDT	mg/kg	0.009	ND	03/14/91 :
Dieldrin	mg/kg	0.004	ND	03/14/91 :
Endosulfan I	mg/kg	0.002	ND	03/14/91 :
Endosulfan II	mg/kg	0.005	ND	03/14/91 :
Endosulfan Sulfate	mg/kg	0.032	ND	03/14/91 :
Endrin	mg/kg	0.013	ND	03/14/91 :
Endrin aldehyde	mg/kg	0.20	ND	03/14/91 :
Heptachlor	mg/kg	0.002	ND	03/14/91 :
Heptachlor epoxide	mg/kg	0.002	ND	03/14/91 :
Methoxychlor	mg/kg	0.052	ND	03/14/91 :
Toxaphene	mg/kg	0.30	ND	03/14/91 :
PCB-1016	mg/kg	0.030	ND	03/14/91 :
PCB-1221	mg/kg	0.030	ND	03/14/91 :
PCB-1232	mg/kg	0.030	ND	03/14/91 :
PCB-1242	mg/kg	0.030	ND	03/14/91 :
PCB-1248	mg/kg	0.030	ND	03/14/91 :
PCB-1254	mg/kg	0.030	ND	03/14/91 :
PCB-1260	mg/kg	0.030	ND	03/14/91 :

MDL Method Detection Limit
ND Not detected at or above the MDL.

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April 05, 1991
PACE Project Number: 910301510

Trempealeall NWR

Parameter	Units	MDL	Tremp-3	DATE AND TIME ANALYZED	
PACE Sample Number:			10 0084395		
Date Collected:			02/28/91		
Date Received:			03/01/91		
SUBCONTRACT ANALYSIS					
INDIVIDUAL PARAMETERS					
Moisture	%	0.01	21	03/05/91	:
Particle Size Sieve No.200 (passing)	%	1.0	4.8	03/05/91	:
Total Organic Carbon	mg/kg	570	730 (SC)	04/02/91	:
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Arsenic	mg/kg	1	ND	03/15/91	14:40
Cadmium	mg/kg	0.60	ND	03/16/91	13:33
Chromium	mg/kg	1.0	4.5	03/16/91	13:33
Copper	mg/kg	0.50	2.5	03/16/91	13:33
Cyanide, Total	mg/kg	0.5	ND	03/05/91	13:00
Lead	mg/kg	4.5	ND	03/16/91	13:33
Manganese	mg/kg	0.20	50	03/16/91	13:33
Mercury	mg/kg	0.02	ND	03/22/91	10:30
Nickel	mg/kg	2.1	3.0	03/16/91	13:33
Nitrogen, Ammonia	mg/kg	20	63	03/05/91	15:00
Selenium	mg/kg	0.5	ND	03/13/91	09:05
Solids, Percent Total	%	0.1	84	03/04/91	10:30
Solids, Percent Volatile	%	0.01	0.58	03/06/91	06:30
Zinc	mg/kg	0.60	9.7	03/16/91	13:33
ORGANIC ANALYSIS					
ORGANOCHLORINE PESTICIDES AND PCBS-8080					
Date Analyzed			03/14/91		
Aldrin	mg/kg	0.002	ND	03/14/91	:
a-BHC	mg/kg	0.002	ND	03/14/91	:
b-BHC	mg/kg	0.004	ND	03/14/91	:
g-BHC (Lindane)	mg/kg	0.002	ND	03/14/91	:
d-BHC	mg/kg	0.005	ND	03/14/91	:

MDL Method Detection Limit
ND Not detected at or above the MDL.
SC Interregional work is verified by the laboratory managers in the region in which the work was performed.

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Trempealeall NWR

PACE Sample Number:			10 0084395		
Date Collected:			02/28/91		
Date Received:			03/01/91		
Parameter	Units	MDL	Tremp-3	DATE AND TIME ANALYZED	
ORGANIC ANALYSIS					
ORGANOCHLORINE PESTICIDES AND PCBS-8080					
Chlordane (tech)	mg/kg	0.10	ND	03/14/91	:
4,4'-DDD	mg/kg	0.013	ND	03/14/91	:
4,4'-DDE	mg/kg	0.006	ND	03/14/91	:
4,4'-DDT	mg/kg	0.009	ND	03/14/91	:
Dieldrin	mg/kg	0.004	ND	03/14/91	:
Endosulfan I	mg/kg	0.002	ND	03/14/91	:
Endosulfan II	mg/kg	0.005	ND	03/14/91	:
Endosulfan Sulfate	mg/kg	0.032	ND	03/14/91	:
Endrin	mg/kg	0.013	ND	03/14/91	:
ndrin aldehyde	mg/kg	0.20	ND	03/14/91	:
eptachlor	mg/kg	0.002	0.003	03/14/91	:
Heptachlor epoxide	mg/kg	0.002	ND	03/14/91	:
Methoxychlor	mg/kg	0.052	ND	03/14/91	:
Toxaphene	mg/kg	0.30	ND	03/14/91	:
PCB-1016	mg/kg	0.030	ND	03/14/91	:
PCB-1221	mg/kg	0.030	ND	03/14/91	:
PCB-1232	mg/kg	0.030	ND	03/14/91	:
PCB-1242	mg/kg	0.030	ND	03/14/91	:
PCB-1248	mg/kg	0.030	ND	03/14/91	:
PCB-1254	mg/kg	0.030	ND	03/14/91	:
PCB-1260	mg/kg	0.030	ND	03/14/91	:

MDL Method Detection Limit
ND Not detected at or above the MDL.

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PACE Project Number: 910301510

Trempealeall NWR

Parameter	Units	MDL	Tremp-4	DATE AND TIME ANALYZED
PACE Sample Number:			10 0084409	
Date Collected:			02/28/91	
Date Received:			03/01/91	
SUBCONTRACT ANALYSIS				
INDIVIDUAL PARAMETERS				
Moisture	%	0.01	85	03/05/91 :
Particle Size Sieve No.200 (passing)	%	1.0	69	03/05/91 :
Total Organic Carbon	mg/kg	2500	30000 (SC)	04/02/91 :
INORGANIC ANALYSIS				
INDIVIDUAL PARAMETERS				
Arsenic	mg/kg	1	ND	03/15/91 14:40
Cadmium	mg/kg	0.60	ND	03/16/91 13:33
Chromium	mg/kg	1.0	4.8	03/16/91 13:33
Copper	mg/kg	0.50	3.5	03/16/91 13:33
Cyanide, Total	mg/kg	0.5	ND	03/06/91 16:00
Lead	mg/kg	4.5	ND	03/16/91 13:33
Manganese	mg/kg	0.20	100	03/16/91 13:33
Mercury	mg/kg	0.02	ND	03/22/91 10:30
Nickel	mg/kg	2.1	2.9	03/16/91 13:33
Nitrogen, Ammonia	mg/kg	20	140	03/05/91 15:00
Selenium	mg/kg	0.5	ND	03/13/91 09:05
Solids, Percent Total	%	0.1	71	03/04/91 10:30
Solids, Percent Volatile	%	0.01	2.9	03/06/91 06:30
Zinc	mg/kg	0.60	4.0	03/16/91 13:33
ORGANIC ANALYSIS				
ORGANOCHLORINE PESTICIDES AND PCBS-8080				
Date Analyzed			03/14/91	
Aldrin	mg/kg	0.002	ND	03/14/91 :
a-BHC	mg/kg	0.002	ND	03/14/91 :
b-BHC	mg/kg	0.004	ND	03/14/91 :
g-BHC (Lindane)	mg/kg	0.002	ND	03/14/91 :
d-BHC	mg/kg	0.005	ND	03/14/91 :

MDL Method Detection Limit
ND Not detected at or above the MDL.
SC Interregional work is verified by the laboratory managers in the region in which the work was performed.

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Trempealeall NWR

PACE Sample Number:			10 0084409	
Date Collected:			02/28/91	
Date Received:			03/01/91	
Parameter	Units	MDL	Tremp-4	DATE AND TIME ANALYZED
ORGANIC ANALYSIS				
ORGANOCHLORINE PESTICIDES AND PCBS-8080				
Chlordane (tech)	mg/kg	0.10	ND	03/14/91 :
4,4'-DDD	mg/kg	0.013	ND	03/14/91 :
4,4'-DDE	mg/kg	0.006	ND	03/14/91 :
4,4'-DDT	mg/kg	0.009	ND	03/14/91 :
Dieldrin	mg/kg	0.004	ND	03/14/91 :
Endosulfan I	mg/kg	0.002	ND	03/14/91 :
Endosulfan II	mg/kg	0.005	ND	03/14/91 :
Endosulfan Sulfate	mg/kg	0.032	ND	03/14/91 :
Endrin	mg/kg	0.013	ND	03/14/91 :
Endrin aldehyde	mg/kg	0.20	ND	03/14/91 :
Heptachlor	mg/kg	0.002	ND	03/14/91 :
Heptachlor epoxide	mg/kg	0.002	ND	03/14/91 :
Methoxychlor	mg/kg	0.052	ND	03/14/91 :
Toxaphene	mg/kg	0.30	ND	03/14/91 :
PCB-1016	mg/kg	0.030	ND	03/14/91 :
PCB-1221	mg/kg	0.030	ND	03/14/91 :
PCB-1232	mg/kg	0.030	ND	03/14/91 :
PCB-1242	mg/kg	0.030	ND	03/14/91 :
PCB-1248	mg/kg	0.030	ND	03/14/91 :
PCB-1254	mg/kg	0.030	ND	03/14/91 :
PCB-1260	mg/kg	0.030	ND	03/14/91 :

MDL Method Detection Limit
ND Not detected at or above the MDL.

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PACE Project Number: 910301510

Trempealeall NWR

Parameter	Units	MDL	Tremp-5	DATE AND TIME ANALYZED	
PACE Sample Number:			10 0084417		
Date Collected:			02/28/91		
Date Received:			03/01/91		
SUBCONTRACT ANALYSIS					
INDIVIDUAL PARAMETERS					
Moisture	%	0.01	19	03/05/91	:
Particle Size Sieve No.200 (passing)	%	1.0	3.4	03/05/91	:
Total Organic Carbon	mg/kg	1400	1800 (SC)	04/02/91	:
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Arsenic	mg/kg	1	ND	03/15/91	14:40
Cadmium	mg/kg	0.60	ND	03/16/91	13:33
Chromium	mg/kg	1.0	1.3	03/16/91	13:33
Copper	mg/kg	0.50	0.60	03/16/91	13:33
Cyanide, Total	mg/kg	0.5	ND	03/06/91	16:00
Lead	mg/kg	4.5	ND	03/16/91	13:33
Manganese	mg/kg	0.20	69	03/16/91	13:33
Mercury	mg/kg	0.02	ND	03/22/91	10:30
Nickel	mg/kg	2.1	ND	03/16/91	13:33
Nitrogen, Ammonia	mg/kg	20	70	03/05/91	15:00
Selenium	mg/kg	0.5	ND	03/13/91	09:05
Solids, Percent Total	%	0.1	85	03/04/91	10:30
Solids, Percent Volatile	%	0.01	0.26	03/06/91	06:30
Zinc	mg/kg	0.60	4.0	03/16/91	13:33
ORGANIC ANALYSIS					
ORGANOCHLORINE PESTICIDES AND PCBS-8080					
Date Analyzed			03/14/91		
Aldrin	mg/kg	0.002	ND	03/14/91	:
a-BHC	mg/kg	0.002	ND	03/14/91	:
b-BHC	mg/kg	0.004	ND	03/14/91	:
g-BHC (Lindane)	mg/kg	0.002	ND	03/14/91	:
d-BHC	mg/kg	0.005	ND	03/14/91	:

MDL Method Detection Limit
ND Not detected at or above the MDL.
SC Interregional work is verified by the laboratory managers in the region in which the work was performed.

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Trempealeall NWR

Parameter	Units	MDL	Tremp-5	DATE AND TIME ANALYZED
PACE Sample Number:			10 0084417	
Date Collected:			02/28/91	
Date Received:			03/01/91	
ORGANIC ANALYSIS				
ORGANOCHLORINE PESTICIDES AND PCBS-8080				
Chlordane (tech)	mg/kg	0.10	ND	03/14/91 :
4,4'-DDD	mg/kg	0.013	ND	03/14/91 :
4,4'-DDE	mg/kg	0.006	ND	03/14/91 :
4,4'-DDT	mg/kg	0.009	ND	03/14/91 :
Dieldrin	mg/kg	0.004	ND	03/14/91 :
Endosulfan I	mg/kg	0.002	ND	03/14/91 :
Endosulfan II	mg/kg	0.005	ND	03/14/91 :
Endosulfan Sulfate	mg/kg	0.032	ND	03/14/91 :
Endrin	mg/kg	0.013	ND	03/14/91 :
Endrin aldehyde	mg/kg	0.20	ND	03/14/91 :
Heptachlor	mg/kg	0.002	ND	03/14/91 :
Heptachlor epoxide	mg/kg	0.002	ND	03/14/91 :
Methoxychlor	mg/kg	0.052	ND	03/14/91 :
Toxaphene	mg/kg	0.30	ND	03/14/91 :
PCB-1016	mg/kg	0.030	ND	03/14/91 :
PCB-1221	mg/kg	0.030	ND	03/14/91 :
PCB-1232	mg/kg	0.030	ND	03/14/91 :
PCB-1242	mg/kg	0.030	ND	03/14/91 :
PCB-1248	mg/kg	0.030	ND	03/14/91 :
PCB-1254	mg/kg	0.030	ND	03/14/91 :
PCB-1260	mg/kg	0.030	ND	03/14/91 :

MDL Method Detection Limit
ND Not detected at or above the MDL.

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PACE Project Number: 910301510

Trempealeall NWR

Parameter	Units	MDL	Tremp-6	DATE AND TIME ANALYZED	
PACE Sample Number:			10 0084425		
Date Collected:			02/28/91		
Date Received:			03/01/91		
SUBCONTRACT ANALYSIS					
INDIVIDUAL PARAMETERS					
Moisture	%	0.01	27	03/05/91	:
Particle Size Sieve No.200 (passing)	%	1.0	12	03/05/91	:
Total Organic Carbon	mg/kg	2700	28000 (SC)	04/02/91	:
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Arsenic	mg/kg	1	ND	03/15/91	14:40
Cadmium	mg/kg	0.60	ND	03/16/91	13:33
Chromium	mg/kg	1.0	7.4	03/16/91	13:33
Copper	mg/kg	0.50	5.5	03/16/91	13:33
Cyanide, Total	mg/kg	0.5	ND	03/06/91	16:00
Lead	mg/kg	4.5	4.5	03/16/91	13:33
Manganese	mg/kg	0.20	670	03/16/91	13:33
Mercury	mg/kg	0.02	ND	03/22/91	07:30
Nickel	mg/kg	2.1	7.3	03/16/91	13:33
Nitrogen, Ammonia	mg/kg	20	98	03/05/91	15:00
Selenium	mg/kg	0.5	ND	03/13/91	09:05
Solids, Percent Total	%	0.1	64	03/04/91	10:30
Solids, Percent Volatile	%	0.01	4.1	03/06/91	06:30
Zinc	mg/kg	0.60	28	03/16/91	13:33
ORGANIC ANALYSIS					
ORGANOCHLORINE PESTICIDES AND PCBS-8080					
Date Analyzed			03/14/91		
Aldrin	mg/kg	0.002	ND	03/14/91	:
a-BHC	mg/kg	0.002	ND	03/14/91	:
b-BHC	mg/kg	0.004	ND	03/14/91	:
g-BHC (Lindane)	mg/kg	0.002	ND	03/14/91	:
d-BHC	mg/kg	0.005	ND	03/14/91	:

MDL Method Detection Limit
ND Not detected at or above the MDL.
SC Interregional workis verified by the laboratory managers in the region in which the work was performed.

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PACE Sample Number:			10 0084425	
Date Collected:			02/28/91	
Date Received:			03/01/91	
Parameter	Units	MDL	Tremp-6	DATE AND TIME ANALYZED
ORGANIC ANALYSIS				
ORGANOCHLORINE PESTICIDES AND PCBS-8080				
Chlordane (tech)	mg/kg	0.10	ND	03/14/91 :
4,4'-DDD	mg/kg	0.013	ND	03/14/91 :
4,4'-DDE	mg/kg	0.006	ND	03/14/91 :
4,4'-DDT	mg/kg	0.009	ND	03/14/91 :
Dieldrin	mg/kg	0.004	ND	03/14/91 :
Endosulfan I	mg/kg	0.002	ND	03/14/91 :
Endosulfan II	mg/kg	0.005	ND	03/14/91 :
Endosulfan Sulfate	mg/kg	0.032	ND	03/14/91 :
Endrin	mg/kg	0.013	ND	03/14/91 :
Endrin aldehyde	mg/kg	0.20	ND	03/14/91 :
Heptachlor	mg/kg	0.002	ND	03/14/91 :
Heptachlor epoxide	mg/kg	0.002	ND	03/14/91 :
Methoxychlor	mg/kg	0.052	ND	03/14/91 :
Toxaphene	mg/kg	0.30	ND	03/14/91 :
PCB-1016	mg/kg	0.030	ND	03/14/91 :
PCB-1221	mg/kg	0.030	ND	03/14/91 :
PCB-1232	mg/kg	0.030	ND	03/14/91 :
PCB-1242	mg/kg	0.030	ND	03/14/91 :
PCB-1248	mg/kg	0.030	ND	03/14/91 :
PCB-1254	mg/kg	0.030	ND	03/14/91 :
PCB-1260	mg/kg	0.030	ND	03/14/91 :

MDL Method Detection Limit
ND Not detected at or above the MDL.

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April 05, 1991
PACE Project Number: 910301510

Trempealeall NWR

Parameter	Units	MDL	Tremp-7	DATE AND TIME ANALYZED	
PACE Sample Number:			10 0084433		
Date Collected:			02/28/91		
Date Received:			03/01/91		
SUBCONTRACT ANALYSIS					
INDIVIDUAL PARAMETERS					
Moisture	%	0.01	23	03/05/91	:
Particle Size Sieve No.200 (passing)	%	1.0	9.8	03/05/91	:
Total Organic Carbon	mg/kg	2100	15000 (SC)	04/02/91	:
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Arsenic	mg/kg	1	ND	03/15/91	14:40
Cadmium	mg/kg	0.60	ND	03/16/91	13:33
Chromium	mg/kg	1.0	3.0	03/16/91	13:33
Copper	mg/kg	0.50	2.0	03/16/91	13:33
Cyanide, Total	mg/kg	0.5	ND	03/06/91	16:00
Lead	mg/kg	4.5	ND	03/16/91	13:33
Manganese	mg/kg	0.20	51	03/16/91	13:33
Mercury	mg/kg	0.02	ND	03/22/91	10:30
Nickel	mg/kg	2.1	2.2	03/16/91	13:33
Nitrogen, Ammonia	mg/kg	20	42	03/05/91	15:00
Selenium	mg/kg	0.5	ND	03/13/91	09:05
Solids, Percent Total	%	0.1	78	03/04/91	10:30
Solids, Percent Volatile	%	0.01	1.6	03/06/91	06:30
Zinc	mg/kg	0.60	8.3	03/16/91	13:33
ORGANIC ANALYSIS					
ORGANOCHLORINE PESTICIDES AND PCBS-8080					
Date Analyzed			03/14/91		
Aldrin	mg/kg	0.002	ND	03/14/91	:
a-BHC	mg/kg	0.002	ND	03/14/91	:
b-BHC	mg/kg	0.004	ND	03/14/91	:
g-BHC (Lindane)	mg/kg	0.002	ND	03/14/91	:
d-BHC	mg/kg	0.005	ND	03/14/91	:

MDL Method Detection Limit
ND Not detected at or above the MDL.
SC Interregional work is verified by the laboratory managers in the region in which the work is performed.

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April 05, 1991
PACE Project Number: 910301510

Trempealeall NWR

PACE Sample Number:			10 0084433	
Date Collected:			02/28/91	
Date Received:			03/01/91	
Parameter	Units	MDL	Tremp-7	DATE AND TIME ANALYZED
ORGANIC ANALYSIS				
ORGANOCHLORINE PESTICIDES AND PCBS-8080				
Chlordane (tech)	mg/kg	0.10	ND	03/14/91 :
4,4'-DDD	mg/kg	0.013	ND	03/14/91 :
4,4'-DDE	mg/kg	0.006	ND	03/14/91 :
4,4'-DDT	mg/kg	0.009	ND	03/14/91 :
Dieldrin	mg/kg	0.004	ND	03/14/91 :
Endosulfan I	mg/kg	0.002	ND	03/14/91 :
Endosulfan II	mg/kg	0.005	ND	03/14/91 :
Endosulfan Sulfate	mg/kg	0.032	ND	03/14/91 :
Endrin	mg/kg	0.013	ND	03/14/91 :
Endrin aldehyde	mg/kg	0.20	ND	03/14/91 :
Heptachlor	mg/kg	0.002	ND	03/14/91 :
Heptachlor epoxide	mg/kg	0.002	ND	03/14/91 :
Methoxychlor	mg/kg	0.052	ND	03/14/91 :
Toxaphene	mg/kg	0.30	ND	03/14/91 :
PCB-1016	mg/kg	0.030	ND	03/14/91 :
PCB-1221	mg/kg	0.030	ND	03/14/91 :
PCB-1232	mg/kg	0.030	ND	03/14/91 :
PCB-1242	mg/kg	0.030	ND	03/14/91 :
PCB-1248	mg/kg	0.030	ND	03/14/91 :
PCB-1254	mg/kg	0.030	ND	03/14/91 :
PCB-1260	mg/kg	0.030	ND	03/14/91 :

MDL Method Detection Limit
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April 05, 1991
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Trempealeall NWR

Parameter	Units	MDL	Tremp-8	DATE AND TIME ANALYZED	
PACE Sample Number:			10 008444		
Date Collected:			02/28/91		
Date Received:			03/01/91		
SUBCONTRACT ANALYSIS					
INDIVIDUAL PARAMETERS					
Moisture	%	0.01	21	03/05/91	:
Particle Size Sieve No.200 (passing)	%	1.0	4.4	03/05/91	:
Total Organic Carbon	mg/kg	2200	8400 (SC)	04/02/91	:
INORGANIC ANALYSIS					
INDIVIDUAL PARAMETERS					
Arsenic	mg/kg	1	ND	03/15/91	14:40
Cadmium	mg/kg	0.60	ND	03/16/91	13:33
Chromium	mg/kg	1.0	1.5	03/16/91	13:33
Copper	mg/kg	0.50	1.4	03/16/91	13:33
Cyanide, Total	mg/kg	0.5	ND	03/06/91	16:00
Lead	mg/kg	4.5	ND	03/16/91	13:33
Manganese	mg/kg	0.20	93	03/16/91	13:33
Mercury	mg/kg	0.02	ND	03/22/91	10:30
Nickel	mg/kg	2.1	ND	03/16/91	13:33
Nitrogen, Ammonia	mg/kg	20	84	03/05/91	15:00
Selenium	mg/kg	0.5	ND	03/13/91	09:05
Solids, Percent Total	%	0.1	82	03/04/91	10:30
Solids, Percent Volatile	%	0.01	0.50	03/06/91	06:30
Zinc	mg/kg	0.60	4.2	03/16/91	13:33
ORGANIC ANALYSIS					
ORGANOCHLORINE PESTICIDES AND PCBS-8080					
Date Analyzed			03/14/91		
Aldrin	mg/kg	0.002	ND	03/14/91	:
a-BHC	mg/kg	0.002	ND	03/14/91	:
b-BHC	mg/kg	0.004	ND	03/14/91	:
g-BHC (Lindane)	mg/kg	0.002	ND	03/14/91	:
d-BHC	mg/kg	0.005	ND	03/14/91	:

MDL Method Detection Limit
ND Not detected at or above the MDL.
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PACE Sample Number:			10 0084441		
Date Collected:			02/28/91		
Date Received:			03/01/91		
Parameter	Units	MDL	Tremp-8	DATE AND TIME ANALYZED	
ORGANIC ANALYSIS					
ORGANOCHLORINE PESTICIDES AND PCBS-8080					
Chlordane (tech)	mg/kg	0.10	ND	03/14/91	:
4,4'-DDD	mg/kg	0.013	ND	03/14/91	:
4,4'-DDE	mg/kg	0.006	ND	03/14/91	:
4,4'-DDT	mg/kg	0.009	ND	03/14/91	:
Dieldrin	mg/kg	0.004	ND	03/14/91	:
Endosulfan I	mg/kg	0.002	ND	03/14/91	:
Endosulfan II	mg/kg	0.005	ND	03/14/91	:
Endosulfan Sulfate	mg/kg	0.032	ND	03/14/91	:
Endrin	mg/kg	0.013	ND	03/14/91	:
Endrin aldehyde	mg/kg	0.20	ND	03/14/91	:
Heptachlor	mg/kg	0.002	ND	03/14/91	:
Heptachlor epoxide	mg/kg	0.002	ND	03/14/91	:
Methoxychlor	mg/kg	0.052	ND	03/14/91	:
Toxaphene	mg/kg	0.30	ND	03/14/91	:
PCB-1016	mg/kg	0.030	ND	03/14/91	:
PCB-1221	mg/kg	0.030	ND	03/14/91	:
PCB-1232	mg/kg	0.030	ND	03/14/91	:
PCB-1242	mg/kg	0.030	ND	03/14/91	:
PCB-1248	mg/kg	0.030	ND	03/14/91	:
PCB-1254	mg/kg	0.030	ND	03/14/91	:
PCB-1260	mg/kg	0.030	ND	03/14/91	:

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April 05, 1991
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Trempealeall NWR

The data contained in this report were obtained using EPA or other approved methodologies. All analyses were performed by me or under my supervision.

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APPENDIX B

HYDRAULIC DESIGN

APPENDIX B

HYDRAULIC DESIGN

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GENERAL

1. Trempealeau National Wildlife Refuge is located in Buffalo and Trempealeau Counties, Wisconsin, in Pool 6 of the upper Mississippi River from about River Mile 718 to River Mile 725. The Mississippi River borders the refuge to the southwest, and is separated from the refuge by the Burlington Northern Railroad (BNRR) embankment. The Trempealeau River borders the refuge to the north and east, and is separated from the refuge by a series of barrier dikes constructed when the river was diverted around the current refuge lands during the early 1900's when the lands were in private ownership. To the northwest, the refuge is bordered by State Trunk Highway (STH) 35 and the high bluffs beyond. To the west, the refuge is bordered by a service road, called Upper Farm Road, and adjoining high ground. The location of the refuge in the upper Mississippi Valley is shown in Plate B-1; a close-up of the refuge in its existing condition is shown in Plate B-2. The physical make-up of the border conditions has the effect of isolating the refuge from the Mississippi and Trempealeau River systems. The western and central areas of the refuge contain large areas of aquatic vegetation; the eastern end of the refuge is mostly open. Because this area is deeper than the rest of the refuge, and because it is large enough to be subject to long wind fetches from the two most prevalent wind directions, it is subject to wave action which inhibits aquatic plant growth and promotes turbidity.

2. The proposed project will take advantage of the refuge's isolation from the Mississippi and Trempealeau River systems to enable the U. S. Fish and Wildlife Service to manage the refuge for the enhancement of waterfowl and game fish habitat. This will be done through a system of dikes, culverts, and pumps. For planning purposes, the refuge has been divided into four general areas. These are identified as Pool A, Pool B, Pool C, and Pool E, and are shown in Plate B-3. As the management plan was developed, Pool E was further subdivided into upper and lower pools. An additional area, currently owned by Dairyland Power Cooperative, has been designated as Pool F. This area could be included in the project if efforts to purchase it for the refuge are successful; at the current time this effort is on hold, so it will not be included in the detailed discussion that follows. The locations of these and other water management features are shown in Plate B-3. Pool A is to be separated from Pool B by a dike to be constructed between the southeasternmost end of Kiep's Island and the BNRR embankment. Water surface elevations in Pool A will then be controlled by an existing water control structure outletting to the Trempealeau River, a gate through the proposed dike, and a pump station to be constructed along the dike near where it joins the BNRR embankment. This station will have the capability of pumping water into the Mississippi River from either Pool A or Pool B. It will be primarily used to periodically draw down Pool A to expose portions of its bed in the hope of aiding the establishment of vegetation, or to eliminate excess rough fish populations; it will sometimes be used to drain excess water from Pool B in the spring when Pool A would be held down. A weir and culvert will be used to re-fill Pool A from Pool B after a drawdown period, and to route water from Pool to Pool during off-operation. Pool B is already separated from Pool E by the Green Bay and Western (GB&W) railroad embankment. Upper Pool E will be managed for maximum habitat flexibility. An abandoned road will be upgraded to serve as a dike, a portable pump will raise water levels by pumping water in from lower Pool E, and a gated culvert will release water back into

lower Pool E. Pool C will be managed as part of Pool B, except for a portion of both Pool B and Pool C in their northwest corner common area, which will be enclosed by a dike. This is an area that the private non-profit conservation organization, Ducks Unlimited (DU), had proposed for management by them as a moist soil unit. Their plans were dropped because of cost, and the area will now be managed by the Fish and Wildlife Service in a similar way. It will hereafter be referred to as the C2 pool, and the dike enclosing it as the C2 dike. The water level in the C2 pool will be periodically raised by alternately allowing inflow into the pool from the Trempealeau River through a gated culvert and pumping water from Pool B using a portable pump, and re-lowered by releasing the water back into Pool B through a gated culvert to be placed through the proposed dike. Pool B is connected to lower Pool E by an at-grade box culvert under the GB&W embankment. Pool B, Pool C, and lower Pool E can be treated as one system, except for the area enclosed by the C2 dike. Except for elevation changes resulting from management of the other pools (which will be as small and infrequent as possible), this system will be allowed to rise and fall naturally.

HYDROLOGIC MASS BALANCE

3. A hydrologic mass balance analysis was performed for existing conditions in the refuge. The purpose of this analysis was to attempt to estimate the impact of groundwater exchange on the hydrologic condition of the existing refuge pool, so as to account for this exchange in project design and management. An existing mass balance model developed using the 20/20 spread sheet computer program was modified for the Trempealeau National Wildlife Refuge and used in the analysis. This model is based on continuity as applied to the refuge, i.e.

$$Rv + Pv - Ev - dS - Og + G = 0 \qquad (1)$$

where

Rv - volume of runoff from watersheds draining into the refuge, primarily from the bluffs across STH 35 from the refuge, as determined from measured precipitation using Soil Conservation Service (SCS) methods;

Pv - volume of direct precipitation onto the open waters of the refuge;

Ev - volume of evaporation from the surface of open water areas, as estimated from pan evaporation measurements at Lock and Dam 6;

dS - change of storage in the refuge pool, based on refuge elevation changes as measured in the field and a morphometric equation describing the shape of the pool;

Og - gravity outflow (or inflow) through Trempealeau River water control structure when open (= 0 when structure is closed);

G - groundwater exchange.

All of the above except groundwater exchange can be determined, either by direct measurement or indirectly through calculation, from field information. The

groundwater exchange term, G, as used here, includes all possible groundwater sources and sinks. For the Trempealeau National Wildlife Refuge, the known sources are artesian wells, seepage through the railroad embankment and diversion dikes, and subsurface inflow off the bluffs. The ideal situation would be to be able to break down the groundwater exchange into the contributions of each of these components. However, field conditions are such that the only components for which a specific contribution can be estimated are the artesian wells. For these, capacity estimates based on measurements taken for similar wells in neighboring Perrot State Park allow for a conclusion that their contribution can be neglected. Therefore, groundwater exchange for this area will be assumed to mean total net groundwater inflow (or outflow) across the perimeter of the refuge.

4. Measured hydrologic data used in the mass balance analysis were daily precipitation, daily refuge water surface elevation, daily pan evaporation, and total refuge drainage area. Daily precipitation measured at Lock and Dam 6 was used to estimate daily runoff using procedures given in the SCS Engineering Handbook (Reference 3). Precipitation for a given day and the 4 preceding days was added, and an antecedent moisture condition (AMC) was estimated using the following criteria:

5-day accumulated precip. < 1.4"	AMC = 1	CN = 51
1.4 < 5-day accumulated precip. < 2.1"	AMC = 2	CN = 70
5-day accumulated precip. > 2.1'	AMC = 3	CN = 85.

The SCS curve number (CN) was estimated for each AMC using criteria given in SCS TR-55 (Reference 4). The daily runoff was then calculated using the following relation:

$$r = \begin{cases} 0 & p <= Ia \\ \{p-0.2*[(1000/CN)-10]\}**2/\{p+0.8*[(1000/CN)-10]\} & p > Ia \end{cases} \quad (2)$$

where: r - daily runoff in inches;
p - daily precipitation in inches, measured at Lock and Dam 6;
CN - SCS runoff curve number;
Ia - initial abstraction, given by Ia = 0.2*[(1000/CN)-10].

The daily water surface elevation was measured at the location identified as Holton's Corner in Plate B-3, and was used to calculate an estimated water surface area, in acres, based on an approximate linear relation developed from the Pool 6 flowage surveys. From this, the direct precipitation volume Pv, in acre-feet per day, was calculated by multiplying the water surface area by the daily precipitation, with appropriate unit conversions. Contributing drainage area in acres was calculated by subtracting the water surface area from the total drainage area of the refuge as determined by planimeter. The runoff volume Rv in acre-feet per day was then found by multiplying the contributing drainage area by the computed daily runoff, r, computed in Equation (2), with appropriate unit conversions. Daily pan evaporation measured at Lock and Dam 6 was used to calculate the evaporation volume Ev, in acre-feet per day, using the relation:

$$Ev = 0.8 * Ep * \text{water surface area} * \text{unit conversions} \quad (3)$$

where Ep - pan evaporation in inches, measured at Lock and Dam 6. Change in Storage dS between two days m and n (n being the later) was calculated by estimating the volume of water in the refuge for days m and n using a morphometric equation, then subtracting the volume for day n from the volume for day m. The gravity outflow Og, when applicable, is found either by using a rating curve or by direct measurement. Once these five volume quantities were known, the groundwater exchange G was found using Equation (1), rearranged as

$$G = dS + Ev - Pv - Rv + Og$$

Three forms of G were considered: a daily value based on daily mass balance (m=n-1 in the storage discussion above); a 5-day running mean based on the daily values; and a continuous mean based on the total change in storage from day m=1, total runoff, total precipitation, and total evaporation. All three of these groundwater exchange quantities were computed by the 20/20 mass balance model.

5. The daily groundwater exchange and the 5-day running mean groundwater exchange were developed with the intention of finding a relationship between groundwater exchange and measured hydrologic quantities such as rainfall and head differential between the rivers and the refuge. However, graphic comparisons between groundwater exchange and these quantities showed only the most general trend toward groundwater flow into the refuge either after a significant rainfall period or with river stages higher than refuge stages. Therefore, specific relations of this kind were not developed, and it was decided to use the continuous mean groundwater exchange as a single value for design purposes.

6. Four periods of record were chosen for study using the 20/20 mass balance model. These were 25 June through 22 September, 1987; 1 June through 30 September, 1988; 7 July through 17 September, 1989; and 20 July through 26 October, 1990. These periods were chosen based on the time of year (i.e. warm season), availability of reliable hydrologic data, and also because, during these periods, the water control structure outletting to the Trempealeau River was closed (Og = 0), making it easier to isolate the groundwater exchange in the computations. The results of the computations showed a range of seasonal daily average groundwater inflow values from 3.80 cfs to 9.68 cfs. The value for the 1989 time period, 9.68 cfs or 4356 gallons per minute (gpm), was the largest value computed. This figure, rounded upward to 5000 gpm, was used as part of the design criteria for sizing the permanent Pool A pumping station.

DESIGN OF HYDRAULIC FEATURES

7. POOL B - POOL A DIKE. This dike will separate the existing open water area into two pools, Pool A and Pool B (See Plate B-3). The purpose of this separation is to manage Pool A so that waterfowl and game fish habitat can be enhanced, while allowing Pool B, which has good habitat, to be left as is. Two dike designs have been prepared. Both have 15-foot top widths, with one consisting of rock revetment to stabilize the dike, the other being a "low" berm design with rock groins. The latter design would include a 6-inch topsoil layer on top of the berms to allow for vegetation growth. Rock groin protection is needed for this design because the dike will be exposed to excessive wave action. The berm-groin design has been chosen as the preferred alternative

because it has a somewhat lower cost. It is also more environmentally sound in that it is more aesthetically satisfying and offers some habitat diversity potential. Both design alternatives will provide for an access road on the dike for the maintenance of a permanent pumping station and associated channel, weir, and gate structures. Cross-sections for these designs are shown in Plate B-4; a cross-section of the groin which is part of the berm-groin design is shown in Plate B-17. Design details are listed in Table B-1.

8. C2 DIKE. This dike will define the area described earlier as the C2 pool. The C2 pool will generally be dry during normal conditions. It will be managed to promote aquatic vegetation growth and to provide feeding areas for waterfowl and shore birds. This dike will consist entirely of new construction, and will be constructed of fill material deposited on a geotextile filter bed. The top of the dike will serve as an access road for the maintenance of a gated culvert and portable pump. The cross-section for this proposed dike is shown in Plate B-5. Design details are listed in Table B-1. Because this dike will not be exposed to wave action there is no need for rock protection. However, topsoil and seeding will be used to promote vegetation growth.

9. UPPER POOL E - LOWER POOL E DIKE. This dike will divide Pool E into upper and lower units (See Plate B-3). Upper Pool E will then be managed for maximum habitat flexibility. The dike will be established by upgrading an existing abandoned road between the GB&W railroad embankment and Upper Farm Road. The top of this dike will serve as an access road for the operation and maintenance of a gated culvert and portable pump. The cross- section for this proposed dike is shown in Plate B-6. Design details are listed in Table B-1. As for the C2 dike, no rock protection will be required and topsoil and seeding will be used to promote vegetation growth.

10. EMERGENCY SPILLWAYS. Emergency spillways will be constructed over all of the proposed dikes. Their purpose is to provide an overflow section that would prevent failure of the greater dike system due to excessive inflow either from excessive rainfall on the bluffs or the Trempealeau River culvert into the C2 pool being inadvertently left open. The emergency spillways will consist of notches 200 feet long at elevation 651 (+-0.3) for the C2 dike and the Pool B-Pool A dike, and 649 (+-0.3) for the upper Pool E - lower Pool E dike (all elevations refer to the 1912 datum). Geotextile reinforcement will be placed on the top and sides and overlain by the gravel road on top, and further reinforced with rock revetment on the downstream side. A plan view, profile, and cross-section of this proposed feature is shown in Plate B-7. The preferred location along the dikes would be one which is easily accessible for future maintenance if overtopping were to cause the loss of some road material.

11. PERMANENT PUMPING STATION. Pool A will be drawn down using a 22,000 gpm permanent pumping station. This station will consist of twin 11,000 GPM pumps, and be located in the dike near the BNRR embankment. Pump station capacity was selected to complete a two-foot drawdown of Pool A in no more than 20 days, taking both Pool A volume and the assumed 5000 GPM groundwater inflow into account. Design of the station was based on criteria given in EM 1110-2-3102, EM 1110-2-3105, and the Flygt Technical Specification and Application Manual (References 5 through 7). A detailed discussion of the mechanical design of the station is given in the main report. An elevation-storage curve for Pool

A is given in Plate B-8.

12. PORTABLE PUMPS. Upper Pool E will be drawn up using a 9000 GPM portable pump station. Pump station capacity was selected to complete a two-foot draw-up of upper Pool E in not more than 21 days. A similar system will be available to draw up the C2 pool when use of inflow from the Trempealeau River is not practical. The pumps will be single units transported onto the dikes enclosing the pools by motorized tow, and operated using 3-phase electric power. A detailed discussion of the mechanical design of the pumps is given in the main report. Elevation-storage curves for upper Pool E and the C2 Pool are given in Plates B-9 and B-10, respectively.

13. CULVERTS. Reinforced concrete pipe (RCP) culverts equipped with either stoplog closures or slide gates will be placed through the C2 and upper-lower Pool E dikes. There will also be a culvert, similarly equipped, under the existing dike separating the C2 pool from the Trempealeau River. A 3'X6' reinforced concrete box culvert will convey water from Pools A and B to the proposed pumping station. It will be equipped with a slide gate on the Pool A side and be headed by a stoplog weir and inflow crib on the Pool B side (see Paragraph 14). It will serve the dual purpose of flow exchange between Pool A and Pool B when the project is not operating, and as a re-fill conduit for Pool A from Pool B after a drawdown period, as needed. The culverts through the C2 dike and upper Pool E - lower Pool E dike will be used to drain the C2 pool and upper Pool E after draw-up periods for these pools; they will be open when the project is not operating. The culvert from the Trempealeau River into the C2 pool will be used to raise the C2 pool with inflow from the Trempealeau River when water quality conditions in the river are acceptable. This culvert will be closed at all other times. Design details for these conduits are given in Table B-2. Rating curves for the C2 Pool culvert and the upper-lower Pool E culvert are given in Plate B-11. A plan view of the Pool B-Pool A channel layout is shown in Plate B-12. All culverts were sized using criteria given in TM 5-820-4 (Reference 8). The invert elevations given were chosen based on the best currently available topographic and bathymetric information. Besides these, there are existing culverts into lower and upper Pool E from outside the refuge, and between Pool B and Pool C away from the C2 Pool. These will all be left in place.

14. POOL B - POOL A INFLOW CRIB. One cause of high turbidity and resulting inhibited aquatic plant growth is thought to be rough fish activity. A secondary management goal for Pool A of reducing or eliminating rough fish populations to whatever extent possible has been established. The capability for lowering Pool A would provide a means to eliminate rough fish in Pool A. The Pool B - Pool A dike will inhibit the migration of rough fish into Pool A but would not completely stop this migration because of the flow exchange between Pool B and Pool A when a drawdown is not in progress. Therefore, an additional feature was added to further inhibit the migration of rough fish between the pools. This is a stoplog-controlled inflow crib immediately upstream (i.e. Pool B side) of the Pool B - Pool A channel. Design of this crib is shown in Plate B-13. Its purpose will be to provide a barrier between Pool B and Pool A, with four bays in the barrier in which stoplogs will be placed. The number of stoplogs in the bays (and hence the effective height of the barrier) would be set to form weirs to provide whatever flow into the crib, and thence into the channel, is desired

during refill of Pool A after a drawdown. It is intended that the stoplogs will be set so that the barrier will be as high as possible, and that the flow over the stoplogs will be as shallow as possible, to achieve the desired inflow while blocking as much as possible the movement of fish with the flow. Curves for the flows over various combinations of heads across the stoplogs are shown in Plate B-14. From these curves, and a knowledge of conditions in Pool B, it can be determined what combinations of stoplog settings will be required to achieve the desired operational goals. During off-operation, when there will be free exchange of water between the pools, the stoplog weirs should be set as high as possible without completely blocking flow between the pools at the equilibrium elevation; this situation will need to be estimated in the field.

15. EROSION PROTECTION. Erosion protection will be required at all culvert outlets, since exit velocities, while not excessive, will be high enough to cause scour. Protection will be in the form of a horizontal blanket of riprap. The dimensions of the horizontal blanket assume a high tailwater situation at all outlets. Minimum hydraulic design requirements are given in Table B-3 and Plate B-15. These minimum requirements are in accordance with WES TR H-74-9, EM 1110-2-1601, and ETL 1110-2-120 (References 9 through 11). Notwithstanding these minimum requirements, a gradation of riprap in general use at projects in the region (Reference 12) will be available for this project, also. It is intended to be used for the Pool B - Pool A dike, and can also be used for the culvert outlets. This riprap is used in an 18-inch layer, and can be placed in the blanket dimensions that have already been determined. The gradation is shown in Plate B-16. Erosion protection is also recommended for the river side of Kiep's Island (See Plate B-3), since this shore is subject to wave erosion and is known to contain valuable archaeological sites. Protection in the form of rock fill is recommended for this shore to minimize disturbance during construction. A typical cross-section is shown in Plate B-17. Erosion protection in the form of an 18-inch layer of riprap is also required for the Pool B - Pool A channel. The same gradation of rock used for other elements of the project can also be used for this channel.

PLAN OF OPERATION

16. POOL A. The main management goal of Pool A is the establishment and maintenance of an aquatic plant community through periodic drawdowns of Pool A, about once every 6 to 8 years, which will expose shallow areas to the air in order to promote seed germination. A secondary objective will be, about once every 15 to 20 years, to reduce or eliminate rough fish populations. The preferred time for the drawdown of Pool A for the main goal is from mid-summer through early to mid-fall, since this time provides the best opportunity for vegetation to become established. The best conditions for operation are pool elevation near 646 and normal antecedent precipitation, although the only occasion when it absolutely should not be done is during high water in the refuge. The usual initial operating condition will be for the stoplog weirs to be set as high as possible without blocking free exchange of water at the equilibrium elevation, the Pool A slide gate to be open, and the pump station to be turned off. The existing Trempealeau River water control structure could be open or closed, depending on river conditions. Once a decision is made to draw down Pool A, all stoplogs are lowered into place at the crib, the existing Trempealeau River water control structure is closed if it is open, and the pump

station is activated. Drawdown can be expected to take between 2 and 3 weeks to complete. When Pool A has been drawn down to elevation 644, the pump station is turned off. Conditions in Pool A are then monitored with an eye toward unexpected raises in elevation which could hinder the desired vegetation growth. If, because of heavy rainfall and/or unexpectedly high groundwater inflow, Pool A rises above elevation 644.5, the pump station will be re-activated and kept on until Pool A drops below elevation 644, at which time it will once again be turned off. Pool A will be maintained in this way for at least 2 to 3 months after drawdown is completed. When it is decided that the summer management objectives for Pool A have been met, there are two options, depending on what additional management goals the Fish and Wildlife Service has for the year. If the only goal was to promote aquatic vegetation, then there is no need to continue the drawdown. The appropriate number of stoplogs are removed to give the desired flow over the stoplog weirs, and Pool A will be allowed to re-fill. It can be expected to take about one month for Pool A and the Pool B system to reach equilibrium, based on sample calculations using recent historic data (1987 through 1990). These same calculations also show that, relative to actual observed conditions for the sample years, little or no loss of Pool B elevation would have occurred in these years. One set of sample calculations, using data for June through September, 1988, is provided in tabular form as Table B-4, and in graphic form as Plate B-18. The drop in Pool B elevation at the end of the period can be attributed to drought conditions which occurred during the period, and is consistent with existing refuge stage records for the period. If, on the other hand, the additional management goal of eliminating rough fish exists, then Pool A is left drawn down, with all stoplogs in place, and the pump station operated as needed until freeze-up, then shut down for the winter. In this case, either the stoplog system is set at the beginning of the next high water season to prevent the excessive head differential that can be expected to occur as the combination of snowmelt and spring rains causes Pool B to rise, or the permanent pumping station is used to remove excess spring runoff from Pool B, and Pool A is allowed to rise gradually through the combination of precipitation, snowmelt, seepage, and inflow from springs. If excess water is to be pumped from Pool B, the Pool A slide gate is closed and all stoplogs are removed from the stoplog weir before the pump station is turned on. Once the pumping operation is completed, the pumps are turned off, the stoplog weir is re-set to have the shallowest possible depth at its crest, and the Pool A slide gate is re-opened. The choice of whether or not to use the pumping option to draw down Pool B will be a management decision made in the field at the time.

17. UPPER POOL E. This pool is to be managed for maximum habitat flexibility. That is, the Fish and Wildlife Service wants the ability to raise and lower upper Pool E to accomplish a variety of objectives including discouraging undesirable plant growth, encouraging desirable plant growth, and enhancing habitat for selected waterfowl such as puddle ducks; these objectives will often overlap. Upper Pool E can therefore be managed throughout the year, depending on the specific goal at the time; it is expected that it will be operated most often in the fall. As with Pool A, a general initial condition of elevation 646 and normal antecedent precipitation is optimal. Operation is possible during high water conditions in the refuge, but would probably not be necessary during these times because much of the area which would be flooded by the operation would already be underwater. The usual initial operating condition will be for the outlet culvert through the dike to be open. When a decision is made to

raise upper Pool E, the exit culvert will be closed and the portable pump station moved into place and turned on. Upper Pool E is to be raised to elevation 648. This will take about 3 weeks. Once the target elevation is reached, the portable pump station will be turned off. The pool will then remain raised for 2 to 3 months. When it has been decided that the management objectives have been met, the exit culvert will be opened and the pool will be allowed to drain. It can be expected to take about 3 weeks for upper Pool E to reach equilibrium with the Pool B - lower Pool E system. Because the volume of water being exchanged is small compared to the total volume of the Pool B -lower Pool E system, operation of upper Pool E is not expected to have an adverse impact on this system.

18. C2 POOL. This pool is to have the capability for maximum habitat and water management flexibility and for year-round operation, similar to upper Pool E. As with Pool A and upper Pool E, a general initial condition of elevation 646 and normal antecedent precipitation would be considered optimal. The proposed target elevation for the C2 pool is 650. The C2 pool can be raised in either of two ways. When water quality conditions are acceptable on the Trempealeau River, water will be allowed to flow into the pool through the Trempealeau River culvert. When they are not, a 9000-GPM portable pump will be used to pump water into the pool from Pool B. Because of the small volume of the C2 pool relative to Pool B, adverse impacts of this pumping on the Pool B system will be minimal. There is also the possibility that alternate use of gravity flow and pumping will be required if conditions on the Trempealeau River change during operation. This could take the form of rising discharge on the Trempealeau River, indicating potential deteriorating water quality, or very low flow on the river. The 10 year 7-day low flow discharge for the Trempealeau River at Dodge, Wisconsin, is 132 cfs; the design flow through the culvert is 20 cfs, or about .15 of this discharge. This will need to be considered in a decision whether to use gravity inflow or the pump to raise the C2 Pool, although, in general, the system will not be operated during a season when very low flow is anticipated.

19. A typical operating sequence would start with an initial condition of the outlet culvert into Pool B being open and the inlet culvert from the Trempealeau River being closed. It has been determined that a previous day's discharge of 400 cfs in the Trempealeau River at Dodge, Wisconsin, with either a steady or decreasing trend, should be the initial start-up criteria; a discharge greater than 400 cfs and/or a rising trend would suggest significant upstream agricultural runoff and associated water quality problems. An additional check of local water quality conditions using some easily monitored water quality indicator such as Secchi Disk depth is also recommended. Once a decision to start operation is made, the outlet culvert will be closed, the portable pumps moved into place, and the inlet culvert opened. From this point onward, the Trempealeau River is to be monitored on a regular basis (at least twice a day is recommended) for two conditions: the discharge at Dodge and Secchi Disk depth (or similar local water quality indicator) near the culvert intake. If this proposed monitoring were to indicate a rising discharge in excess of 400 cfs, or a decrease in Secchi Disk depth below a predetermined threshold value, then the inflow culvert will be closed and the pumps turned on. The raise of the C2 pool will then continue by pump either until water quality and discharge conditions on the Trempealeau River are again acceptable, at which time the pumps will be turned off and the inflow culvert re-opened, or the raise is

complete. It is expected that the combined operation of culvert and pumps to raise the elevation of the C2 Pool to 650 will take about 11 to 12 days. When elevation 650 is reached, the raise will be complete, and either the culvert will be closed or the pumps turned off, whichever is in operation at the time. The elevation will then be held at 650 for the length of time required to achieve operational goals.

20. Once elevation 650 is reached, it will need to be monitored during the ice-free season for the possibility of lowering due to seepage outflow and/or evaporation. Were the elevation to drop 0.5 feet below the target elevation, then either the pumps would need to be turned on or the inflow culvert reopened to raise the pool back to the target elevation, depending on conditions in the Trempealeau River. Once the operational goals are achieved, the outflow culvert will be opened and Pool C will be allowed to drain until it reaches equilibrium with the Pool B system. For a Pool B system elevation of 646, this is expected to take about 8 to 9 days. As with the raise, no significant adverse impact on the Pool B system is anticipated.

21. GAGE NETWORK. The Fish and Wildlife Service has established a network of staff gages through the refuge and along the Trempealeau River. The purpose of this network is to obtain river and refuge stage information for use in making operational decisions, and to have a regular record of conditions in and near the refuge. Gages have been set at four places in the refuge and two places along the Trempealeau River. The refuge gages are identified as Upper Farm Road, School Bus Point, Holton's Corner, and the refuge side of the Trempealeau River water control structure. The Trempealeau River gages are identified as Lower Farm and the river side of the water control structure. These locations are shown in Plate B-3. They are subject to change, including additions and subtractions, if future monitoring requirements dictate.

22. FUTURE INCLUSION OF POOL F. The hydraulic design and plan of operation given in this appendix is for the refuge in its current configuration. There is the possibility that an additional area will be purchased for the refuge. This area is west of the current refuge boundary at Upper Farm Road, between TH 35, the BNRR tracks, and an old access road, and has been designated as Pool F. Should this area be purchased and included in the refuge, it will provide additional management opportunity, and additional management responsibility, for the refuge. At this time, two management scenarios are envisioned for Pool F. One is to leave the connections between Pool F and lower Pool E as they are and manage Pool F, lower Pool E, Pool C, and Pool B (aside from the C2 pool) together in an essentially as-is state. The other is to block the flow into lower Pool E from Pool F, divert flow from Pool F into upper Pool E, probably by means of a gated culvert, and manage Pool F either separately or as part of upper Pool E. At this time no definite plan for possible future management of Pool F will be introduced, since plans for its purchase are not currently being pursued. Inflow into the refuge from the Pool F area has been treated as part of the base flow condition in the preceding analyses.

23. STAGE-DURATION CURVE. The stage-duration curve for the Mississippi River at Lock and Dam 6 - Pool is shown in Plate B-19. There is no stage-duration curve for the Trempealeau River near the refuge due to the absence of a formal record in that area.

REFERENCES

1. Problem Appraisal Report for Trempealeau National Wildlife Refuge Habitat Rehabilitation and Enhancement Project, U. S. Army Corps of Engineers, St. Paul District, November 1990.

2. Master Plan for Trempealeau National Wildlife Refuge, Fish and Wildlife Service, U. S. Department of the Interior, May 1982.

3. National Engineering Handbook, Section 4, Hydrology (NEH-4), Soil Conservation Service, U. S. Department of Agriculture, 1972.

4. TR-55, Urban Hydrology for Small Watersheds, Engineering Division, Soil Conservation Service, U. S. Department of Agriculture, June 1986.

5. EM 1110-2-3102, General Principles of Pumping Station Design and Layout, U. S. Army Corps of Engineers, Office of the Chief of Engineers, December 1962.

6. EM 1110-2-3105, Mechanical and Electrical Design of Pumping Stations, U. S. Army Corps of Engineers, Office of the Chief of Engineers, July 1990.

7. Flygt PL-7000 Propeller Pumps Technical Specification and Application Manual.

8. TM 5-820-4, Drainage for Areas Other than Airfields, Department of the Army, Headquarters, July 1965.

9. WES Technical Report H-74-9, Practical Guidance for Design of Lined Channel Expansions at Culvert Outlets, U. S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi, October, 1974.

10. EM 1110-2-1601, Hydraulic Design of Flood Control Channels, U. S. Army Corps of Engineers, Office of the Chief of Engineers, July 1970.

11. ETL 1110-2-120, Additional Guidance for Riprap Channel Protection, U. S. Army Corps of Engineers, Office of the Chief of Engineers, May 1971.

12. Specifications for Pool 8 Island Construction, Phase 1, Stage 2, U. S. Army Corps of Engineers, St. Paul District, August, 1991.

TABLE B-1

Details of Dike Design

Dike	Crest Elevation +-0.5' Tolerance	Top Width (feet)	Side Slope	Erosion Protection
Pool B - Pool A Rock	650	15	1V:3H	18" riprap (see Plate B-4)
Pool B - Pool A Berm	650	15	variable (see Plate B-4)	vegetation, beach, and rock groins
C2 dike	652	15	1V:5H	topsoil plantings or natural revegetation
upper Pool E - lower Pool E	650	15	1V:5H	topsoil plantings or natural revegetation

TABLE B-2

Details of Culvert Design

Culvert	Number of Culverts	Dimensions	Length (feet)	U/S Invert Elevation	D/S Invert Elevation
Pool B - Pool A Culvert	1	3'X6' box	130	642.0	642.0
C2 Pool - Pool B Culvert	1	30" dia.	100	644.5	644.5
upper Pool E - lower Pool E Culvert	1	30" dia.	100	643.5	643.5
Trempealeau River - C2 Pool Culvert	1	30" dia.	100	648.0	646.0

Note: All elevations refer to NGVD, 1912 adj.

TABLE B-3

Minimum Erosion Protection Requirements at Culvert Outlets

Culvert	Layer Thickness (inches)	Gradation	Dimensions in Feet (See Plate B-15): Lsp	Wsp	3Wo
Pool B - Pool A	12	LA	40.3	23.3	7.5
C2 Pool - Pool B	12	LA	40.3	23.3	7.5
upper-lower Pool E	12	LA	40.3	23.3	7.5
Trempealeau River-C2 pool	18	LB	40.3	23.3	7.5

Gradations:

LA		LB	
pct finer by weight	wt limits in pounds	pct finer by weight	wt limits in pounds
100	86-35	100	169-67
50	26-17	50	50-34
15	13-5	15	25-11

TABLE B-4

Sample Calculations for Pool B - Pool A System Operation for 1988

TREMPEALEAU EMP
TREMPEALEAU NATIONAL WILDLIFE REFUGE
POOL A MANAGEMENT PLAN - DRY SEASON OF HISTORIC DATA
6/1 through 9/30, 1988
1.3 CFS = BASE FLOW INTO POOL A
3.2 CFS = BASE FLOW INTO POOL B SYSTEM

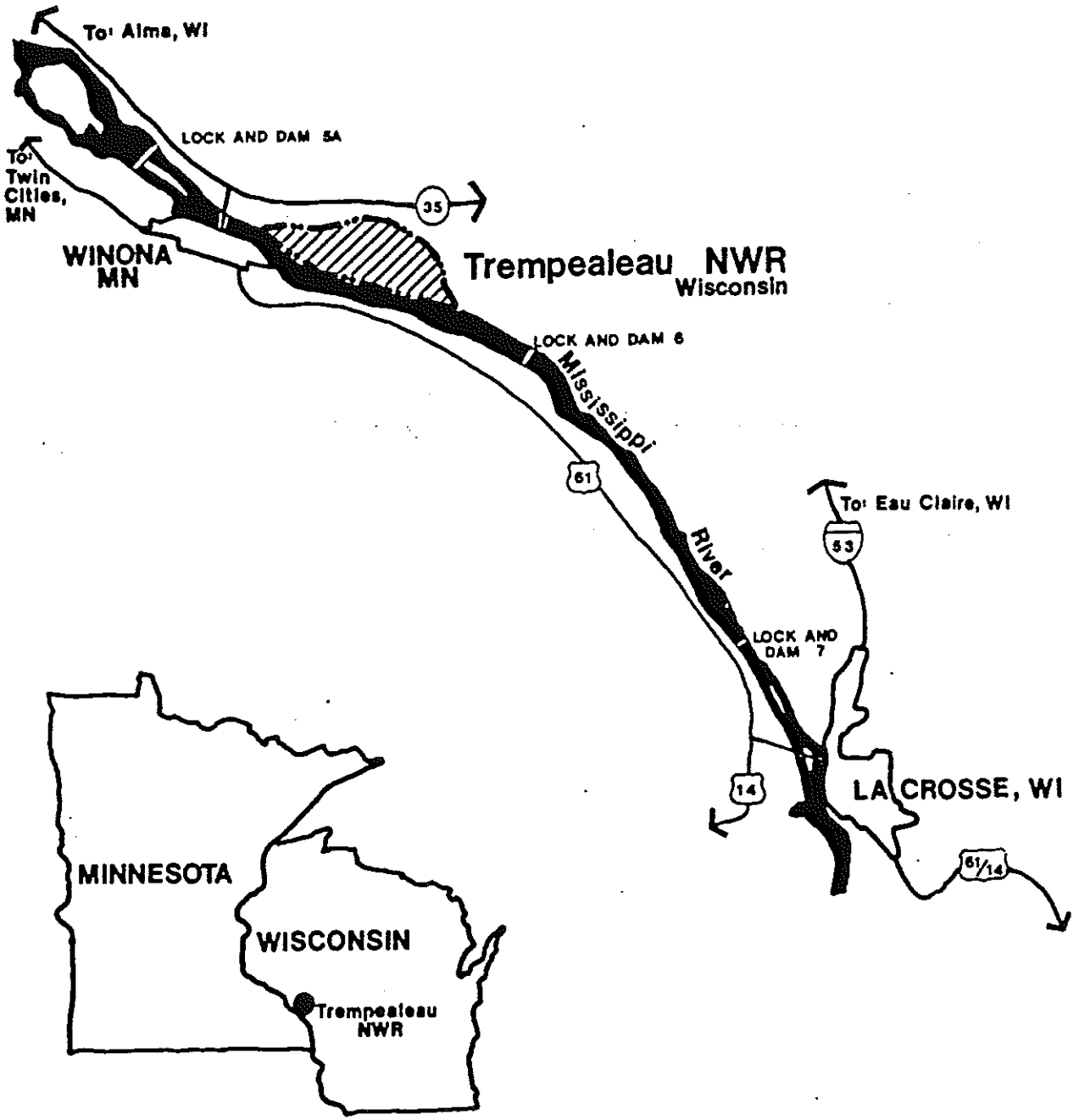
DATE	STARTING POOL A ELEV. 1912DATUM	STARTING POOL B ELEV. 1912DATUM	DAILY PRECIP INCHES	5-DAY TOTAL PRECIP INCHES	AMC	SCS CURVE NUMBER	RUNOFF INTO POOL B ACFT/DAY	PAN EVAP INCHES	POOL A EVAP LOSS ACFT/DAY	POOL B EVAP LOSS ACFT/DAY	DIV-ERT DIVERT 1=YES 2=NO	PUMP ONT 1=YES 0=NO	DIVERT FLOW CFS	PUMP RATE CFS	VOLUME CHANGE POOL A ACFT	VOLUME CHANGE POOL B ACFT	NEW POOL A VOLUME ACFT	NEW POOL B VOLUME ACFT	NEW POOL A ELEV 1912DATUM	NEW POOL B ELEV 1912DATUM
6/1	645.54	645.54		0.00	1	51	0.0	0.37	3.4	8.1	0	1	0.0	52	+104.82	+1.69	2190.43	3815.24	645.41	645.54
2	645.41	645.54		0.00	1	51	0.0	0.18	8.8	20.6	0	1	0.0	52	+110.19	+14.43	2099.71	3799.59	645.27	645.53
3	645.27	645.53		0.00	1	51	0.0	0.25	12.2	28.9	0	1	0.0	52	+113.59	+22.69	1986.63	3775.85	645.12	645.51
4	645.12	645.51		0.00	1	51	0.0	0.28	9.7	23.1	0	1	0.0	52	+111.14	+16.71	1863.99	3757.86	644.98	645.50
5	644.98	645.50		0.00	1	51	0.0	0.28	9.7	23.1	0	1	0.0	52	+111.11	+16.71	1752.58	3739.92	644.84	645.49
6	644.84	645.49		0.00	1	51	0.0	0.19	6.9	11.6	0	1	0.0	52	+106.25	+6.97	1645.63	3723.79	644.70	645.48
7	644.70	645.48		0.00	1	51	0.0	0.15	7.3	17.1	0	1	0.0	52	+108.66	+10.66	1536.66	3721.79	644.56	645.48
8	644.56	645.48		0.00	1	51	0.0	0.18	6.8	11.6	0	1	0.0	52	+106.23	+6.97	1429.75	3715.57	644.43	645.47
9	644.43	645.47		0.00	1	51	0.0	0.58	14.2	34.1	0	1	0.0	52	+115.63	+27.71	1363.59	3686.66	644.28	645.45
10	644.28	645.45		0.00	1	51	0.0	0.36	2.7	6.8	0	1	0.0	52	+104.14	+0.42	1288.94	3644.93	644.14	645.45
11	644.14	645.45		0.00	1	51	0.0	0.17	7.6	19.3	0	1	0.0	52	+109.01	+12.93	1189.61	3670.75	644.01	645.44
12	644.01	645.44		0.00	1	51	0.0	0.39	17.1	44.3	0	1	0.0	52	+118.51	+37.95	1080.39	3631.35	643.85	645.42
13	643.85	645.42		0.00	1	51	0.0	0.24	10.1	27.3	0	0	0.0	0	+7.48	+20.89	1062.39	3609.61	643.86	645.48
14	643.86	645.48		0.00	1	51	0.0	0.37	2.9	8.0	0	0	0.0	0	+0.34	+1.56	1091.53	3606.59	643.87	645.48
15	643.87	645.48		0.00	1	51	0.0	0.37	2.9	8.0	0	0	0.0	0	+0.34	+1.56	1100.66	3603.78	643.88	645.48
16	643.88	645.48		0.00	1	51	0.0	0.26	10.9	29.1	0	0	0.0	0	+8.32	+22.68	1101.84	3579.35	643.88	645.38
17	643.38	645.38		0.00	1	51	0.0	0.31	13.0	34.7	0	0	0.0	0	+10.42	+28.28	1100.90	3550.32	643.84	645.36
18	643.84	645.36		0.00	1	51	0.0	0.10	6.2	11.2	0	0	0.0	0	+1.60	+4.79	1108.78	3544.29	643.89	645.36
19	643.89	645.36		0.00	1	51	0.0	0.37	2.9	7.8	0	0	0.0	0	+0.34	+1.63	1117.92	3541.61	643.91	645.36
20	643.91	645.36	0.31	0.31	1	51	0.0	0.37	3.0	7.8	0	0	0.0	0	16.24	41.92	1163.65	3582.27	643.94	645.38
21	643.94	645.38		0.31	1	51	0.0	0.33	14.2	36.9	0	0	0.0	0	+11.58	+30.51	1161.56	3550.51	643.94	645.36
22	643.94	645.36		0.31	1	51	0.0	0.30	12.9	33.6	0	0	0.0	0	+10.29	+27.16	1163.75	3522.18	643.94	645.36
23	643.94	645.36		0.31	1	51	0.0	0.18	7.7	20.1	0	0	0.0	0	+5.14	+13.75	1165.18	3507.11	643.94	645.33
24	643.94	645.33	0.42	0.73	1	51	0.0	0.18	7.7	20.1	0	0	0.0	0	17.43	44.99	1172.31	3550.35	643.98	645.36
25	643.98	645.36	0.22	0.64	1	51	0.0	0.32	13.8	35.8	0	0	0.0	0	0.67	1.37	1162.16	3550.97	644.00	645.38
26	644.00	645.36		0.64	1	51	0.0	0.48	17.2	44.7	0	0	0.0	0	+14.59	+38.34	1177.56	3511.37	643.99	645.36
27	643.99	645.36		0.64	1	51	0.0	0.15	6.4	16.8	0	0	0.0	0	+3.85	+10.38	1182.70	3499.75	644.00	645.35
28	644.00	645.35		0.64	1	51	0.0	0.28	8.6	22.4	0	0	0.0	0	+5.99	+15.97	1186.19	3482.32	644.00	645.32
29	644.00	645.32	1.66	1.66	2	70	66.8	0.36	14.9	38.8	0	1	0.0	52	+26.39	264.51	1169.89	3745.78	643.98	645.49
30	643.98	645.49		1.66	2	70	0.0	0.17	7.3	19.3	0	0	0.0	0	+4.71	+12.93	1174.37	3731.60	643.98	645.48
7/1	643.98	645.48		1.66	2	70	0.0	0.32	43.8	34.4	0	0	0.0	0	+11.15	+29.99	1172.48	3700.36	643.98	645.46
2	643.98	645.46		1.66	2	70	0.0	0.29	12.5	33.0	0	0	0.0	0	+9.56	+26.58	1172.22	3672.33	643.98	645.46
3	643.98	645.4		1.66	2	70	0.0	0.22	9.5	25.0	0	0	0.0	0	+6.85	+18.62	1174.55	3652.86	643.98	645.43
4	643.98	645.43		0.00	1	51	0.0	0.26	11.2	29.6	0	0	0.0	0	+8.57	+23.17	1175.57	3628.25	643.99	645.41
5	643.99	645.41		0.00	1	51	0.0	0.26	10.3	27.3	0	0	0.0	0	+7.71	+20.89	1177.56	3606.11	643.98	645.40
6	643.99	645.40		0.00	1	51	0.0	0.25	10.7	28.4	0	0	0.0	0	+8.14	+22.33	1178.68	3582.83	643.99	645.38
7	643.99	645.38		0.00	1	51	0.0	0.31	13.3	34.7	0	0	0.0	0	+10.72	+28.28	1177.44	3553.30	643.99	645.37
8	643.99	645.37		0.00	1	51	0.0	0.34	14.6	38.0	0	0	0.0	0	+12.01	+31.63	1174.92	3520.42	643.98	645.34
9	643.98	645.34	0.63	0.63	1	51	0.0	0.23	9.9	25.7	0	0	0.0	0	26.56	68.76	1210.96	3587.93	644.04	645.39
10	644.04	645.39	0.54	1.17	1	51	0.0	0.39	3.9	10.1	0	1	0.0	52	+75.74	71.84	1166.71	3658.51	643.94	645.43
11	643.94	645.43	0.03	1.20	1	51	0.0	0.23	9.9	26.2	0	0	0.0	0	+5.67	+15.49	1148.32	3641.77	643.95	645.42
12	643.95	645.42		1.20	1	51	0.0	0.25	10.7	28.4	0	0	0.0	0	+8.14	+22.33	1149.86	3618.58	643.95	645.41
13	643.95	645.41	0.15	1.35	1	51	0.0	0.28	8.6	22.7	0	0	0.0	0	2.06	4.98	1161.61	3622.22	643.97	645.41
14	643.97	645.41	0.06	0.78	1	51	0.0	0.37	3.0	8.0	0	0	0.0	0	2.81	6.97	1173.71	3627.96	643.98	645.41
15	643.98	645.41		0.24	1	51	0.0	0.47	20.2	53.6	0	0	0.0	0	+17.60	+47.95	1165.60	3579.65	643.97	645.38
16	643.97	645.38		0.21	1	51	0.0	0.37	3.0	7.8	0	0	0.0	0	+0.61	+1.63	1174.68	3576.96	643.98	645.38
17	643.98	645.38	0.44	0.65	1	51	0.0	0.55	23.6	61.5	0	0	0.0	0	2.60	6.60	1186.76	3582.17	644.00	645.38
18	644.00	645.38		0.50	1	51	0.0	0.37	3.1	7.8	0	1	0.0	52	+104.47	+1.63	1091.78	3579.63	643.87	645.38
19	643.87	645.38		0.44	1	51	0.0	0.31	13.0	34.7	0	0	0.0	0	+10.42	+28.28	1090.84	3549.97	643.87	645.36
20	643.87	645.36	0.15	0.59	1	51	0.0	0.37	2.9	7.8	0	0	0.0	0	7.54	19.54	1107.86	3548.28	643.89	645.38
21	643.89	645.38	0.20	0.79	1	51	0.0	0.28	11.8	31.3	0	0	0.0	0	1.34	3.34	1118.68	3549.99	643.91	645.38
22	643.91	645.38		0.35	1	51	0.0	0.33	14.2	36.9	0	0	0.0	0	+11.58	+30.51	1116.59	3538.25	643.90	645.36
23	643.90	645.36		0.35	1	51	0.0	0.21	9.0	23.5	0	0	0.0	0	+6.42	+17.09	1119.65	3519.89	643.91	645.36
24	643.91	645.36		0.35	1	51	0.0	0.25	10.7	28.0	0	0	0.0	0	+8.14	+21.57	1120.99	3497.87	643.91	645.33
25	643.91	645.33	0.06	0.26	1	51	0.0	0.07	3.0	7.8	0	0	0.0	0	1.74	4.16	1132.21	3499.98	643.93	645.33
26	643.93	645.33		0.06	1	51	0.0	0.31	13.3	34.7	0	0	0.0	0	+10.72	+28.28	1130.97	3470.66	643.92	645.31
27	643.92	645.31		0.06	1	51	0.0	0.22	9.5	24.6	0	0	0.0	0	+6.85	+18.21	1133.60	3451.30	643.93	645.30
28	643.93	645.30		0.06	1	51	0.0	0.26	10.3	26.6	0	0	0.0	0	+7.71	+20.00	1135.36	3429.75	643.93	645.28
29	643.93	645.28		0.06	1	51	0.0	0.25	10.7	27.5	0	0	0.0	0	+8.14	+21.18	1136.72	3407.39	643.93	645.27
30	643.93	645.27		0.08	1	51	0.0	0.11	4.7	12.1	0	0	0.0	0	+2.13	+5.70	1146.37	3400.44	643.94	645.26
31	643.94	645.26		0.08	1	51	0.0	0.29	12.5	31.9	0	0	0.0	0	+9.86	+25.58	1143.70	3373.69	643.94	645.25
8/1	643.94	645.25		0.00	1	51	0.0	0.30	12.9	33.0	0	0	0.0	0	+10.29	+26.60	1142.89	3345.84	643.94	645.23
2	643.94	645.23		0.00	1	51	0.0	0.35	15.0	38.5	0	0	0.0	0	+12.44	+32.18	1139.93	3312.48	643.94	645.21
3	643.94	645.21	0.12	0.12	1	51	0.0	0.32	13.8	35.2	0	0	0.0	0	+4.71	+12.38	1144.71	3298.93	643.94	645.20
4	643.94	645.20	0.56	0.68	1	51	0.0	0.24	10.3	26.0	0	0	0.0	0	22.37	58.15	1176.57	3353.83	643.99	645.23
5	643.99	645.23	0.28	0.96	1	51	0.0	0.13	5.6	14.3	0	0	0.0	0	12.35	30.60	1198.11	3383.18	644.02	645.25
6	644.02	645.25		0.96	1	51	0.0	0.33	14.5	34.3	0	1	0.0	52	+115.88	+29.90	1091.72	3352.03	643.87	645.23
7	643.87	645.23		0.96	1	51	0.0	0.22	9.2	24.2	0	0	0.0	0	+6.64	+17.80	1094.56	3332.98	643.87	645.22
8	643.87	645.22	0.99	1.83	2	70	0.2	0.29	12.2	31.9	0	0	0.0	0	42.61	112.85	1148.45	3444.58	643.95	645.29
9	643.95	645.29	0.42	1.69	2	70	0.0	0.19	8.2	20.9	0	0	0.0	0	17.00	43.25	1172.93	3466.58	643.98	645.32
10	643.98	645.32		1.41	2	70	0.0	0.11	4.7	12.3	0	0	0.0	0	+2.13	+5.98	1180.29	3479.42	643.99	645.32
11	643.99	645.32		1.41	2	70	0.0	0.33	14.2	36.9	0	0	0.0	0	+11.58	+30.51	1178.19	3447.44	643.99	645.30

TABLE B-4 (continued)

TEXAS EAGLE ERP
TEXAS EAGLE NATIONAL WILDLIFE REFUGE
POOL A MANAGEMENT PLAN - ONE SEASON OF HISTORIC DATA
6/1 through 9/30, 1988
1.3 CFS = BASE FLOW INTO POOL A
3.2 CFS = BASE FLOW INTO POOL B SYSTEM

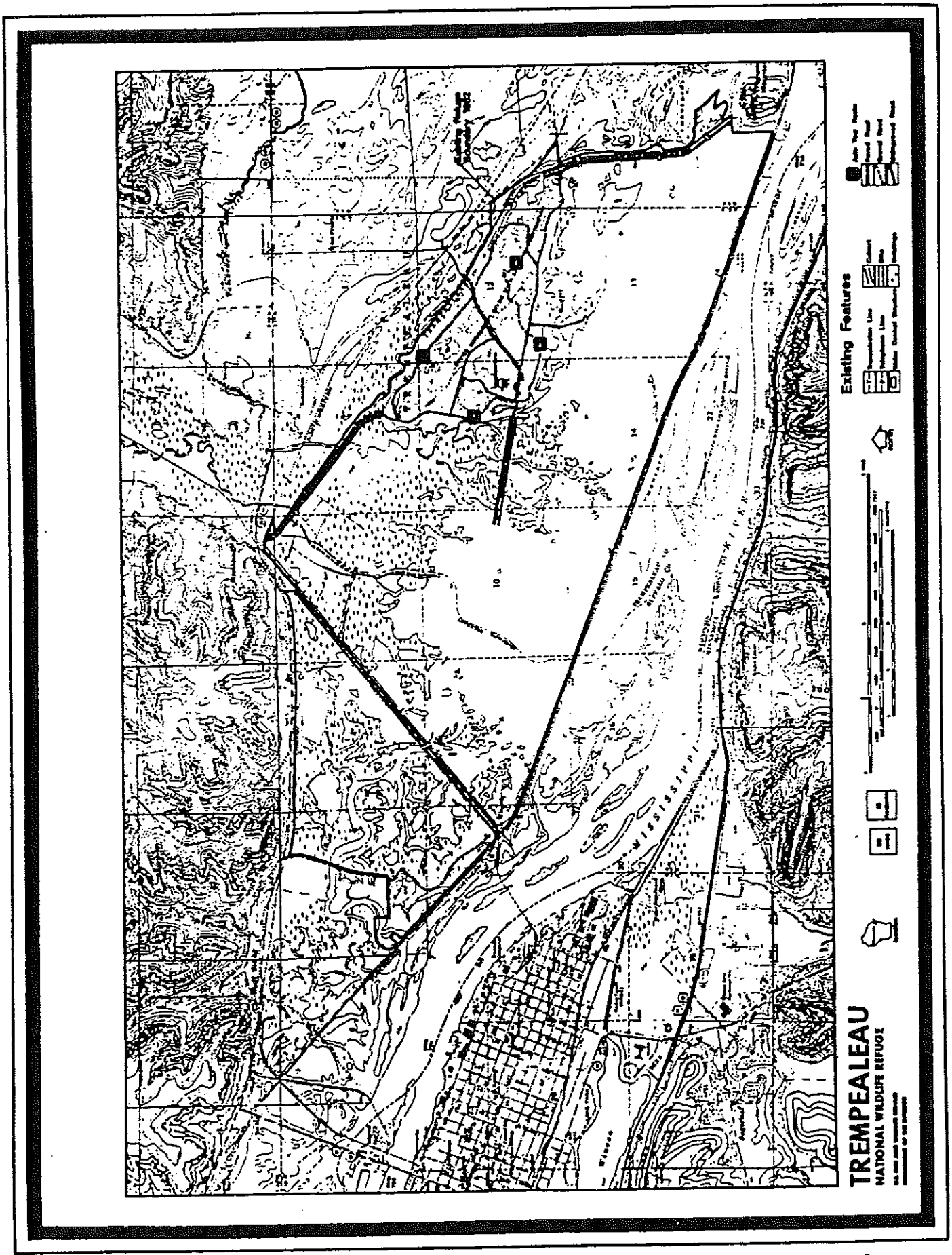
DATE	STARTING POOL A ELEV. 1912DSL	STARTING POOL B ELEV. 1912DSL	DAILY PRECIP INCHES	5-DAY TOTAL PRECIP INCHES	AMC	SCS CURVE NUMBER	RUNOFF INTO POOL B ACFT/DAY	PAN EVAP INCHES	POOL A EVAP LOSS ACFT/DAY	POOL B EVAP LOSS ACFT/DAY	CULVERT OPER? 1=YES 0=NO	PUMP ON? 1=YES 0=NO	CULVERT FLOW CFS	PUMP RATE CFS	VOLUME CHANGE POOL A ACFT	VOLUME CHANGE POOL B ACFT	REV POOL A VOLUME ACFT	REV POOL B VOLUME ACFT	REV POOL A ELEV 1912DSL	REV POOL B ELEV 1912DSL
'2	643.99	645.30		1.61	2	70	0.0	0.13	5.6	14.3	0	0	0.0	0	+2.99	+7.90	1184.69	3438.51	[illegible]	645.29
'3	644.00	645.29		0.62	1	51	0.0	0.06	3.4	8.8	0	0	0.0	0	-0.84	-2.40	1183.34	3434.86	[illegible]	645.29
'4	644.01	645.29	0.21	0.21	1	51	0.0	0.12	5.3	13.2	0	1	0.0	52	-95.15	22.58	1107.66	3455.68	[illegible]	645.30
'5	643.89	645.30	0.12	0.33	1	51	0.0	0.10	4.2	11.2	0	0	0.0	0	4.70	11.99	1121.86	3466.63	[illegible]	645.31
'6	643.91	645.31		0.33	1	51	0.0	0.25	10.7	28.8	0	0	0.0	0	-8.14	-21.57	1123.20	3443.61	[illegible]	645.29
'7	643.91	645.29		0.33	1	51	0.0	0.48	17.2	44.3	0	0	0.0	0	-14.59	-37.60	1118.10	3406.76	[illegible]	645.27
'8	643.91	645.27		0.33	1	51	0.0	0.25	10.7	27.5	0	0	0.0	0	-8.16	-21.10	1119.44	3342.61	[illegible]	645.25
'9	643.91	645.25	0.55	0.67	1	51	0.0	0.06	1.7	4.4	0	0	0.0	0	30.43	77.63	1159.35	3458.78	[illegible]	645.30
20	643.96	645.30		0.55	1	51	0.0	0.09	3.9	10.1	0	0	0.0	0	+1.27	-3.67	1147.57	3453.67	[illegible]	645.30
21	643.97	645.30		0.55	1	51	0.0	0.10	4.3	11.3	0	0	0.0	0	+1.70	-4.60	1175.35	3448.62	[illegible]	645.28
22	643.99	645.30		0.55	1	51	0.0	0.07	3.0	7.7	0	0	0.0	0	+0.61	-1.30	1184.63	3445.66	[illegible]	645.29
23	644.00	645.29	1.20	1.75	2	70	16.1	0.07	3.0	7.7	0	0	0.0	0	64.35	177.60	1257.97	3622.52	[illegible]	645.61
24	644.10	645.41		1.20	1	51	0.0	0.31	13.9	35.3	0	1	0.0	52	-115.28	-28.85	1152.18	3591.92	[illegible]	645.59
25	643.95	645.39		1.20	1	51	0.0	0.15	6.4	16.8	0	0	0.0	0	-3.85	-10.38	1157.82	3580.29	[illegible]	645.58
26	643.96	645.38		1.20	1	51	0.0	0.20	8.6	22.6	0	0	0.0	0	-5.99	-15.97	1161.31	3563.36	[illegible]	645.57
27	643.97	645.37	0.13	1.33	1	51	0.0	0.41	17.6	45.9	0	0	0.0	0	-8.36	-21.29	1162.76	3540.53	[illegible]	645.56
28	643.97	645.36	0.16	0.29	1	51	0.0	0.13	5.6	14.5	0	0	0.0	0	5.61	14.23	1177.85	3553.51	[illegible]	645.57
29	643.99	645.37		0.29	1	51	0.0	0.19	8.2	21.3	0	0	0.0	0	+5.56	+14.85	1181.77	3537.49	[illegible]	645.55
30	643.99	645.35		0.29	1	51	0.0	0.14	6.3	15.7	0	0	0.0	0	-3.42	-9.26	1187.84	3526.89	[illegible]	645.55
31	644.00	645.35		0.29	1	51	0.0	0.17	7.5	19.8	0	1	0.0	52	-106.84	-12.62	1068.47	3513.53	[illegible]	645.54
9/1	643.86	645.34		0.16	1	51	0.0	0.22	9.2	24.6	1	0	25.5	0	44.36	+69.21	1142.31	3442.57	[illegible]	645.29
2	643.94	645.29		0.00	1	51	0.0	0.08	3.4	8.8	1	0	25.5	0	50.16	+53.60	1201.96	3387.92	[illegible]	645.27
3	644.02	645.26		0.00	1	51	0.0	0.20	8.8	22.8	1	0	25.5	0	44.83	+66.60	1254.27	3320.06	[illegible]	645.21
4	644.10	645.21	0.24	0.24	1	51	0.0	0.04	1.8	4.4	1	0	24.3	0	62.52	+13.52	1328.28	3305.30	[illegible]	645.20
5	644.20	645.20		0.24	1	51	0.0	0.10	4.5	11.3	1	0	23.0	0	44.17	-50.64	1381.94	3253.48	[illegible]	645.17
6	644.27	645.17		0.24	1	51	0.0	0.05	2.3	5.4	1	0	21.7	0	43.78	-42.67	1435.20	3209.69	[illegible]	645.14
7	644.35	645.14		0.24	1	51	0.0	0.05	2.3	5.4	1	0	20.4	0	41.14	-39.87	1485.83	3166.57	[illegible]	645.11
8	644.42	645.11		0.24	1	51	0.0	0.22	10.4	25.8	1	0	19.1	0	30.60	-55.65	1525.72	3111.68	[illegible]	645.07
9	644.48	645.07		0.00	1	51	0.0	0.25	11.9	26.6	1	0	17.8	0	26.30	-55.74	1561.52	3056.69	[illegible]	645.04
10	644.53	645.04		0.00	1	51	0.0	0.21	10.2	22.3	1	0	16.4	0	25.30	-44.77	1594.31	3004.67	[illegible]	645.00
11	644.57	645.00		0.00	1	51	0.0	0.10	4.8	10.6	1	0	15.1	0	27.87	-34.33	1633.68	2969.39	[illegible]	644.98
12	644.63	644.98		0.00	1	51	0.0	0.19	9.2	19.8	1	0	13.7	0	20.71	-40.75	1663.86	2927.09	[illegible]	644.95
13	644.67	644.95		0.00	1	51	0.0	0.06	2.9	6.3	1	0	12.2	0	24.14	-24.31	1697.52	2901.52	[illegible]	644.94
14	644.72	644.94		0.00	1	51	0.0	0.22	10.7	23.0	1	0	10.8	0	13.44	-38.58	1729.46	2862.19	[illegible]	644.91
15	644.75	644.91		0.00	1	51	0.0	0.14	6.8	14.6	1	0	9.2	0	14.24	-26.65	1744.20	2834.30	[illegible]	644.89
16	644.78	644.89	0.02	0.02	1	51	0.0	0.11	5.3	11.3	1	0	7.6	0	13.65	-17.69	1767.35	2815.56	[illegible]	644.88
17	644.81	644.88	0.28	0.30	1	51	0.0	0.03	1.5	3.1	1	0	5.8	0	29.76	27.60	1806.60	2861.98	[illegible]	644.90
18	644.87	644.90	1.16	1.46	2	70	11.3	0.16	7.8	16.4	1	0	3.7	0	72.65	162.56	1868.75	2983.21	[illegible]	644.99
19	644.98	644.99	0.26	1.72	2	70	0.0	0.09	4.4	9.4	1	0	1.6	0	17.16	27.80	1915.41	3009.76	[illegible]	645.01
20	645.02	645.01	1.38	3.10	3	85	211.5	0.04	1.9	4.3	1	0	+2.8	0	78.87	602.62	2003.77	3611.14	[illegible]	645.27
21	645.15	645.27	0.03	3.11	3	85	0.0	0.18	8.8	19.8	1	0	8.2	0	12.00	-25.61	2025.27	3584.28	[illegible]	645.25
22	645.16	645.25	0.83	3.66	3	85	56.3	0.08	3.9	8.8	1	0	6.4	0	62.08	155.21	2096.85	3538.23	[illegible]	645.36
23	645.28	645.36	0.45	2.95	3	85	2.8	0.05	2.4	5.4	1	0	6.5	0	60.56	53.54	2164.92	3590.53	[illegible]	645.39
24	645.35	645.39		2.69	3	85	0.0	0.04	2.0	4.5	1	0	4.8	0	10.30	-7.73	2166.73	3581.55	[illegible]	645.38
25	645.37	645.38		1.31	1	51	0.0	0.02	1.0	2.2	1	0	2.3	0	6.32	-0.53	2162.55	3579.77	[illegible]	645.38
26	645.48	645.38		1.28	1	51	0.0	0.11	5.4	12.3	1	0	-2.6	0	-8.00	-0.68	2186.06	3577.84	[illegible]	645.38
27	645.48	645.38		0.45	1	51	0.0	0.44	21.5	49.2	1	0	-2.9	0	-24.76	-36.94	2168.82	3539.66	[illegible]	645.36
28	645.38	645.36		0.00	1	51	0.0	0.27	13.2	30.2	1	0	-3.3	0	-17.11	-17.27	2161.22	3521.13	[illegible]	645.34
29	645.37	645.34	0.30	0.30	1	51	0.0	0.06	2.9	6.7	1	0	-5.4	0	11.18	48.42	2181.91	3568.38	[illegible]	645.38
30	645.39	645.38		0.30	1	51	0.0	0.02	1.0	2.2	1	0	-3.2	0	-4.81	10.60	2166.60	3577.65	[illegible]	645.38

Location



Location of Trempealeau National Wildlife Refuge
(Source: Trempealeau NWR Master Plan)

PLATE B-



Existing Features and Boundaries at Trempealeau National Wildlife Refuge
(Source: Trempealeau NWR Master Plan)

PLATE B-1

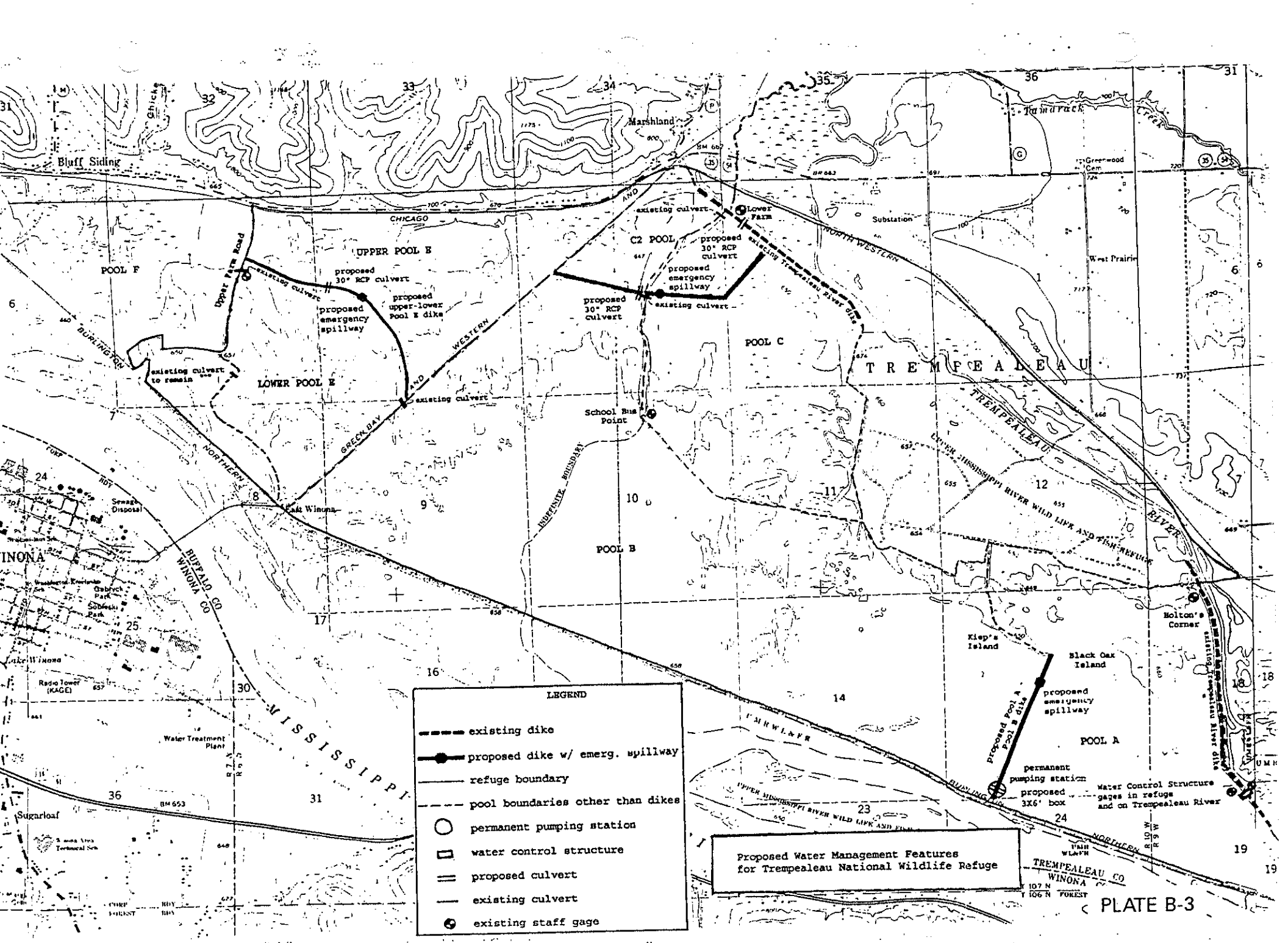

Bluff Siding
Marshland
Tamarack Creek
Greenwood Cem.
Substation
West Prairie
CHICAGO AND NORTH WESTERN
Lower Farm
existing culvert
C2 POOL
proposed 30" RCP culvert
proposed emergency spillway
existing Trempealeau River dike
UPPER POOL E
POOL F
Upper Farm Road
existing culvert
proposed 30" RCP culvert
proposed emergency spillway
proposed upper-lower Pool E dike
proposed 30" RCP culvert
existing culvert
POOL C
TREMPEALEAU
BURLINGTON NORTHERN
existing culvert to remain
LOWER POOL E
existing culvert
School Bus Point
GREEN BAY AND WESTERN
TREMPEALEAU
UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE
RIVER
INDEPENDENCE BOUNDARY
FORT ROAD
Sewage Disposal
East Winona
POOL B
WINONA
Gabrych Park
Sobieski Park
BUFFALO CO
WINONA CO
Lake Winona
Radio Tower (KAGE)
Water Treatment Plant
MISSISSIPPI
Holton's Corner
Kiep's Island
Black Oak Island
proposed emergency spillway
proposed Pool A - Pool B dike
POOL A
permanent pumping station
proposed 3X6' box
Water Control Structure gages in refuge and on Trempealeau River
UMR
Sugarloaf
BM 653
BURLINGTON NORTHERN
TREMPEALEAU CO
WINONA CO
T 107 N
T 106 N
FOREST
LEGEND
existing dike
proposed dike w/ emerg. spillway
refuge boundary
pool boundaries other than dikes
permanent pumping station
water control structure
proposed culvert
existing culvert
existing staff gage
Proposed Water Management Features for Trempealeau National Wildlife Refuge

PLATE B-3

CENCS14 23JAN92

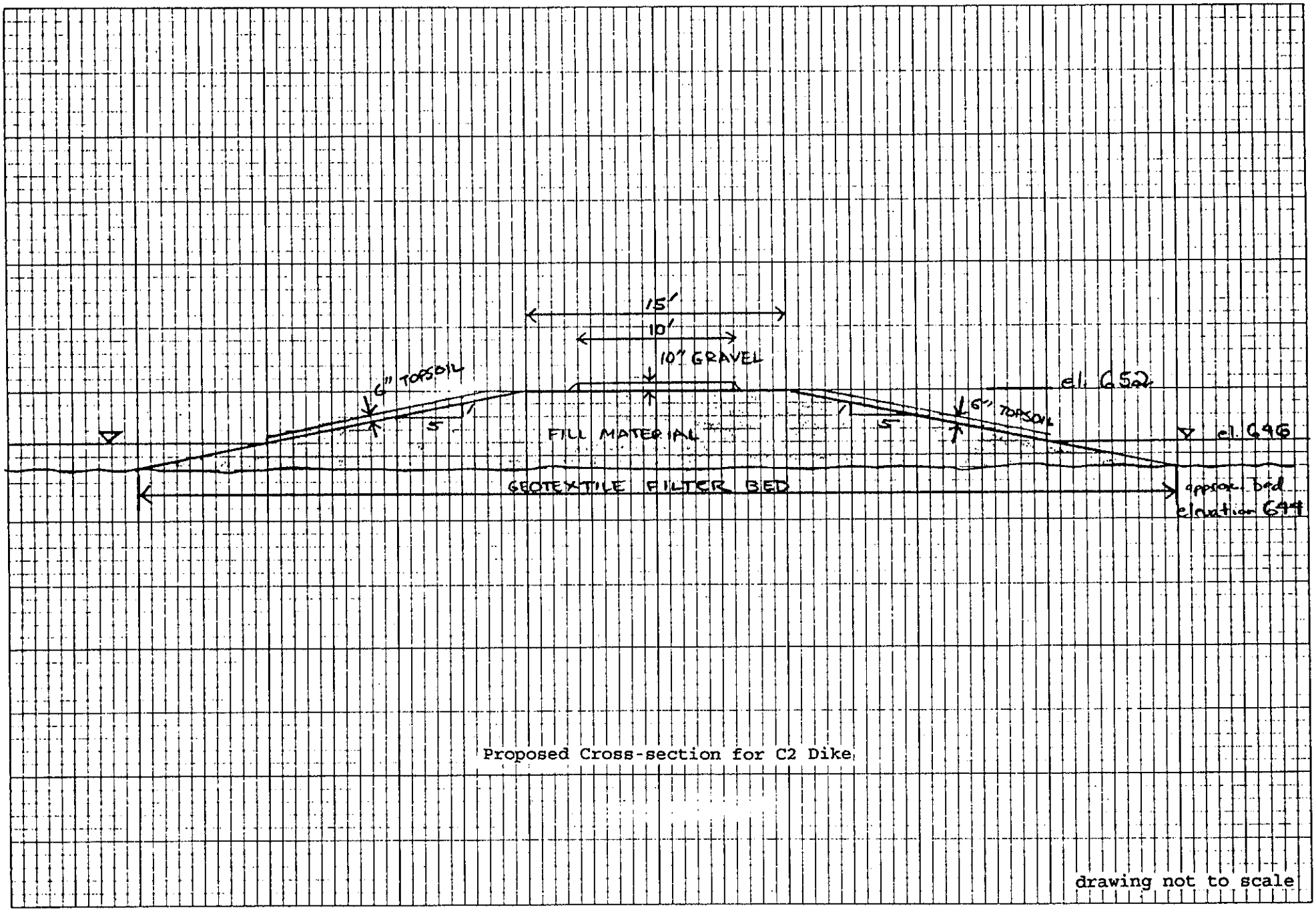
Proposed Cross-Sections for Pool B - Pool A Dike

US Army Corps of Engineers Saint Paul District	PROJECT TITLE: Tremperleau EMP
SUBJECT TITLE: Pool B - Pool A Dike Design	COMPUTED BY:
CHECKED BY:	DATE:
DATE:	SHEET:
CONTRACT NO.	

PLATE B-4

NO. 341-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.



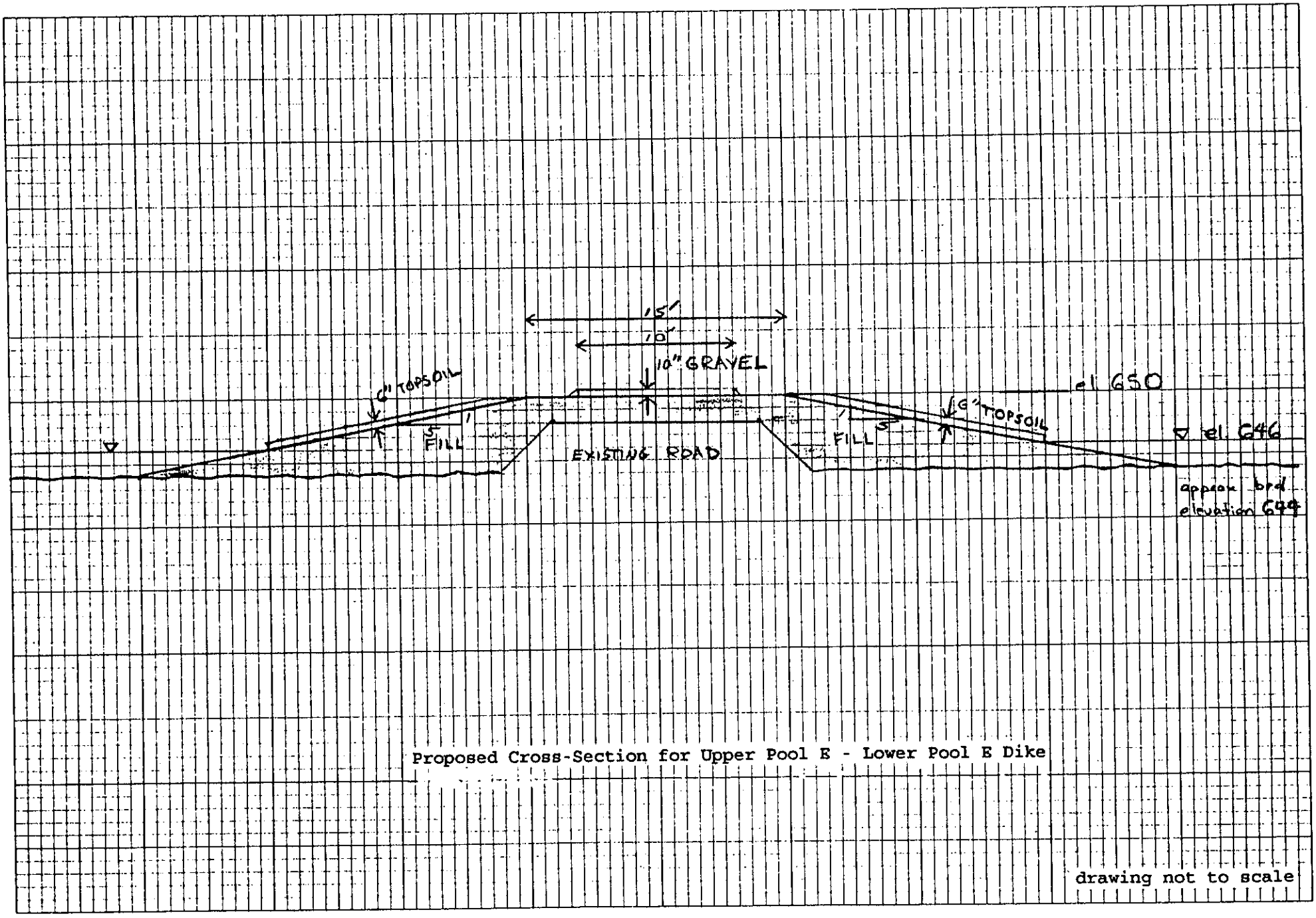
Proposed Cross-section for C2 Dike

drawing not to scale

PLATE B-5

NO. 341-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.



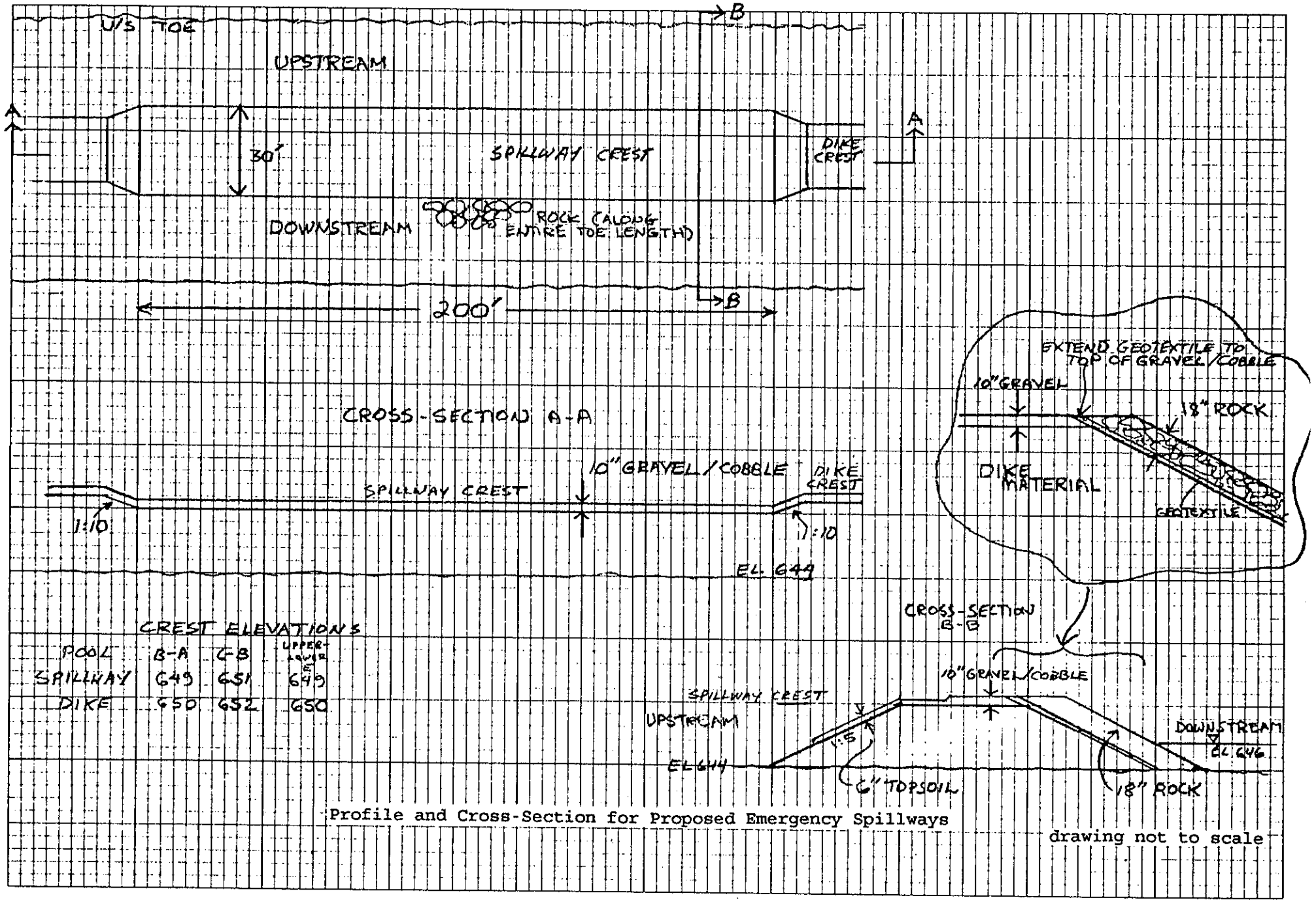
Proposed Cross-Section for Upper Pool E - Lower Pool E Dike

drawing not to scale

PLATE B-6

NO. 341-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.



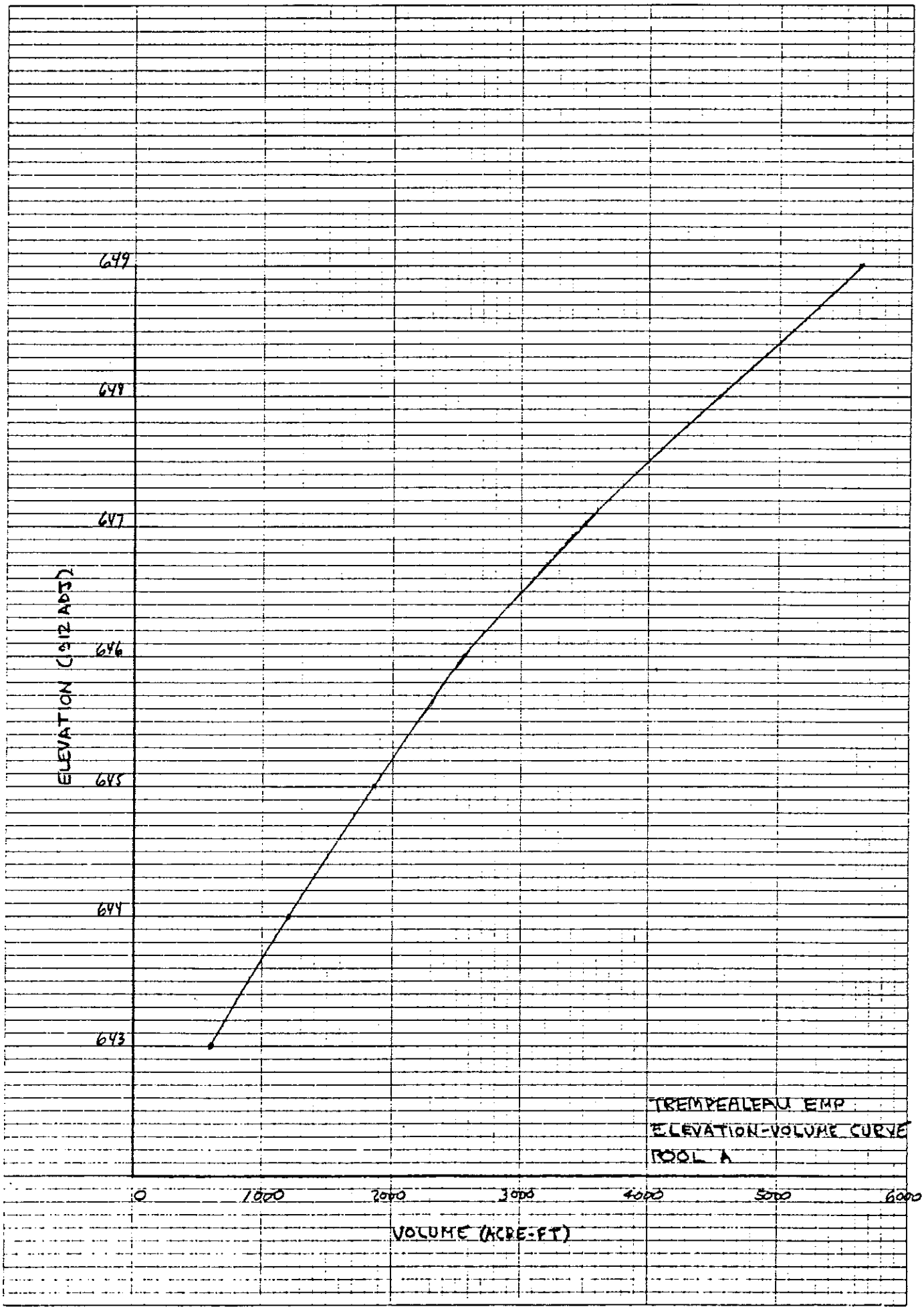
CREST ELEVATIONS

POOL	B-A	C-B	UPPER-LOWER E
SPILLWAY	649	651	649
DIKE	650	652	650

Profile and Cross-Section for Proposed Emergency Spillways

drawing not to scale

PLATE B-7



460700

PLATE B-8

K&E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO MADE IN U.S.A.

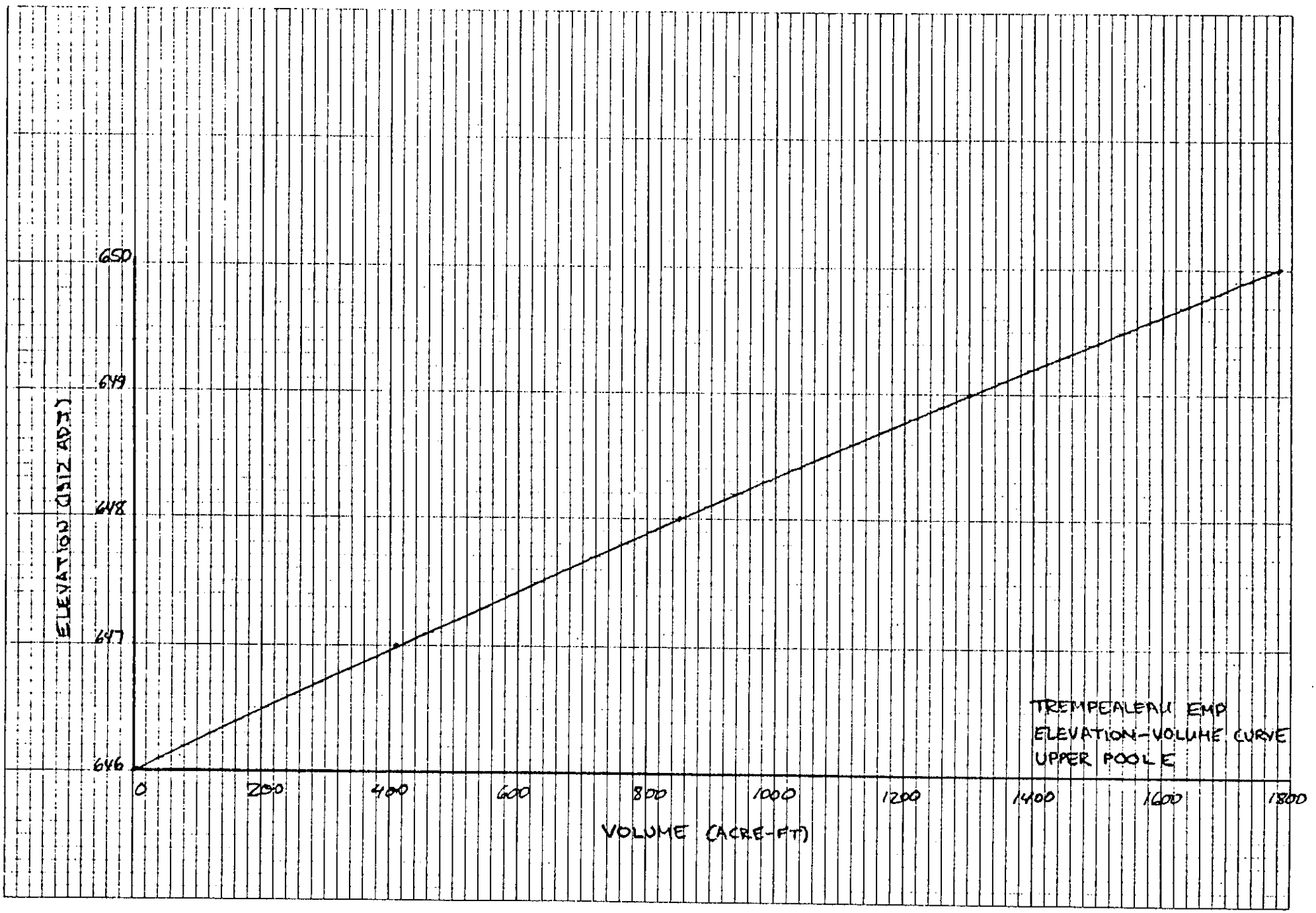
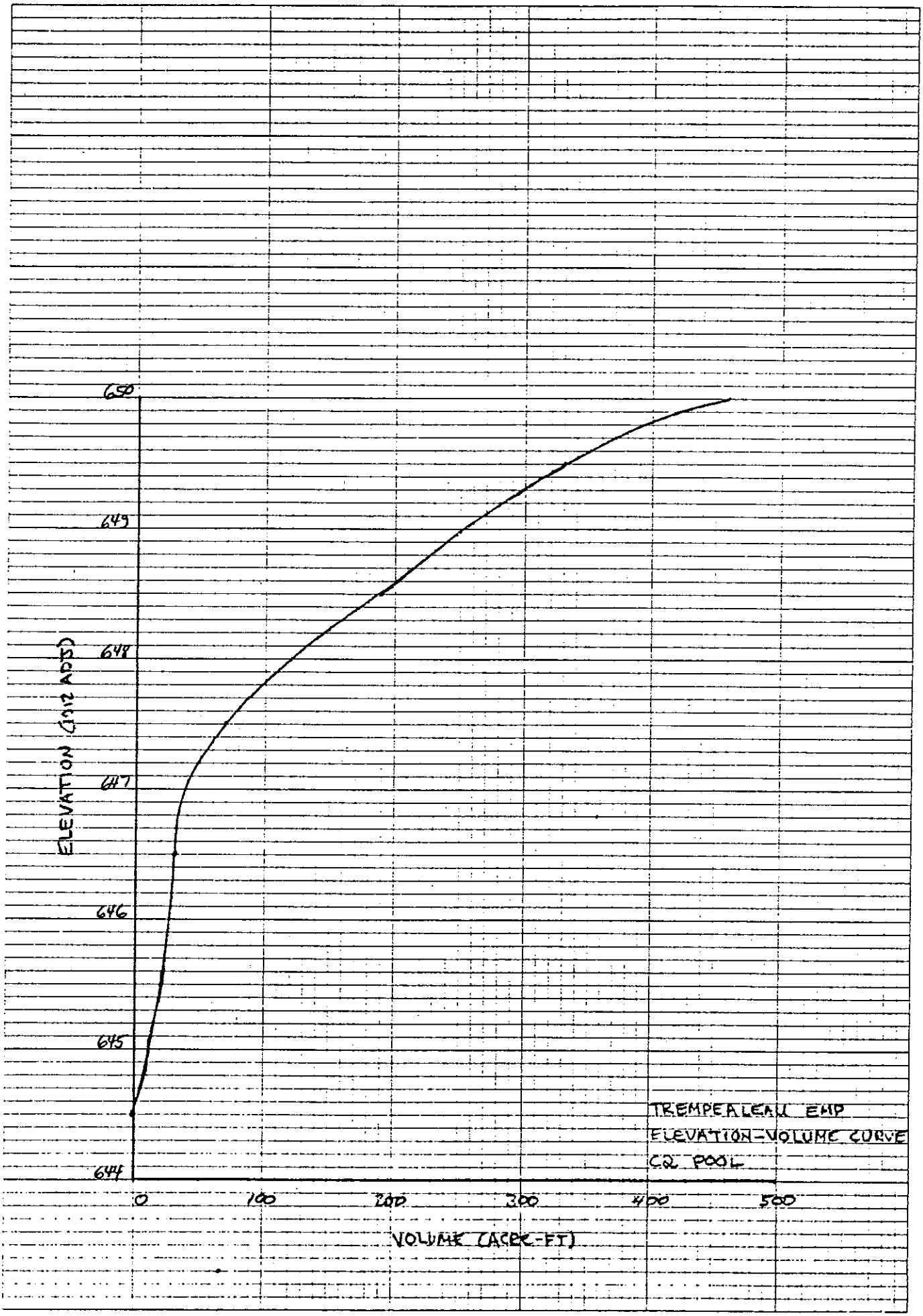


PLATE B-9



46 0700

PLATE B-10

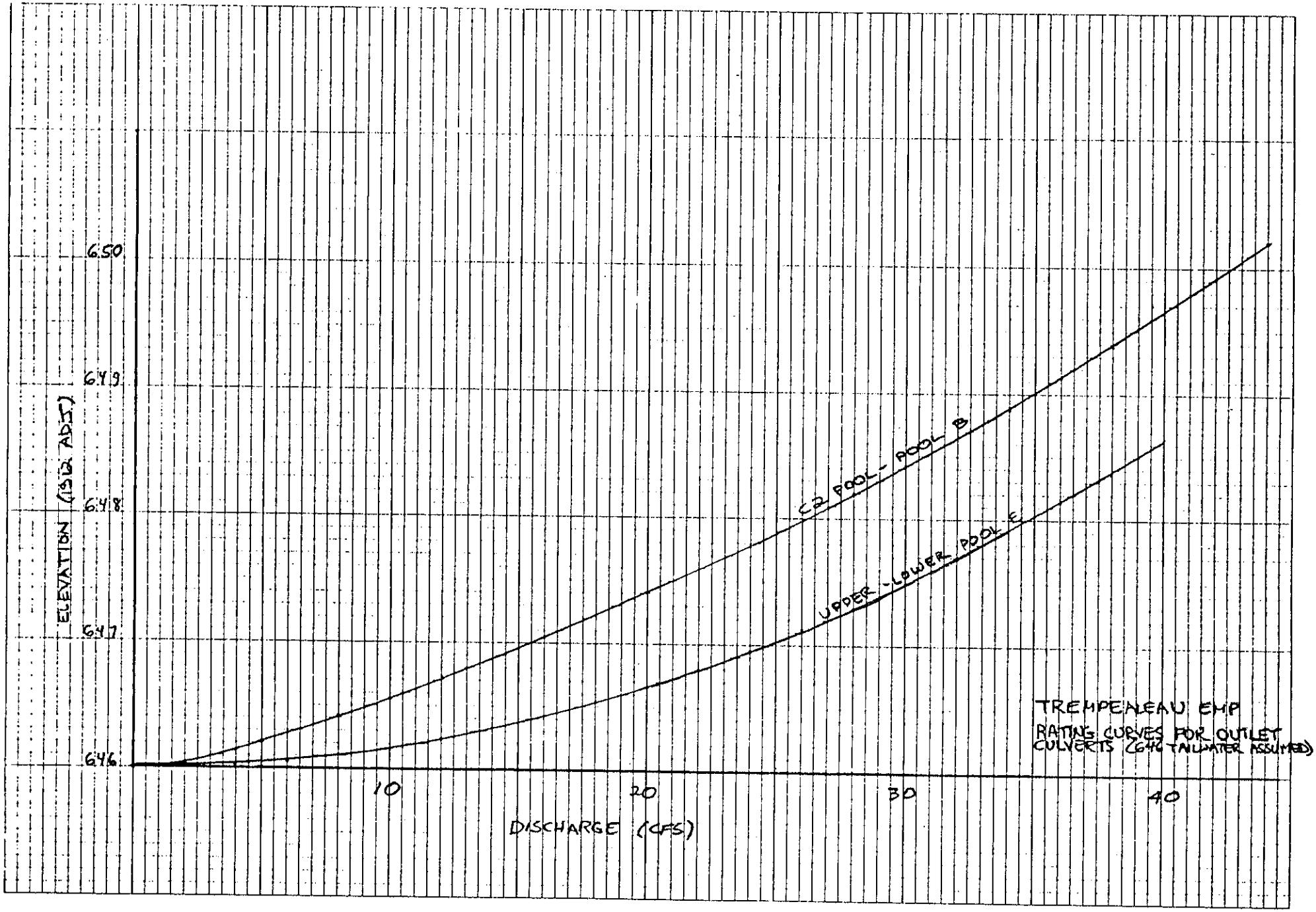
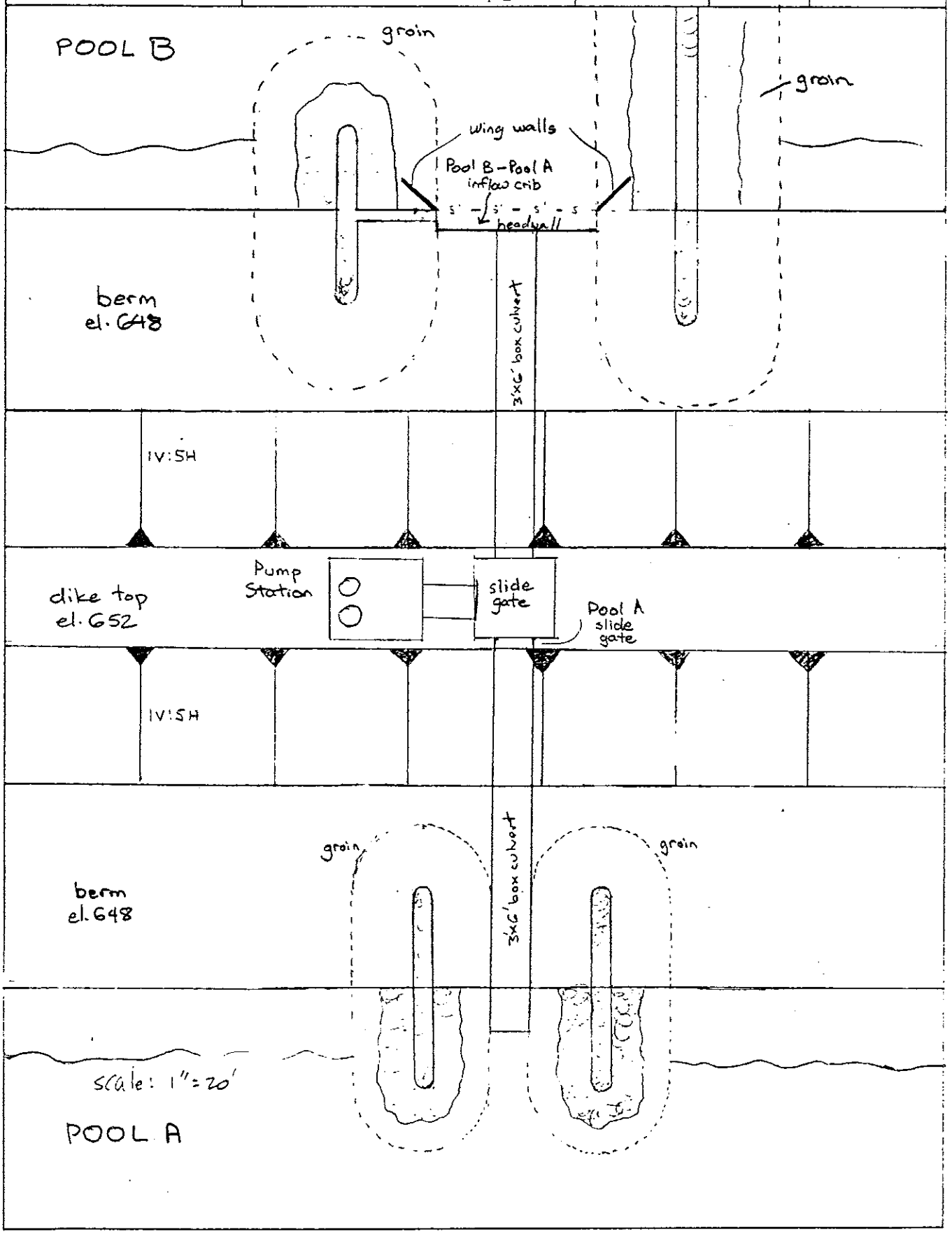

ELEVATION (DISK ADJ.)
6.50
6.49
6.48
6.47
6.46
10
20
30
40
DISCHARGE (CFS)
C2 POOL - POOL B
UPPER - LOWER POOL E
TREMPEALEAU EMP
RATING CURVES FOR OUTLET CULVERTS (6.46 TAILWATER ASSUMED)

PLATE B-11

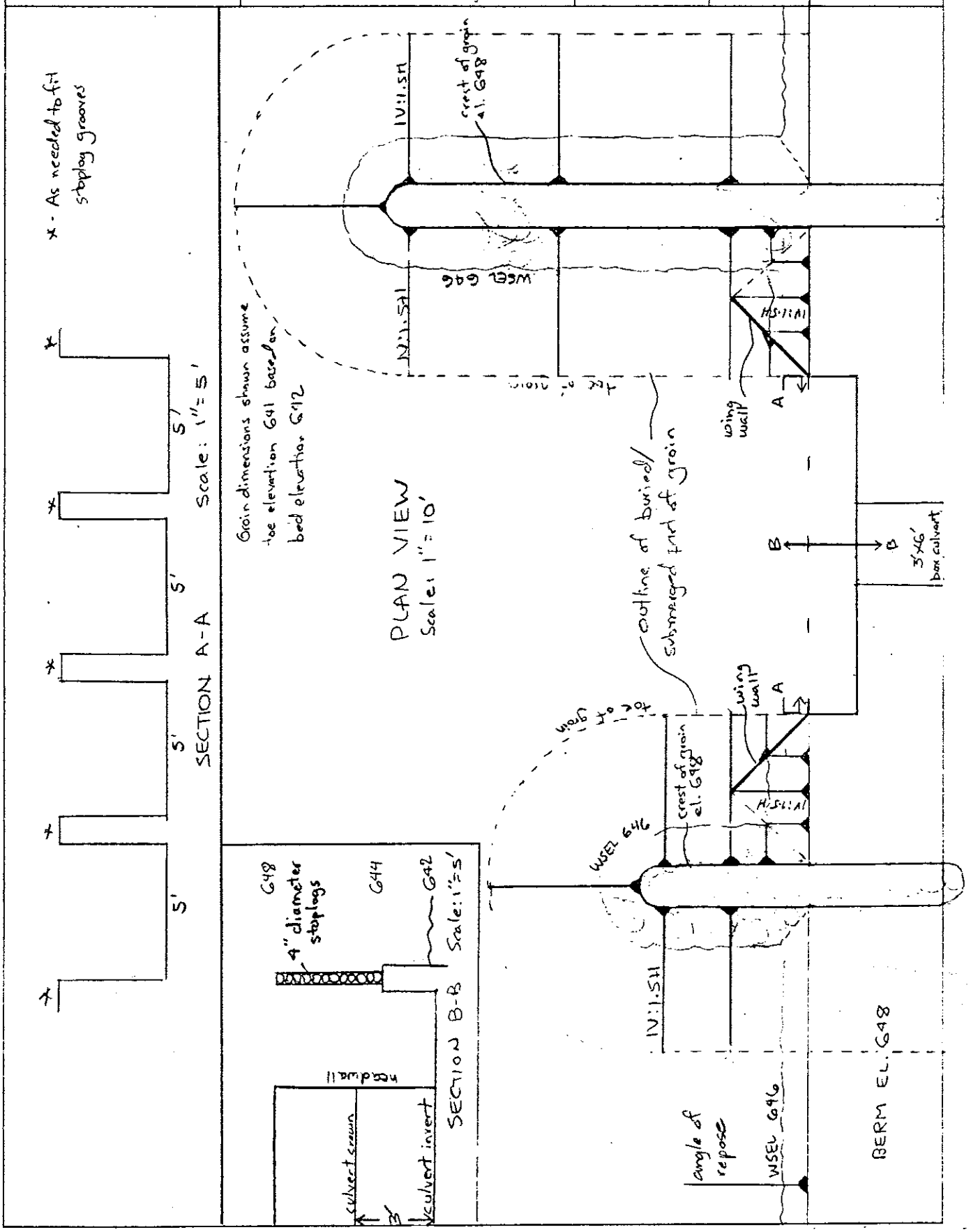
US Army Corps of Engineers Saint Paul District	PROJECT TITLE TREMPEALEAU EMP	COMPUTED BY	DATE	SHEET
	SUBJECT TITLE PLAN VIEW OF POOL B - POOL A INFLOW CHANNEL AND PUMP STATION	CHECKED BY	DATE	CONTRACT NO



CENCS14 23JAN92

PLATE B-12

US Army Corps of Engineers	PROJECT TITLE:	COMPUTED BY	DATE	SHEET
Saint Paul District	TREMPEALEAU EMP			
	SUBJECT TITLE: STOPLOG-CONTROLLED INFLOW CRIB FOR S-A OPEN CONDUIT, POOL B SIDE	CHECKED BY:	DATE:	CONTRACT NO.



CENCS14 23JAN92

PLATE B-13

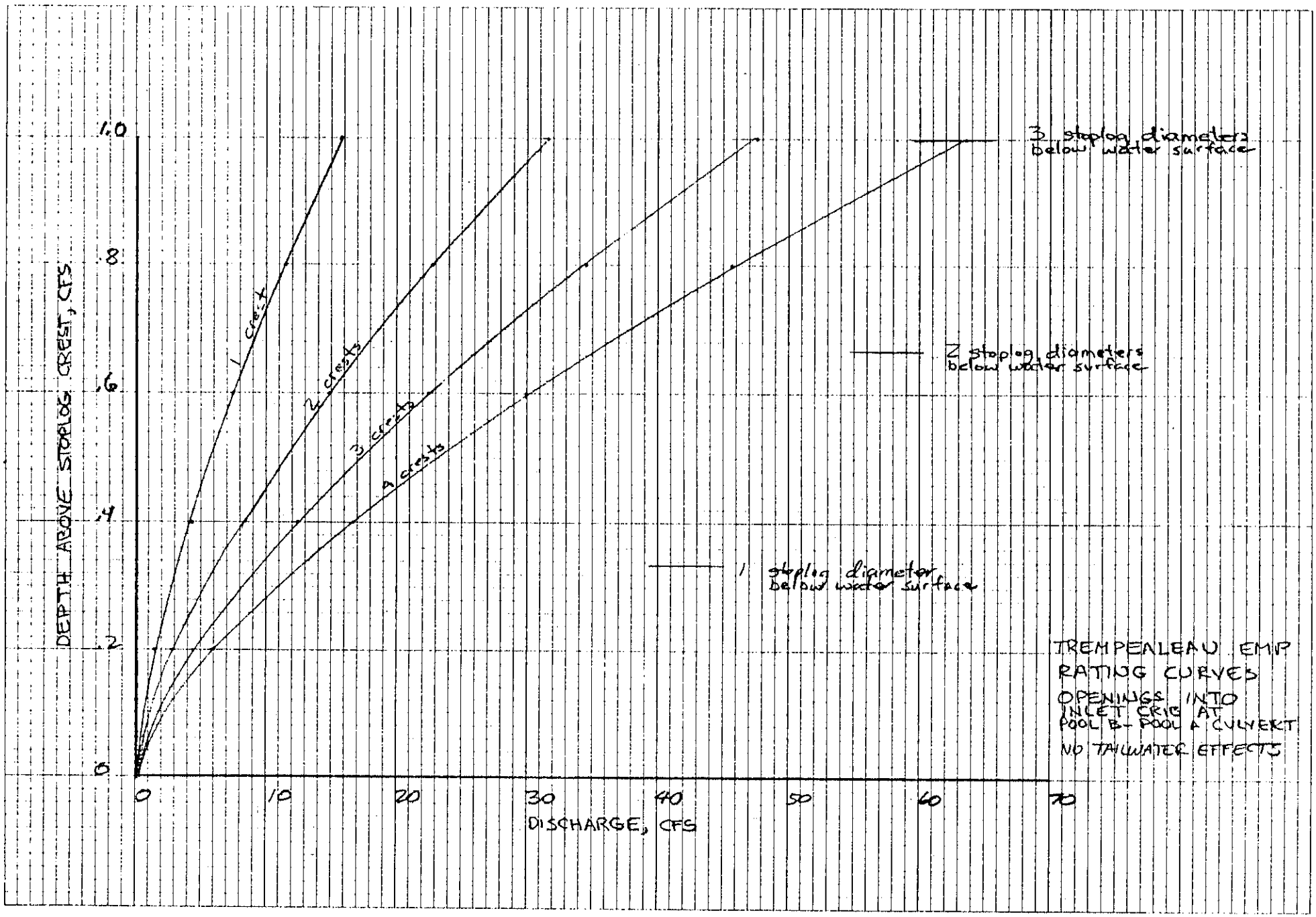
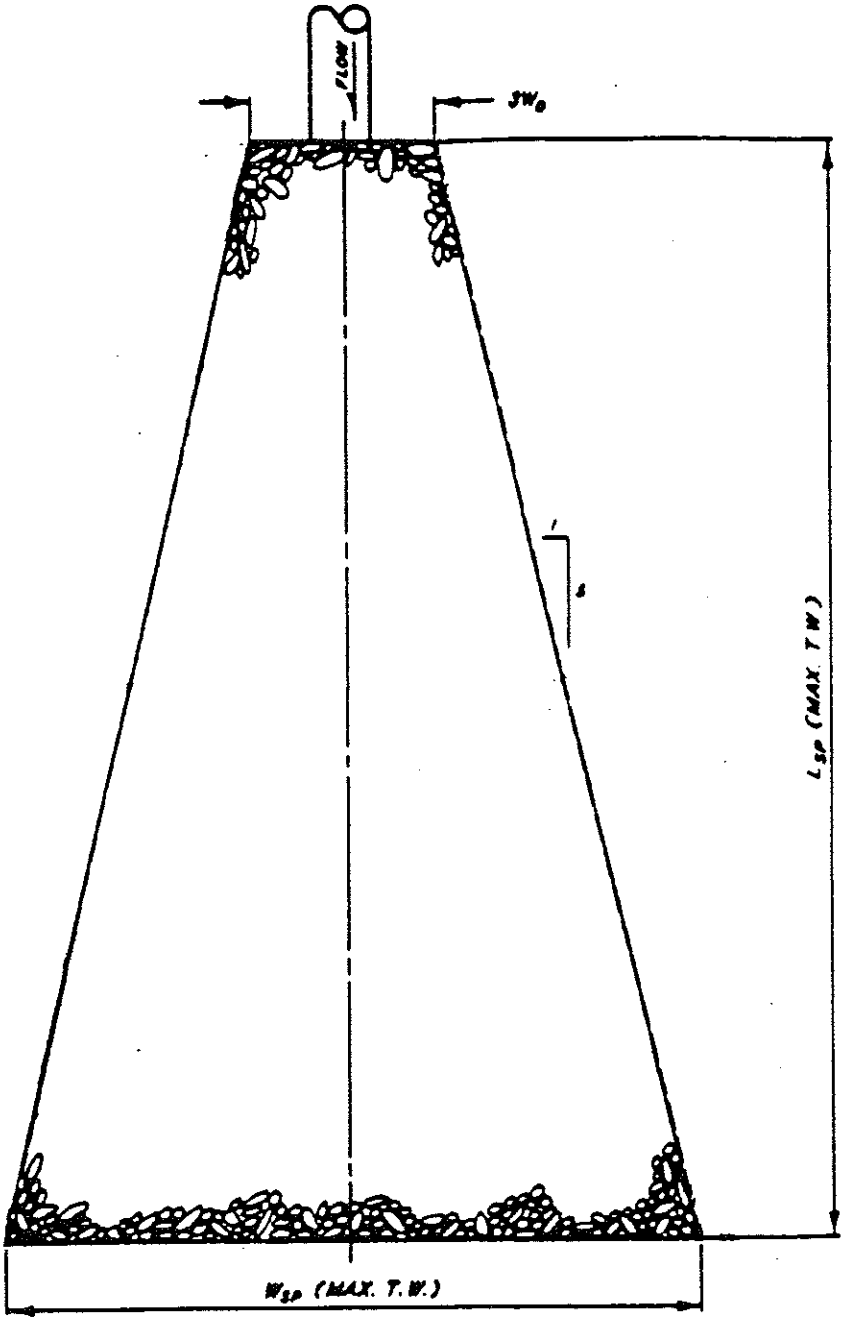
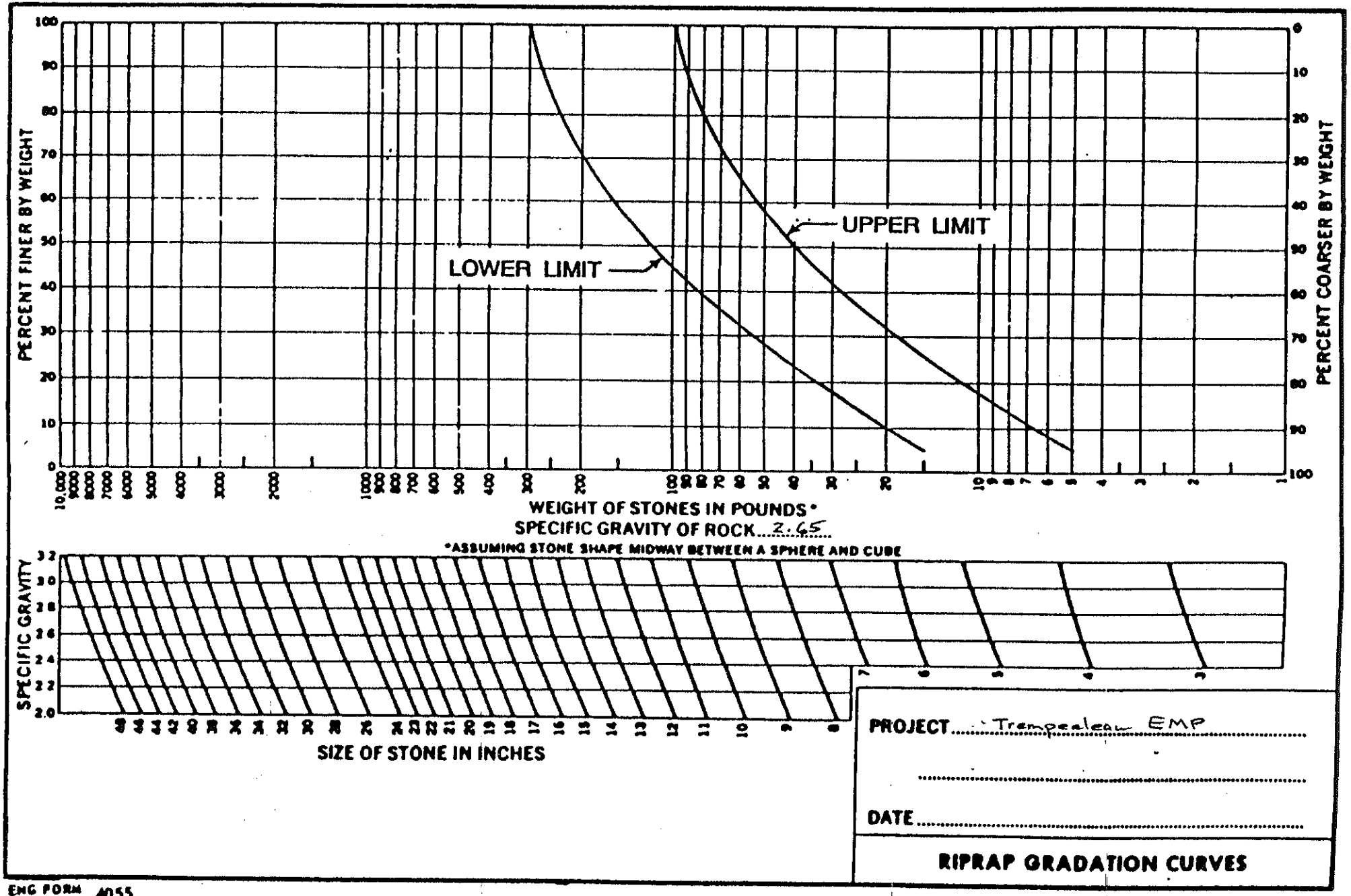

DEPTH ABOVE STOPLOG CREST, CFS
1.0
.8
.6
.4
.2
0
0
10
20
30
40
50
60
70
DISCHARGE, CFS
1 crest
2 crests
3 crests
4 crests
3 stoplog diameters below water surface
2 stoplog diameters below water surface
1 stoplog diameter below water surface
TREMPEALEAU EMP
RATING CURVES
OPENINGS INTO
INLET CRIB AT
POOL B- POOL A CULVERT
NO TAILWATER EFFECTS

PLATE B-14



Recommended configuration of riprap blanket

PLATE B-15



PROJECT Trempealeau EMP

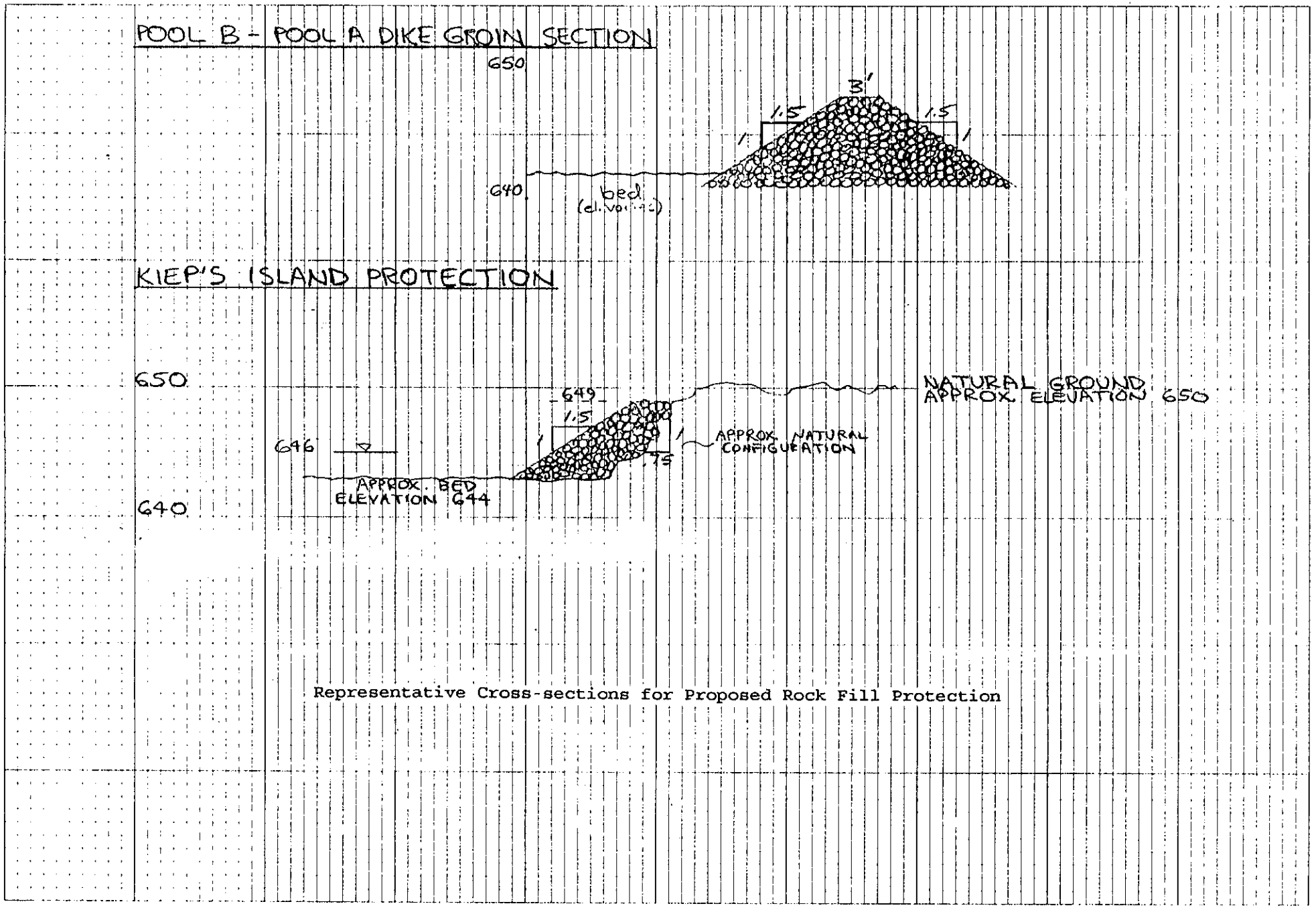
DATE

RIPRAP GRADATION CURVES

ENG FORM 4055 APR 97

PLATE R-16

K+E 10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO MADE IN U.S.A.



Representative Cross-sections for Proposed Rock Fill Protection

PLATE B-17

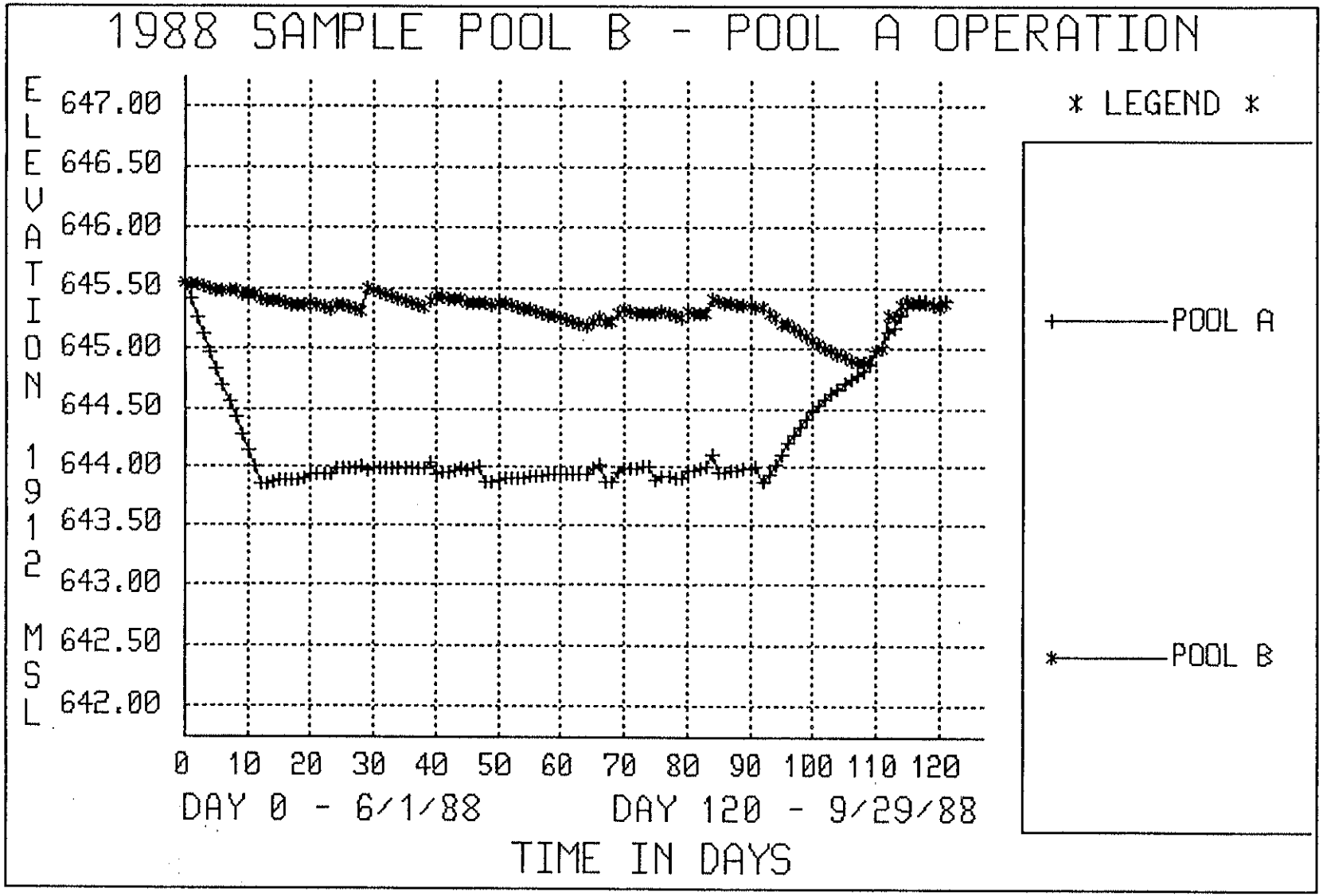

1988 SAMPLE POOL B - POOL A OPERATION
ELEVATION 1912 MSL
647.00
646.50
646.00
645.50
645.00
644.50
644.00
643.50
643.00
642.50
642.00
0 10 20 30 40 50 60 70 80 90 100 110 120
DAY 0 - 6/1/88
DAY 120 - 9/29/88
TIME IN DAYS
* LEGEND *
POOL A
POOL B

PLATE B-18

L/D 6 POOL

STAGE-DURATION CURVE

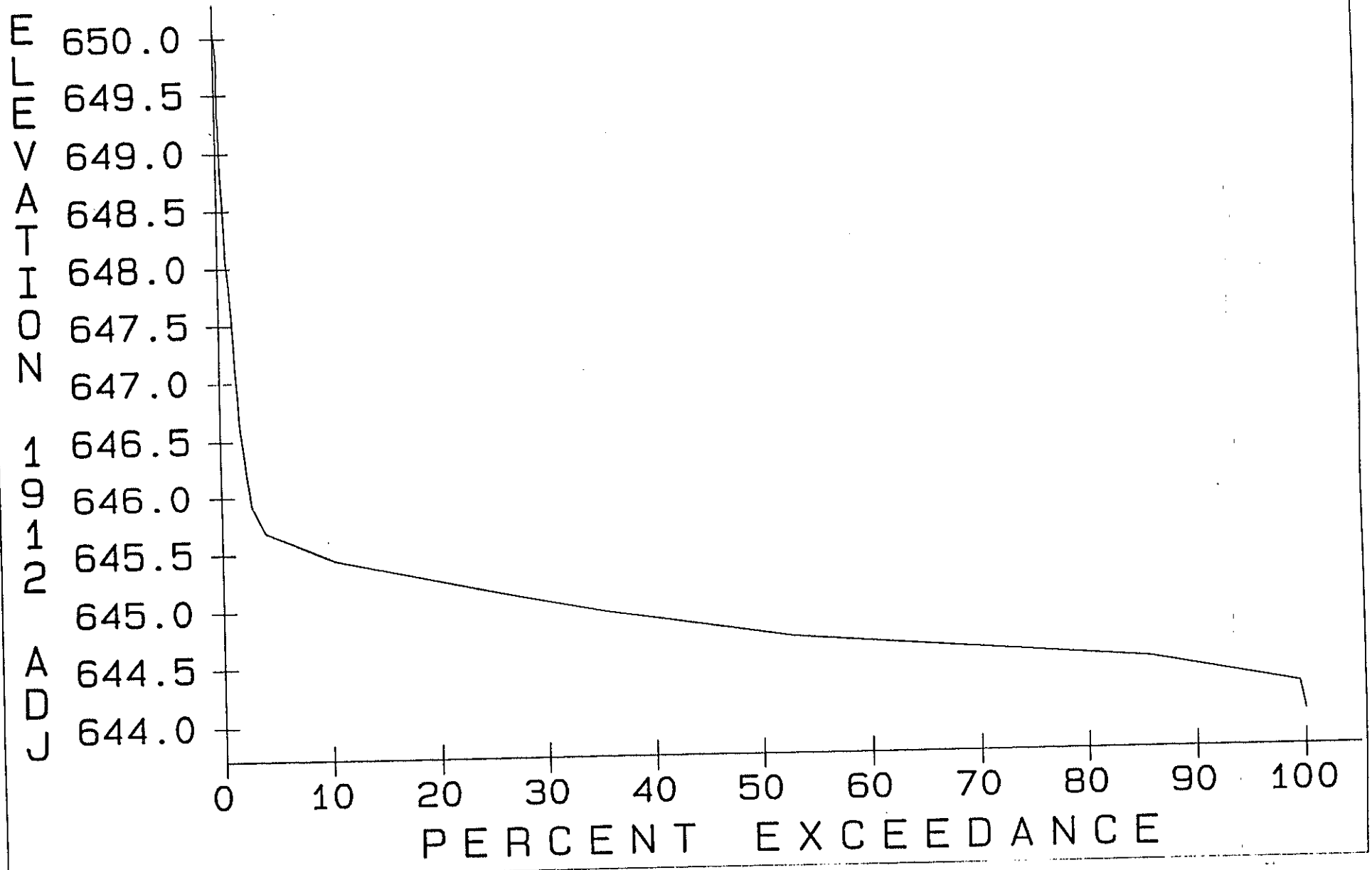


PLATE B-19

APPENDIX C

GEOTECHNICAL DESIGN

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ROCK SOURCES: 5

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PLANS AND SPECIFICATIONS: 5

Bibliography 6

UPPER MISSISSIPPI RIVER SYSTEM
ENVIRONMENTAL MANAGEMENT PROGRAM
DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT (SP-15)
TREMPEALEAU NATIONAL WILDLIFE REFUGE
HABITAT REHABILITATION AND ENHANCEMENT PROJECT
TREMPEALEAU CO., WISCONSIN

APPENDIX C
GEOTECHNICAL DESIGN

1. **GENERAL:** This Appendix presents the geologic and geotechnical data, analysis, and computations for the Trempealeau EMP project. The geologic information was taken from the U.S.G.S. Hydrologic Investigations Atlas HA-474 and the Wisconsin Geologic and Natural History Survey Bulletin No. XXXVI. The geotechnical data includes borings taken in the project area to define soil parameters and to locate possible borrow sites. Analysis and computations made from these data include stability and settlement, judgements on borrow sites, and rockfill gradation analysis. Finally, the work that needs to be done in plans and specifications will be discussed.

2. **PHYSIOGRAPHY:** The Trempealeau National Wildlife Refuge project is located near the confluence of the Trempealeau and Mississippi Rivers in Pool No. 6 of the Mississippi River navigation system. The Mississippi River valley lies in the Central Lowlands physiographic province, which can be further subdivided into the Western Uplands physiographic region of Wisconsin in the project area. Approximately 3/4 of the Western Uplands was never overridden by ice during Pleistocene glaciation. This unique, unglaciated region is known as the Driftless Area.

3. The uplands region has been dissected into a system of ridges and valleys with practically no broad upland areas remaining. Nearly all of Trempealeau county is dominated by this ridge and valley topography. The steep sided valleys are known locally as coulees.

4. The Trempealeau River cuts it's way through the Driftless Area as it flows south to join the Mississippi. In the headwaters, the Trempealeau River is characterized by steep gradients of 15 to 30 feet per mile while in it's lower reaches the gradient is a moderate 4 to 5 feet per mile. The lower reaches are aggraded and eventually match the very low gradient of the Mississippi River. Steep gradients in the headwaters result from continuing headward erosion of relatively soft Cambrian period sandstones.

5. The Mississippi River lies in a broad, bedrock gorge or trench. The gorge is a relatively youthful, U-shaped feature with steep-sided limestone bluffs rising 400 to 500 feet above river

level on either side. Glacial meltwaters scoured the original valley greatly enlarging it's size. Since glacial times the river has rapidly diminished in size so that it occupied only a small portion of the gorge prior to it being flooding for navigation. In the project area the gorge is nearly 4 miles across. The river gradient is quite low, averaging approximately 4 inches to the mile. Side channels, meanders, and sloughs are evidence of the low gradient. Well developed gravel terraces parallel the river, and small amounts of water can be obtained from these.

6. **GENERAL GEOLOGY:** Glaciers invaded the area several times during the Pleistocene Epoch. For reasons still unclear, the Driftless Area was never overridden by ice although it was completely surrounded. The topographic features evident in the Western Upland Driftless Area today are thought to reflect conditions as they were over much of Wisconsin prior to glaciation.

7. Unconsolidated surface deposits in the Trempealeau River headwaters are of two types. Topsoil consists of a thin blanket of windblown silt or loess. The loess blanket gradually thickens toward the Mississippi River. Over most of the basin silt thickness averages 0.5 to 4 feet with a maximum thickness of 8 to 16 feet. The second type of deposit is very fine to fine grained sediment ranging from clay to sand. Much of this alluvium is derived from erosion of the bedrock Cambrian sandstones and siltstones. Alluvium thickness ranges from 50 to 100 feet.

8. In the lower reaches of the Trempealeau, the channel has aggraded to the level of the modern day Mississippi River. The locks and dams of the river navigation system have transformed the Mississippi into a series of pools or shallow lakes, so that the confluence of the two rivers is essentially flooded. Lake-type sediments of stratified sand, silt, and clay reflect these slow water conditions.

9. Although the Mississippi River gorge probably existed as long as 180 million years ago, the major geologic event which created the valley we see today occurred about 10,000 years ago near the end of Pleistocene glaciation. During the glacial period the Mississippi gorge was filled with outwash sand and gravel deposits. These coarse grained deposits were quite extensive and filled the gorge completely in the Trempealeau area. After deposition of the outwash sediments, large volumes of meltwater from the southward outflow of Glacial Lake Agassiz eroded the sand/gravel deposits while 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, led to the development of a braided stream environment. Stream conditions were characterized by numerous channels, swampy depressions, natural levees, islands, and shallow lakes. Completion of Lock

and Dam #6 flooded the area, obscured the braided stream characteristics, and deposited a thin veneer of silts, sands, and clays over most of the present river bottom. In the project area, alluvial valley fill forms a cap approximately 150 feet thick above the entrenched bedrock river valley.

10. About one mile southeast of the project area a series of high rock hills known as the Trempealeau Bluffs stand isolated in the middle of the Mississippi gorge. A broad expanse of flat, sandy bottomland stretches north and east of the bluffs for about four miles to the cliffs of the Wisconsin uplands. This bottomland stretch is the abandoned channel of the glacial age Mississippi River. Between the Minnesota upland and the Trempealeau Bluffs a channel less than one mile wide is now occupied by the modern Mississippi.

11. Bedrock exposures are readily observable along the Mississippi River bluffs. Ordovician period dolomites and limestones of the Prairie du Chien Formation cap the bluffs and ridges. In descending order, the cliffs and hillsides are comprised of the Jordan Sandstone, the St. Lawrence Formation dolomites and siltstones, Franconia Formation sandstones, and Dresbach Formation sandstones of the Cambrian period.

12. The bedrock Mississippi gorge is entrenched into the lowermost Cambrian period rock; the Dresbach Formation. This unit is comprised of marine deposited quartz sandstones. The sandstone is relatively easy to erode and this erodibility helps to account for the wide, U-shaped geometry of the bedrock gorge. Older, Precambrian sedimentary and crystalline rocks lie below the Dresbach Formation and are assumed to be thousands of feet thick.

13. The structural geology of this portion of the Mississippi gorge has not been determined in detail. The sedimentary rocks dip gently and thicken to the southwest, conforming to the Precambrian basement. Solution weathering in the Ordovician period dolomites is common. Stress relief joints which tend to parallel the trend of the Mississippi gorge may also be observed in the river bluffs. The region is considered structurally stable and without tectonic disturbances of regional or local magnitude.

14. **GENERAL GEOTECHNICAL DESIGN:** The following paragraphs describe the Subsurface Exploration, the Pool A Dike Design and its Stability Analysis, the Ducks Unlimited (C2) and Pool E Dikes Design, and the Geotechnical work expected to be completed for Plans and Specifications. The alignments of the all the dikes that are in the selected plan are shown on Plate 11.

15. **SUBSURFACE EXPLORATION:** Twenty-two borings were taken in and around the project site to assess the suitability of the river bed as a foundation for dikes and to locate any possible borrow sites for the clean sand (SP) required to construct these dikes. Sixteen

of the borings were drilled in 1991 and an additional six were obtained in 1993. Plate C-1 shows the boring locations and the boring logs are shown on Plates C-2 though C-4. Soils within the Refuge range from alluvial types in the wetlands to finely eroded sands on the steeper uplands. Varying depths of silt overlie adjacent sand and gravel sediments in the wetlands. Isolation of the Refuge from adjacent river floodwaters has reduced the degree of siltation compared to other Upper Mississippi River backwater areas. The 700-acre central upland portion of the Refuge is an area of rolling sand dunes formed from wind-blown material deposited during a former dry period. The borings indicate that there are no locations within the backwater area that are likely to have sand that would be cost effective to use. The sand for the Pool A dike construction will be obtained from the adjacent Mississippi River channel. For the C2 and the Pool E dikes, the sand will probably be maintenance-dredging sand trucked in from Fountain City.

16. **DESIGN OF THE POOL A DIKE:** Two alternatives were looked at for the design of Pool A dike. Typical cross sections for both alternatives are shown on Plate 7. One is a trapezoidal dike with a 15 foot top width and riprapped, 1 on 3 side slopes. The other design includes 40 foot wide berms with top elevations of 648.0 and perpendicular groins on both sides of the dike. The groins cross section is shown on Plate 12. They will be spaced 180 feet apart which is shown on the plan view on Plate 11. Both designs have a top elevation of 650.0. The berms, on the second alternative, were designed to work together with the groins to absorb wave energy without threatening the integrity of the dike. The berms will form a gently sloping beach, over time, and the groins will form hard points in the beach. Because of the soft foundation material, it will be necessary to underlay the groins in this design with a geotextile. The advantage of the riprap design is that it will protect the dike from erosion with a high degree of confidence of the probable O&M costs. However, the riprap design lacks both in aesthetics and diversity of habitat and its life-cycle cost is higher. The advantage of the groin design is that it will provide a greater diversity of habitat and its live-cycle cost is lower. Its disadvantage is that it has not been tested as thoroughly as the riprap design and so its O&M costs may be higher. However, a year-old project with a similar design in Pool 8 has been tested by high water with wave action on the sand core and has withstood this even before the proposed vegetation has been established.

17. **STABILITY:** The strength test done for Pool A dike was done on a boring taken along a former alignment approximately 400 feet upstream from the current alignment. Although, this soil had an undrained shear-test strength of about 600 psf, a lower strength was assumed because the boring was not along the current alignment of Pool A dike. An end-of-construction stability was computed using the computer program UTEXAS2 using Spencer's method and assuming the following strengths: dike material - cohesion of zero

and an angle of internal friction of 25; and fine grained foundation material - cohesion of 200 psf and an angle of internal friction of zero. End-of-construction was the only case analyzed because it will be the worst case. As shown on Plates C-5 and C-6, both the alternative designs had a computed factor-of-safety that was greater than 1.3.

18. **DESIGN OF THE C2 AND POOL E DIKES:** The stability analyses have not been completed for either the C2 or the Pool E dikes. Typical cross sections for these dikes are shown on Plate 9. The C2 dike alignment is shown on Plate 8. The alignment of the Pool E dike (alignment shown on Plate 10) is along an existing roadway. This makes the proposed weight of added fill lower and its stability less likely to change.

19. **PUMP STATION SETTLEMENT:** A consolidation settlement of approximately one foot was computed using EM 1110-1-1904. Boring 93-21M was used as representative of the soil strengths under the pumping station. This computation is shown on Plate C-8. A preload of 1300 lbs./sq.ft. in place for about a year before construction of the structure will be used for consolidating the soil.

20. **ROCK SOURCES:** Rockfill is available locally. Numerous rock quarries have been developed in the rock bluffs which form the gorge of the Mississippi River. These are predominantly limestone and/or dolomite quarries, and the resources available are extensive. Rock quality can vary from quarry to quarry, however acceptable quality rock should be available within a 10 to 20 mile radius of any work in Pool No. 6.

21. **ROCK GRADATION:** The gradation for the rock to be use either for the riprap or for the groins, is shown on Plate C-7. It was designed using an adjusted wind speed of 45 mph.

Table: Rock Gradation

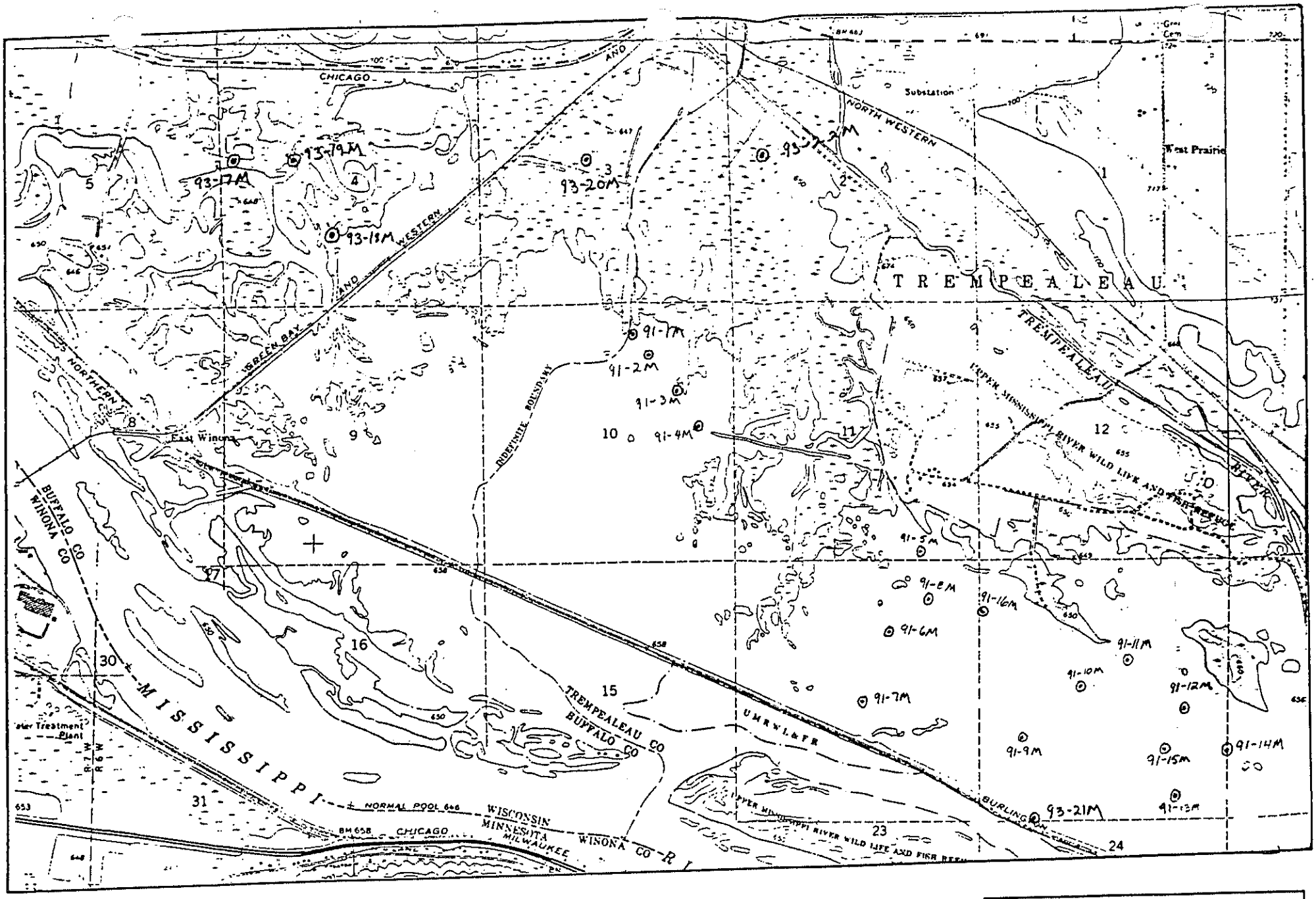
Percent Less then by Weight	Maximum	Minimum
100	300	100
50	120	40
15	25	8
5	15	5

22. **PLANS AND SPECIFICATIONS:** A stability analysis will be done on both the C2 and E dikes.

Bibliography

1. The Physical Geography of Wisconsin, Lawrence Martin, Wisconsin Geological and Natural History Survey Bulletin No. XXXVI, 1932.

2. Water Resources of Wisconsin, Trempealeau-Black River Basin, U.S.G.S. Hydrologic Investigations Atlas HA-474, H.L. Young and



1 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

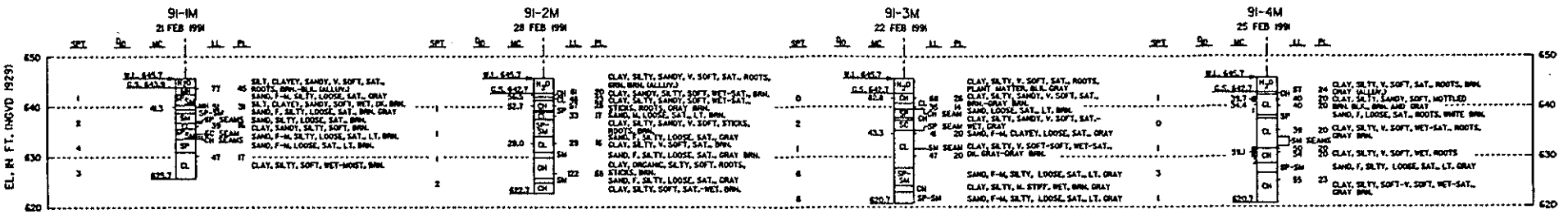
1 5 0 1 KILOMETRE

CONTOUR INTERVAL 20 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Trempealeau NWR

Boring Location Map

HREP/EMP ..



NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 636.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 640.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 636.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 641.7 AND DRILLING MUD USED BELOW.
3. UNDISTURBED SAMPLES OBTAINED WITH SHELBY TUBES IN OFFSET HOLE.
4. CASINGS PULLED AND HOLES ALLOWED TO CAVE IN.

GENERAL BORING LEGEND

84-1M — YEAR OF BORING-BORING NUMBER, BORING TYPE (E.G. M=MACHINE, A=AUGER, TP=TEST PIT, P=PIEZOMETER)

MAY 1984 — DATE 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. 1295.7 — WATER LEVEL ON DATE OF BORING

300 — ELEVATION AT BOTTOM OF BORING

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 1-3/8" 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.

SYMBOL	DESCRIPTION	DATE	APPROVAL

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

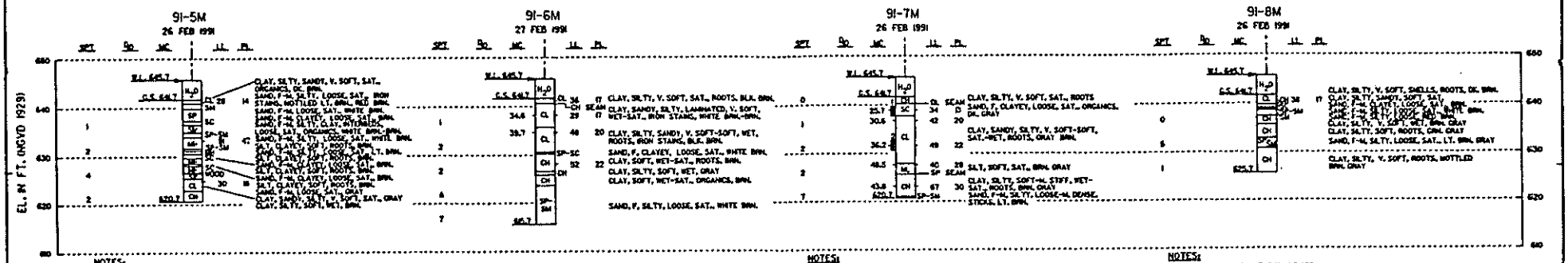
AE APPROVING OFFICIAL:

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT
TREMPEALEAU NATIONAL WILDLIFE REFUGE
ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER
TREMPEALEAU NWR HREP TREMPEALEAU WISCONSIN
GEOLOGIC DATA
BORING LOGS
91-1M THRU 91-4M

DESIGNED:
DRAWN:
CHECKED:
DESIGNED: L.A./ARA
CHECKED: ARK
DATE: 01-08-92
CAD FILE NAME: TRIBWOOD.DGN
SPEC NO:
DRAWING NUMBER: BASIN-T-CC/FND.1
UNIT 1
SY 3

Plate C-2

Plate C-3

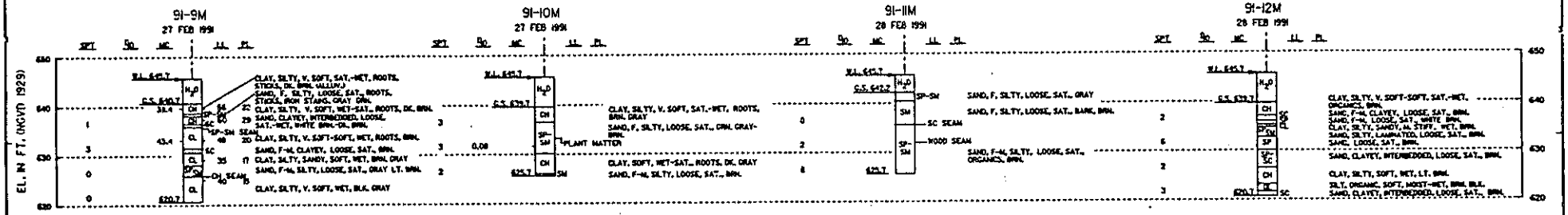


NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 638.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 638.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 638.7 AND DRILLING MUD USED BELOW.
3. UNDISTURBED SAMPLES OBTAINED IN OFFSET HOLE.
4. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. CASING SET TO EL. 638.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.



NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 638.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 638.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 638.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 638.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

SYMBOL	DESCRIPTION	DATE	APPROVAL

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

AE APPROVING OFFICIAL:

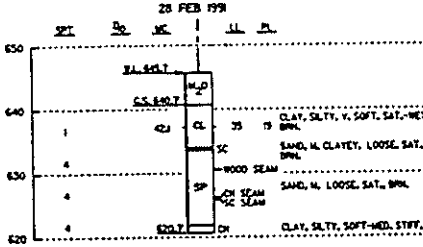
DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT
TREMPEALEAU NATIONAL WILDLIFE REFUGE
ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER
TREMPEALEAU NWR HREP TREMPEALEAU, WISCONSIN
GEOLOGIC DATA
BORING LOGS
91-5M THRU 91-12M

DESIGNED:
CHECKED:
DRAWN:
DESIGNED L.R./ANL
CHECKED ANL
DATE: 01-06-92

CAD FILE NAME: TRYBNDO1.DGN
SPEC NO:
DRAWING NUMBER: BASIN-T-CC/FND.1
SHT 2 OF 3

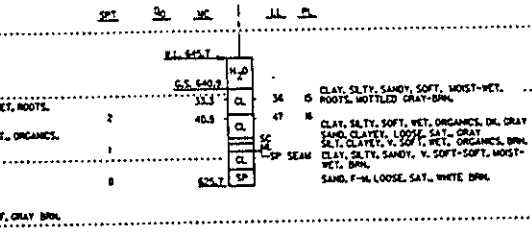
PLATE C-4

91-13M
28 FEB 1991



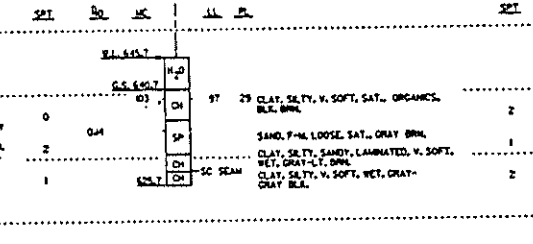
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. CASING SET TO EL. 634.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

91-14M
28 FEB 1991



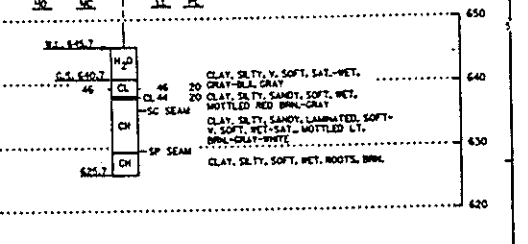
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. 4" CASING SET TO EL. 636.7 AND DRILLING MUD USED BELOW.
3. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

91-15M
1 MAR 1991



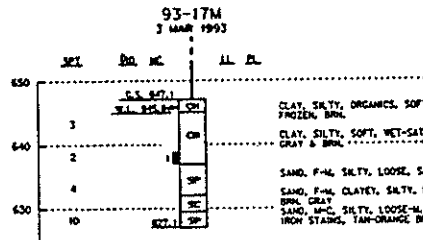
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. RAIN DURING SAMPLING MAY HAVE AFFECTED MOISTURE CONTENTS.
3. CASING SET TO EL. 636.7 AND DRILLING MUD USED BELOW.
4. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

91-16M
1 MAR 1991



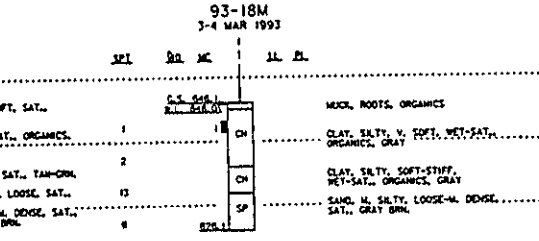
NOTES:
1. WATER LEVEL AT TOP OF ICE.
2. HEAVY RAIN DURING SAMPLING MAY HAVE AFFECTED MOISTURE CONTENTS.
3. CASING SET TO EL. 636.7 AND DRILLING MUD USED BELOW.
4. CASING PULLED AND HOLE ALLOWED TO CAVE IN.

93-17M
3 MAR 1993



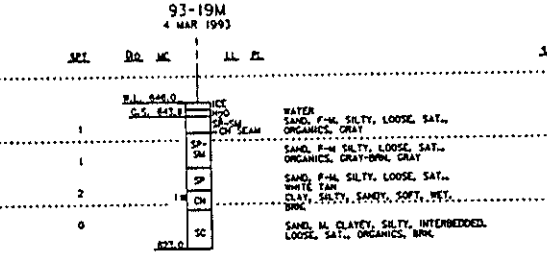
NOTES:
1. WATER LEVEL DETERMINED AFTER 30 MINUTES BOTTOM OF CASING AT EL. 642.1 BOTTOM OF HOLE AT EL. 639.8 AFTER SAMPLING TO EL. 637.1.
2. FOUR INCH CASING SET TO EL. 642.1, HOLE STABILIZED WITH DRILLING MUD BELOW EL. 642.1.
3. THREE INCH UNDISTURBED SAMPLE TAKEN IN AN OFF SET HOLE.
4. BOTH HOLES ALLOWED TO CAVE AFTER CASING REMOVAL.

93-18M
3-4 MAR 1993



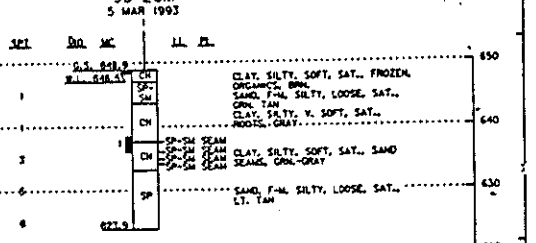
NOTES
1. WATER LEVEL DETERMINED IMMEDIATELY IN UNCASED HOLE BOTTOM OF HOLE AT EL. 642.1 AFTER SAMPLING TO EL. 641.1
2. FOUR INCH CASING SET TO EL. 641.1, HOLE STABILIZED WITH DRILLING MUD BELOW EL. 641.1.
3. SAND HEAVED TO EL. 630.1 AFTER SAMPLING TO EL. 628.1.
4. THREE INCH UNDISTURBED SAMPLE TAKEN FROM AN OFFSET HOLE.
5. BOTH HOLES ALLOWED TO CAVE AFTER CASING REMOVAL.

93-19M
4 MAR 1993



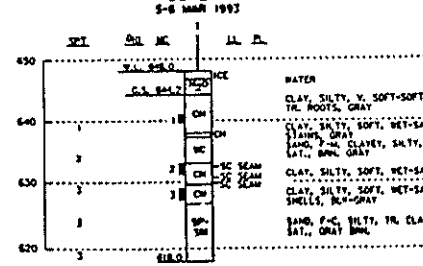
NOTES
1. FOUR INCH CASING SET TO EL. 641.0 AFTER SAMPLING TO EL. 641.0. HOLE STABILIZED WITH DRILLING MUD BELOW EL. 641.0.
2. THREE INCH UNDISTURBED SAMPLE TAKEN IN AN OFFSET HOLE.
3. BOTH HOLES ALLOWED TO CAVE AFTER CASING REMOVAL.

93-20M
5 MAR 1993



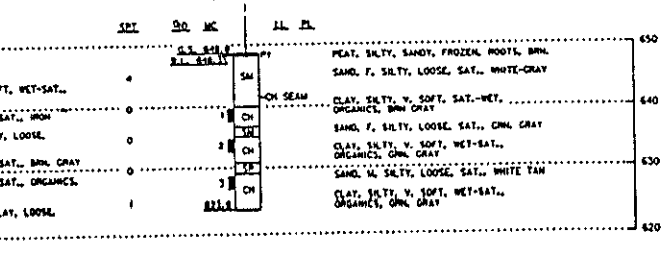
NOTES
1. WATER LEVEL DETERMINED AFTER 85 MINUTES IN UNCASED HOLE BOTTOM OF HOLE AT EL. 648.9 AFTER SAMPLING TO EL. 643.9.
2. FOUR INCH SET TO EL. 643.9. HOLE STABILIZED WITH DRILLING MUD BELOW EL. 643.9.
3. SAND HEAVE ENCOUNTERED AFTER SAMPLING TO EL. 640.9 AND AGAIN AFTER SAMPLING TO EL. 630.9.
4. THREE INCH UNDISTURBED SAMPLE TAKEN IN AN OFFSET HOLE.
5. BOTH HOLES ALLOWED TO CAVE AFTER CASING REMOVAL.

93-21M
5-6 MAR 1993



NOTES
1. FOUR INCH CASING SET TO EL. 638.0 AFTER SAMPLING TO EL. 638.0. HOLE STABILIZED WITH WATER BETWEEN EL. 643.0 AND EL. 640.0. PRIOR TO CASING ADVANCEMENT. HOLE STABILIZED WITH DRILLING MUD BELOW EL. 638.0.
2. SAND HEAVED TO EL. 622.0 AFTER SAMPLING TO EL. 620.0.
3. THREE INCH UNDISTURBED SAMPLES TAKEN IN AN OFFSET HOLE.
4. BOTH HOLES ALLOWED TO CAVE AFTER CASING REMOVAL.

93-22M
8 MAR 1993



NOTES
1. WATER LEVEL DETERMINED AFTER 15 MINUTES IN UNCASED HOLE BOTTOM OF HOLE AT EL. 647.8 AFTER SAMPLING TO EL. 643.6.
2. FOUR INCH CASING SET TO EL. 644.6. HOLE STABILIZED WITH DRILLING MUD BELOW EL. 644.6.
3. THREE INCH UNDISTURBED SAMPLES TAKEN IN OFFSET HOLE. 4. HOLE ALLOWED TO CAVE AFTER CASING REMOVAL.

SYMBOL	DESCRIPTION	DATE	APPROVAL

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

AE APPROVING OFFICIAL

DESIGNED:
DRAWN:
CHECKED:
DESIGNED: LJL/AHK
CHECKED: AHK/JJF
DATE: APRIL 1994

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT
TREMPEALEAU NATIONAL WILDLIFE REFUGE
ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER
TREMPEALEAU NWR MREP TREMPEALEAU, WISCONSIN

GEOLOGIC DATA
BORING LOGS
91-13M THRU 93-22M

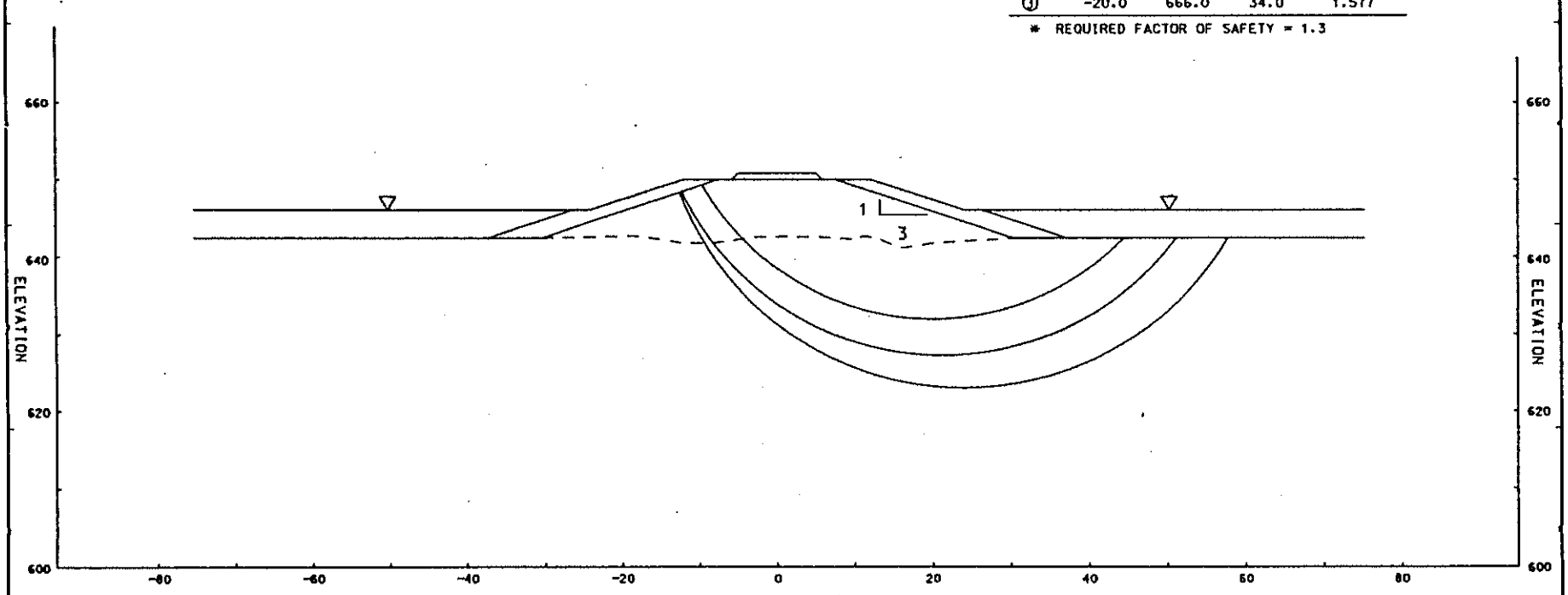
CAD FILE NAME: T**BH002.dgn
SPEC NO:
DRAWING NUMBER: BASIN-T-CC/FNOJ
SHT 3 OF 3

END OF CONSTRUCTION

TABULATION OF ARC DATA

ARC NO.	CENTER COORDINATES X	Y	RADIUS	FACTOR OF SAFETY*
1	-24.0	662.0	39.0	1.553
2	-21.2	664.3	37.1	1.544
3	-20.0	666.0	34.0	1.577

* REQUIRED FACTOR OF SAFETY = 1.3



SOIL PARAMETERS

SOIL NO.	DESCRIPTION	UNIT WEIGHT MOIST	SATURATED	Q-TEST C(PSF)	φ(DEG)
1	ROCKFILL	120.0	120.0	0.0	25.0
2	RIVERBED	96.0	96.0	200.0	0.0

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

DEFINITE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT
TREMPEALEAU NATIONAL WILDLIFE REFUGE
ENVIRONMENTAL MGMT. PROGRAM - MISSISSIPPI RIVER
TREMPEALEAU NWR HREP TREMPEALEAU, MN
POOL A DIKE STABILITY:
RIPRAP ALTERNATIVE

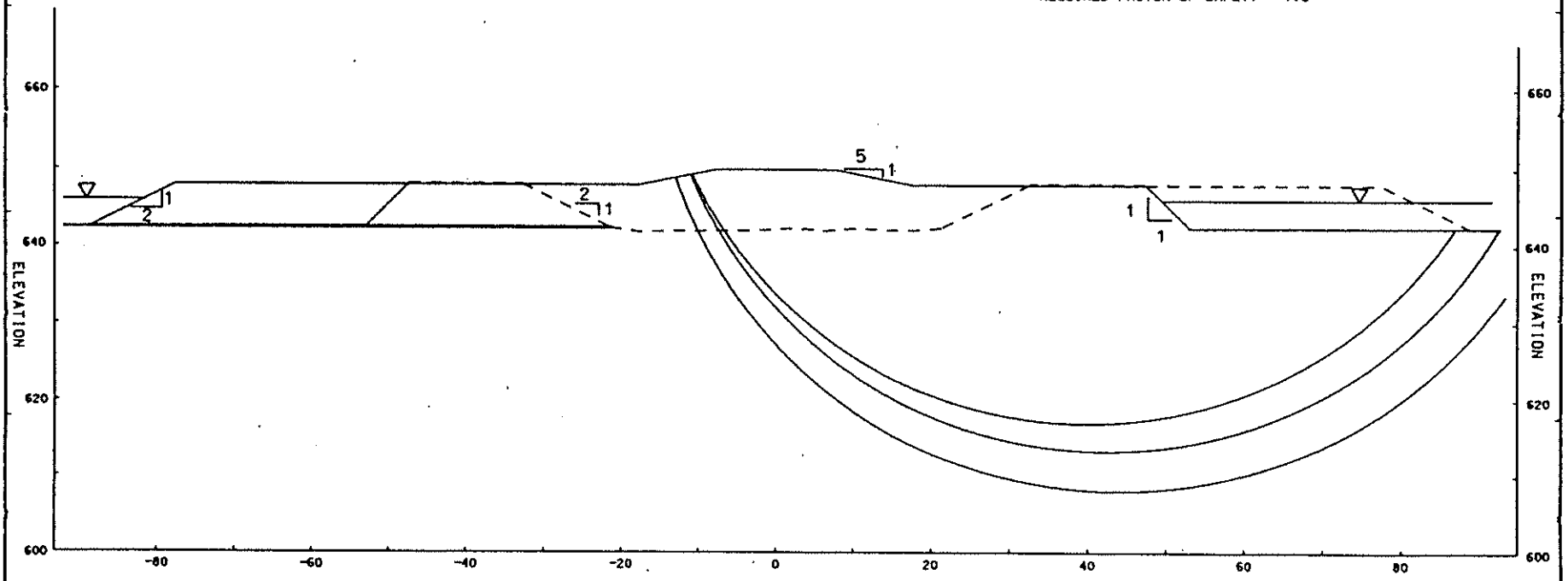
PLATE C-5

PLATE C-6

END OF CONSTRUCTION
TABULATION OF ARC DATA

ARC NO.	CENTER COORDINATES X	Y	RADIUS	FACTOR OF SAFETY *
①	-44.0	668.0	60.0	1.686
②	-42.4	670.9	57.5	1.675
③	-40.0	673.0	56.0	1.685

* REQUIRED FACTOR OF SAFETY = 1.3



SOIL PARAMETERS

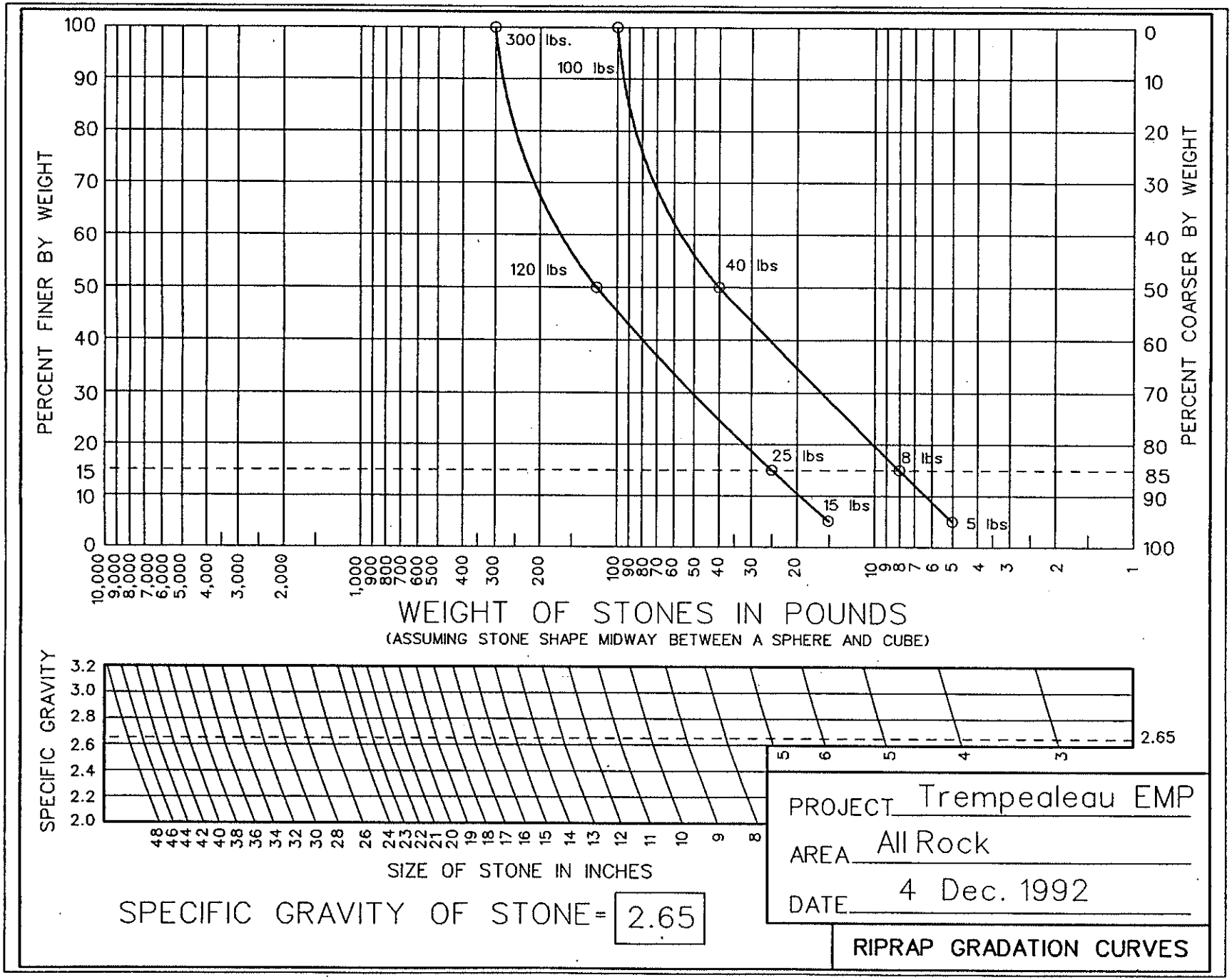
SOIL NO.	DESCRIPTION	UNIT WEIGHT MOIST	SATURATED	Q-TEST C(PSF)	Ø(DEG)
[1]	ROCKFILL	120.0	120.0	0.0	25.0
[2]	RIVERBED	96.0	96.0	200.0	0.0

DEPARTMENT OF THE ARMY

DEFIANCE PROJECT REPORT/ENVIRONMENTAL ASSESSMENT
TREMPEALEAU NATIONAL WILDLIFE REFUGE
ENVIRONMENTAL INVEST. PROGRAM - UPPER MISSISSIPPI RIVER
TREMPEALEAU NWR HREP TREMPEALEAU, WI

POOL A DIKE STABILITY:
GROIN ALTERNATIVE

PLATE C-7


PERCENT FINER BY WEIGHT
PERCENT COARSER BY WEIGHT
300 lbs.
100 lbs
120 lbs
40 lbs
25 lbs
8 lbs
15 lbs
5 lbs
WEIGHT OF STONES IN POUNDS
(ASSUMING STONE SHAPE MIDWAY BETWEEN A SPHERE AND CUBE)
SPECIFIC GRAVITY
2.65
SIZE OF STONE IN INCHES
SPECIFIC GRAVITY OF STONE = 2.65
PROJECT Trempealeau EMP
AREA All Rock
DATE 4 Dec. 1992
RIPRAP GRADATION CURVES

P_c Computation p. 3-29

$$C_c = \frac{e_1 - e_2}{\log \frac{e_1}{e_2}} = \frac{.745 - .653}{\log \frac{4}{8}} = 0.31 \text{ along experimental curve}$$

using Casagrand construction

$C_c = 0.32$

$$\Delta P_{AV} = 1/6 \left[\Delta P_t + 4 \Delta P_m + \Delta P_b\right]$$

$\Delta P_z = 1{,}000$ psf $= q_0$

$\Delta P_m \Rightarrow$ $m = \frac{B}{Z} = \frac{7}{8.8} = 0.7955$ $I = 0.1641$

$Z = \frac{17.6}{2} = 8.8$ $n = \frac{L}{Z} = \frac{10}{8.8} = 1.13636$

$\Delta P_m = 4 I q_0 = 4(0.1641)1{,}000 = 656$ psf

$\Delta P_t \Rightarrow$ $m = \frac{7}{17.6} = 0.4$ $I = 0.08009$

$n = \frac{10}{17.6} = 0.6$

$\Delta P_t = 4 I q_0 = 4(0.08000)(1{,}000) = 320$

$\Delta P_{AV} = 1/6 (1{,}000 + 4(656) + 320) = 657$ psf

$P_o = 8.8 (115.6 - 62.4) = 468$

$$P_c = \frac{C_c H}{1 + e_o} \log \frac{P_o + \Delta P_{AV}}{P_o} = \frac{0.32(17.6)}{1.983} \log \frac{(468 + 657)}{468}$$

$P_c = 1.08$ ft

Pool 9 Island Construction

Pump Station Settlement Calculations

HREP/EMP

APPENDIX D

MECHANICAL AND ELECTRICAL DESIGN SUMMARY

TREMPEALEAU EMP PROJECT
MECHANICAL AND ELECTRICAL DESIGN SUMMARY

I. MECHANICAL AND ELECTRICAL SUMMARY.

1. The project will consist of several pumping features. A permanent pump station will be built into the new dike between pools A and B. Three phase electrical service will be brought into the site for power at the pump station. Power will be obtained from the Trempealeau CO-OP power company and will be underground as opposed to overhead.

2. A pump station built into the levee offers competitive cost and has an advantage from an operation and maintenance standpoint. The pump station will be capable of pumping from either pool A or pool B into the Mississippi River. The pump station will include a gatewell and bulkhead structure.

3. Four electric, portable pumps will be provided for filling pool E and pool C. Pumps will be set on concrete slabs. Three different types of portable pumps were considered and evaluated and are shown in the attached catalogue literature. Alternate pumps considered (in lieu of electric pumps) were two types of diesel driven, hydraulic pumps. These pumps incorporate a diesel engine driving a hydraulic motor. From an environmental standpoint, the electric pumps will emit no exhaust and are virtually silent during operation. Diesel driven pumps typically operate around 100db. A present worth analysis(see attached) was done on all three types of pumps.

II. PERMANENT PUMP STATION IN LEVEE.

1. This pump station will provide capability for drawing down either pool A or pool B. A gatewell will be constructed as part of the pump station and can also provide gravity flow between pool A and B. The gatewell will also incorporate a bulkhead closure structure.

2. Because of low static pumping head, a submersible, propeller type pump can be selected. This type of pump provides for a compact installation. Refer to the attached sketch for the proposed layout of the station. Refer also to the catalogue literature attached to this section. The pumps will be installed inside of a discharge tube and pump straight up the tube. Pumps would seal and seat on the bottom of the discharge tube. The pumps can be pulled from the discharge tube for service with a truck crane. There would not be a need for personnel to enter the wet well to service the pumps.

3. PUMPS.

a. 28 inch size (discharge tube) submersible, propeller, stormwater pumps will be used to match the head and capacity requirements developed.

b. A design station pumping capacity of 22,000 gallons per minute (gpm) will be used. The total dynamic pumping head requirement will be 15 feet of water. This pumping rate will provide for a total drawdown of two feet of water (elevation 646.0 to elevation 644.0) over a 20 day period.

c. Two pumps of 11,000 GPM each will be provided for the pump station. Each pump will thus provide one-half of the required station capacity. Reference hydraulic design write-up in this report.

d. As stated, the pumps will mount inside of a discharge tube. No external lubrication will be required for this type of pump. Two inch diameter solids can be pumped. Submersible pumps in the type and capacity required are available from at least three manufacturers. Outline drawings and performance curves are attached to the end of this section. Pumps will be supplied from the manufacturer complete, including discharge tube and elbow, electrical cable, control panel and controls, and float switches.

e. Cycle times. Pumps will run continuous during pumping operations. This will be over a 20 day time frame. When either pool A or B reaches elevation 644.0 feet, the pumps will shut off.

4. CRANE.

a. The pumps supplied for the pump station will weigh approximately 2000#. The Fish and Wildlife Service will need to provide a truck crane for removal of the pumps. The construction of the new dike will allow for driving up next to the pump station. The requirement will be to lift 2000# at a distance of 20'. These requirements will be given in the operation and maintenance manuals for the pump station.

b. The electric, portable pumps will also require a crane or hoist to set and remove. These pumps can be reached from the new dikes at pools C and E. Each pump will weigh around 1100 pounds.

5. PUMP STATION STRUCTURE.

a. During pumping conditions, the pump station wetwell will be pumped down to the common off float elevation(644.0 feet). A sump pump will be provided to pump water out of the station for maintenance purposes. Both pumps will commence pumping at elevation 646.0 feet.

b. One inlet pipe will enter the pump station. Three gates will be used in the gatewell to control water levels between the pools. Pump discharge lines will be installed for pumping into the river.

c. The Fish and Wildlife Service will be required to perform periodic maintenance on the station. This will include cleaning out silt and debris from the pump and discharge bays. Trashrack will be installed at the station. Before and after a pumping event, the Fish and Wildlife Service will need to inspect the station. A ladder built into the station will provide access into both the pump bay and discharge bays.

d. No superstructure to be provided for the station. The operating level of the station will be enclosed in a barbed wire fence. Operating level to be approximately two feet higher than the top of the dike.

e. Electrical control panel will be pedestal mounted on the operating floor. Details of this will be provided in the plans and specifications stage. Panel will be designed for outdoor exposure.

f. Access into the lower pump and discharge bays will be provided by removing grating above the ladder. Grating has also been provided at other locations shown on the pump station drawing.

g. Discharge tubes will be provided for each pump. The size of discharge tubes will be per manufacturer's recommendation and within the design guidelines given in the calculations. A nominal 28" size has been selected to lay out the station.

h. The pumps will discharge straight up the tube, through an elbow, and then into the discharge lines. Details on this manifold system will be provided at plans and specifications stage. Discharge tubes and elbows will be provided by the pump manufacturer.

6. OUTLET GATES.

a. Gates specified will be slide gate type. Slide gates are shown on the attached sketch and will provide adequate water control at considerably less cost than heavy duty sluice gates. Slide gates will be rising stem type and a standard manufacturer's item. Slide gates in the sizes required are available from at least three suppliers including Rodney Hunt, Hydro-Gate, and Waterman.

b. Slide gates at the gatewell will be manually operated with a handwheel. Further details, including final gate type selection and seating head, will follow in the plans and specifications portion of this project.

7. OPERATION.

a. Operation of the station to be automatic. The operation and maintenance requirements for the station will require the operator to check the station one to two times during a "shift". Sequence of steps to follow for setting controls for automatic mode will also be given as will maintenance requirements for the pumping equipment.

Pumping Station Operating Elevations:

Wetwell Floor	640.5'
Both Pumps Start	646.0'
Both Pumps Shut Off	644.0'

7. REFERENCES.

a) EM 1110-2-3102 "General Principles of Pumping Station Design and Layout" dated December 1962.

b) EM 1110-2-3105 "Mechanical and Electrical Design of Pumping Stations" dated December 1962 & final draft revision dated July 1990.

c) Hydraulic Design of Pump Sumps and Intakes, M.J. Prosser, dated July 1977, British Hydromechanics Research Association.

d) Design of Wastewater and Stormwater Pumping Stations, Manual of Practice No. FD-4, dated 1980, Water Pollution Control Federation.

III. PORTABLE ELECTRIC PUMPS.

1. PUMP.

a. Four submersible, portable, dewatering pumps will be furnished and installed. Electrical service will be brought into each pumping location. Two pumps will be provided for filling upper pool E and two pumps will be provided for pool C. Pumping will be from lower pool E into upper pool E and from pool B into pool C.

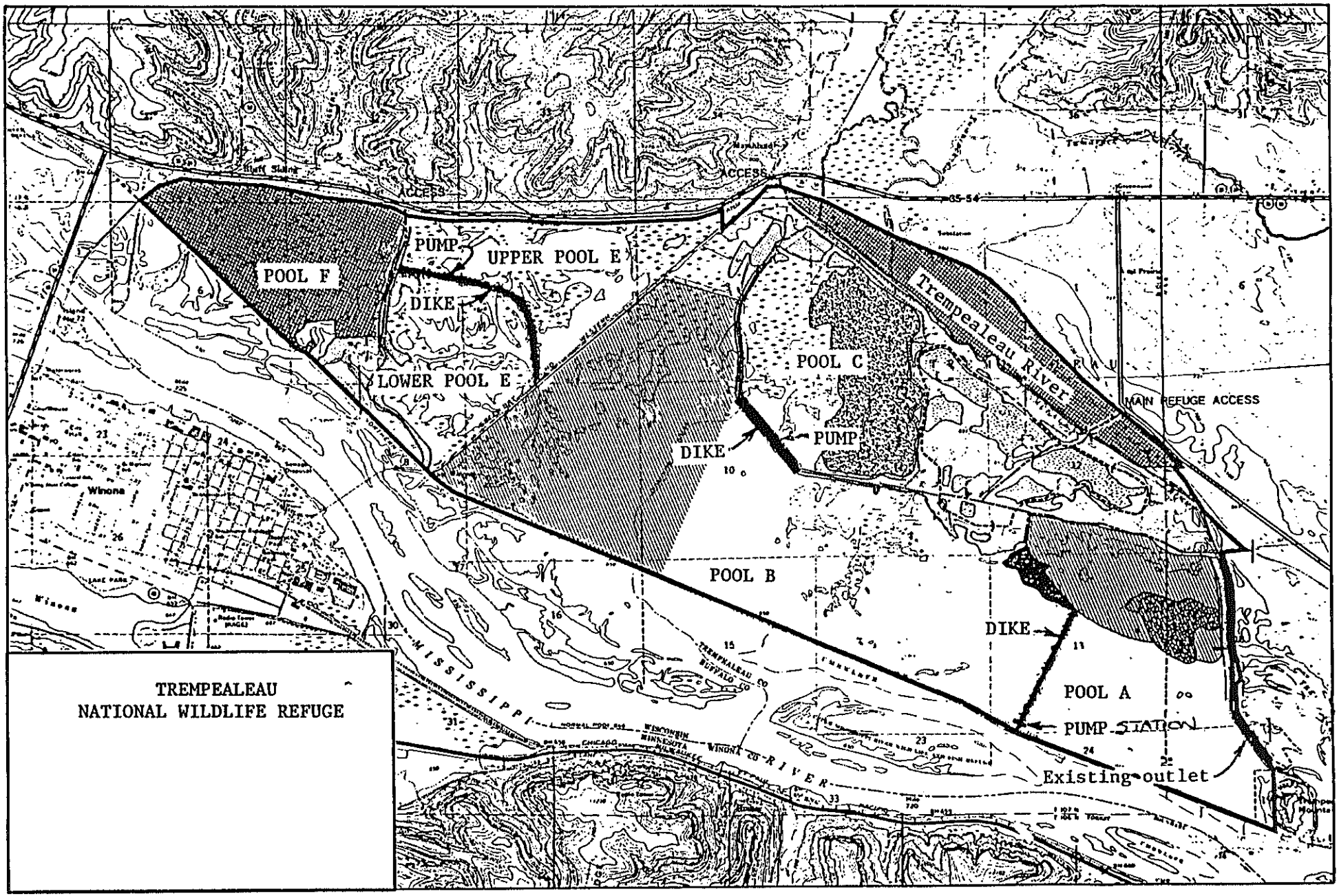
b. Capacities. Each pump will have the capability of pumping 4500 gal/min against a total head of 15 feet. The speed of the pump will not exceed 3500 revolutions per minute. Each pump will have a requirement of 40 horsepower.

c. Pump Lifting System. Each pump will be equipped with lifting eyes or carrying handles. A truck crane or similar lifting mechanism will be required to set the pumps. Construction of the new dikes will allow vehicle access into the area.

d. Discharge Hose Assembly. A hose or tubing assembly for each pump will be provided. Hose size shall match pump discharge size and be suitable for pressurized application of the pump. Approximately 50 feet of hose or tube will be provided for each pump.

e. Pump Motor. The pump motor will be squirrel-cage, induction, shell type design, housed in an air filled or oil filled, watertight chamber. It will be suitable for submersible application. Each motor will be wound for 3-phase, 60 hz, alternating current, 480 volt operation.

f. Pump cable. Fifty feet of pump (or motor) cable shall be supplied. The motor cable will be suitable for submersible pump application. Cable will be continuous from the pump motor to a manual start and stop control box. From the control box, the cable will run to a service pole and terminate with a horsepower rated, 3-phase plug and matching receptacle. With this arrangement, the pumps can simply be plugged in or unplugged.

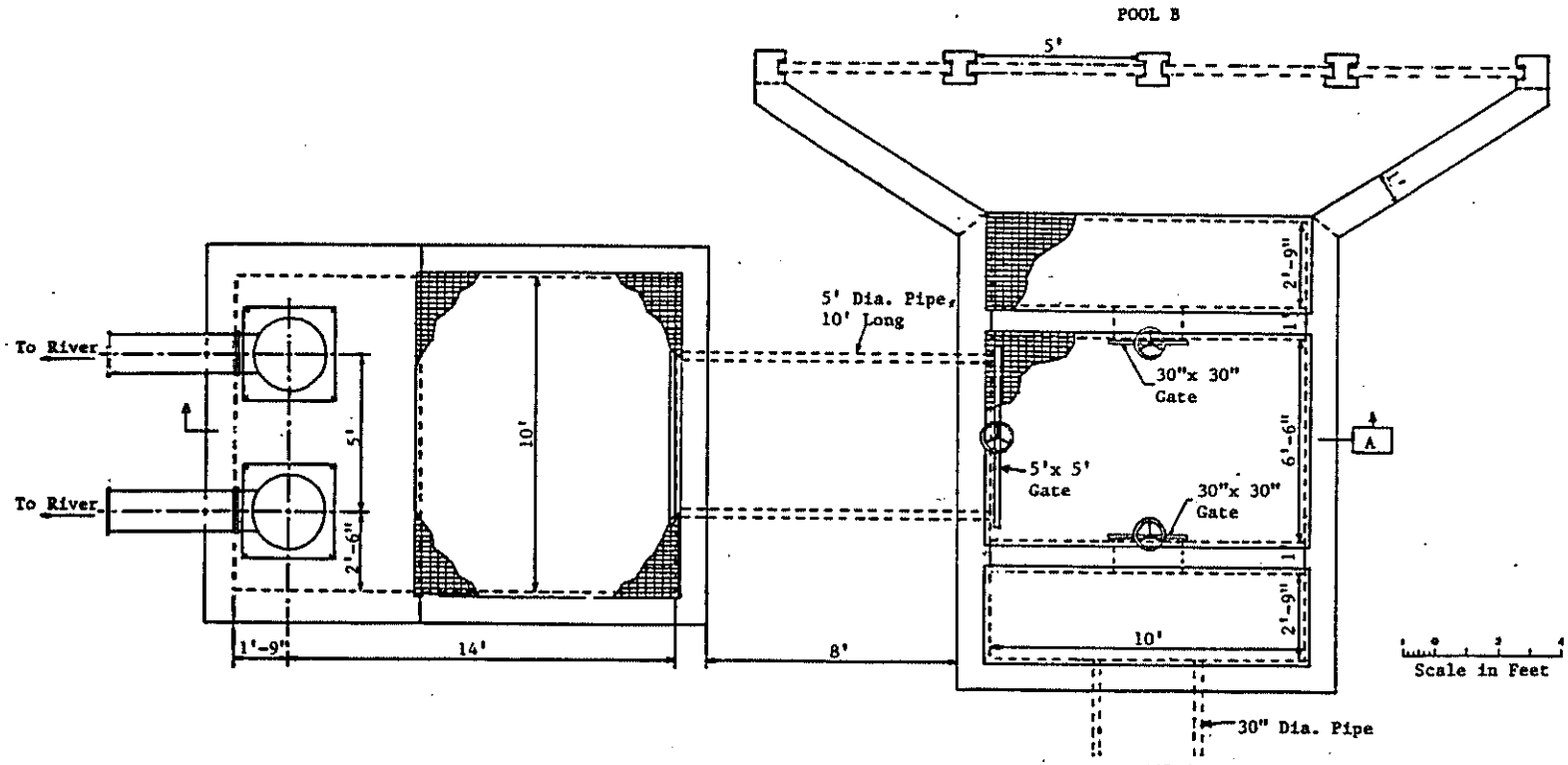


TREMPEALEAU
NATIONAL WILDLIFE REFUGE

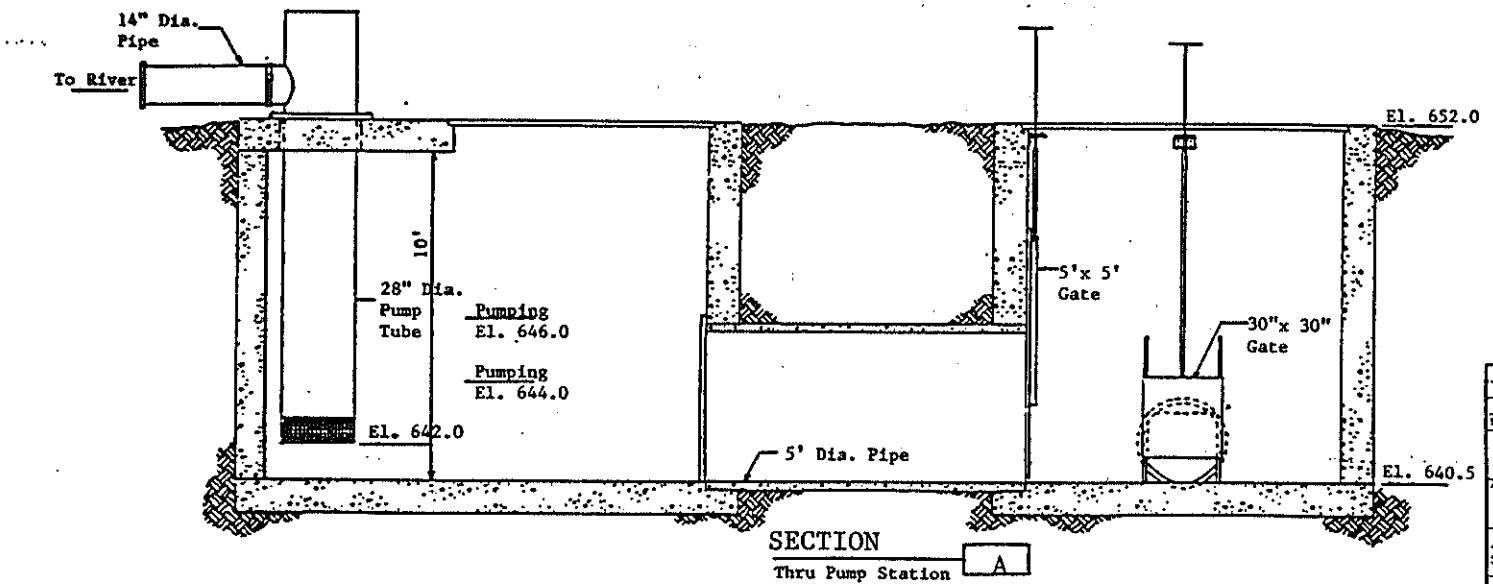
U.S. FISH AND WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

location

north



PLAN
Pump Station



SECTION
Thru Pump Station A

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

TREMPELEAU EMP

PUMP STATION

TABLE 1

PRESENT WORTH ANALYSIS
OF ELECTRIC AND HYDRAULIC PORTABLE PUMPS
FOR TREMPEALEAU EMP PROJECT

	ELECTRIC PUMPS	HYDRAULIC PUMPS	HYDRAULIC PUMPS
Type	Submersible, Electric, Portable Trash Pump	Diesel Driven, Hydraulic, Portable Centrifigal Trash Pump	Diesel Driven, Hydraulic, Portable Axial Flow Pump
Size	10" Discharge	12" or 14" Discharge	12" or 14" Discharge
# Pumps	4 required	4 required	2 required
Capacity (GPM)	4500/Pump	4500/Pump	10,000/Pump
Head (T.D.H)	15.0 Feet	15.0 Feet	15.0 Feet
Horsepower	40	100 to 150(Diesel Engine)	100 to 150(Diesel Engine)
RPM(Pump)	3500	1200	1200
Efficiency	60 – 80%(Pump and Motor)	30 – 60%(Diesel Engine & Pump)	40 – 70%(Diesel Engine & Pump)
Prime Mover	Submersible Electric Motor	Diesel Engine	Diesel Engine
Power Source	100A, 480V, 30 Service	Hydraulic Motor	Hydraulic Motor
Advantages/ Disadvantages	Low Maintenance & Noise Demand Charge & Electric Service	No Demand Charge & Electric Servic High Maintenance & Noise	No Demand Charge & Electric Servic High Maintenance & Noise
Material or Supplier	Flygt CS 3201 or Equal Submersible, Portable Pump	D & D Size 12T Hydraulic Portable Trash Pump	M & W HAC 316 Hydraulic Axial Flow Pump
First Cost for Pumps	$80,000	$250,000	$150,000
Hose, Tubing & Discharge Pipe	$5,000	$5,000	$15,000
Electrical Controls & Equipment	$15,000	$0	$0
Installation of Pump & Controls	$15,000	$10,000	$10,000
Electrical Service	$75,000	$0	$0
Operating Costs(P.W.)	$219,640	$198,137	$148,603
Maintenance Costs(P.W.)	$48,859	$282,345	$141,172
Total Cost	$458,499	$745,482	$464,775

COMPUTATION SHEET

Name of Office	Project	Date	Page
ST. PAUL DISTRICT ED-D	TRENTON ENP	10/11/91	1 of 2

PORTABLE PUMPING - PRESENT WORTH of OPERATING COSTS (1-20 DAY EVENT)

Computed by	Checked by	Approved by	Price Level
TMP			

ELECTRIC PORTABLE PUMPS (4 TOTAL PUMPS - 40 HP EACH)

ENERGY CHARGE = $0.052/KWHR X 160 KW X 20 DAYS X 24 HR/DAY
= $3994 FOR 1 PUMPING EVENT of 20 DAYS

MONTHLY DEMAND CHARGE
= $6.0/KW X 160 KW
= $960 MONTH X 12 MONTHS
= $11,520/YEAR

IF (2) PUMPING EVENTS PER YEAR ARE ASSUMED, THEN
ANNUAL COST = 2 X $3994 + $11,520 = $19,510

OVER 30 YEARS 8% INTEREST
PW = A X [((1+i)**n - 1)/(i X (1+i)**n)]
= $19,510 [((1+.08)**30 - 1)/(.08 X (1+.08)**30)] = $219,640

DIESEL DRIVEN HYDRAULIC PUMPS
TWO DIFFERENT OPTIONS:
2 AXIAL FLOW PUMPS
4 CENTRIFUGAL TRASH PUMPS

AXIAL FLOW PUMPS

FUEL CONSUMPTION = 150 GALLONS/DAY X 20 DAYS
= 3000 GALLONS PER PUMP
COST = 3000 GALLONS X $1.10/GALLON
= $3300 X 2 PUMPS = $6600
With (2) PUMPING EVENTS
ANNUAL COST = $13,200
PW = $148,603 (30 YEARS i = 8%)

CENTRIFUGAL TRASH PUMP

FUEL CONSUMPTION PER PUMP = 100 GALLONS/DAY X 20 DAYS
= 2000 GALLONS PER PUMP
COST = 2000 GAL X $1.10/GALLON
$2200 X 4 PUMPS = $8800
WITH (2) PUMPING EVENTS
ANNUAL COST = $17,600

OVER 30 YEARS, 8% INTEREST
PW = $198,137

COMPUTATION SHEET

Date	Page
10/11/91	2 of 2

Name of Office	Project
ST PAUL DISTRICT ED-D	TRENPEALEAU EMD

PORTABLE PUMPING - PRESENT WORTH of MAINTENANCE COSTS

Computed by	Checked by	Approved by	Price Level
TMP			

ELECTRIC PORTABLE PUMPS (4 TOTAL PUMPS)

ANNUAL COST of MAINTENANCE -
SETTING PUMPS - 8 HRS / PER PUMPING EVENT
RETRIEVING & STORING PUMPS - 8 HRS / PER PUMPING EVENT
MONITORING PUMPS - 2 HRS / DAY X 20 DAYS = 40 HRS
GENERAL MAINTENANCE-PUMPS - 8 HRS / PER PUMPING EVENT
TOTAL HRS - 64
MAN-HOUR COST PER PUMP EVENT (20 DAYS)
= 64 HRS X $30/HR = $1920

ANNUALIZED MAINTENANCE COST of PUMPS = $500
ASSUMING (2) PUMPING EVENTS of 20 DAYS
ANNUAL COST = 2 X $1920 + $500
= $4340
PW (30 YEAR LIFE, i = 8%) = $48,859

DIESEL DRIVEN HYDRAULIC PUMPS { 2 AXIAL FLOW PUMPS / 4 CENTRIFUGAL TRASH PUMPS }
WILL ASSUME THAT THE ANNUAL COST of AXIAL FLOW OPTION WILL BE 1/2 of CENTRIFUGAL TRASH PUMP OPTION. (HAVE 2 PUMPS VS 4)

ANNUAL COST of MAINTENANCE { AXIAL FLOW OPTION - 2 PUMPS } -
SETTING PUMPS - 12 HRS PER PUMP EVENT
RETRIEVING & STORING PUMPS - 12 HRS PER PUMP EVENT
MONITORING PUMPS - 4 HRS PER DAY X 20 DAYS = 80 HRS
FUEL DELIVERY - 2 HRS PER DAY X 20 DAYS = 40 HRS
GENERAL MAINTENANCE - 2 HRS PER DAY X 20 DAYS = 40 HRS
TOTAL HRS - 184 HRS
MAN-HOUR COST PER PUMP EVENT (20 DAYS)
= 184 HRS X $30/HR
= $5520

ANNUALIZED MAINTENANCE COST of PUMPS = $1500

ASSUMING (2) PUMPING EVENTS PER YEAR (20 DAYS)
ANNUAL COST = 2 X $5520 + $1500 = $12,540

PW (30 YEARS, i = 8%) = $141,172

TREMPEALEAU ELECTRIC COOPERATIVE
ARCADIA, WISCONSIN

LARGE POWER RATE

(120 HP)

Effective
Rate Code L

TIM — LOCATION #1 WOULD REQUIRE 112½ KVA
OTHER TWO WOULD HAVE 75 KVA EACH.

AVAILABILITY

Available to all consumers with over 75 kVA single phase and 50 kVA three phase transformer capacity and limited to all existing consumers on this rate and new consumers having 500 kVA or less of installed transformer capacity. Subject to rules and regulations of the Cooperative.

TYPE OF SERVICE

Single and multiphase, 60 cycle, at available secondary voltages. Motors shall not exceed of 260 amps inrush current for single phase and 450 amps for multiphase without prior consent of the Cooperative. All multiphase equipment shall be protected for loss of phase.

MONTHLY RATE

Service Charge:	$25.00
Facilities Charge:	$ .50 per kVA over minimum kVA
Demand Charge:	$6.00 per kW
Energy Charge:	5.2¢ per kWhr

PURCHASE POWER ADJUSTMENT

The above rates shall be increased or decreased coincident with a change in the Cooperative's wholesale rate by 0.1 mill per kilowatthour for each 0.1 mill or major fraction thereof by which the Cooperative's average purchased power cost for the projected twelve (12) month period using the current wholesale rate exceeds or is less than 46.47 mills per kilowatthour.

DEMAND CHARGE

Measured demand shall be the maximum kilowatt demand established by the consumer for any period of 60 consecutive minutes recorded.

MINIMUM CHARGE

The minimum monthly charge shall be the service charge plus facility charge.

VOLTAGE DISCOUNT

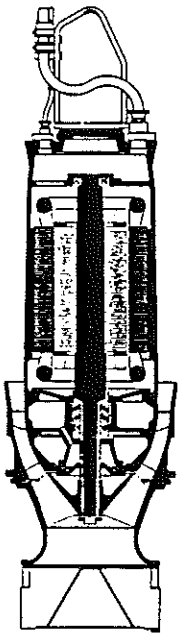
A discount of 5 percent of the net bill will be allowed when the consumer receives and is metered at the available primary voltage. A discount of 2 percent of the net bill will be allowed when the consumer receives service at available secondary voltages and is metered at the primary voltage.

PERMANENT PUMP STATION

SUBMERSIBLE PUMPS

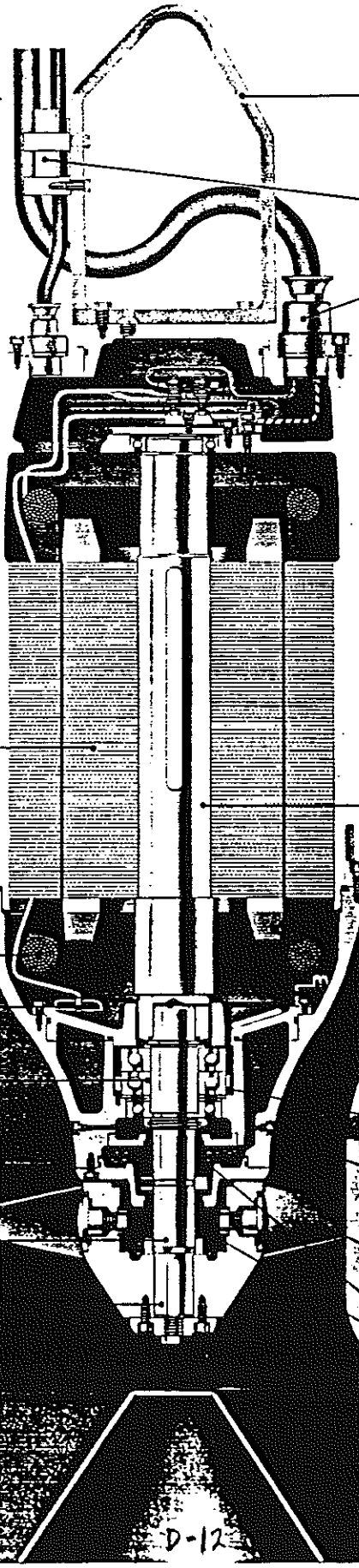
TYPICAL CATALOGUE DATA

Submersible motor pumps PNT and SNT – compact, sturdy and durable



SNT
with mixed-flow impeller

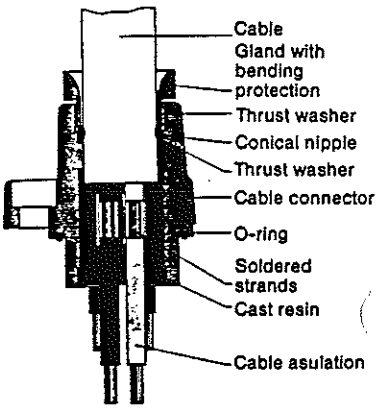
PNT
with
axial propeller



Lifting handle suitable to allow assembly and dismantling even with a flooded inlet chamber (no need to enter the sump)

Cable mounted with strain relief

The cable entry is absolutely water-tight with insulation at several points. Even in the event of damage to the cable and core insulation there is no possibility of moisture entering the motor chamber along the strands due to capillary action



Operationally safe, dry running three-phase induction motor, surface cooled

From pump size PNT 800 with planetary gear between motor and pump

Higher efficiency by means of a motor shaft of ferromagnetic steel

Motor housing with stator removable after loosening the flange connections (simple visual inspection of the motor)

Thermal protection avoids motor overheating

Self-centering positioning of the pump in the tube by its own weight

Patented standard moisture probe as an additional safety device

No additional anchoring or rotational provention of the pump required

Fast assembly and disassembly, since no cable or pipes must be loosened

Easy assembly journal/guide bearing unit: defined load ratios due to flexible construction elements for all operating conditions. Leakage collecting reservoir equipped with level control
- PNT 800 and above
- SNT all sizes

Early fault detection by means of bearing temperature control

Inspection ports for both the upper and lower mechanical seals

Pump shaft made of corrosion resistant chromium steel

Minimum bearing load and deflection of the shaft due to short shaft overhang

Blades manually adjustable after dismantling of the propeller

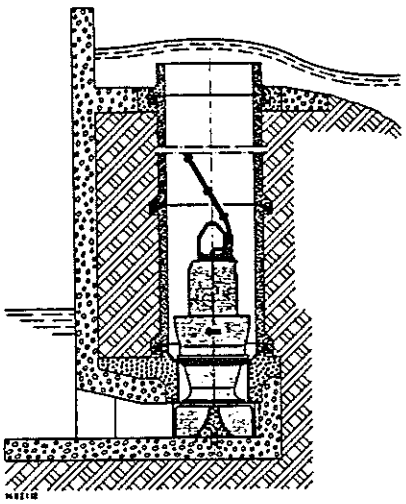
Mechanical seals in tandem arrangement, trouble free operation for many years due to:
- statically sealing rubber bellows on the shaft
- common liquid feed with large air cushion for expansion
- high quality, wear resistant metal carbide/ceramic sealing materials

No vortex formation of the inflowing liquid due to suction cone

KSB

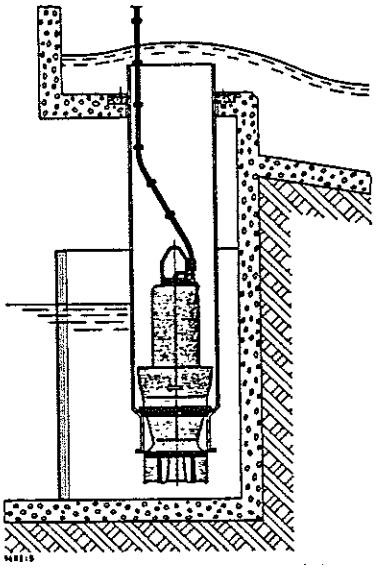
PNT 200 B to 1140
SNT 290 to 586

Installation



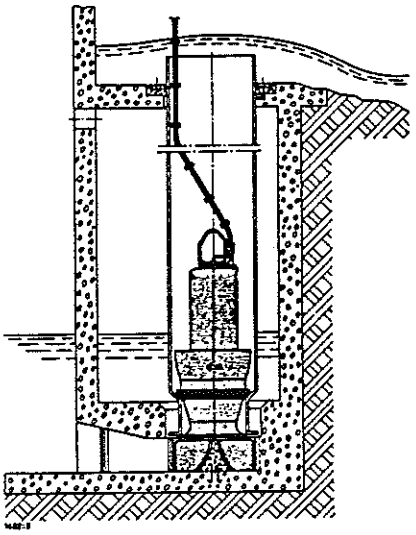
A

for low water level in suction chamber in a concrete column



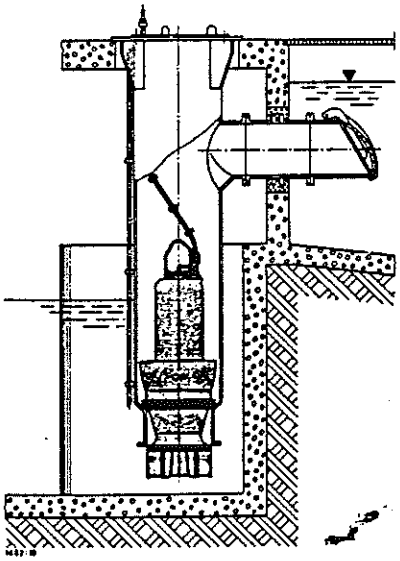
B

for high water level in suction chamber in a steel tubular column



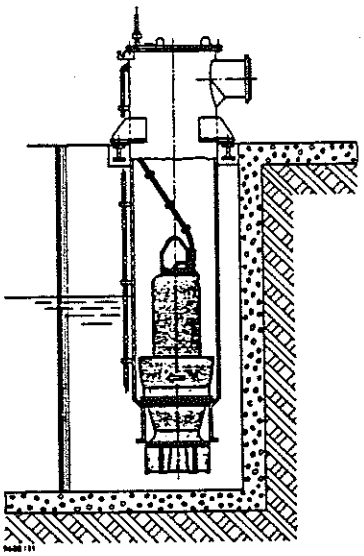
B 1

for low water level in suction chamber in a steel tubular column



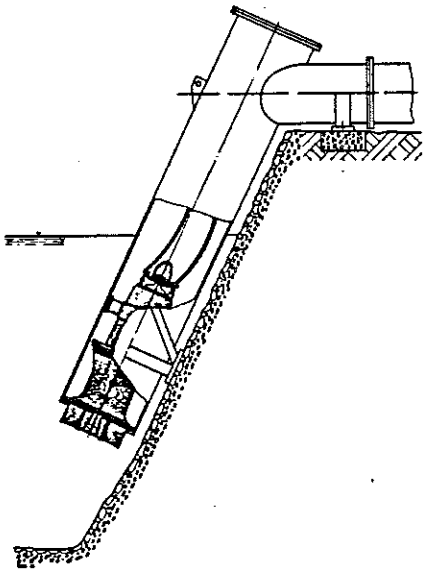
C

vertical installation for below ground discharge



D

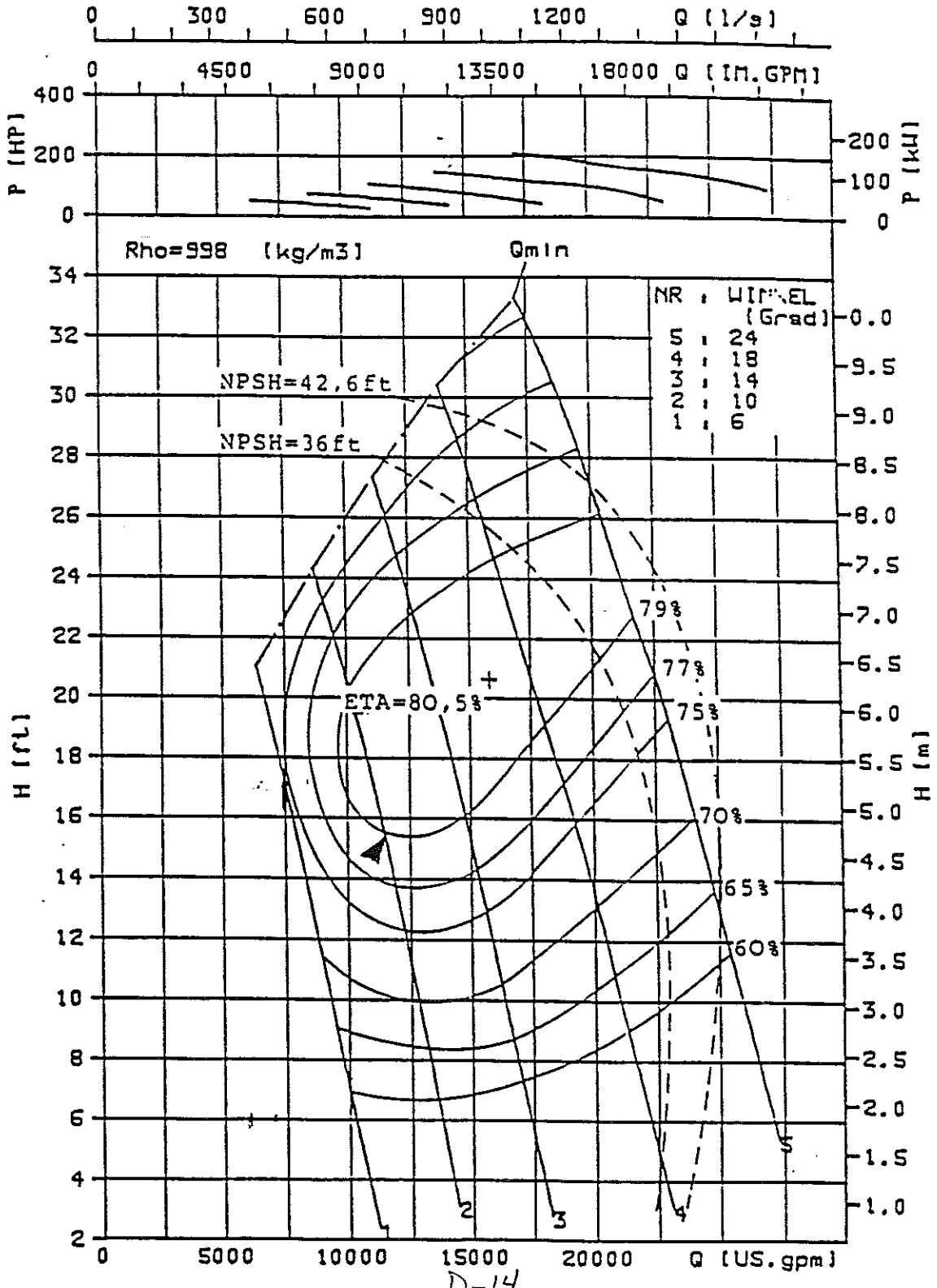
vertical installation for above ground discharge



F

angular installation for above ground discharge

PNT PM 900-550	890 (1/min)	KSB Aktiengesellschaft Geschäftsbereich Pumpen Umwelttechnik Postfach 1725 Johann-Klein-Straße 9 D-6710 Frankenthal

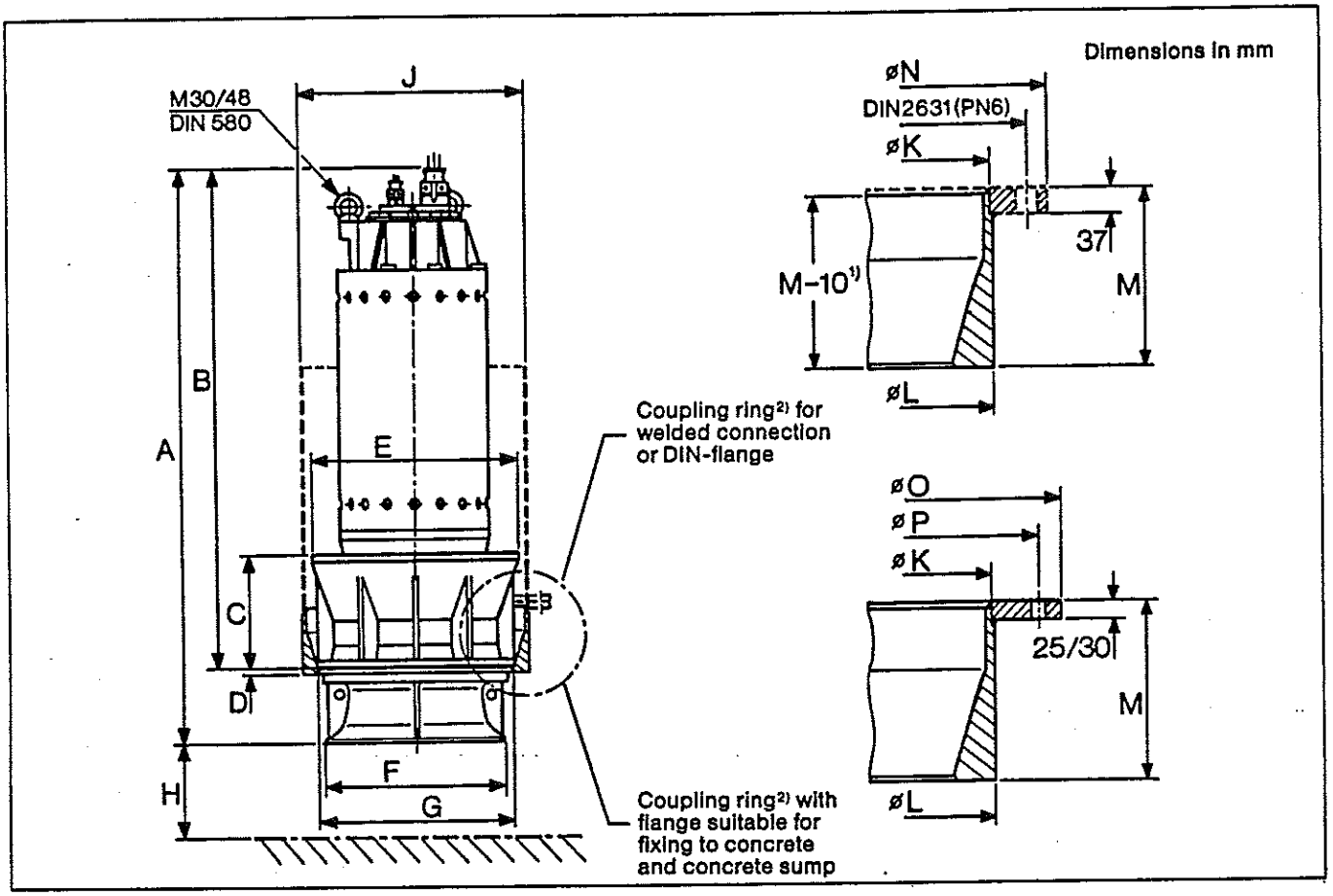


D-14

PNT PM 900-550	QH-Curve No.	Date	Name

Dimensions

ABS



Nominal Dia.	Type VUP-H	Motor Size	Weight w. cable 10 m	A	B	C	D	E	F	G	H	J	K	L	M	N	O	P
DN			kg															
400	450-4	W2	650	1610	1400	285	15	570	425	530	250	600	610	590	120	760	810	750 8 x Ø18
	550-4	↓	660	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
	750-4	▼	780	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	
500	550-6	W3	890	1720	1488	320	20	660	550	610	300	700	711	680	160	863	913	850 8 x Ø18
	750-6	↓	985	1850	1618	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
	900-6	▼	1040	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	
	1100-6		1120	2000	1768													
600	370-8	W3	995	1750	1480	417	23	750	650	705	350	800	813	820	260	975	1015	950 8 x Ø18
	450-8	↓	1040	1880	1610	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
	550-8		1130	▼	▼													
	750-8		1200	2030	1760													
	900-8	▼	1285	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	
800	750-8	W3	1820	2240	1881	511	29	950	850	898	450	1000	1016	1020	260	1178	1278	1210 12 x Ø18
	900-8	▼	1920	▼	▼	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
	1100-10	W4	2490	2290	1931													
	1320-10	↓	2660	2450	2091													
	1600-10		2785	▼	▼													
	2000-10	▼	3080	2610	2251	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	
1000	1100-10	W4	3270	2642	2210	649	35	1150	1050	1110	600	1200	1220	1220	260	1402	1480	1400 12 x Ø22
	1320-10	↓	3395	▼	▼	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	
	1600-10	▼	3610	2802	2370													
	2000-12	W5	4150	2805	2375													
	2500-12	▼	4280	3005	2575	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	▼	

Data applies to 60 Hz versions

1) Height of coupling ring for welded connection
2) Accessory, dimensions for other accessories on request

Exact dimensions for the design of a pump station should be taken from the individual dimension data sheets.

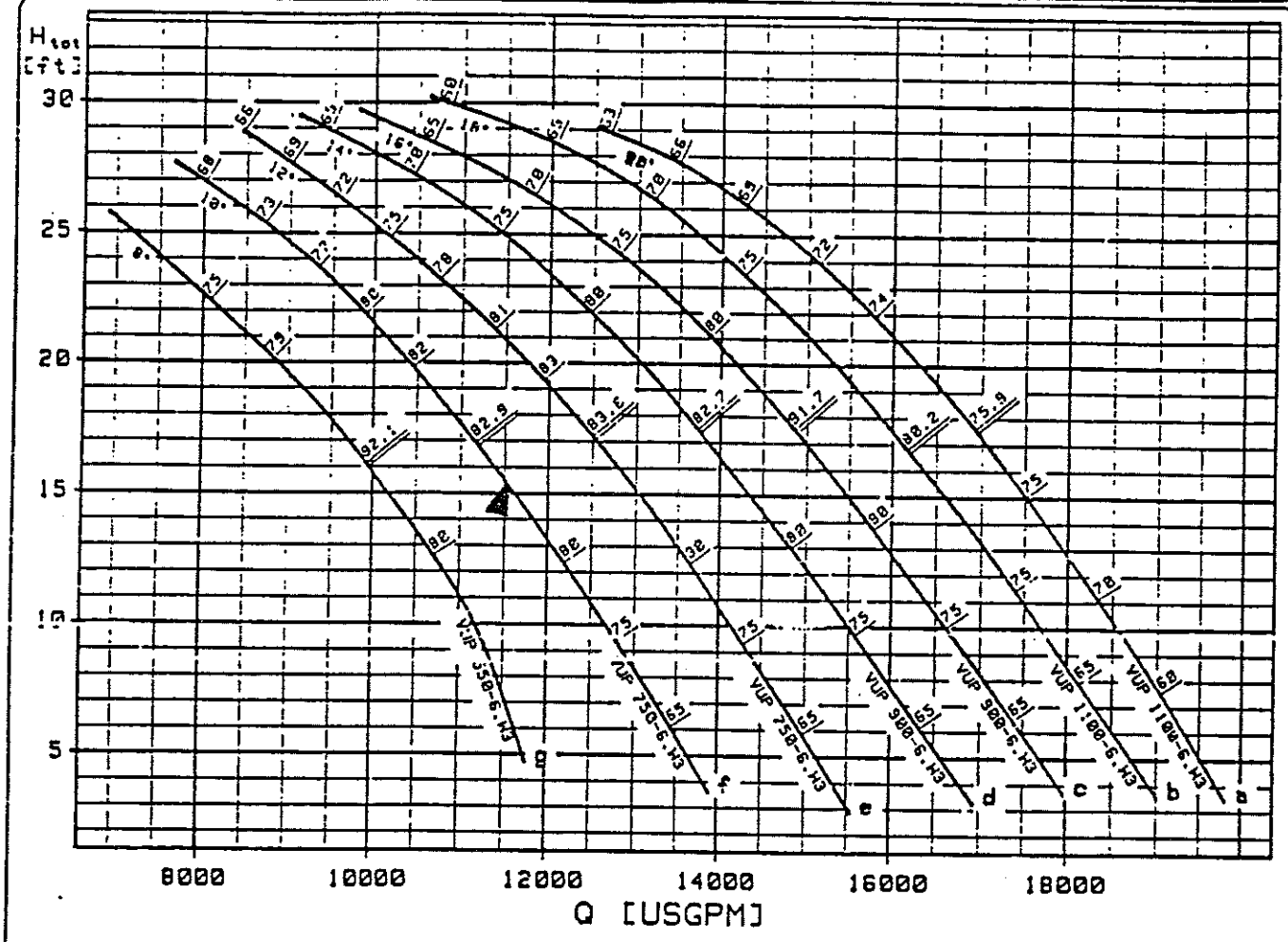
D-15

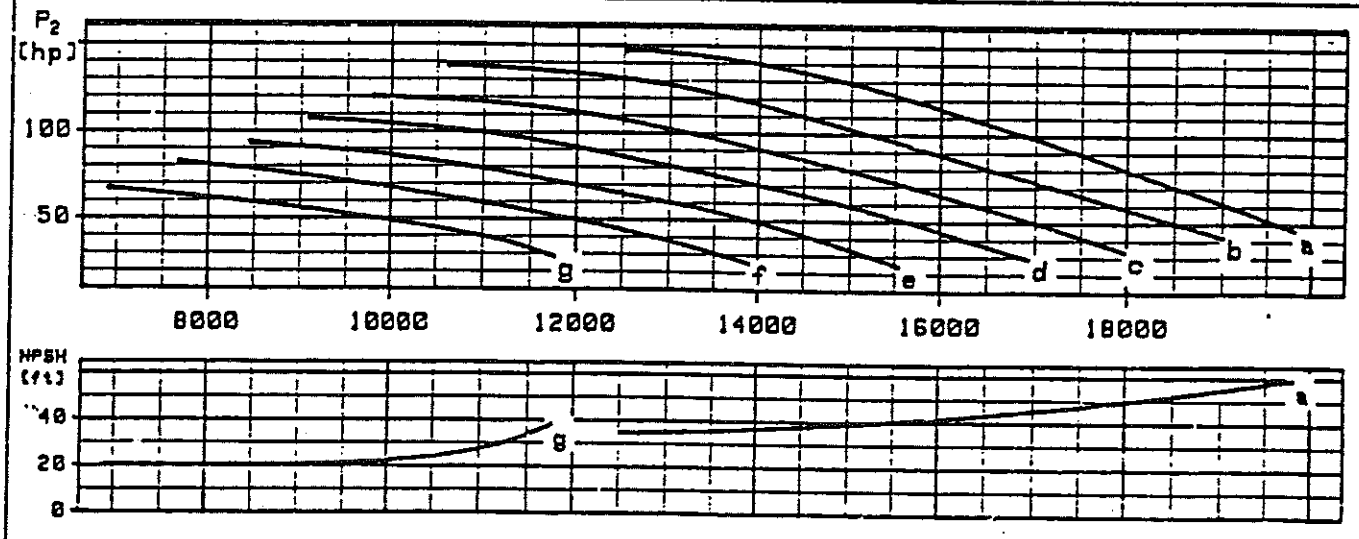
Performance curve

60 Hz

TECHDAT

VUP 550-6.W3 - VUP 1100-6.W3





Hydraulic type : axial flow impeller H 501

Blades : 3 | Speed : 1170 RPM

DN 500

Tolerance according to ISO 2548 class C

2nd Jan 1989 | D-16 | 6.60.0500.06.1310-00

FLYGT

PERFORMANCE CURVE

PROD. 7050

CURVE NO 63-1175B4

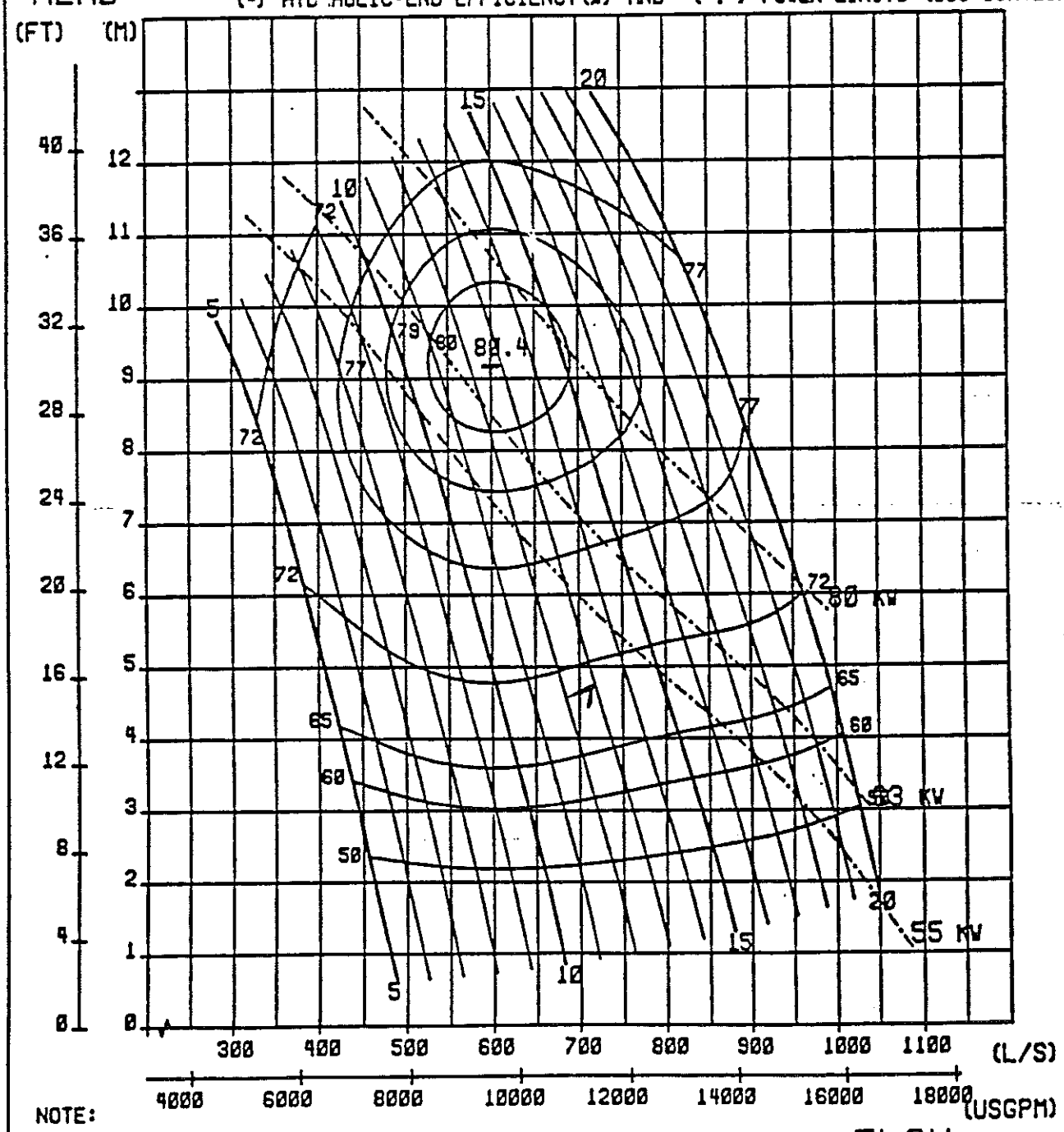
DATE	ISSUE	FREQ	NOMINAL HYDRAULIC-END SPEED
1984-06-05	3	60 HZ	1175 RPM

IMPELLER/HUB DIAMETER	TYPE OF BLADES	NO. OF BLADES	AVAILABLE BLADE ANGLES
460/260 MM	B	4	EVERY DEG. FROM 5 TO 20 DEG

MOTOR	POLES	SHAFT POWER	GEARTYPE	GEAR RATIO	GEAR EFFICIENCY (1/1-3/4 LOAD)	RATED SPEED
35-24-6	6	55 KW				1165 RPM
35-28-6	6	63				1170
40-30-6	6	80				1175
40-44-6	6	125				1175

HEAD

(-) HYDRAULIC-END EFFICIENCY(%) AND (-.-) POWER LIMITS (ISO-CURVES)



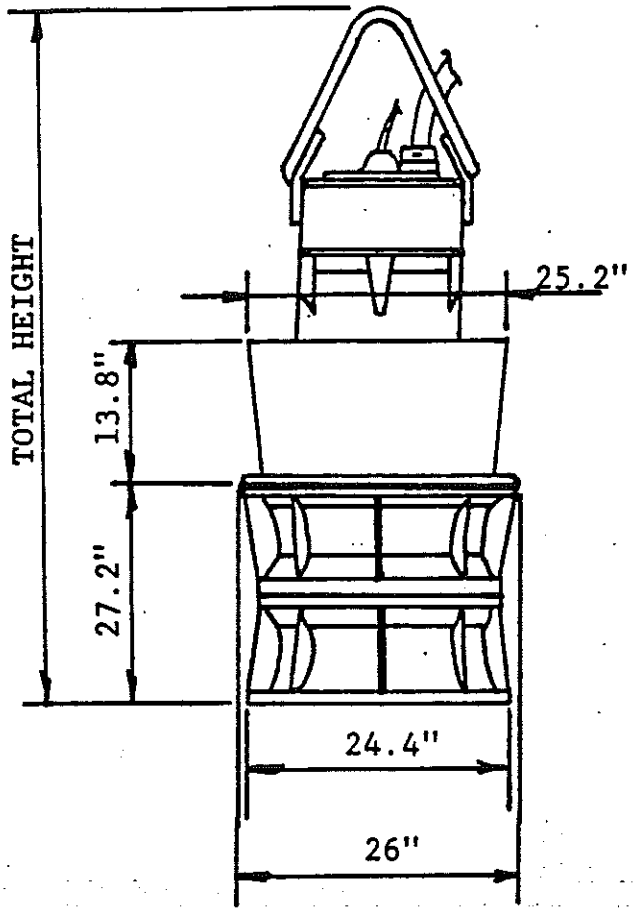
NOTE:

CURVES ARE BASED ON NOMINAL CONSTANT HYDRAULIC-END SPEED AND SHOW PERFORMANCE WITH CLEAR WATER.

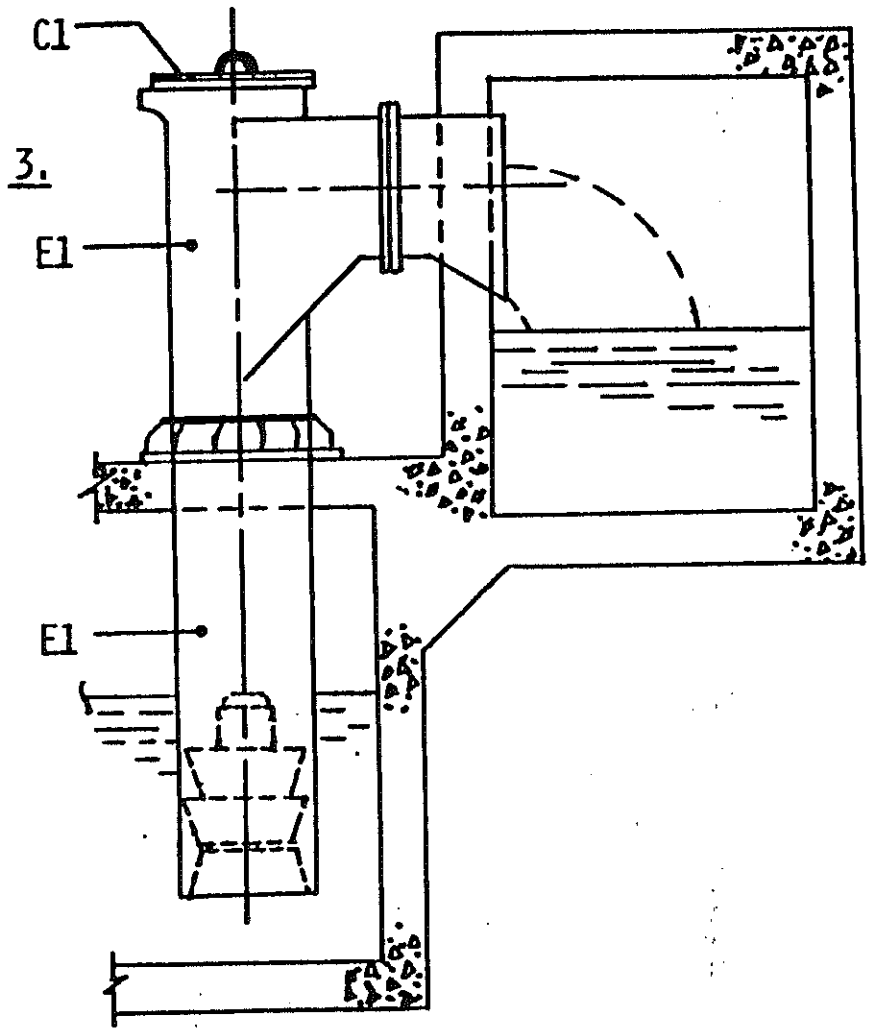
ALL HYDRAULIC LOSSES UP TO 500 MM. ABOVE THE PUMP/MOTOR TOP ARE INCLUDED

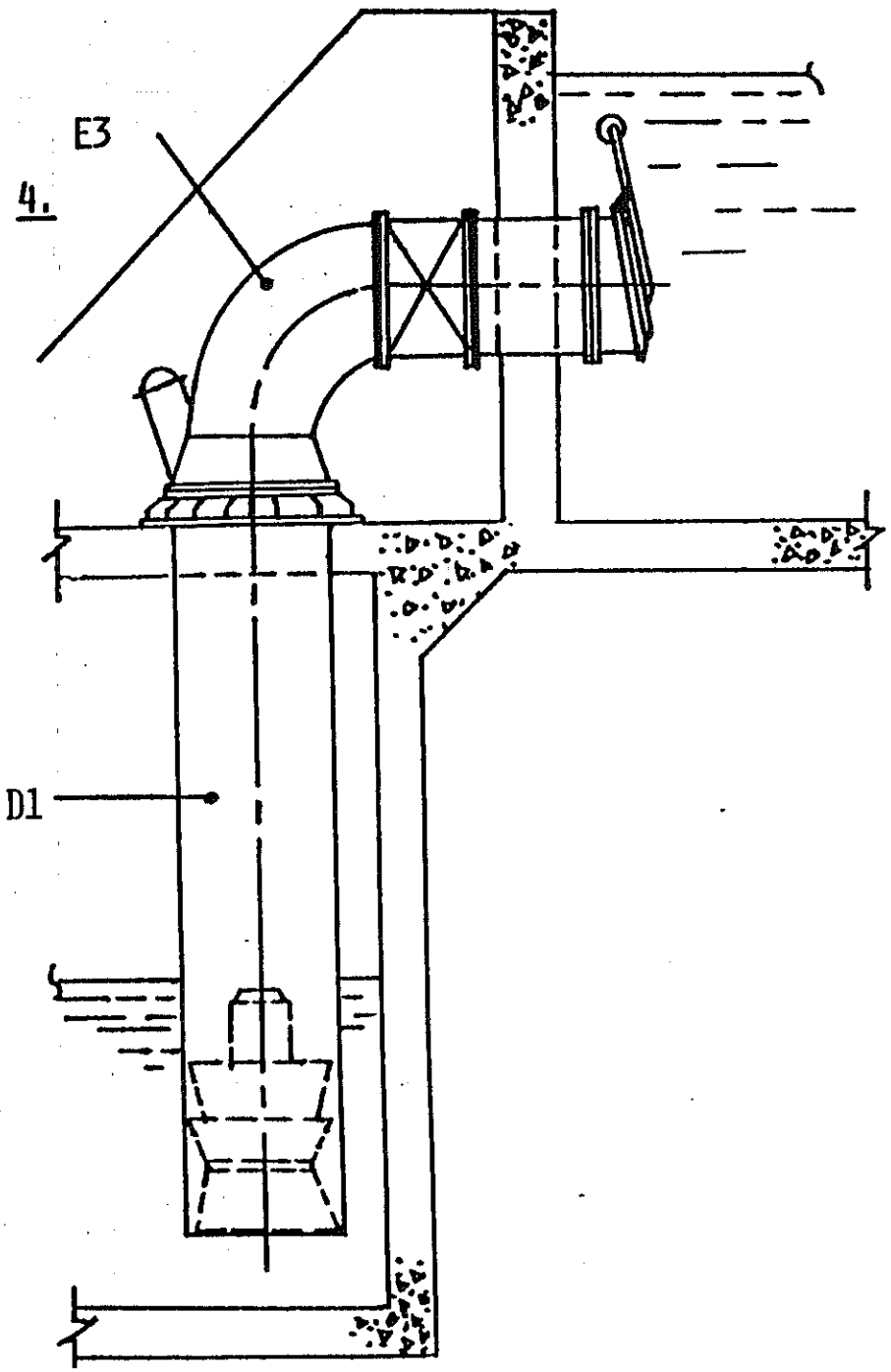
FLYGT

PL-7050



MOTOR NO.	KW	DRIVE UNIT	TOTAL HEIGHT	WEIGHT
35-24-1	20	680	68.5"	1720#
35-24-8	33	680	68.5"	1720#
→ 35-24-6	55	680	68.5"	1720#
35-28-1	33	680	68.5"	1786#
35-28-8	45	680	68.5"	1786#
35-28-6	63	680	68.5"	1786#
40-30-1	45	760	83.5"	2205#
40-30-8	63	760	83.5"	2205#
40-30-6	80	760	83.5"	2205#
40-44-8	100	770	94.2"	2645#
40-44-6	125	770	94.2"	2645#


C1
3.
E1
E1

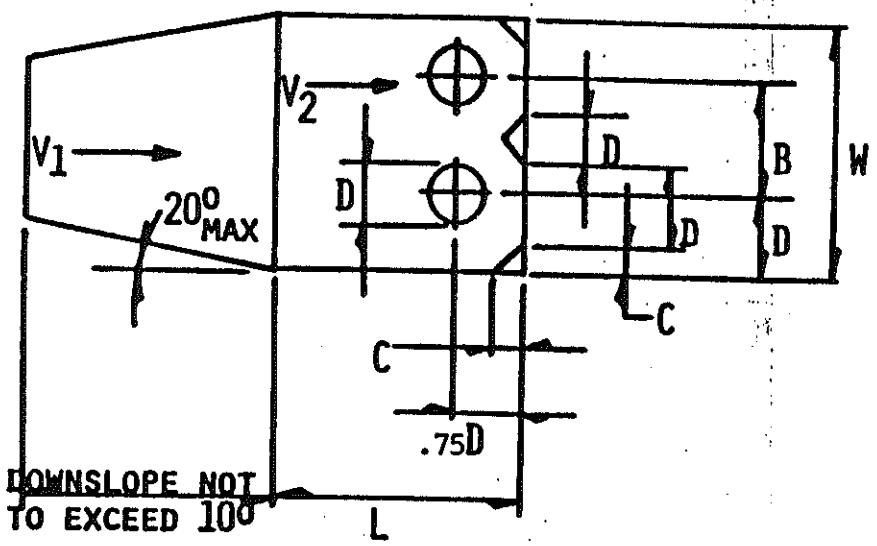

E3
4.
D1

DUPLEX STATION (REV.III)

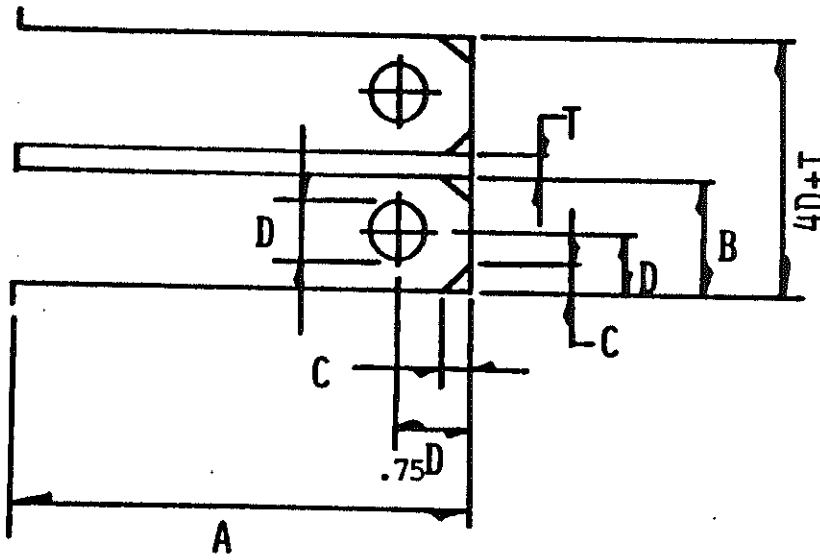
SUMP CONFIGURATION (2)

D-20

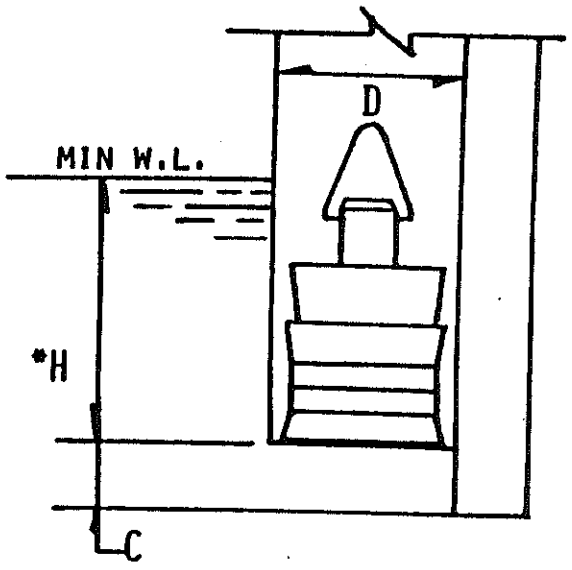
ALT. I



ALT. II



PUMP	A	B	C	D	MIN. *H	W	T	L	V_1	V_2
7045	110	56	14	28		112	VARIES WITH DESIGN	75	MAXIMUM OF 4 FT/SEC.	MAXIMUM OF 1 FT/SEC.
⇒ 7050	110	56	14	28		112		75		
7055	126	64	16	32		128		86		
7060	126	64	16	32		128		86		
7075	158	80	20	40		160		107		
7080	158	80	20	40		160		107		
7100	189	96	24	48		192		128		
7120	220	112	28	56		224		150		
7140	250	128	32	64		256		172		



NOTE: ALL DIMENSIONS IN INCHES.

*SEE SUBMERGENCE DIAGRAM FOR EXACT DIMENSION.

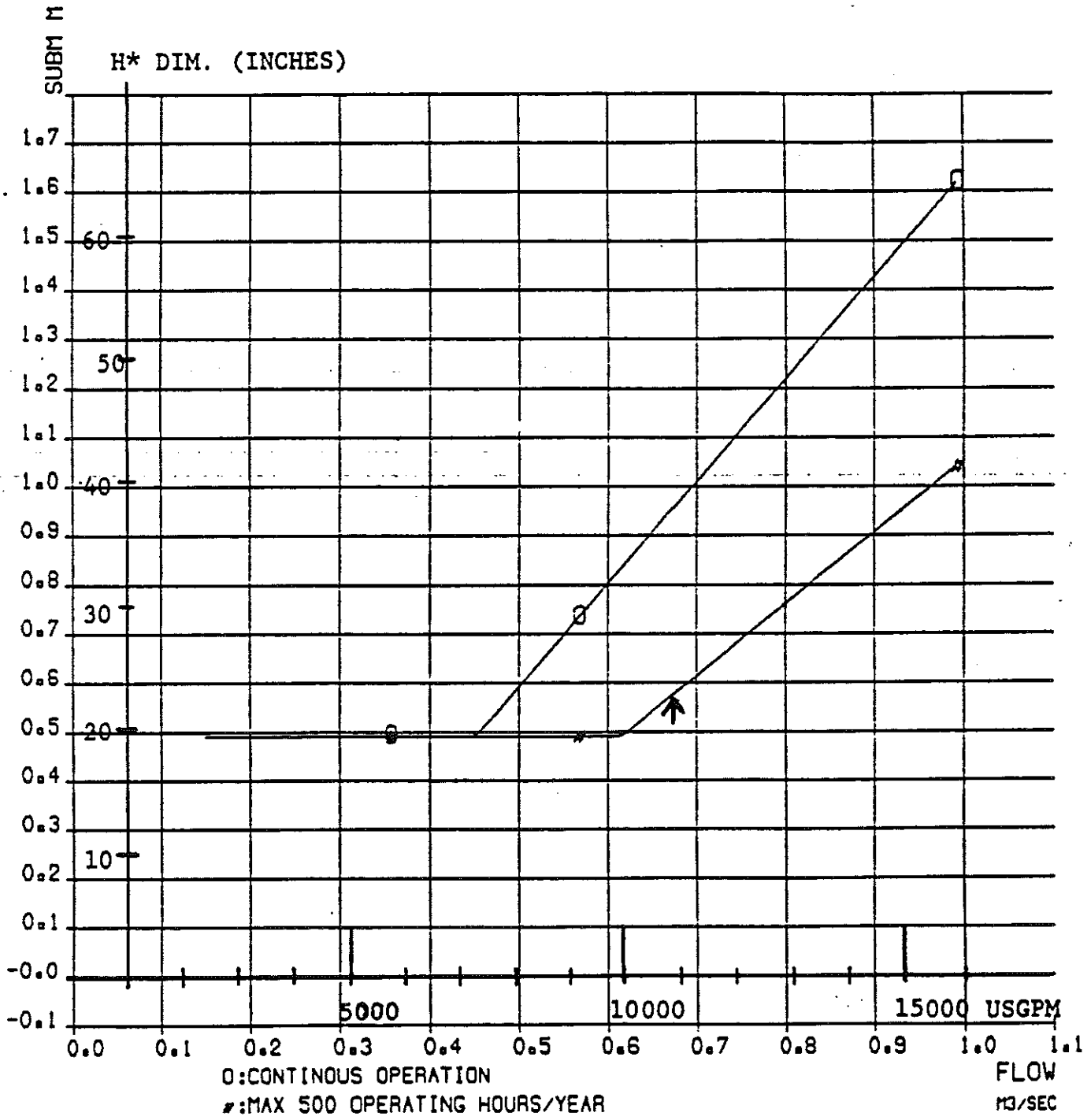
FLYGT

SYSTEM AND APPLICATION ENGINEERING

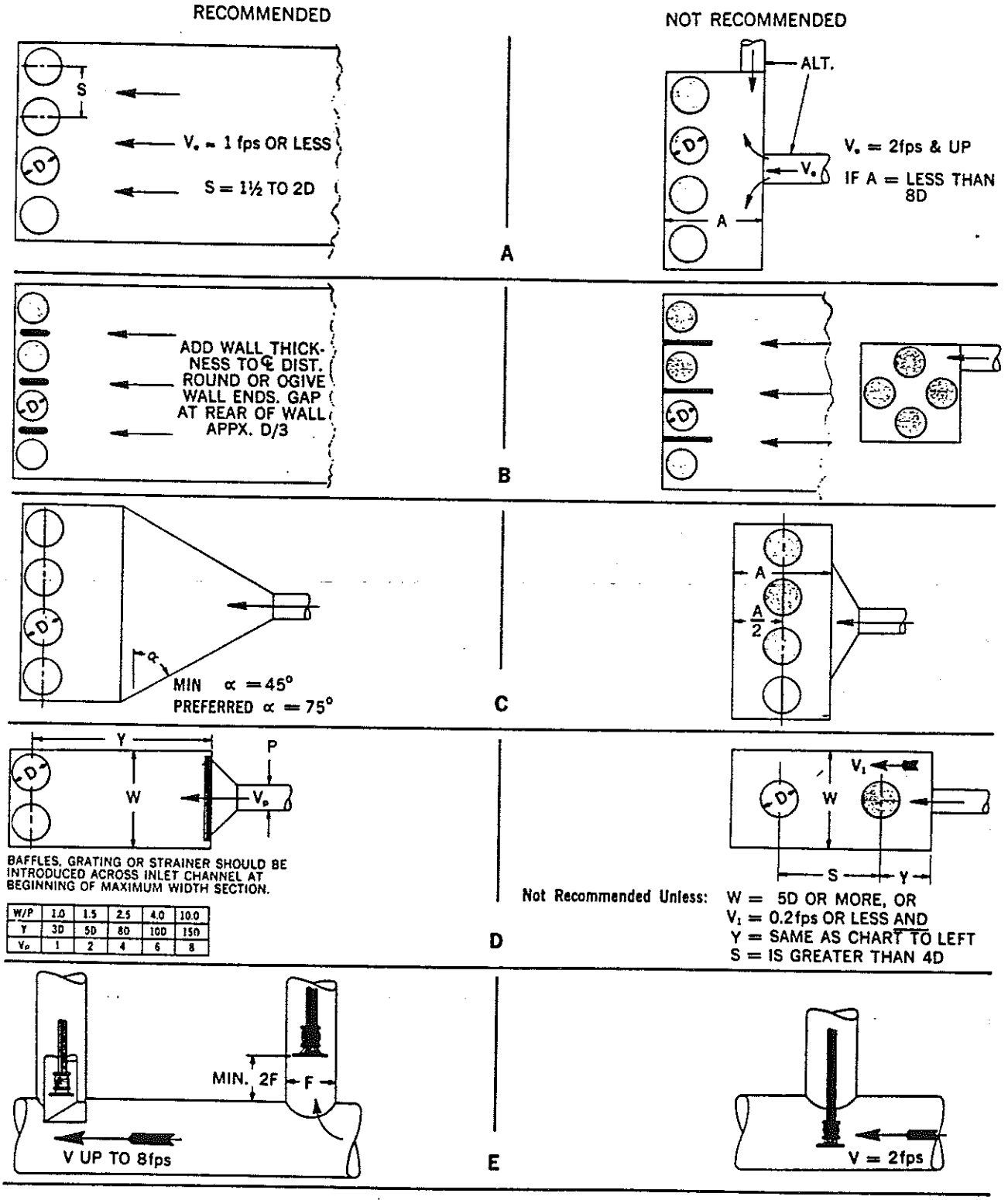
DIAGRAM: SUBMERGENCE REQUIREMENTS FOR PL 7045/50 | ISSUE: 2 | DATE: 84-05-23

REQUIRED SUBMERGENCE FOR SUMP DESIGN ACCORDING TO FLYGT TYPE "A","B".

REQUIRED SUBMERGENCE TO PREVENT VORTEXING WHICH WOULD AFFECT THE PERFORMANCE OF THE PUMP. IN SOME INSTANCES ADDITIONAL SUBMERGENCE MAY BE REQUIRED BECAUSE OF NPSH REQUIREMENTS.



centrifugal pumps applications



W/P	1.0	1.5	2.5	4.0	10.0
Y	3D	5D	8D	10D	15D
V_p	1	2	4	6	8

Fig. 71 MULTIPLE PUMP PITS

The Dimension D is generally the diameter of the suction bell measured at the inlet. This dimension may vary depending upon pump design. Refer to the pump manufacturer for specific dimensions.

Note: Figures apply to sumps for clear liquid. For fluid-solids mixtures refer to the pump manufacturer.

D-22

PORTABLE PUMP

CATALOGUE DATA

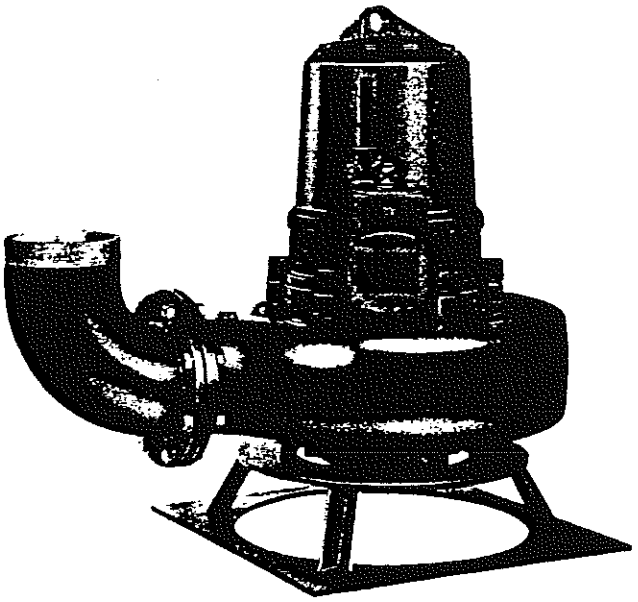
Trash handling portable submersible pumps

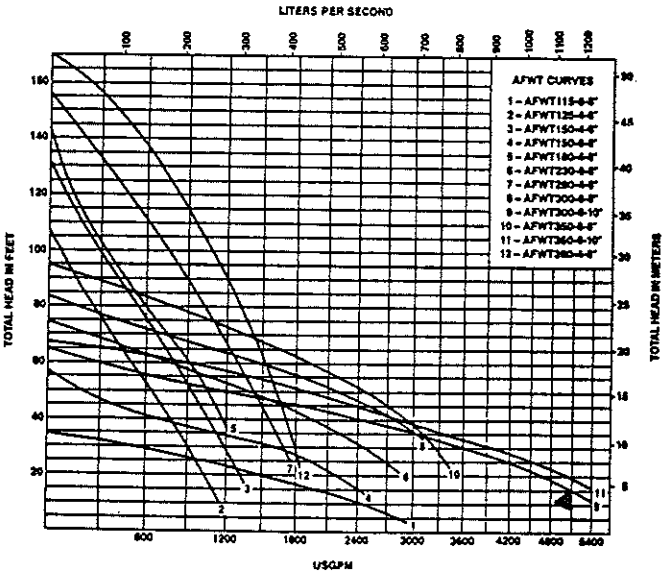
15 to 48 HP

ELECTRIC

AFWT 15 to 48 HP

- Portable submersible pumps designed for large volumes of trash laden and contaminated water.
- Special features — "Seal-minder" moisture detector, closed impeller, oversized double row ball bearings, cast iron construction, stainless steel hardware, guaranteed to run dry.
- Pump comes complete with 30' of cable and manual control.
- Optional features — Stainless steel or rubber coated hydraulic parts, tandem connection, automatic controls. Guide rail assembly available for mining applications.





AFWT	115	125	150	150	180	230	290	300	350	360
HP	15	17	20	20	24	31	39	40	47	48
RPM	1150	1750	1750	1150	1750	1150	1750	1150	1150	1750
Voltage AMPS	230/460 41.8/20.9	230/460 42.8/21.4	230/460 50.6/25.3	230/460 49.8/24.9	230/460 60.4/30.2	230/460 75.2/37.6	230/460 102.4/51.2	230/460 102/51	230/460 118.8 59.4	230/460 123.4/61.7
Phase	3	3	3	3	3	3	3	3	3	3
Hertz	60	60	60	60	60	60	60	60	60	60
Discharge	8"	6"	6"	8"	6"	8"	6"	8"/10"	8"/10"	6"
Weight with cable (lbs.)	595	505	540	1005	545	1045	890	1105/1120	1120/1130	965
Height (max.)	38"	37"	35"	43"	35"	43"	43"	43"/45"	43"/45"	43"
Width (max.)	47"	40"	39"	55"	39"	55"	46"	55"/58"	55" 58"	46"

For models available in different RPM, consult factory.
Pumps available in 600 volt, consult factory.

Flygt Submersible Dewatering and Trash Pumps

Flygt submersible dewatering and trash pumps bring a new dimension of efficiency and reliability to mine and contractor dewatering. Unlike conventional engine-driven pumps, Flygt submersibles have no suction limitation or priming problems, require no operator attention, are virtually maintenance-free and are not dependent on gasoline and diesel fuel.

Light Weight/Portable
Flygt submersible dewatering pumps are relatively light in weight and can be moved easily. The smallest ones can be carried by hand.

No suction limitation—no priming problems

Being completely submersible, Flygt contractor pumps have no suction or priming problems. Heads range up to 650'. No need to continuously move pump as water level drops.

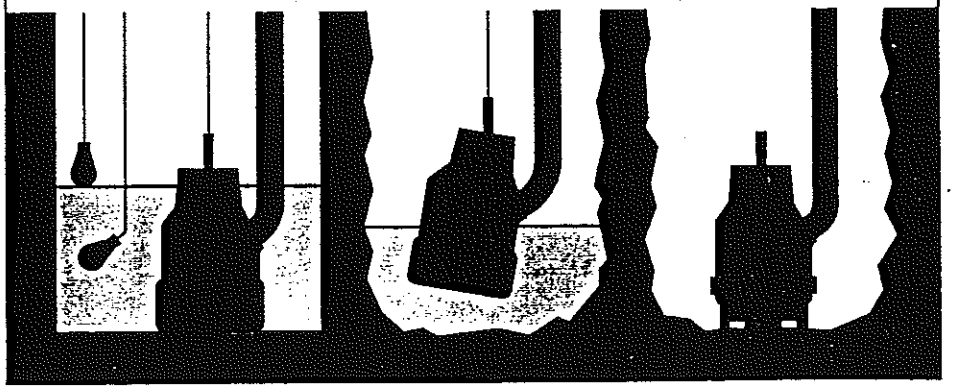
No starting problems—completely floodproof

Flygt submersibles are non-overloading and are sure starting even in the wettest weather.

Maintenance-free—no dependence on gasoline or diesel fuel

Flygt submersibles need no carburation adjustment, spark plug cleaning, tune-up, etc. And there are no fuel problems to worry about. Flygt pumps stay on line longer. Only periodic inspection is required.

Installations
Flygt pumps can be positioned directly on the bottom...hung from a chain or wire cable...connected directly to a pipeline.



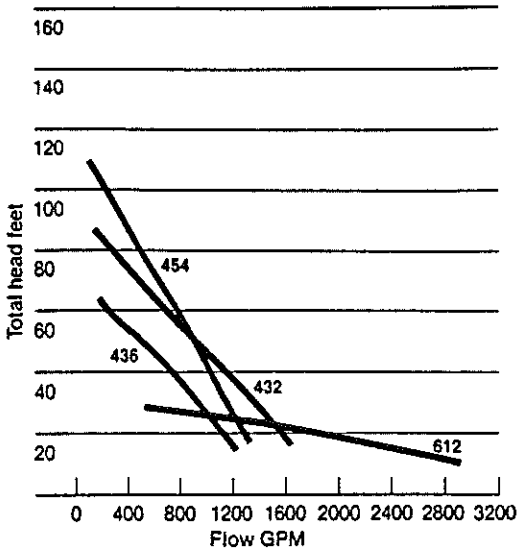
CS

Trash

Non-clog, single or multi-vane impeller. Impeller and volute both cast iron.

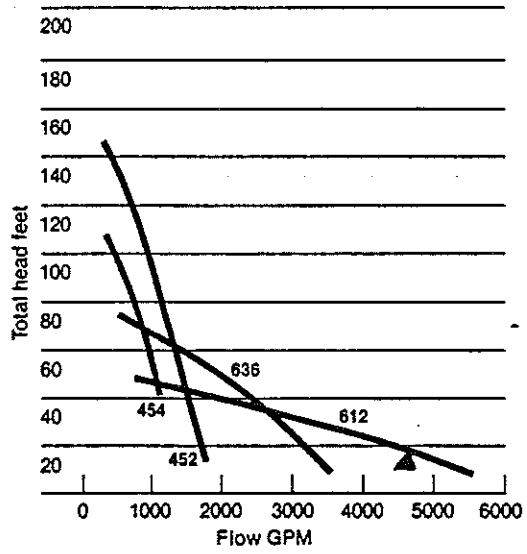
CS 3152

Service:	60 Hz 3ø
Voltage:	200, 230/460 or 575 V
HP rating:	14, 14.8 and 20
RPM:	1150 and 1750
Pump dimensions:	37¼" W (max.) x 49½" H (max.)
Min. opening pump clears:	39" x 25" rect. or 42" dia.
Versions:	6" High head Imp. Code 454, 20 HP 8" Std. performance Imp. Code 432, 20 HP Imp. Code 436, 14.8 HP 8" High volume Imp. Code 612, 14 HP
Max. weight (lbs.):	750
Special features:	Integral cooling system. Pilot thermal sensors embedded in stator. A single phase version, with a 16.1 HP motor, is available with impeller 436. Available in warm liquid (pg. 25) or explosion proof (pg. 32) variants.



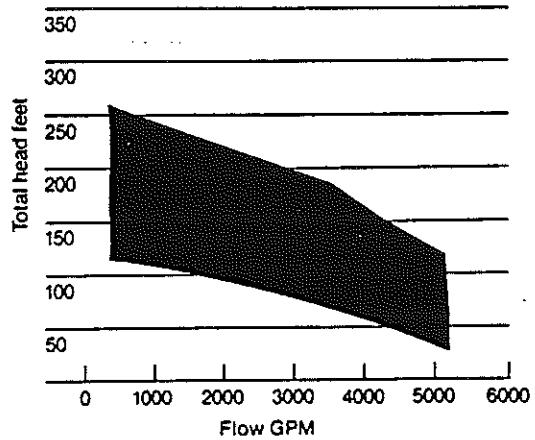
CS 3201

Service:	60 Hz 3ø
Voltage:	230/460 or 575 V
HP rating:	29, 35 and 47
RPM:	1150 and 1750
Pump dimensions:	48½" W (max.) x 58⅝" H (max.)
Min. opening pump clears:	50" x 32" rect. or 52" dia.
Versions:	6" High head, Imp. Code 452, 47 HP; Imp. Code 454, 29 HP 8" Std. performance Imp. Code 636, 35 HP 10" High volume Imp. Code 612, 35 HP
Max. weight (lbs.):	1294
Special features:	Integral cooling system. Pilot thermal sensors embedded in stator. Available in stainless steel (pg. 20), warm liquid (pg. 25) or explosion proof (pg. 32) variants.



CS 3230

Service:	60 Hz 3ø
Voltage:	460 or 575 V
HP rating:	120 through 214
RPM:	1775
Pump dimensions:	49½" W (max.) x 84⅝" H (max.)
Min. opening pump clears:	52" x 42" rect. or 65" dia.
Versions:	8" High head (trimmable)
Max. weight (lbs.):	2830
Special features:	Integral cooling system. Independent thermal sensors embedded in stator and in lower bearing housing. Leakage sensor in lower stator housing.



ELECTRIC PORTABLE FLYGT

D-26

DIESEL DRIVEN

HYDRAULIC PORTABLE PUMPS

DEWATERING DESIGNERS PUMPS

POWER UNITS

HYDRAULIC POWER UNITS

Back in the 17th century Blaise Pascal discovered that a fluid under pressure could be used to transmit power.

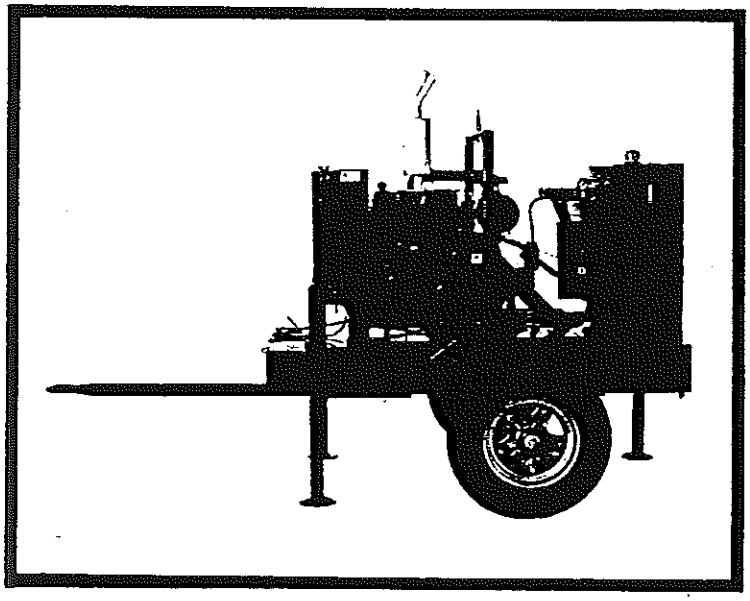
Hydraulics is transmitting power through a fluid, in a fluid conductor to do work. This is the most unique method of transmitting energy to do work. It is less cumbersome than straight shaft mechanical transmission. It has virtually infinite speed control and is more precise in controlling energy.

By use of the hydraulic motors compactness, light weight, and the flexibility of the hydraulic hoses, permits the power source to be remotely located in a safe and accessible area. It also provides a means of varying the speed of the impeller by controlling the flow of the oil to the pump head.

D & D uses this versatile, horsepower dense, form of power transmission, to drive their pumps. By utilization of variable displacement or multi-section pumps allows D & D power units to drive a wide range of pump heads or multiple pump heads.

With the availability of additional options the power units can drive generators, air compressors and hydraulic tools, making D & D power units a stand alone power source.

Power units are available in Diesel or Electric on trailer or skid mounts and may be custom built to your needs.



HYDRAULIC POWER UNIT SPECIFICATIONS DIESEL

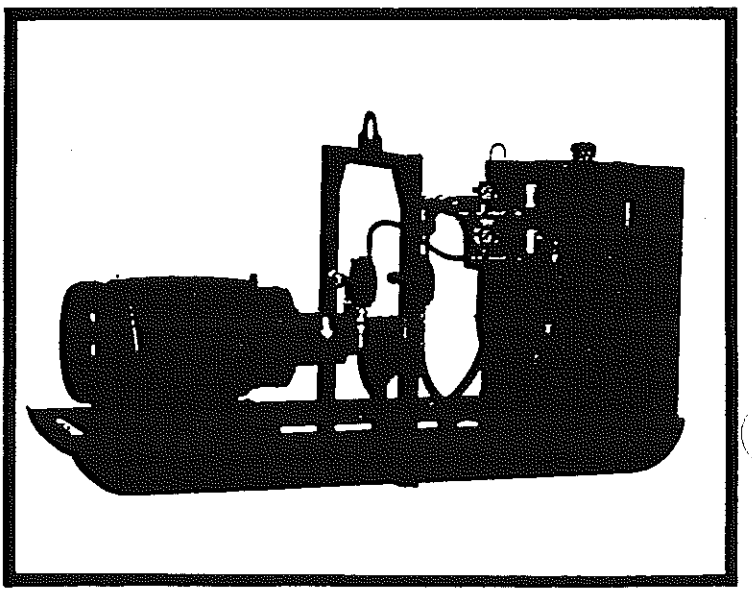
Power Unit Model	Recommended Pump Heads	H.P.	Hose Size	Volume Cu. Ft./Cu. Mtr.	Weight Lbs./Kg.
50/60*	3LT, 4LT	16	.50" & .50"	19.5/.54	250/114
75	4LT, 8AX	19	.50" & .50"	21/.58	700/318
100	4T, 10AX	22	.50" & .75"	58/1.6	1300/590
250	4S, 6T, 12AX, 14AX	40	.75" & 1.0"	165/4.7	1625/737
400	6S, 8T, 16AX	65	1.0" & 1.25"	235/6.7	2750/12147
500T*	6S, 8T, 20AX	100	1.0" & 1.25"	235/6.7	2900/1318
600	10T, 20AX	89	1.25" & 1.50"	286/8.1	3650/1656
700T*	12T, 24AX	119	1.25" & 1.50"	286/8.1	3800/1727
800	18T, 24AX, 30AX	146	1.50" & 2.0"	400/11.3	4650/2109
1000	36AX, 48AX	A.R.	A.R.	C.F.	C.F.

*Special Head Requirements
A.R. — As Required
C.F. — Consult Factory

HYDRAULIC POWER UNIT SPECIFICATIONS ELECTRIC

Power Unit Model	Recommended Pump Heads	H.P.	Hose Size	Volume Cu. Ft./Cu. Mtr.	Weight Lbs./Kg.
50	3LT	15	.50" & .50"	32/.91	635/289
75	4LT, 8AX	20	.50" & .50"	32/.91	655/298
100	4T, 10AX	25	.50" & .75"	49/1.4	725/329
250	4S, 6T, 12AX, 14AX	30	.75" & 1"	49/1.4	810/368
400	6S, 8T, 16AX	50	1.0" & 1.25"	88/2.5	1635/743
500*	6S, 8T, 16AX	60	1.0" & 1.25"	88/2.5	1701/773
600	10T, 20AX	75	1.25" & 1.50"	88/2.5	1750/795
700*	12T, 24AX	100	1.25" & 1.50"	88/2.5	2095/952
800	18T, 24AX, 30AX	125	1.50" & 2.0"	215/6.1	4650/2114
1000	36AX, 48AX	A.R.	A.R.	C F	C.F.

*Special Head Requirements
A.R. — As Required
C.F. — Consult Factory

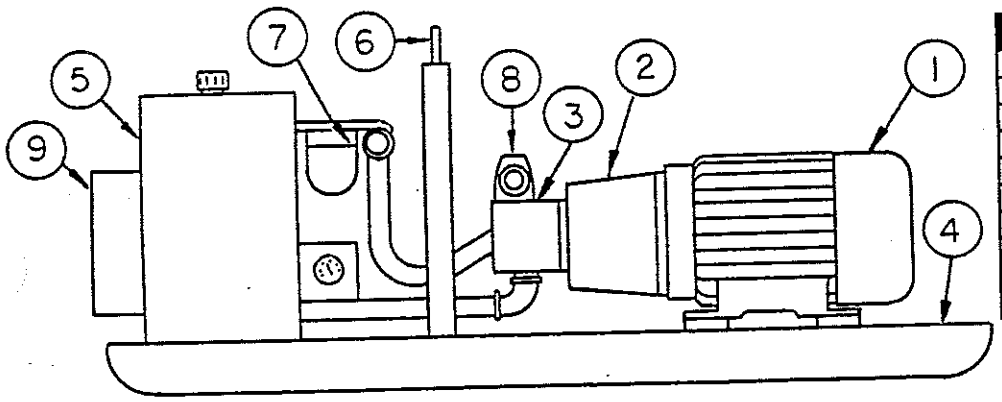


STANDARD FEATURES

- High speed trailer or "I" beam construction skid
  Easy to move or set in place.
- Three stabilizing legs on trailer
  Keeps power unit level on any terrain.
- Prime mover can be diesel engine or electric motor. Utilizes most economical power source.
- Centralized control and gauge panel
  Easy start up and monitoring of system.
- Automatic safety shutdowns
  Protection for low hydraulic oil, high hydraulic oil temp., low engine oil pressure and high engine temperature.
- Prime mover and hydraulic pump close couples
  No hydraulic pump failures due to belt drives.
- Hydraulic oil suction strainer, return filter, tank filter breather. Protects hydraulic system against dirt contamination.
- Large fuel tank
  24 hours of run time or more.
- Control valve unloads hydraulic system
  Start and shutdown are done with no load.
- 50′ of pressure and 50′ return hydraulic hose
  Power unit can be remotely located for safety.
- Spin-on hydraulic hose connection
  Fast and easy setup.

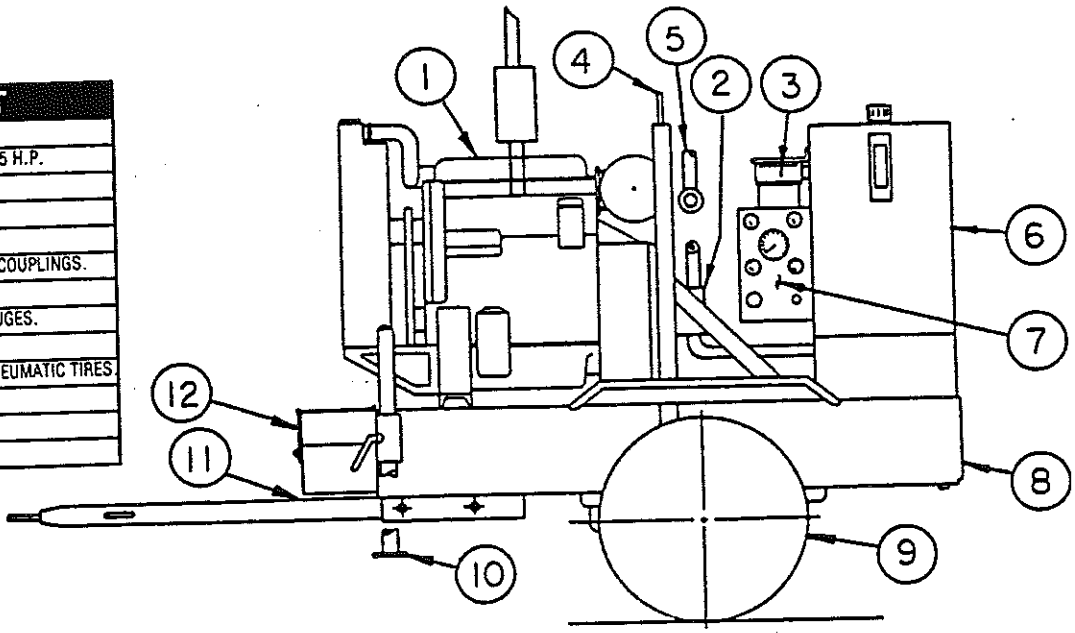
OPTIONS

- Tandem or Variable Displacement Pump
- Extra Hydraulic Hose (up to 150′)
- Flow Control to Operate Tools
- Generator or Air Compressor Drive.



ELECTRIC POWER UNIT	
ITEM	DESCRIPTION
1	MOTOR-ELECTRIC, 15 TO 150 H.P.
2	HYDRAULIC PUMP TO MOTOR ADAPTER
3	PUMP-HYDRAULIC, 4 TO 86 G.P.M.
4	SKID.
5	HYDRAULIC RESERVOIR.
6	ROLL BAR & LIFTING BRACKET.
7	FILTER-RETURN LINE, SPIN ON.
8	HYDRAULIC HOSE W/QUICK DISCONNECT COUPLINGS.
9	ELECTRIC MOTOR CONTROL PANEL.

DIESEL POWER UNIT	
ITEM	DESCRIPTION
1	ENGINE-DIESEL, WATER COOLED, 22 TO 175 H.P.
2	PUMP-HYDRAULIC, 8 TO 86 G.P.M.
3	FILTER-RETURN LINE, SPIN-ON.
4	ROLL BAR & LIFTING BRACKET.
5	HYDRAULIC HOSE W/QUICK DISCONNECT COUPLINGS.
6	HYDRAULIC RESERVOIR.
7	ENGINE ELECTRIC CONTROL PANEL W/GAUGES.
8	FUEL TANK-SELF-CONTAINED.
9	AXLE ASS'Y-HIGH SPEED 1, 2 OR 3 AXLE, PNEUMATIC TIRES.
10	ADJUSTABLE LEGS.
11	REMOVEABLE TONGUE.
12	BATTERY-12 VOLT.



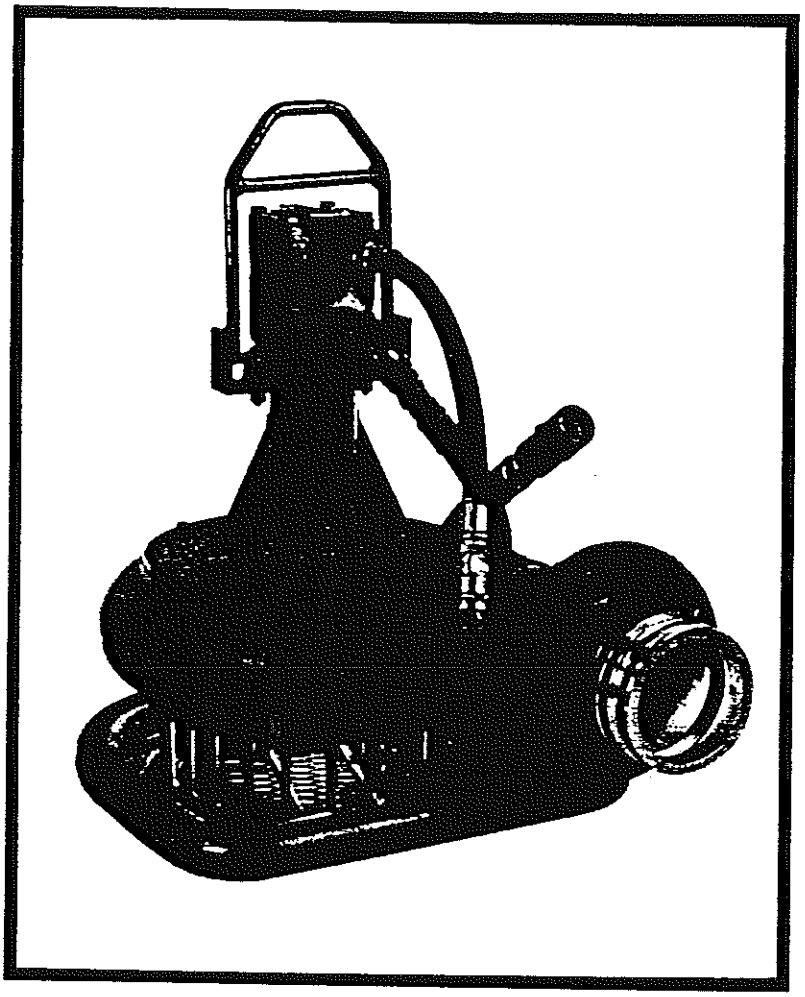
Corp. & Mfg. Facilities
D&D Machine & Hydraulics, Inc.
10945 Metro Parkway S.E.
Fort Myers, FL 33912
813-275-7177 — 813-275-5350 FAX
Cable DD Pumps — Telex 759033

DEWATERING DESIGNERS PUMPS

N.E. Regional Sales Office
Commercial Ave.
Hudson, N.H. 03051
603-886-0522
FAX 603-889-6379

DEWATERING DESIGNERS PUMPS

TRASH PUMP



SUBMERSIBLE OPEN TYPE TRASH PUMP

Submersible Trash Pumps are designed to pump water containing solids such as mud, weeds, trash, sticks and other foreign materials which can not be pumped with conventional centrifugal pumps.

The semi-open intake design permits the inflow of water at varying rates and does not require any suction lines. As the inflow of water increases or decreases, the pump motor can be regulated to handle the varying conditions at maximum efficiency and minimum wear on the pump head.

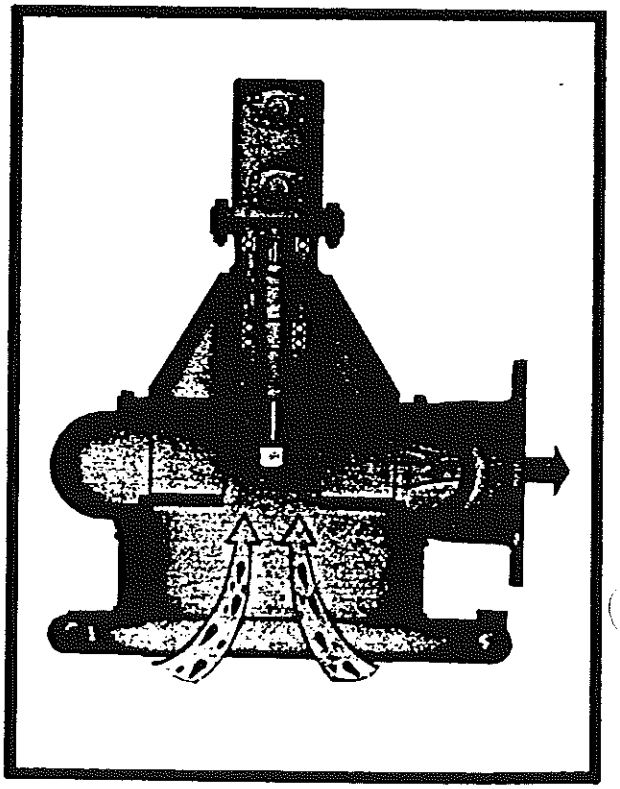
Whatever the dewatering requirement may be; from gradual seepage of water into a manhole; the dewatering of a borrow pit or quarry that requires the removal of millions of gallons of water per day; there is a D & D built pump for the job.

Trash pumps are available in sizes 3" through 18".

TRASH PUMP SPECIFICATIONS

Size	Weight Lbs./Kg.	Volume Cu. Ft./Cu. Mtr.	Capacity @ 20'-6.1 Mtr. G.P.M/-Ltr. P.M.	Required Hydraulic Oil GPM	Power Unit Required	Horse-Power
3LT	50/23	2.2/.06	450/1,703	8	50	16
4LT	57/26	3.2/.09	700/2,649	10/12	60/75	19
4T	67/30	3.6/.10	710/2,687	12	100	22
6T	335/152	11.8/.33	1,700/6,434	18	250	40
8T	490/222	25.4/.72	2,875/10,882	44	400	65
10T	620/281	31.4/.90	4,400/16,654	61	600	89
12T	720/327	40.7/1.15	5,250/19,871	80	700	119
18T	847/384	44.7/1.26	7,100/26,873	86	800	146

TRASH IMPELLER



WHY HYDRAULIC SUBMERSIBLE TRASH PUMPS??

- Easy Setup
- Remote Portable Power Source
- Can Run Dry
- Regulate Flow
- No Priming Required
- Self-Monitoring Safety Shutdowns
- Multiple Pumps From One Power Unit
- Extreme Head Capabilities

APPLICATIONS

- **CONSTRUCTION •**
  Manhole - Sewer by Pass - Lakes - Canals - Pipe Laying - General Excavation
- **MINING •**
  Gravel Pits - Open Pit Mines Settling Ponds - Shaft Mines
- **AGRICULTURE •**
  Field Drying - Irrigation - Flood Control Livestock Watering

STANDARD FEATURES AND BENEFITS

- Special Hydraulic Motor
  Provides Bearing Lubrication
- Cast Steel Bearing Tube
  Oil Bath Bearing Lubrication
- 304 Stainless Steel Pump Shaft
  Long Pump Life
- Two Sets of Ball Bearings
  No Side Load Wear
- Cast Iron Volute and Impeller
  Uniform Performance
- #125 Discharge Flange
  Easy Connection
- Lifting Bale
  Easy to Move
- Inlet Screen
  Keeps Out Oversized Objects
- Spin on Hydraulic Connectors
  Fast Setup

OPTIONS

- Epoxy Coating
- All Stainless Steel Pump
- Discharge Flange to Pipe Adapter 90° - straight

Corp. & Mfg. Facilities
D&D Machine & Hydraulics, Inc.
10945 Metro Parkway S.E.
Fort Myers, FL 33912
813-275-7177 — 813-275-5350 FAX
Cable DD Pumps — Telex 759033

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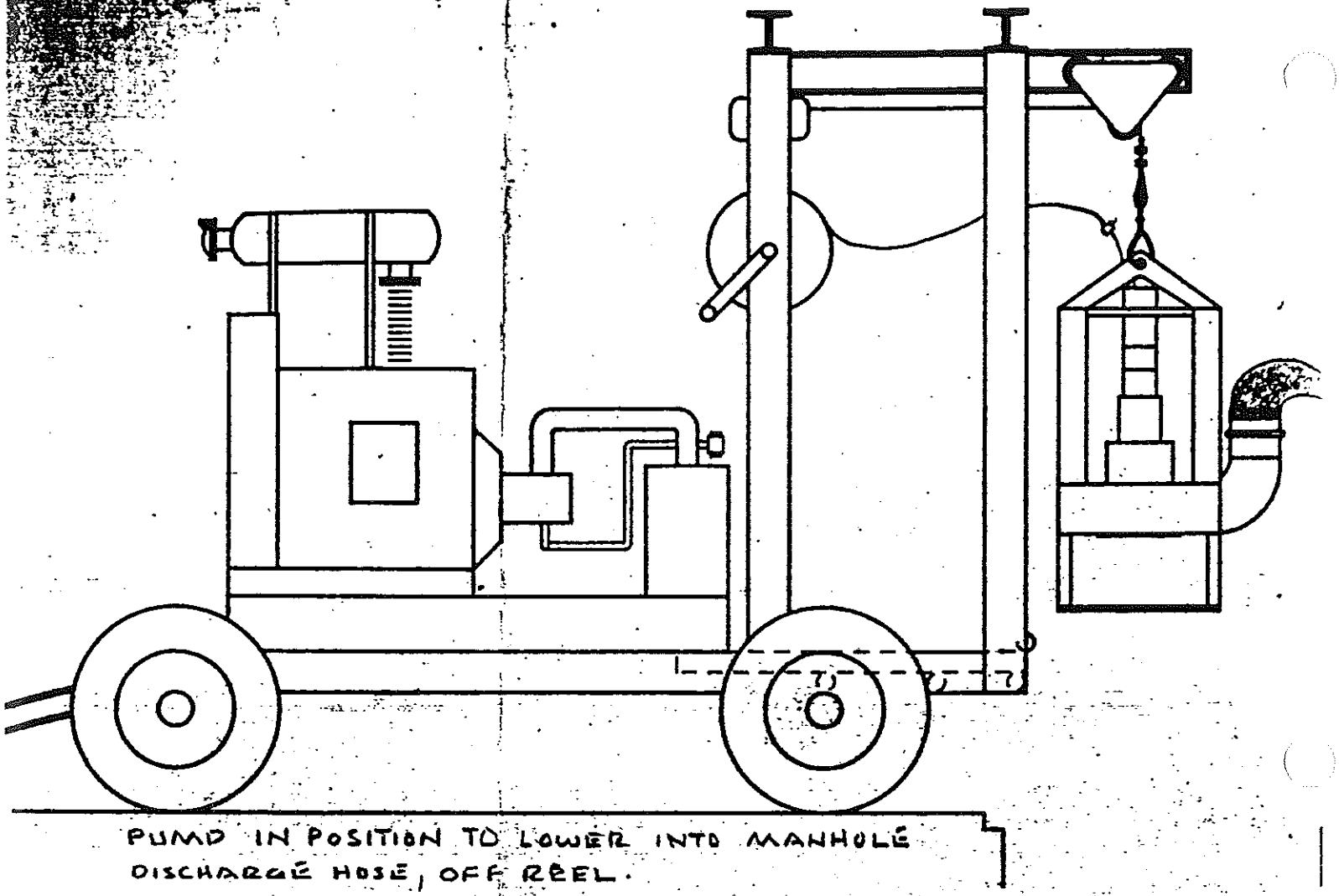
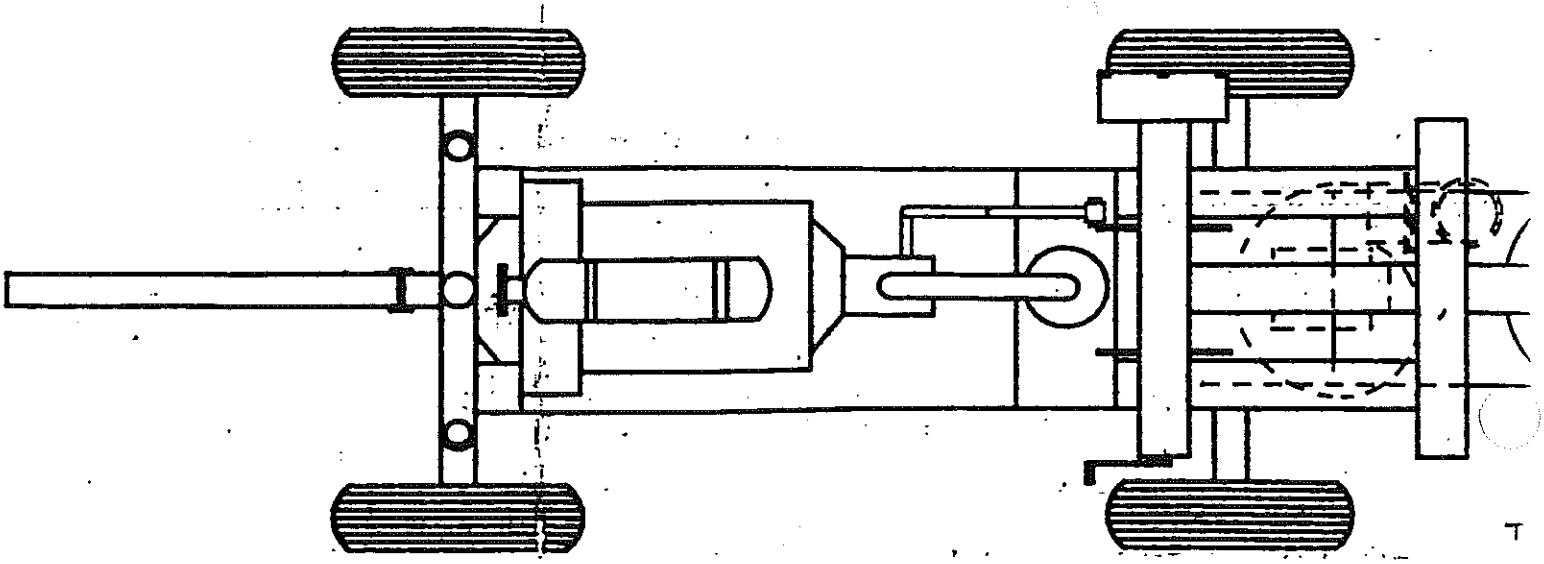
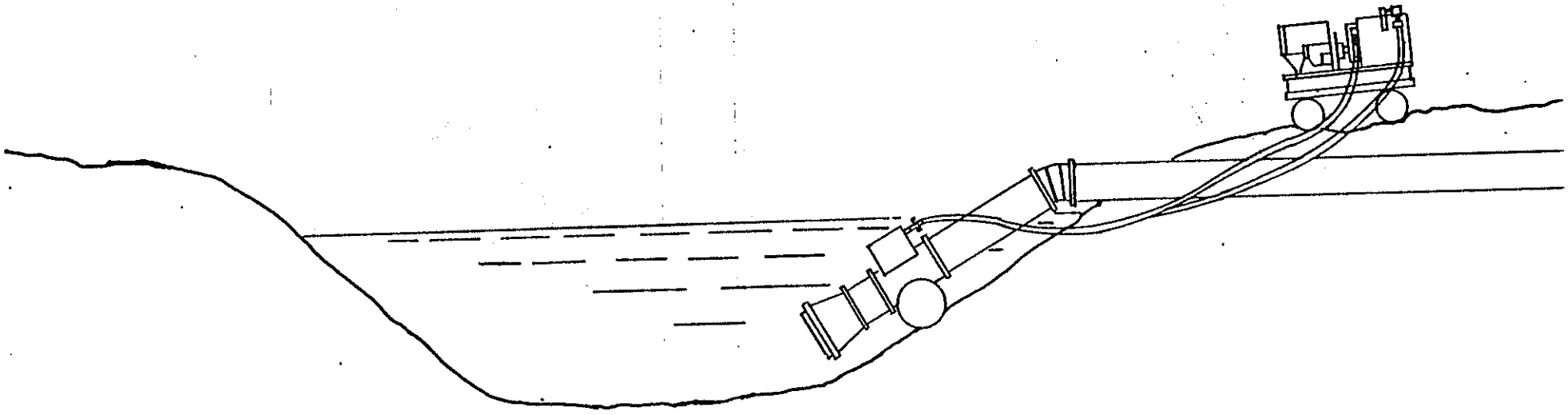


PUMP IN POSITION TO LOWER INTO MANHOLE
DISCHARGE HOSE, OFF REEL.



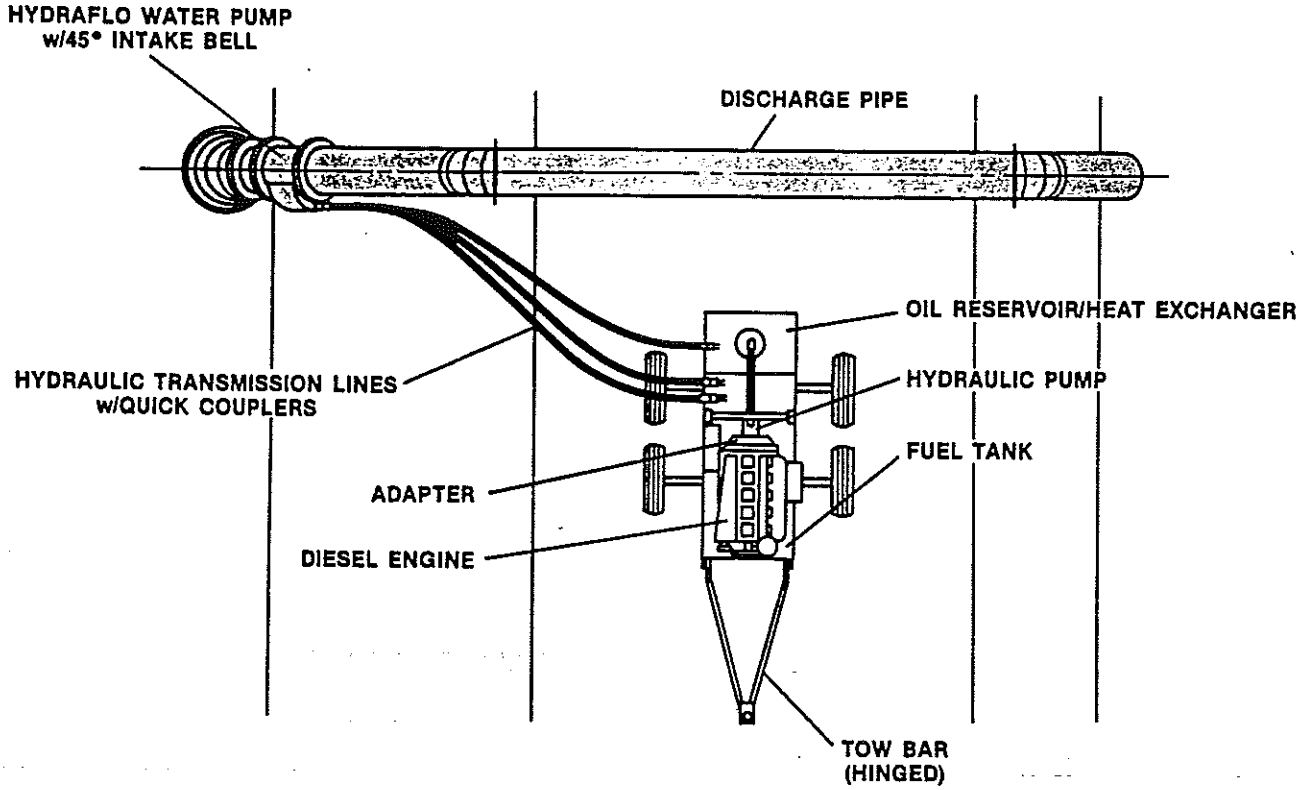


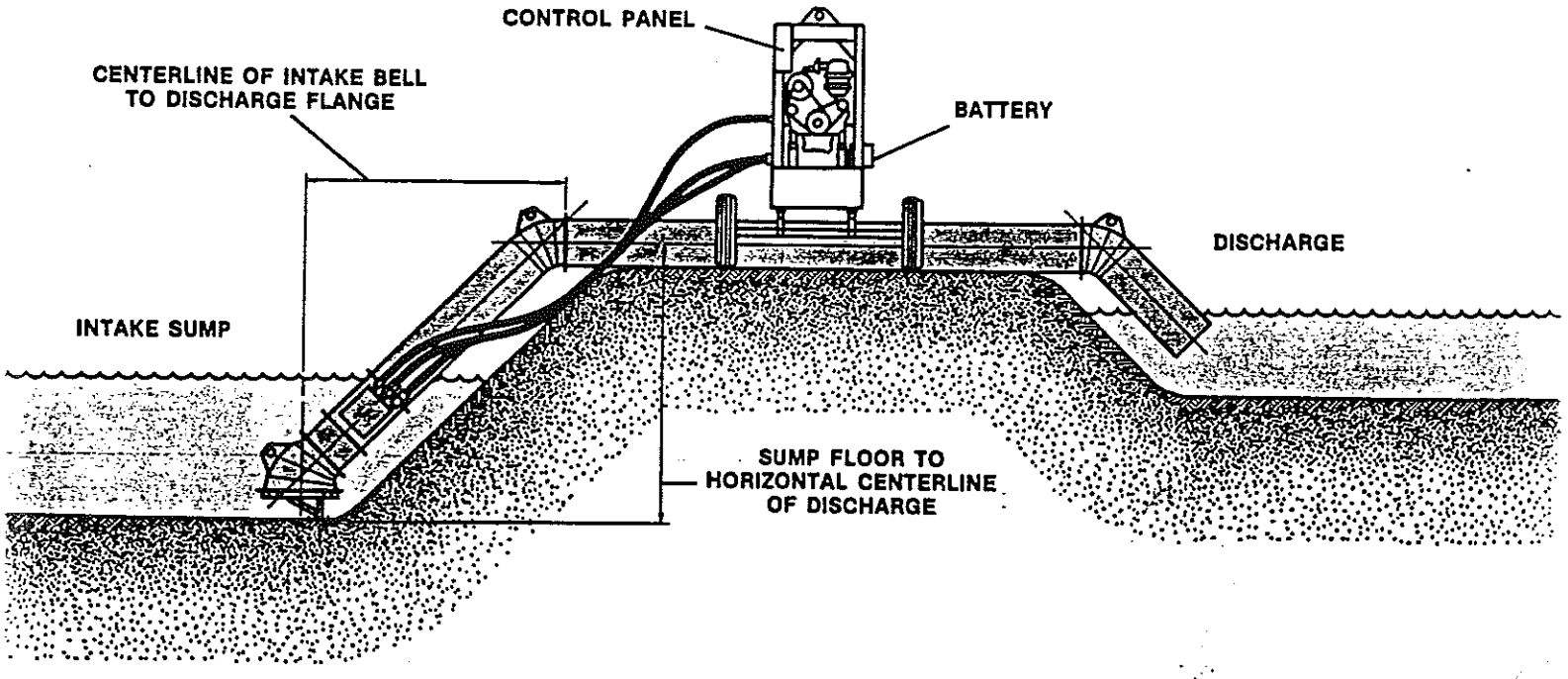
⑵ Trailer mounted – Diesel / Electric } driven Hydraulic Power Unit

End suction "propeller" axial flow centrifugal

M&W PUMP CORPORATION

TYPICAL APPLICATION FOR
PORTABLE DIESEL DRIVE UNIT
WITH 45 DEGREE HYDRAFLO WATER PUMP





FOR MINIMUM INSTALLATION DIMENSIONS, SEE APPLICATION GUIDE, SECTION I, A-2 & SECTION II, D

33 N.W. 2nd Street Deerfield Beach, Florida 33441 U.S.A. Phone: (305) 426-1500 Telex: 51-9272

DO NOT USE FOR CONSTRUCTION UNLESS CERTIFIED BY FACTORY
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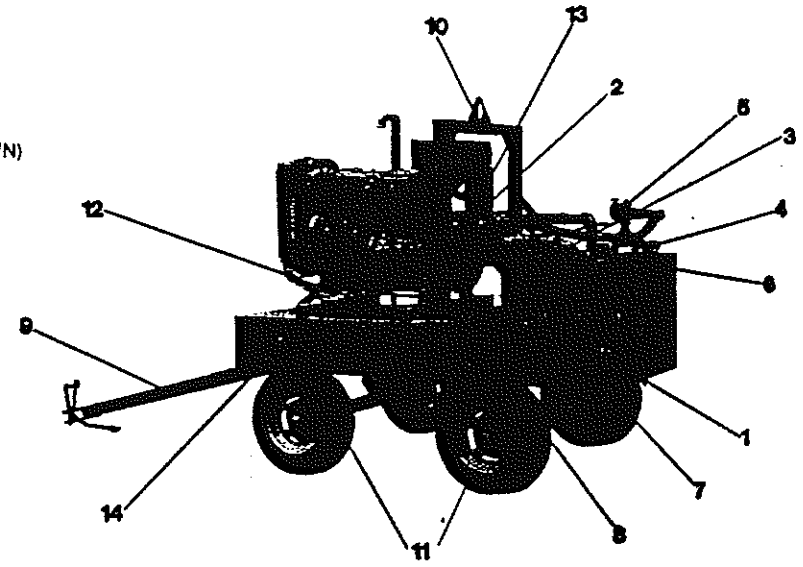
M&W PUMP CORPORATION

PORTABLE DIESEL ENGINE

STANDARD EQUIPMENT

1. OIL RESERVOIR / HEAT EXCHANGER
2. HYDRAULIC OIL LEVEL SWITCH GAUGE (NOT SHOWN)
3. RETURN FILTER
4. QUICK COUPLERS
5. RELIEF VALVE
6. SUCTION STRAINER (BELOW)
7. HYDRAULIC PUMP
8. DIESEL ENGINE
9. TOW BAR
10. LIFTING EYES
11. WHEEL / SPRING / AXLE ASSEMBLY
12. BATTERY
13. CONTROL PANEL WITH ENGINE CONTROLS
    - A. SUCTION STRAINER VACUUM GAUGE
    - B. HYDRAULIC SYSTEM PRESSURE GAUGE
    - C. OIL TEMPERATURE GAUGE
    - D. FAILURE RESET
    - E. SYSTEM LOADING VALVE
14. DAY TANK



OPTIONS AVAILABLE

1. TAIL LIGHT KITS
2. HYDRAULIC BRAKE SYSTEM (LARGER UNITS ONLY)
3. TOW BAR HITCH TO MATCH TOWING VEHICLE
4. STEERABLE FRONT END (LARGER MULTIPLE WHEEL UNITS ONLY)
5. ELECTRIC MOTOR PRIME MOVER IN LIEU OF DIESEL ENGINE
6. ELECTRIC MOTOR PRIME MOVER IN ADDITION TO DIESEL ENGINE UTILIZING DIESEL AS STANDBY

GENERAL INFORMATION

MODEL NUMBER	WATER PUMP note 1	HYDRAULIC OIL RESERVOIR CAPACITY IN U.S. GALS.	DAY TANK CAPACITY FUEL OIL U.S. GALS.	HOSE CONNECTION DIA. OF HOSE IN INCHES note 2			DIESEL ENGINE BHP RANGE note 3	NUMBER OF AXLES	NUMBER OF WHEELS	TOW BAR ARRANGEMENT note 4
				SUPPLY	RETURN	CASE DRAIN				
400P	HM304	28	46	.75	1	-	10-25	1	2	RIGID WITH ADJ. STAND
500P	HT004	28	46	.75	1	.75	5-25	1	2	RIGID WITH ADJ. STAND
600P	HT006	28	46	.75	1	.75	10-30	1	2	RIGID WITH ADJ. STAND
700P	HH506	42	62	1	1.25	-	30-40	1	2	RIGID WITH ADJ. STAND
800P	HAC308	28	46	.75	1	-	10-20	1	2	RIGID WITH ADJ. STAND
1200P	HAC312	42	62	1	1.25	.75	20-40	1	2	RIGID WITH ADJ. STAND
1300P	HH512	127	170	1.25	1.50	.75	50-75	2	4	HINGED
1600P	HAC316	77	77	1.25	1.50	.75	30-60	2	4	HINGED
1800P	HH518	179	179	1.50	1.50	.75	125	3	6	HINGED
2000P	HAC320	127	170	1.25	1.50	.75	40-75	2	4	HINGED
2400P	HAC324	179	179	1.50	1.50	.75	60-125	3	6	HINGED
2500P	HH524	294	133	1.50-2	2	.75	200-250	3	6	RIGID WITH ADJ. STAND
3000P	HAC330	294	133	1.50-2	2	.75	125-250	3	6	RIGID WITH ADJ. STAND
3600P	HAC336	294	133	1.50-2	2	.75	150-250	3	6	RIGID WITH ADJ. STAND
4200P	HH542	294	133	1.50-2	2	.75	150-250	3	6	RIGID WITH ADJ. STAND

NOTES:
1. Last two digits in this number indicate pump discharge diameter.
2. Hose sizes may vary due to length requirements. Standard length is 50 feet (15.2m).
3. Actual horsepower for prime mover depends upon manufacturer's ratings and pumping requirements (GPM/TDH).
4. Standard tow bar is provided with a standard pin type hitch arrangement.

SEE REVERSE SIDE FOR PHYSICAL DATA

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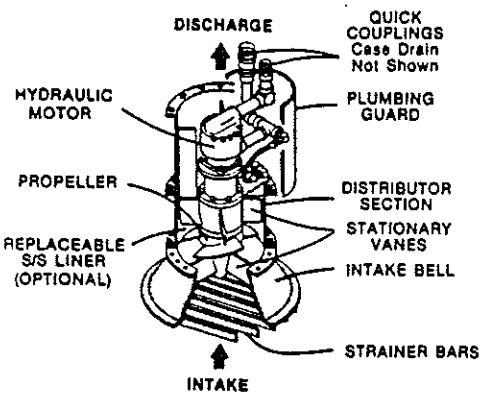
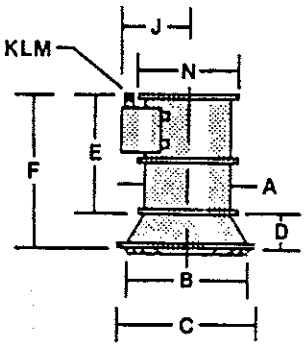
HYDRAFLO WATER PUMP

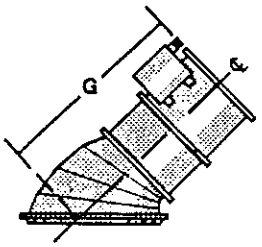
SINGLE STAGE



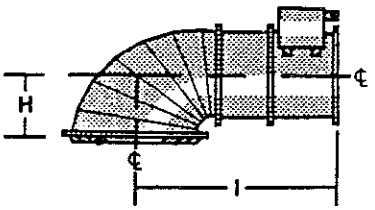
CUT-AWAY VIEW OF STANDARD HYDRAFLO PUMP



STANDARD VERTICAL HYDRAFLO PUMP



OPTIONAL ANGLE HYDRAFLO PUMP



OPTIONAL HORIZONTAL HYDRAFLO PUMP

NOTE: DO NOT USE FOR CONSTRUCTION UNLESS CERTIFIED BY FACTORY.

PHYSICAL DATA

MODEL	HOUSING DIAMETER A		INTAKE OPENING DIAMETER B		INTAKE FLANGE OUTER DIAMETER C		STANDARD VERTICAL INTAKE FLANGE TO FLANGE (NOTE 1) D		PUMP HOUSING FLANGE TO FLANGE (NOTE 3) E		STANDARD INTAKE FLANGE TO DISCHARGE FLANGE F		OPTIONAL INTAKE (NOTE 2) 45° HORIZONTAL INTAKE FLANGE TO DISCHARGE FLANGE G		OPTIONAL INTAKE (NOTE 2) 90° HORIZONTAL INTAKE FLANGE TO HOUSING CENTERLINE H		OPTIONAL INTAKE (NOTE 2) 90° INTAKE CENTERLINE TO VERTICAL DISCHARGE FLANGE I	
	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm
HAC308	8.625	219	12.0	305	17.0	432	6.375	162	20.0	508	26.375	670	29.5	749	—	—	—	—
HAC312	12.75	324	18.0	457	22.0	559	6.375	162	22.25	565	28.625	727	36.75	933	11.0	279	35.25	895
HH512	12.75	324	18.0	457	22.0	559	6.375	162	29.0	737	35.375	899	43.5	1105	11.0	279	42.0	1067
HAC316	16.875	429	24.0	610	28.0	711	8.375	213	29.25	743	37.625	956	46.25	1175	17.0	432	49.25	1251
HH518	18.875	479	27.0	686	31.0	787	10.375	264	37.5	953	47.875	1216	55.0	1397	18.0	457	58.5	1486
HAC320	20.0	508	30.0	762	34.0	864	8.375	213	33.0	838	41.375	1051	52.0	1321	19.5	495	55.5	1410
HAC324	25.062	637	36.0	914	39.5	1003	11.0	279	38.0	965	49.0	1245	58.5	1486	21.0	533	62.5	1588
HH524	25.062	637	36.0	914	39.5	1003	11.0	279	52.125	1324	63.125	1603	72.625	1845	21.0	533	76.625	1946
HAC330	30.0	762	45.0	1143	50.0	1270	12.5	318	53.125	1349	65.625	1667	79.625	2022	25.0	635	83.125	2111
HAC336	37.375	949	54.0	1372	60.125	1527	14.75	375	60.875	1546	75.625	1921	92.875	2359	28.5	724	95.375	2423
HAC342	43.75	1111	63.0	1600	70.625	1794	14.75	375	60.0	1524	74.75	1899	92.0	2337	32.0	813	99.0	2515
HAC360	62.0	1575	90.0	2286	98.0	2489	24.75	629	84.0	2134	106.75	2762	126.75	3219	39.5	1003	135.5	3442

MODEL	HOUSING CENTERLINE TO PLUMBING GUARD J		HOSE CONNECTION DIAMETER OF HOSE K SUPPLY	L RETURN	M CASE DRAIN	FLANGE AT DISCHARGE (NOTE 4) N NO. OF HOLES	DIAMETER OF HOLES		BOLT CIRCLE DIAMETER		OUTER DIAMETER		STANDARD VERTICAL PUMP VOLUME (Approx.)		STANDARD VERTICAL PUMP WEIGHT (Approx.)	
	inch	mm					inch	mm	inch	mm	inch	mm	cu. ft.	cu.mts.	lbs.	kg.
HAC308	10.0	254	.75	1.0	—	8	.5625	14.3	10.75	273	12.75	324	4.42	.125	170	77
HAC312	12.0	305	1.0	1.25	.75	12	.5625	14.3	14.875	378	16.0	406	8.02	.227	300	136
HH512	12.0	305	1.25	1.5	.75	12	.5625	14.3	14.875	378	16.0	406	9.91	.28	360	163
HAC316	15.0	381	1.25	1.5	.75	12	.5625	14.3	19.0	483	20.8125	529	17.1	.484	550	249
HH518	18.0	457	1.5	1.5	.75	16	.5625	14.3	20.25	514	22.5	572	26.63	.754	1100	499
HAC320	19.0	483	1.25	1.5	.75	16	.5625	14.3	22.0	559	24.125	613	27.7	.784	925	420
HAC324	22.0	559	1.5	1.5	.75	20	.5625	14.3	26.375	670	28.625	727	44.24	1.25	1500	680
HH524	22.0	559	1.5 - 2.0	2.0	.75	20	.5625	14.3	26.375	670	28.625	727	57.0	1.614	1800	816
HAC330	26.0	660	1.5 - 2.0	2.0	.75	24	.5625	14.3	32.75	832	34.125	867	95.0	2.7	2200	998
HAC336	30.0	762	1.5 - 2.0	2.0	.75	28	.75	19.05	40.625	1032	43.125	1095	158.21	4.5	3400	1542
HAC342	33.0	838	1.5 - 2.0	2.0	.75	30	.75	19.05	45.5	1156	49.5	1257	215.6	6.1	4000	1814
HAC360	48.0	1219	(2) 2	(2) 2	(2) .75 (1) 1	50	.81	20.57	63.0	1600	66.13	1680	604	17.1	10,000	4536

NOTE 1: Strainer bars (intake screen) extend beyond intake flange (variable up to 2 inches). Dimension to intake flange is utilized here as a guide for spacing of opening to sump bottom.
NOTE 2: Intake bells are available as 45°'s & 90°'s as well as the standard vertical unit. (Consult factory for other available intakes.) All intakes can be provided with a stand to support water pump and ensure minimum inlet water requirements.
NOTE 3: If there are dimension limitations, consult factory as a shorter dimension may be obtainable.
NOTE 4: Optional A.S.A. and A.N.S.I. diameter and drilling flanges are available to match customer's existing pipe. Consult factory.

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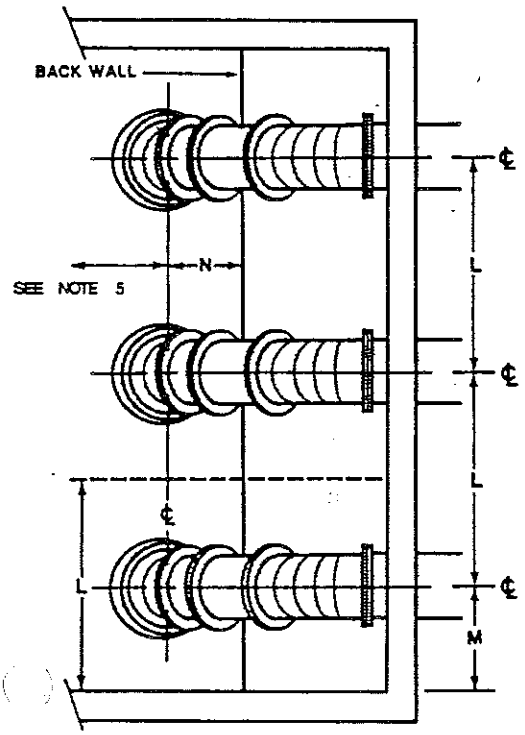
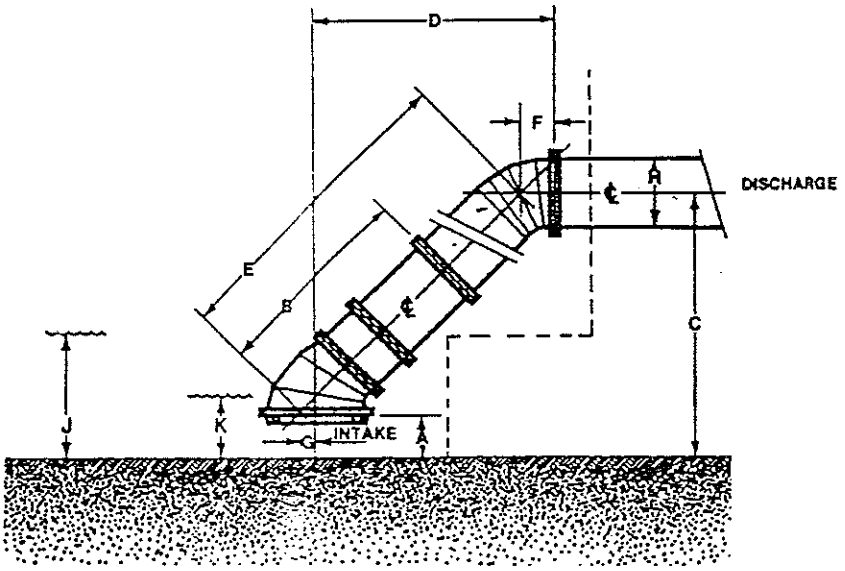


PLAN VIEW



PUMP ELEVATION VIEW

MODEL	A INTAKE CLEARANCE in.	A mm.	B HYDRAFLO PUMP in.	B mm.	C SUMP FLOOR TO HORIZONTAL CENTERLINE OF DISCHARGE in.	C mm.	D CENTERLINE OF INTAKE BELL TO DISCHARGE FLANGE in.	D mm.	E INTAKE FLANGE TO HORIZONTAL CENTERLINE OF DISCHARGE in.	E mm.	F DISCHARGE FLANGE TO CENTERLINE in.	F mm.	G INTAKE BELL CENTERLINE TO 45° PUMP CENTERLINE in.	G mm.
HAC308	9.0	229	29.5	749	32.375	822	24.5	622	33.125	841	3.625	92	2.5	63
HAC312	9.0	229	36.75	933	38.75	984	30.5	775	42.0	1067	5.25	133	4.5	114
HH512	9.0	229	43.5	1105	43.5	1105	35.25	895	48.75	1238	5.25	133	4.5	114
HAC316	10.0	254	46.25	1175	47.375	1203	39.25	997	52.875	1343	6.625	168	4.75	121
HH518	12.0	305	55.0	1397	56.25	1429	47.0	1194	62.5	1588	7.5	191	4.625	117
HAC320	12.0	305	52.0	1321	54.625	1387	46.375	1178	60.25	1530	8.25	210	4.5	114
HAC324	18.0	457	58.5	1486	66.375	1686	53.73	1365	68.5	1740	10.0	254	4.625	117
HH524	18.0	457	72.625	1845	76.375	1940	63.75	1619	82.625	2099	10.0	254	4.625	117
HAC330	18.0	457	79.625	2022	83.0	2108	71.5	1816	92.0	2337	12.375	314	5.875	149
HAC336	24.0	610	90.875	2308	98.75	2508	83.5	2121	105.75	2686	14.875	378	6.125	156
HAC342	24.0	610	92.0	2337	111.375	2829	89.0	2261	109.375	2778	17.375	441	5.75	146
HAC360	36.0	914	126.5	3213	143.0	3632	126.25	3207	151.375	3845	24.875	632	5.625	143
	NOTE 1 & 3				NOTE 1		NOTE 1		NOTE 1		NOTE 1 & 2		NOTE 1	

NOTES:
1. Dimensions shown are minimum and can be increased as required.
2. Dimension shown is based on short radius elbow (see SECTION II, SHT. A-2).
3. Strainer bars on intake extend below intake flange opening.
4. Depth of sump should always be designed liberally to accommodate possible future decreasing intake water levels and to maximize the potential draw down (there is no maximum submergence).
5. Dimension is subject to submergence, inlet channel, etc.

MODEL	H DISCHARGE PIPE DIAMETER m.	H mm.	J MINIMUM WATER LEVEL FOR PUMP STARTING in.	J mm.	K MINIMUM WATER LEVEL FOR PUMP SHUT OFF in.	K mm.	L SUGGESTED MINIMUM in.	L mm.	M SUGGESTED MINIMUM PUMP CENTERLINE TO SIDE WALL in.	M mm.	N SUGGESTED MAXIMUM PUMP CENTERLINE TO BACK WALL in.	N mm.
HAC308	8.625	219	20.0	508	13.0	330	36.0	914	18.0	457	14.0	356
HAC312	12.75	324	25.0	635	13.0	330	40.0	1016	20.0	508	16.0	406
HH512	12.75	324	26.0	660	13.0	330	40.0	1016	20.0	508	16.0	406
HAC316	16.0	406	30.0	762	15.0	381	54.0	1372	27.0	686	23.0	584
HH518	18.0	457	34.0	864	18.0	457	58.0	1473	29.0	737	24.0	610
HAC320	20.0	508	35.0	889	17.0	432	66.0	1676	33.0	838	28.0	711
HAC324	24.0	610	44.0	1118	24.0	610	80.0	2032	40.0	1016	36.0	914
HH524	24.0	610	44.0	1118	24.0	610	80.0	2032	40.0	1016	36.0	914
HAC330	30.0	762	51.0	1295	25.0	635	100.0	2540	50.0	1270	46.0	1168
HAC336	36.0	914	64.0	1626	32.0	813	114.0	2896	57.0	1448	50.0	1270
HAC342	42.0	1067	69.0	1753	32.0	813	132.0	3353	66.0	1676	66.0	1676
HAC360	60.0	1524	95.0	2413	49.0	1245	180.0	4572	90.0	2286	90.0	2286
	NOTE 1		NOTE 4									

FOR PUMP SUPPORT REFER TO SECTION II A-1 (383) FOR DIMENSIONS AND DRAWINGS OF INTAKE WITH STAND ARRANGEMENTS.

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Aerators, Surface Type

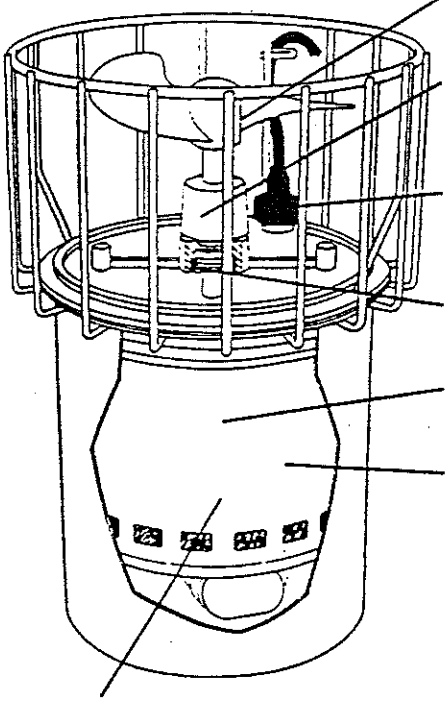
NEW - IMPROVED!

AES is the exclusive distributor of Kasco Marine aeration products.
All Kasco products are built for saltwater use.

Kasco offers some of the most cost effective vertical pump type aerators on the market. Testing at Auburn University in 1988 shows that the 1/2 hp and 3/4 hp Kasco's produced excellent oxygen transfer (2.9 lbs. of oxygen/horsepower hour) in their standardized testing. The high efficiency makes them a wise choice for continuous duty applications. Their easily mobile nature also makes them ideal for quick emergency use in ponds and lakes, and wherever another aerator may have failed.

Stainless Steel Safety Cage - for propeller protection.

New improved end plate eliminates leaks.



Special propeller for maximum thrust.

Renewable zinc anode for corrosion protection on 316 SS shaft.

Exterior water tight connection for easy cable replacement.

Kasco double-sealed shaft system.

Ball bearings used top and bottom.

Large capacity dielectric oil provides lifetime lubrication and maximum cooling.

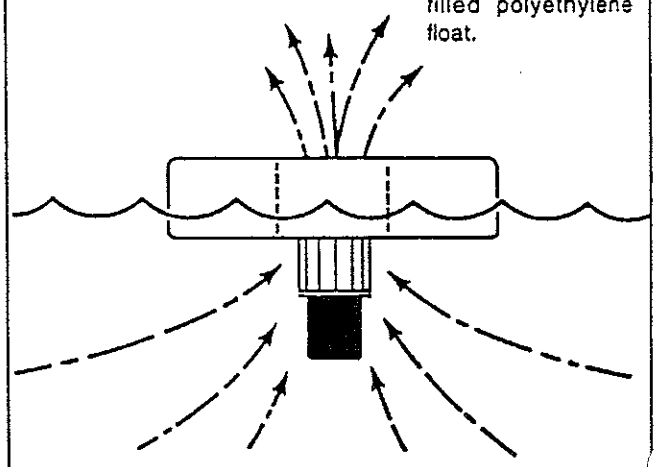
Stainless Steel Housing.

Two 25' mooring ropes are included.

The motor is a custom designed, energy efficient, permanent-split capacitor type, continuous duty, 120 Volt, 60 Hz, single phase with automatic reset thermal overload protection. Kasco motors exceed NEMA specifications. 50 Hz and 3 phase not available.

One year warrantee.

Heavy duty, foam filled polyethylene float.



See page 138 for plastic netting.

Saltwater Compatible.

Here is a recent quote from a state fisheries biologist after he installed some of the 3/4 hp aerators - "The aerators delivered exactly what was desired, a quick influx of dissolved oxygen into a pond . . . The results show a marked increase in dissolved oxygen in the 24 hour period immediately following the introduction of the aerator. The amazing result to me is the quick destratification of the pond and the greatly increased oxygen levels on the bottom of the pond."

Aquatic Eco-Systems, Inc. is an authorized Kasco repair facility.

PART NO.	DESCRIPTION	RUNNING AMPS	VOLTAGE	THRUST	PUMPING RATE (gpm)	SHIP WT. (LBS.)
KA 501	Aerator, .5 hp, less cord	5	115	26 lbs.	500	22 + 20
KA 751	Aerator, .75 hp, less cord	6.7	115	34 lbs.	650	33 + 20
★ KA 752	Aerator, .75 hp, less cord	3.3	230	34 lbs.	650	33 + 20 ★
KA 202	Aerator, 2 hp, less cord	10	230	56 lbs.	1450	46 + 35
KS 751	Shrimp, .75 hp, less cord	6.7	115	34 lbs.	650	33 + 26
KS 752	Shrimp, .75 hp, less cord	3.3	230	34 lbs.	650	33 + 26
KS 202	Shrimp, 2 hp, less cord	11.7	230	56 lbs.	1450	46 + 55
KC 51	Power Cord, 50', 16/3	---	115	---	---	5
KC 52	Power Cord, 50', 16/3	---	230	---	---	5
KC 101	Power Cord, 100', 14/3	---	115	---	---	10
KC 102	Power Cord, 100', 14/3	---	230	---	---	10
KD	Dock Mount	---	---	---	---	22
KM 501	Motor, .5 hp	5	115	26 lbs.	---	22
KM 751	Motor, .75 hp	6.7	115	34 lbs.	---	33
KM 752	Motor, .75 hp	3.3	230	34 lbs.	---	33
KM 202	Motor, 2 hp	10	230	55 lbs.	---	46

APPENDIX E

DETAILED COST ESTIMATE

APPENDIX E

DETAILED COST ESTIMATE

TABLE OF CONTENTS

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E.5	COST RELATIONSHIPS	E-4
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APPENDIX E

DETAILED COST ESTIMATE

E.1 GENERAL

1. This appendix contains the detailed project cost estimate prepared for the design and construction of the Trempealeau National Wildlife Refuge Habitat Rehabilitation and Enhancement Project. The estimate has been prepared using the MCACES computer program. Results are presented on a spread sheet showing contingencies and costs escalated for anticipated inflation to arrive at a fully funded amount. This write-up is prepared to explain cost relationships and development of the contingencies. Guidance for preparation of this appendix was obtained from ER 1110-2-1150, Engineering and Design for Civil Works Projects, and EC 1110-2-263, Civil Works Construction Cost Estimating. The estimate is in the Code of Accounts format as directed by EC 1110-2-538, Civil Works Project Cost Estimating - Code of Accounts.

E.2 PRICE LEVEL

1. Estimated costs are based on January 1994. Indirect costs including overhead, profit, and bond have been added to the prices to obtain the unit costs. These costs are considered fair and reasonable to a prudent and capable contractor. Estimated costs on the Total Project Cost Summary Sheet are rounded to the nearest $1,000.00.

E.3 PROJECT DESCRIPTION

1. The project is located in the Trempealeau National Wildlife Refuge which is near Trempealeau Wisconsin. It is across the Mississippi River from Winona, Minnesota. The refuge is bounded on one side by a railroad embankment which separates it from the Mississippi River and on the other side by the Trempealeau River.

2. The purpose of the project is to enhance management of the refuge for wildlife. This will be accomplished by the construction of dikes , culverts, and pumping facilities. These features will be used enhance water quality and to control water levels in different areas of the refuge.

3. In the report and in this estimate, these dikes are named Dike A, Dike C2 and Dike E. The dikes are constructed of sandfill with topsoil and turf for erosion protection. Additional erosion protection is provided by the construction of

rock groins on each side of Dike A. Each dike will have an overflow section protected from erosion by a layer of geotextile fabric and rockfill.

4. Other major features of the project include the construction of Outlet Culverts through Dike C2 and Dike E and an Inlet Culvert from the Trempealeau River to the pond contained by Dike C2. Each of the ponds contained by Dikes C2 and E will be able to be filled by portable pumps which will be placed on the downstream side of these dikes on concrete pads.

5. A permanent pump station with a capacity of 22,000 gallons per minute will be constructed in Dike A adjacent to the railroad embankment. The pump station consists of several features. A wet well, which contains the pumps, is connected to a gatewell by a 60 inch diameter reinforced concrete pipe. Water is brought to the gatewell by a gravity flow culvert from Pool A and Pool B. (Dike a separates Pool A from Pool B). A concrete stop log structure will be constructed on the end of the culvert in Pool B to prevent the movement of fish from Pool B to Pool A. The entire structure including the gatewell, stoplog structure, and culverts, is supported on steel H-piling to prevent settlement which is expected to occur due to the placement of the sandfill for Dike A. A steel sheet pile cutoff to will be constructed beneath all the pump station features. The pump station will be used to pump water from Pool A or Pool B to the Mississippi River. The gravity flow conduits from each pool to the pump station will be used to pass water from Pool B to Pool A by gravity flow. Two 14 inch pumps with check valves will be installed which will share a common 24 inch diameter discharge pipe with a concrete headwall and flap gate at the discharge end on the Mississippi River side of the railroad embankment. The pump station will be fenced but will have no superstructure.

6. Other features include rock protection for an embankment which has experienced erosion, gravel surface on top of the dikes for operation and maintenance traffic, 10 electrically operated aerators in Pool A.

7. The main report contains a more detailed description of features in the selected plan together with overall site plan and sections of the dikes and structures.

E.4 CONSTRUCTION METHODS

1. Several sources of sand are available to construct the dikes. Based on formulation estimates for various alternatives sand sources, it has been determined that the most economical source of sandfill for the Dike A would be from hydraulic dredging the Mississippi River. It is assumed that this sand material will be placed in the dike directly from the end of the

dredge pipeline and shaped with a dozer. This method has been used on similar district projects with very good results. A 48 inch diameter reinforced concrete pipe will be jacked through the railroad embankment. The dredge pipeline will be placed through this pipe so that rail traffic will not be interrupted. This pipe will later be used to pass the pump station discharge pipe through to the Mississippi River.

2. The sand for Dike C2 and Dike E can be economically obtained from an existing dredge material placement site located approximately 7 miles away from the construction site. Costs will include only hauling and placement in the dike section. Hauling costs have been determined considering reduced travel speed within the refuge and on the dikes, and availability of access to the dikes.

3. Topsoil will be placed on the dikes for the establishment of turf. This will provide erosion protection for the sandfill. The topsoil will be obtained by excavation of the fine material in the pools adjacent to the dikes by a crane equipped with a clamshell bucket positioned on the top of the dikes. This material will be allowed to dry out and will be spread on the sandfill dikes with a dozer.

4. Rockfill stone protection can be obtained from quarries in the area. Two separate suppliers were contacted to obtain costs for this material. Rockfill will be delivered to the dikes by dump truck and placed into position with a hydraulic excavator.

5. Cofferdams and dewatering will be required to construct the outlets, the inlet, and the pump station. The amount of pumping required to dewater each site was determined based on the anticipated seepage through the cofferdams. Dewatering pumps and generators are sized to handle the anticipated seepage. Cofferdams will be constructed of the same sandfill material used in the construction of the dikes. These cofferdams will be removed at the completion of the work and the material will be incorporated into the permanent dikes. The cofferdam at the inlet end of the Dike C2 Inlet will be more substantial consisting of sheetpile with an earth berm on the dewatered side.

6. There is not sufficient electrical power in the refuge at this time to operate the permanent and portable pumps. Power will be brought in underground by the power company. Costs for this were obtained by discussions with the power company.

7. The remaining work, consisting of cast-in-place concrete, fabricated metals, pile driving, and miscellaneous other items of work will be accomplished using materials which are readily available in the area using typical conventional construction methods.

E.5 COST RELATIONSHIPS

1. While the design of each of the outlets and the inlet is identical, the costs will vary. This is due to the varying amounts of cofferdams and pumping that will be required during construction. The portable pump pads, which are designed as headwall structures, will be located in the dewatered area for the outlets so that no additional dewatering costs are included for these structures.

2. The prices for the sandfill for the dikes also varies. As was noted previously, formulation estimates were prepared to determine which sources of sand would be the most cost effective for each dike. The source of sand for Dike C2 and Dike E is the same. The difference in cost between the sandfill for Dike C2 and Dike E are due to the difference in haul distance within the refuge and on the levee, and access to the dike construction area. If this source were used for Dike A, the sandfill would be extremely expensive due to the longer haul distance within the levee and the fact that the levee is much longer with access available only from one end. Consequently, obtaining sand from the river by hydraulic dredging becomes more cost effective for this site.

3. Electric service to each dike will be required to operate the pumps. Electric service prices are based on the size and length of the service required.

4. Each dike contains an overflow section that is 200 feet long. However, the dike section for Dike A is much wider than the other dikes and consequently the cost per linear foot of dike is significantly greater.

E.6 CONTINGENCIES

1. After review of the project documents and discussions with the design engineers and project managers, contingencies were developed which reflect the uncertainties associated with each item. Contingency development is based upon the design available and the risks related to the uncertainties or unanticipated conditions identified at the time the estimate is prepared. Per EC 1110-2-263, these contingencies are based on uncertainties in quantities, unit pricing, and unanticipated items of work not defined or recognized at the time of design. Generally, the levels of uncertainty used in this estimate are:

a. 5% for unit pricing,

b. 5% for unanticipated work,

c. 5% to 25% for quantities.

2. 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 for the uncertainty in design and quantity calculations.

a. Feature 06, Fish and Wildlife Facilities. This major project feature includes all the construction including the dikes, pump station, outlets, inlet, and electrical service installation.

1. The sand fill to construct the dikes represents a significant portion of the total construction cost. Contingencies for sand are relatively high at 35% to account for uncertainties in the quantities. In addition, the cost for the sand to be placed in Dike A is based on the assumption that the material would be obtained from dredging. Dredging costs can vary greatly due to water levels and other river conditions, and contractor's workload which affects prices due to competition. Also, the sand to be placed in Dikes C2 and E is assumed to come from a source about 7 miles from the site. The sand is assumed to be available at no cost. The contingency applied to the sandfill will decrease significantly as more design data becomes available and the design is refined so that uncertainty in the quantity is reduced.

2. The design for the rockfill Groin on Dike A is less likely to change and the contingencies for this item reflect this by being set at 25%. The quantities for the other earth work items including gravel for the road surfaces, riprap, and topsoil are set even lower at 15% or 20% due to even more certainty in the design and the quantities.

3. Contingencies for the Outlet Structures, Inlet Structure, and Pump Station are based on a contingency analysis of the component parts of each structure. A separate approximate seepage analysis was prepared for each structure to determine the anticipated amount of pumping that may be required. Also, a preliminary cofferdam design, including a steel sheetpile design for the inlet side of the Inlet Culvert was prepared to determine cofferdam costs. Consequently, contingencies for dewatering and cofferdams was set relatively low at 25%. Other structural items which tended to lower the overall structure contingency included items where the quantity could be accurately determined such as the quantity of sluice gates, flap gates, and slide gates, the length of ladders, quantity of jib cranes and sump pumps, and quantities for other metal items. Other items such as concrete, foundation preparation (timber piles) and steel sheet pile cutoffs have relatively high contingencies since the level of design is minimal. Contingencies for these structures

will decrease as the design is refined based on additional information.

4. The pumps and controls have a 20% contingency. The quantity is precisely known and the cost of the equipment is known fairly accurately based on abstracts from projects with similar equipment. However, there still remains the potential to increase the size of the equipment. Consequently, the contingency is set to account for this.

5. Another major item of work within this feature is the costs for the electrical services to each of the 3 sites. Costs in the estimate are based on discussion with the power company and have not been marked up to account for indirect contractor costs. This means that the assumption has been made that this work will be done under separate contract with the local electrical company. Since the local electrical has visited the site and is very familiar with costs for this type of work since it is their only business, contingencies are set relatively low for this work at 15%.

b. Feature 30, Planning, Engineering and Design. Costs and contingencies are provided by each separate engineering function and are based on experience with similar type projects.

c. Feature 31, Construction Management. Costs and contingencies are provided by Construction Division and are based on experience with similar type projects.

E.7 ATTACHMENTS.

1. The first attachment is the Total Project Cost Summary. This shows the fully funded project cost estimate. It is prepared in accordance with Project Management guidelines and includes costs for construction, engineering and design, and construction management along with the appropriate contingencies and inflation associated with each of these activities through project completion. For this project, there will be no Non-Federal costs and no costs for real estate since the project will be constructed on Federally owned property.

2. The second attachment is the backup to the Total Project Cost Summary. This shows detailed unit costs and detailed contingencies. The unit costs have been determined by an MCACES detailed estimate.

TOTAL - TREMPEALEAU NATIONAL WILDLIFE REFUGE, DPR **** TOTAL PROJECT COST SUMMARIES ****

PROJECT: TREMPEALEAU NATIONAL WILDLIFE REFUGE
LOCATION: POOL 6, UMR, TREMPEALEAU AND BUFFALO COUNTIES, WI SELECTED PLAN
DATE PREPARED: 21 JANUARY, 1994

PREPARED BY: GARY SMITH , CENCS-ED-C

REVIEWED AND APPROVED BY: W. MICHAEL OSTERBY , CHIEF, ED-C

ACCOUNT NUMBER	ITEM DESCRIPTION	ESTIMATED COST($) (EPD)	CONTINGENCY AMOUNT($)	%	TOTAL EST COST (EPD)	OMB INDEX TO 10/94 %	OMB INDEX TO 10/94 AMOUNT	MID POINT OF FEATURE	OMB (%) INDEX (+/-)	INDEXED COST AMOUNT ($)	INDEXED CONTG. AMT. ($)	FULLY FUNDED COST
06---	FISH AND WILDLIFE FACILITIES	3,658,000	991,000	27%	4,649,000	2.4%	4,761,000	APR 96	5.660%	3,958,000	1,072,000	5,030,000
	TOTAL CONSTRUCTION COSTS =====>	3,658,000	991,000	27%	4,649,000		4,761,000			3,958,000	1,072,000	5,030,000
01---	LANDS AND DAMAGES											
30---	PLANNING, ENGINEERING AND DESIGN											
	PRIOR TO 12/93	341,000		0%	341,000	0%	341,000			341,000	0	341,000
	AFTER 12/93	340,000	52,000	15%	392,000	3.8%	407,000			353,000	54,000	407,000
	TOTAL PED	681,000	52,000		733,000		748,000			694,000	54,000	748,000
31---	CONSTRUCTION MANAGEMENT	272,000	74,000	27%	346,000	3.8%	359,000	APR 96	7.760%	305,000	83,000	388,000
	TOTAL PROJECT COSTS ======>	4,611,000	1,117,000		5,728,000		5,868,000			4,957,000	1,209,000	6,166,000

NOTES:
1. Prices are at January 1994 price levels.

ACCOUNT CODE	ITEM		UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	CONTINGENCIES PERCENT	REASON
06.-.-.-	FISH AND WILDLIFE FACILITIES								
06.0.A._	MOBILIZATION, DEMOB. & PREP. WORK								
06.0.A._	MOBILIZATION, DEMOB. & PREP. WORK		JOB	1	86,712	86,712	21,678	25.00%	3
06.3.3.-	POOL A	2,296,698							
06.3.3.B	SANDFILL		CY	125,900	6.72	846,048	296,117	35.00%	1,3,4,7
06.3.3.B	ROCKFILL, GROIN		CY	9,100	36.44	331,604	82,901	25.00%	1,3,4,7
06.3.3.B	GRAVEL, DIKE		CY	900	17.57	15,813	2,372	15.00%	1,3,4,7
06.3.3.B	GRAVEL, ROAD		CY	310	17.57	5,447	817	15.00%	1,3,4,7
06.3.3.B	RIPRAP, ROAD		CY	75	36.44	2,733	547	20.00%	1,3,4,7
06.3.3.B	ROCKFILL, KEIP'S ISLAND		CY	1,400	30.59	42,826	8,565	20.00%	1,3,4,7
06.3.3.B	TOPSOIL		CY	6,100	3.30	20,130	3,020	15.00%	1,3,4,7
06.3.3.B	SEEDING		AC	7.60	3,255.00	24,738	3,711	15.00%	1,3,4,7
06.3.3.B	PUMP STATION		JB	1	458,850.00	458,850	165,186	36.00%	1,4,7,8
06.3.3.B	ELECTRICAL SERVICE		JB	1	280,000	280,000	42,000	15.00%	8
06.3.3.B	SUBMERSIBLE PUMPS		EA	2	90,000	180,000	18,000	10.00%	4,8
06.3.3.B	ELECTRICAL AND CONTROLS		EA	1	50,000	50,000	5,000	10.00%	4,8
06.3.3.B	AERATION		EA	10	1,718.52	17,185	4,296	25.00%	4,8
06.3.3.B	OVERFLOW SPILLWAY		LF	200	99.60	19,920	4,980	25.00%	1,3,4,7
06.3.3.B	BOAT RAMP		JB	1	1404.00	1,404	421	30.00%	1,3,4,7
06.3.3.-	POOL C2	784,824							
06.3.3.B	SANDFILL		CY	50,000	4.91	245,500	85,925	35.00%	1,3,4,7
06.3.3.B	GRAVEL, DIKE		CY	3,200	17.57	56,224	8,434	15.00%	1,3,4
06.3.3.B	TOPSOIL		CY	7,000	3.30	23,100	3,465	15.00%	1,3,4,.
06.3.3.B	SEEDING		AC	10.30	3,255.50	33,532	5,030	15.00%	1,3,4,7
06.3.3.B	CLEARING, LIGHT		AC	7.20	2,873	20,684	3,103	15.00%	1,3,4,7
06.3.3.B	PORTABLE PUMPS		EA	2	25,000	50,000	5,000	10.00%	8
06.3.3.B	ELECTRIC SERVICE		JB	1	70,000	70,000	10,500	15.00%	8
06.3.3.B	OUTLET CULVERT		JB	1	83,462	83,462	28,377	34.00%	1,4,7,8
06.3.3.B	INLET CULVERT		JB	1	168,749	168,749	50,625	30.00%	1,4,7,8
06.3.3.B	OVERFLOW SPILLWAY		LF	200	56.44	11,288	2,822	25.00%	1,3,4,7
06.3.3.B	PORTABLE PUMP PAD		JB	1	22,286	22,286	4,457	20.00%	1,3,4,7
06.3.3.-	POOL E	489,485							
06.3.3.B	SANDFILL		CY	44,700	3.72	166,284	58,199	35.00%	1,3,4,7
06.3.3.B	GRAVEL, DIKE		CY	1,500	17.57	26,355	3,953	15.00%	1,3,4,7
06.3.3.B	TOPSOIL		CY	4,900	3.28	16,072	2,411	15.00%	1,3,4,7
06.3.3.B	SEEDING		AC	5.60	3,255.50	18,231	2,735	15.00%	1,3,4,7
06.3.3.B	CLEARING, MEDIUM		AC	4	3,332.38	13,330	1,999	15.00%	1,3,4,7
06.3.3.B	PORTABLE PUMPS		EA	2	25,000	50,000	5,000	10.00%	8
06.3.3.B	ELECTRIC SERVICE		JB	1	70,000	70,000	10,500	15.00%	8
06.3.3.B	OUTLET CULVERT		JB	1	95,640	95,640	31,561	33.00%	1,4,7,8
06.3.3.B	OVERFLOW SPILLWAY		LF	200	56.44	11,288	2,822	25.00%	1,3,4,7
06.3.3.B	PORTABLE PUMP PAD		JB	1	22,286	22,286	4,457	20.00%	1,3,4,7

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	CONTINGENCIES PERCENT	REASON
	SUBTOTAL CONSTRUCTION COSTS				$3,657,719			
	SUBTOTAL CONTINGENCIES			27.1%		$990,985		
	TOTAL 06. FISH AND WILDLIFE FACILITIES					$4,648,704		

REASONS FOR CONTINGENCIES

1. QUANTITY UNKNOWNS
2. SITE CONDITIONS
3. HAUL DISTANCE
4. UNIT PRICES
5. LEGAL COSTS
6. LAND PRICES
7. PRODUCTION/DURATION
8. MATERIALS
9. INSIGNIFICANT AMOUNT
10. NOT APPLICABLE

NOTES

A. UNIT PRICES AT JANUARY 1994 PRICE LEVEL.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	CONTINGENCIES PERCENT	REASON
30.-.-.-	PLANNING, ENGINEERING AND DESIGN							
30.A.-.-	PLANNING							
30.A.E.-	C.S. DURING E & D	JOB	0	14,300	0	0	30.0%	7
30.A.F.-	C.S. DURING CONSTRUCTION	JOB	0	5,000	0	0	50.0%	7
30.B.-.-	ENGINEERING AND DESIGN PRIOR TO 12/93							
30.B.4.-	DESIGN BY DISTRICT	JOB	1	341,000	341,000	0	0.0%	7
30.C.-.-	RAILROAD PERMITS							
30.C.B.-	RAILROAD PERMITS	JOB	1	6,000	6,000	2,040	34.0%	7
30.D.-.-	ENVI. & REG. ACTIVITIES							
	ENVI. & REG. ACTIVITIES	JOB	1	9,000	9,000	990	11.0%	7
30.D.2.-	CULTURAL RESOURCE INVEST	JOB	1	10,000	10,000	1,000	10.0%	7
30.E.-.-	DESIGN RELATED ENGINEERING							
30.E.3.-	SURVEYS, MAPPING	JOB	1	25,000	25,000	4,000	16.0%	7
	SOIL BORINGS, TESTING	JOB	1	17,000	17,000	3,060	18.0%	7
30.H.-.-	PLANS AND SPECIFICATIONS							
30.H.B.-	FINAL DESIGN (IN-HOUSE)	JOB	1	210,000	210,000	31,500	15.0%	7
30.J.-.-	ENG. DURING CONSTRUCTION							
30.J.9.-	ALL OTHER ENGINEERING	JOB	1	36,000	36,000	6,012	16.7%	
30.N.-.-	CONSTR. & SUPPLY ACTIVITY							
30.N.9.-	PREP. BIDDING DOCUMENTS	JOB	1	8,000	8,000	960	12.0%	7
30.P.-.-	PROJECT MANAGEMENT							
30.P.9.-	PROJECT MANAGER	JOB	1	19,000	19,000	2,090	11.0%	7
	SUBTOTAL CONSTRUCTION COSTS				$681,000			
	SUBTOTAL CONTINGENCIES			7.6%		$51,652		
	TOTAL 30. PLANNING, ENGINEERING AND DESIGN					$732,652		

REASONS FOR CONTINGENCIES

1. QUANTITY UNKNOWNS
2. SITE CONDITIONS
3. HAUL DISTANCE
4. UNIT PRICES
5. LEGAL COSTS
6. LAND PRICES
7. PRODUCTION/DURATION
8. MATERIALS
9. INSIGNIFICANT AMOUNT
10. NOT APPLICABLE

NOTES

A. UNIT PRICES AT JANUARY 1994 PRICE LEVEL.

ACCOUNT CODE	ITEM	UNIT	QUANTITY	UNIT PRICE	AMOUNT	CONTINGENCIES AMOUNT	CONTINGENCIES PERCENT	REASON
31.-.-.-	CONSTRUCTION MANAGEMENT (S&I)							
31.A.-.-	CONST. MGMT (S&I) PRIOR TO _____	LS						
31.B.-.-	CONTRACT ADMINISTRATION							
31.B.3.-	REV AND APPROV OF PAY ESTIMATES	LS	1	34,328	34,328			
31.B.4.-	CONTRACT MODIFICATIONS	LS	1	29,907	29,907			
31.B.5.-	PROGRESS AND COMPLETION REPORTS	LS	1	9,102	9,102			
31.B.9.-	ALL OTHER ACTIVITIES	LS	1	13,783	13,783			
31.B.Z.-	CONTINGENCIES					16,904	19.40%	7
31.D.-.-	REVIEW OF SHOP DRAWINGS	LS	1	19,071	19,071			
31.D.Z.-	CONTINGENCIES					13,177	69.1%	7
31.E.-.-	INSPECTION AND QUALITY ASSURANCE							
31.E.1.-	SCHEDULE COMPLIANCE	LS	1	41,177	41,177			
31.E.2.-	QA SAMPLING AND TESTING	LS	1	31,208	31,208			
31.E.3.-	QUANTITY CALCULATIONS	LS	1	42,477	42,477			
31.E.9.-	ALL OTHER ACTIVITIES	LS	1	21,239	21,239			
31.E.Z.-	CONTINGENCIES					37,276	27.39%	7
31.F.-.-	PROJECT OFFICE OPERATIONS	LS	1	9,016	9,016			
31.F.Z.-	CONTINGENCIES					4,161	46.2%	7
31.G.-.-	DAMAGES ASSESSED CONTRACTORS	LS	1	5,548	5,548			
31.G.Z.-	CONTINGENCIES					2,809	50.6%	7
31.H.-.-	CONTRACTOR INITIATED CLAIMS & LITIGATION	LS	1	2,951	2,951			
31.P.-.-	PROJECT MANAGEMENT	LS	1	12,622	12,622			
	SUBTOTAL CONSTRUCTION COSTS				$272,429			
	SUBTOTAL CONTINGENCIES		27.3%			$74,327		
	TOTAL 31. CONSTRUCTION MANAGEMENT (S&I)					$346,756		

REASONS FOR CONTINGENCIES

1. QUANTITY UNKNOWNS
2. SITE CONDITIONS
3. HAUL DISTANCE
4. UNIT PRICES
5. LEGAL COSTS
6. LAND PRICES
7. PRODUCTION/DURATION
8. MATERIALS
9. INSIGNIFICANT AMOUNT
10. NOT APPLICABLE

NOTES

A. UNIT PRICES AT JANUARY 1994 PRICE LEVEL.

APPENDIX F

PLAN FORMULATION DATA

7/27/93

Trempealeau NWR

ALTERNATIVE COSTS
POOL A

A1
Initial sand berm/riprap dike; pumps; islands

FEATURE	quant	unit $	amount $	contingency $	%	total $
Sandfill (CY)	89,900	5.80	521,420	182,497	35	703,917
Riprap (CY)	9,100	37.01	336,791	84,198	25	420,989
Rockfill, groin (CY)	3,700	37.01	136,937	34,234	25	171,171
Filter fabric (SY)	14,300	1.02	14,586	3,647	25	18,233
Gravel, dike (CY)	1,100	17.86	19,646	2,947	15	22,593
Gravel, road (CY)	300	17.86	5,358	804	15	6,162
Topsoil (CY)	34,500	3.21	110,745	16,612	15	127,357
Seeding (AC)	6.7	1974.81	13,231	1,985	15	15,216
Sandfill, island (CY)	77,400	5.8	448,920	157,122	35	606,042
Riprap, island (CY)	4,480	43.87	196,538	49,134	25	245,672
Rock wedge (CY)	-	-	-	-	-	-
Causeway road						
Riprap (CY)	-	-	-	-	-	-
Gravel (CY)	-	-	-	-	-	-
Pump station (LS)	1	-	541,600	52,400	10	594,000
SUBTOTALS			2,346,000	586,000		

Total Construction Cost	$2,932,000
E&D (20%)	$586,000
S&I (6%)	$176,000
Total Project Cost	$3,694,000
Ave Annual Construction Cost	$310,700
Ave Annual O&M Cost	$17,200
Total Annual Cost	$327,900
Average Annual Habitat Units gained	336
Cost per Ave Annual Habitat Unit	$976

A2
Sand berm dike w/ groins; pumps

FEATURE	quant	unit $	amount $	contingency $	%	total $
Sandfill (CY)	125,900	6.30	793,170	277,610	35	1,070,780
Riprap (CY)	-	-	-	-	-	-
Rockfill, groin (CY)	9,100	37.01	336,791	84,198	25	420,989
Filter fabric (SY)	-	-	-	-	-	-
Gravel, dike (CY)	900	17.86	16,074	2,411	15	18,485
Gravel, road (CY)	300	17.86	5,358	804	15	6,162
Topsoil (CY)	6,100	3.21	19,581	2,937	15	22,518
Seeding (AC)	7.6	1974.81	15,009	2,251	15	17,260
Sandfill, island (CY)	-	-	-	-	-	-
Riprap, island (CY)	-	-	-	-	-	-
Rock wedge (CY)	-	-	-	-	-	-
Causeway road						
Riprap (CY)	75	37.01	2,776	555	20	3,331
Gravel (CY)	10	17.86	179	27	15	205
Pump station (LS)	1	-	541,600	52,400	10	594,000
SUBTOTALS			1,731,000	423,000		

Total Construction Cost	$2,154,000
E&D (20%)	$431,000
S&I (6%)	$129,000
Total Project Cost	$2,714,000
Ave Annual Construction Cost	$228,200
Ave Annual O&M Cost	$12,500
Total Annual Cost	$240,700
Average Annual Habitat Units gained	272
Cost per Ave Annual Habitat Unit	$885

A3
Riprap dike; pumps

FEATURE	quant	unit $	amount $	contingency $	%	total $
Sandfill (CY)	66,700	7.61	507,587	177,655	35	685,242
Riprap (CY)	18,300	37.01	677,283	169,321	25	846,604
Rockfill, groin (CY)	-	-	-	-	-	-
Filter fabric (SY)	35,600	1.02	36,312	9,078	25	45,390
Gravel, dike (CY)	900	17.86	16,074	2,411	15	18,485
Gravel, road (CY)	300	17.86	5,358	804	15	6,162
Topsoil (CY)	200	3.21	642	96	15	738
Seeding (AC)	0.3	1974.81	592	89	15	681
Sandfill, island (CY)	-	-	-	-	-	-
Riprap, island (CY)	-	-	-	-	-	-
Rock wedge (CY)	-	-	-	-	-	-
Causeway road						
Riprap (CY)	75	37.01	2,776	555	20	3,331
Gravel (CY)	10	17.86	179	27	15	205
Pump station (LS)	1	-	541,600	52,400	10	594,000
SUBTOTALS			1,788,000	412,000		

Total Construction Cost	$2,200,000
E&D (20%)	$440,000
S&I (6%)	$132,000
Total Project Cost	$2,772,000
Ave Annual Construction Cost	$233,100
Ave Annual O&M Cost	$13,100
Total Annual Cost	$246,200
Average Annual Habitat Units gained	272
Cost per Ave Annual Habitat Unit	$905

A4
Sand berm/riprap dike w/ groins; pumps

FEATURE	quant	unit $	amount $	contingency $	%	total $
Sandfill (CY)	94,800	6.95	658,860	230,601	35	889,461
Riprap (CY)	9,200	37.01	340,492	85,123	25	425,615
Rockfill, groin (CY)	4,600	37.01	170,246	42,562	25	212,808
Filter fabric (SY)	17,800	1.02	18,156	4,539	25	22,695
Gravel, dike (CY)	900	17.86	16,074	2,411	15	18,485
Gravel, road (CY)	300	17.86	5,358	804	15	6,162
Topsoil (CY)	3,200	3.21	10,272	1,541	15	11,813
Seeding (AC)	3.9	1974.81	7,702	1,155	15	8,857
Sandfill, island (CY)	-	-	-	-	-	-
Riprap, island (CY)	-	-	-	-	-	-
Rock wedge (CY)	-	-	-	-	-	-
Causeway road						
Riprap (CY)	75	37.01	2,776	555	20	3,331
Gravel (CY)	10	17.86	179	27	15	205
Pump station (LS)	1	-	541,600	52,400	10	594,000
SUBTOTALS			1,772,000	422,000		

Total Construction Cost	$2,194,000
E&D (20%)	$439,000
S&I (6%)	$132,000
Total Project Cost	$2,765,000
Ave Annual Construction Cost	$232,500
Ave Annual O&M Cost	$12,800
Total Annual Cost	$245,300
Average Annual Habitat Units gained	272
Cost per Ave Annual Habitat Unit	$902

A5
Sand berm dike w/ groins; pumps; riprap along Kiap's

FEATURE	quant	unit $	amount $	contingency $	%	total $
Sandfill (CY)	125,900	6.30	793,170	277,610	35	1,070,780
Riprap (CY)	0	37.01	0	0	25	0
Rockfill, groin (CY)	9,100	37.01	336,791	84,198	25	420,989
Filter fabric (SY)	-	-	-	-	-	-
Gravel, dike (CY)	900	17.86	16,074	2,411	15	18,485
Gravel, road (CY)	300	17.86	5,358	804	15	6,162
Topsoil (CY)	6,100	3.21	19,581	2,937	15	22,518
Seeding (AC)	7.6	1974.81	15,009	2,251	15	17,260
Sandfill, island (CY)	6,500	12.33	80,145	28,051	35	108,196
Riprap, island (CY)	4,000	36.19	144,760	28,952	20	173,712
Rock wedge (CY)	-	-	-	-	-	-
Causeway road						
Riprap (CY)	75	37.01	2,776	555	20	3,331
Gravel (CY)	10	17.86	179	27	15	205
Pump station (LS)	1	-	541,600	52,400	10	594,000
SUBTOTALS			1,955,000	480,000		

Total Construction Cost	$2,435,000
E&D (20%)	$487,000
S&I (6%)	$146,000
Total Project Cost	$3,068,000
Ave Annual Construction Cost	$258,000
Ave Annual O&M Cost	$8,000
Total Annual Cost	$266,000
Average Annual Habitat Units gained	272
Cost per Ave Annual Habitat Unit	$978

A6
Sand berm dike w/ groins; pumps; rockfill along Kiap's

FEATURE	quant	unit $	amount $	contingency $	%	total $
Sandfill (CY)	125,900	6.30	793,170	277,610	35	1,070,780
Riprap (CY)	0	37.01	0	0	25	0
Rockfill, groin (CY)	9,100	37.01	336,791	84,198	25	420,989
Filter fabric (SY)	-	-	-	-	-	-
Gravel, dike (CY)	900	17.86	16,074	2,411	15	18,485
Gravel, road (CY)	300	17.86	5,358	804	15	6,162
Topsoil (CY)	6,100	3.21	19,581	2,937	15	22,518
Seeding (AC)	7.6	1974.81	15,009	2,251	15	17,260
Sandfill, island (CY)	-	-	-	-	-	-
Riprap, island (CY)	-	-	-	-	-	-
Rock wedge (CY)	1,400	31.53	44,142	8,828	20	52,970
Causeway road						
Riprap (CY)	75	37.01	2,776	555	20	3,331
Gravel (CY)	10	17.86	179	27	15	205
Pump station (LS)	1	-	541,600	52,400	10	594,000
SUBTOTALS			1,775,000	432,000		

Total Construction Cost	$2,207,000
E&D (20%)	$441,000
S&I (6%)	$132,000
Total Project Cost	$2,780,000
Ave Annual Construction Cost	$233,600
Ave Annual O&M Cost	$8,100
Total Annual Cost	$241,900
Average Annual Habitat Units gained	272
Cost per Ave Annual Habitat Unit	$889

SEPARABLE AERATION COST FOR A6

	amount $	contingency $	%	total $
Construction	50,000	30,000	60	$80,000
E&D (20%)				$16,000
S&I (6%)				$5,000
Total aeration cost				$101,000
Ave Annual Construction Cost				$8,500
Ave Annual O&M Cost				$5,000
Total Annual Cost for Aeration				$13,500
Average Annual Habitat Units gained				260
Cost per Ave Annual Habitat Unit				$52

7/27/93
Trempealeau NWR

ALTERNATIVE COSTS
POOL C

	C1						C2						C3					
	Sand dike; pumps; outlet						Sand dike; pumps; outlet; Trempealeau inlet						Sand dike; outlet; Trempealeau inlet					
			amount	contingency					amount	contingency					amount	contingency		
FEATURE	quant	unit $	$	$	%	total $	quant	unit $	$	$	%	total $	quant	unit $	$	$	%	total $
Sandfill (CY)	58,100	5.97	346,857	138,743	40	485,600	58,100	5.97	346,857	138,743	40	485,600	58,100	5.97	346,857	138,743	40	485,600
Filter fabric (SY)	24,900	3.52	87,648	17,530	20	105,178	24,900	3.52	87,648	17,530	20	105,178	24,900	3.52	87,648	17,530	20	105,178
Gravel, dike (CY)	1,500	17.86	26,790	4,019	15	30,809	1,500	17.86	26,790	4,019	15	30,809	1,500	17.86	26,790	4,019	15	30,809
Topsoil (CY)	4,900	3.21	15,729	2,359	15	18,088	4,900	3.21	15,729	2,359	15	18,088	4,900	3.21	15,729	2,359	15	18,088
Seeding (AC)	6.1	1974.81	12,046	1,807	15	13,853	6.1	1974.81	12,046	1,807	15	13,853	6.1	1974.81	12,046	1,807	15	13,853
Clearing, light (AC)	0.75	3051.85	2,289	343	15	2,632	0.75	3051.85	2,289	343	15	2,632	0.75	3051.85	2,289	343	15	2,632
Portable pumps (EA	2	51000.00	102,000	30,600	30	132,600	2	51000.00	102,000	30,600	30	132,600	-	-	-	-	-	-
Electric service (LS)	1	-	70,000	3,500	5	73,500	1	-	70,000	3,500	5	73,500	-	-	-	-	-	-
Outlet culvert (LS)	1	-	38,921	13,622	35	52,543	1	-	38,921	13,622	35	52,543	1	-	38,921	13,622	35	52,543
Inlet culvert (LS)	-	-	-	-	-	-	1	-	38,921	13,622	35	52,543	1	-	38,921	13,622	35	52,543
SUBTOTALS			702,280	212,523					741,201	226,145					569,201	192,045		
	Total Construction Cost					$915,000	Total Construction Cost					$967,000	Total Construction Cost					$761,000
	E&D (20%)					$183,000	E&D (20%)					$193,000	E&D (20%)					$152,000
	S&I (6%)					$55,000	S&I (6%)					$58,000	S&I (6%)					$46,000
	Total Project Cost					$1,153,000	Total Project Cost					$1,218,000	Total Project Cost					$959,000
	Ave Annual Construction Cost					$97,000	Ave Annual Construction Cost					$102,400	Ave Annual Construction Cost					$80,600
	Ave Annual O&M Cost					$7,500	Ave Annual O&M Cost					$8,200	Ave Annual O&M Cost					$7,400
	Total Annual Cost					$104,500	Total Annual Cost					$110,600	Total Annual Cost					$88,000
	Average Annual Habitat Units gained					49	Average Annual Habitat Units gained					49	Average Annual Habitat Units gained					37
	Cost per Average Annual Habitat Unit					$2,133	Cost per Average Annual Habitat Unit					$2,257	Cost per Average Annual Habitat Unit					$2,578

	C4						C2(1)						C2(2)					
	Sand dike (+2'); pumps; outlet; Trempealeau inlet						C2 sand dike; pumps; outlet; Trempealeau inlet						C2 sand dike; outlet; Trempealeau inlet					
			amount	contingency					amount	contingency					amount	contingency		
FEATURE	quant	unit $	$	$	%	total $	quant	unit $	$	$	%	total $	quant	unit $	$	$	%	total $
Sandfill (CY)	111,900	5.97	668,043	300,619	45	968,662	50,000	4.92	246,000	86,100	35	332,100	50,000	4.92	246,000	86,100	35	332,100
Filter fabric (SY)	29,800	3.52	104,896	26,224	25	131,120	-	-	-	-	-	-	-	-	-	-	-	-
Gravel, dike (CY)	1,500	17.86	26,790	4,019	15	30,809	3,200	17.86	57,152	8,573	15	65,725	3,200	17.86	57,152	8,573	15	65,725
Topsoil (CY)	7,400	3.21	23,754	3,563	15	27,317	7,000	3.21	22,470	3,371	15	25,841	7,000	3.21	22,470	3,371	15	25,841
Seeding (AC)	7.6	1974.81	15,009	2,251	15	17,260	10.3	1974.81	20,341	3,051	15	23,392	10.3	1974.81	20,341	3,051	15	23,392
Clearing, light (AC)	0.75	3051.85	2,289	343	15	2,632	7.2	3051.85	21,973	3,296	15	25,269	7.2	3051.85	21,973	3,296	15	25,269
Portable pumps (EA	2	51000.00	102,000	30,600	30	132,600	2	51000.00	102,000	30,600	30	132,600	-	-	-	-	-	-
Electric service (LS)	1	-	70,000	3,500	5	73,500	1	-	70,000	3,500	5	73,500	-	-	-	-	-	-
Outlet culvert (LS)	1	-	38,921	13,622	35	52,543	1	-	38,921	13,622	35	52,543	1	-	38,921	13,622	35	52,543
Inlet culvert (LS)	1	-	38,921	13,622	35	52,543	1	-	38,921	13,622	35	52,543	1	-	38,921	13,622	35	52,543
SUBTOTALS			********	398,364					617,778	165,735					445,778	131,635		
	Total Construction Cost					$1,469,000	Total Construction Cost					$784,000	Total Construction Cost					$577,000
	E&D (20%)					$298,000	E&D (20%)					$157,000	E&D (20%)					$115,000
	S&I (6%)					$89,000	S&I (6%)					$47,000	S&I (6%)					$35,000
	Total Project Cost					$1,876,000	Total Project Cost					$988,000	Total Project Cost					$727,000
	Ave Annual Construction Cost					$157,800	Ave Annual Construction Cost					$83,100	Ave Annual Construction Cost					$61,100
	Ave Annual O&M Cost					$13,600	Ave Annual O&M Cost					$4,400	Ave Annual O&M Cost					$4,100
	Total Annual Cost					$171,400	Total Annual Cost					$87,500	Total Annual Cost					$65,200
	Average Annual Habitat Units gained					50	Average Annual Habitat Units gained					98	Average Annual Habitat Units gained					49
	Cost per Average Annual Habitat Unit					$3,428	Cost per Average Annual Habitat Unit					$893	Cost per Average Annual Habitat Unit					$1,331

7/27/93

ALTERNATIVE COSTS

Trempealeau NWR

POOL E

E1

Sand dike; pumps; outlet

FEATURE	quant	unit $	amount $	contingency $	%	total $
Sandfill (CY)	44,700	3.79	169,413	50,824	30	220,237
Gravel, dike (CY)	1,500	17.86	26,790	4,019	15	30,809
Topsoil (CY)	4,900	4.80	23,520	3,528	15	27,048
Seeding (AC)	5.6	1974.81	11,059	1,659	15	12,718
Clearing, med (AC)	4.0	3560.00	14,240	2,136	15	16,376
Portable pumps (EA)	2	51000.00	102,000	30,600	30	132,600
Electric service (LS)	1	-	70,000	3,500	5	73,500
Outlet culvert (LS)	1	-	38,921	13,622	35	52,543
SUBTOTALS			458,000	110,000		

Total Construction Cost	$566,000
E&D (20%)	$113,000
S&I (6%)	$34,000
Total Project Cost	$713,000
Ave Annual Cost	$60,000
Ave Annual O&M Cost	$4,200
Total Annual Cost	$64,200
Average Annual Habitat Units gained	103
Cost per Average Annual Habitat Unit	$623

7/26/93

Trempealeau NWR

ALTERNATIVE O&M COSTS
POOL A

FEATURE	A1		A2		A3	
	Init sand berm/riprap dike; pumps; islands		Sand berm dike w/ groins; pumps		Riprap dike; pumps	
	O&M Description/Frequency	Annual $	O&M Description/Frequency	Annual $	O&M Description/Frequency	Annual $
Dike	Random fill (60CY/yr@$20)	1,200	Rockfill (5CY/yr@$60)	300	Random fill (5CY/yr@$25)	125
	Riprap (15CY/yr@$60)	900	Gravel (2CY/yr@$40)	80	Riprap (20CY/yr@$70)	1,400
	Gravel (5CY/yr@$40)	200	Riprap Klep's (70CY/yr@$60)	4,200	Riprap Klep's (70CY/yr@$60)	4,200
	Care of vegetation (2 mn-dy@$250)	500	Care of vegetation (3 mn-dy@$250)	750	Gravel (5CY/yr@$40)	200
	Inspection (1 mn-dy@$250)	250	Inspection (1 mn-dy@$250)	250	Inspection (1 mn-dy@$250)	250
	subtotal =	$3,050	subtotal =	$5,580	subtotal =	$6,175
Islands	Random fill (100CY/yr@$40)	3,000	N/A		N/A	
	Riprap (25CY/yr@$80)	2,000				
	Care of vegetation (3 mn-dy@$250)	750				
	Inspection (1 mn-dy/yr@$250)	250				
	subtotal =	$6,000				
Access road	N/A		Gravel (5CY/yr@$40)	200	Gravel (5CY/yr@$40)	200
Pumps	Elec charge (every 5yr@PW$47,660)(veg)	4,120	Elec charge (every 5yr@PW$40,745)(veg)	3,523	Elec charge (every 5yr@PW$40,745)(veg)	3,523
	Pump maint (each yr@PW$13,548)(veg)	1,171	Pump maint (each yr@PW$12,157)(veg)	1,051	Pump maint (each yr@PW$12,157)(veg)	1,051
	Elec charg (every 15yr@PW$17,905)(fish)	1,548	Elec charg (every 15yr@PW$12,689)(fish)	1,097	Elec charg (every 15yr@PW$12,689)(fish)	1,097
	Pump maint (every 15yr@PW$4,008)(fish)	347	Pump maint (every 15yr@PW$3,335)(fish)	288	Pump maint (every 15yr@PW$3,335)(fish)	288
	Station maint (4 mn-dy/yr@$260)	1,000	Station maint (3 mn-dy/yr@$250)	750	Station maint (3 mn-dy/yr@$260)	750
	subtotal =	$8,186	subtotal =	$6,710	subtotal =	$6,710
Total Annual O&M		$17,200		$12,500		$13,100

FEATURE	A4		A5		A6	
	Sand berm/riprap dike; pumps		Sand dike w/ groins; pumps; riprap Klep's		Sand dike w/ groins; pumps; rockfill Klep's	
	O&M Description/Frequency	Annual $	O&M Description/Frequency	Annual $	O&M Description/Frequency	Annual $
Dike	Random fill (3CY/yr@$25)	75	Rockfill (5CY/yr@$60)	300	Rockfill (6CY/yr@$60)	360
	Riprap (10CY/yr@$70)	700	Gravel (2CY/yr@$40)	80	Gravel (2CY/yr@$40)	80
	Riprap Klep's (70CY/yr@$60)	4,200	Care of vegetation (2 mn-dy@$250)	500	Care of vegetation (2 mn-dy@$250)	500
	Gravel (5CY/yr@$40)	200	Inspection (1 mn-dy@$250)	250	Inspection (1 mn-dy@$250)	250
	Care of vegetation (2 mn-dy@$250)	500				
	Inspection (1 mn-dy@$250)	250				
	subtotal =	$5,925	subtotal =	$1,130	subtotal =	$1,190
Islands	N/A		N/A		N/A	
Access road	Gravel (5CY/yr@$40)	200	Gravel (5CY/yr@$40)	200	Gravel (5CY/yr@$40)	200
Pumps	Elec charge (every 5yr@PW$40,745)(veg)	3,523	Elec charge (every 5yr@PW$40,745)(veg)	3,523	Elec charge (every 5yr@PW$40,745)(veg)	3,523
	Pump maint (each yr@PW$12,157)(veg)	1,051	Pump maint (each yr@PW$12,157)(veg)	1,051	Pump maint (each yr@PW$12,157)(veg)	1,051
	Elec charg (every 15yr@PW$12,689)(fish)	1,097	Elec charg (every 15yr@PW$12,689)(fish)	1,097	Elec charg (every 15yr@PW$12,689)(fish)	1,097
	Pump maint (every 15yr@PW$3,335)(fish)	288	Pump maint (every 15yr@PW$3,335)(fish)	288	Pump maint (every 15yr@PW$3,335)(fish)	288
	Station maint (3 mn-dy/yr@$250)	750	Station maint (3 mn-dy/yr@$250)	750	Station maint (3 mn-dy/yr@$250)	750
	subtotal =	$6,710	subtotal =	$6,710	subtotal =	$6,710
Total Annual O&M		$12,800		$8,000		$8,100

SEPARABLE AERATION COST FOR A6	
Elec charg (yrly exc fish kill)	767
Aerator maint (yrly exc fish kill)	4,200
Total Annual Aeration O&M	$5,000

7/26/93

Trempealeau NWR

ALTERNATIVE O&M COSTS
POOL C

FEATURE	C1		C2		C3	
	Sand dike; pumps; outlet		Sand dike; pumps; outlet; Tremp inlet		Sand dike; outlet; Trempealeau inlet	
	O&M Description/Frequency	Annual $	O&M Description/Frequency	Annual $	O&M Description/Frequency	Annual $
Dike	Random fill (200CY/yr@$20)	4,000	Random fill (200CY/yr@$20)	4,000	Random fill (200CY/yr@$20)	4,000
	Gravel (10CY/yr@$35)	350	Gravel (10CY/yr@$35)	350	Gravel (10CY/yr@$35)	350
	Care of vegetation (2 mn-dy@$250)	500	Care of vegetation (2 mn-dy@$250)	500	Care of vegetation (2 mn-dy@$250)	500
	Inspection (1 mn-dy@$250)	250	Inspection (1 mn-dy@$250)	250	Inspection (1 mn-dy@$250)	250
	subtotal =	$5,100	subtotal =	$5,100	subtotal =	$5,100
Access road	Gravel (5CY/yr@$40)	200	Gravel (5CY/yr@$40)	200	Gravel (5CY/yr@$40)	200
Outlet culvert	Gate maint (1 mn-dy/yr@$250)	250	Gate maint (1 mn-dy/yr@$250)	250	Gate maint (1 mn-dy/yr@$250)	250
	Operation (1 mn-dy/yr@$250)	250	Operation (1 mn-dy/yr@$250)	250	Operation (1 mn-dy/yr@$250)	250
	Rock replace (1CY/yr@$70)	70	Rock replace (1CY/yr@$70)	70	Rock replace (1CY/yr@$70)	70
	Debris removal (2 mn-dy/yr@$250)	500	Debris removal (2 mn-dy/yr@$250)	500	Debris removal (2 mn-dy/yr@$250)	500
	subtotal =	$1,070	subtotal =	$1,070	subtotal =	$1,070
Inlet culvert	N/A		Gate maint (1 mn-dy/yr@$250)	250	Gate maint (1 mn-dy/yr@$250)	250
			Operation (1 mn-dy/yr@$250)	250	Operation (1 mn-dy/yr@$250)	250
			Rock replace (1CY/yr@$70)	70	Rock replace (1CY/yr@$70)	70
			Debris removal (2 mn-dy/yr@$250)	500	Debris removal (2 mn-dy/yr@$250)	500
			subtotal =	$1,070	subtotal =	$1,070
Pumps	Elec & maint charges	1,165	Elec & maint charges	760	N/A	
	subtotal =	$1,165	subtotal =	$760		
Total Annual O&M		$7,500		$8,200		$7,400

FEATURE	C4		C2(1)		C2(2)	
	Sand dike(+2');pumps;outlet;Trem inlet		C2 sand dike; pumps; outlet; Trem inlet		C2 sand dike; outlet; Tremp inlet	
	O&M Description/Frequency	Annual $	O&M Description/Frequency	Annual $	O&M Description/Frequency	Annual $
Dike	Random fill (400CY/yr@$20)	8,000	Random fill (25CY/yr@$20)	500	Random fill (25CY/yr@$20)	500
	Gravel (15CY/yr@$35)	525	Gravel (5CY/yr@$35)	175	Gravel (5CY/yr@$35)	175
	Care of vegetation (3 mn-dy@$250)	750	Care of vegetation (2 mn-dy@$250)	500	Care of vegetation (2 mn-dy@$250)	500
	Inspection (2 mn-dy@$250)	500	Inspection (1 mn-dy@$250)	250	Inspection (1 mn-dy@$250)	250
	subtotal =	$9,775	subtotal =	$1,425	subtotal =	$1,425
Access road	Gravel (8CY/yr@$40)	320	N/A		N/A	
Outlet culvert	Gate maint (1 mn-dy/yr@$250)	250	Gate maint (1 mn-dy/yr@$250)	250	Gate maint (1 mn-dy/yr@$250)	250
	Operation (1 mn-dy/yr@$250)	250	Operation (1 mn-dy/yr@$250)	250	Operation (1 mn-dy/yr@$250)	250
	Rock replace (1CY/yr@$70)	70	Rock replace (1CY/yr@$70)	70	Rock replace (1CY/yr@$70)	70
	Debris removal (2 mn-dy/yr@$250)	500	Debris removal (2 mn-dy/yr@$250)	500	Debris removal (2 mn-dy/yr@$250)	500
	subtotal =	$1,070	subtotal =	$1,070	subtotal =	$1,070
Inlet culvert	Gate maint (1 mn-dy/yr@$250)	250	Gate maint (1 mn-dy/yr@$250)	250	Gate maint (1 mn-dy/yr@$250)	250
	Operation (1 mn-dy/yr@$250)	250	Operation (1 mn-dy/yr@$250)	250	Operation (2 mn-dy/yr@$250)	500
	Rock replace (1CY/yr@$70)	70	Rock replace (1CY/yr@$70)	70	Rock replace (1CY/yr@$70)	70
	Debris removal (2 mn-dy/yr@$250)	500	Debris removal (2 mn-dy/yr@$250)	500	Debris removal (3 mn-dy/yr@$250)	750
	subtotal =	$1,070	subtotal =	$1,070	subtotal =	$1,570
Pumps	Elec & maint charges	1,325	Elec & maint charges	866	N/A	
	subtotal =	$1,325	subtotal =	$866		
Total Annual O&M		$13,600		$4,400		$4,100

7/26/93 ALTERNATIVE O&M COSTS

Trempealeau NWR POOL E

FEATURE	E1 Sand dike; pumps; outlet O&M Description/Frequency	Annual $
Dike	Random fill (50CY/yr@$20)	1,000
	Gravel (5CY/yr@$35)	175
	Care of vegetation (2 mn-dy@$250)	500
	Inspection (1 mn-dy@$250)	250
	subtotal =	$1,925
Access road	Gravel (2CY/yr@$40)	80
Outlet culvert	Gate maint (1 mn-dy/yr@$250)	250
	Operation (1 mn-dy/yr@$250)	250
	Rock replace (1CY/yr@$70)	70
	Debris removal (2 mn-dy/yr@$250)	500
	subtotal =	$1,070
Pumps	Elec & maint charges	1,165
	subtotal =	$1,165
Total Annual O&M		$4,200

ALTERNATIVE COSTS TREMPELEAU
REVIEW OF TABLES FROM DON POWELL GARY SMITH

UNIT COSTS FOLLOW MCASES ESTIMATE, GENERALLY.
SANDFILL COSTS GENERALLY FOLLOW SAND FILL WORK ANALYSIS.
HOWEVER, SOME SAND COSTS NEED TO BE ADJUSTED.
ONLY DIKE A AND ISLANDS WILL HAVE HYDRAULICALLY DREDGED SAND.
THIS WILL INCREASE THE COST DUE TO REDUCED QUANTITY.
ALSO, RIPRAP DOES NOT NEED TO BE HIGH QUALITY GRADED RIPRAP.

LOOK AT SAND COSTS, ALL THE A ALTERNATIVES.
PIPELINE LENGTH APPROX 1 MILE.

A1
$5.19 IS THE PRICE FOR HYD DREDGED SAND IF THE QUANTITY IS 283,410 CY.
IF ONLY POOL A DIKE AND ISLANDS ARE HYD DREDGED, THE COST INCREASES.

SEE PAGE 3 OF SAND ANALYSIS

POOL A	89900 CY	
ISLANDS	77400 CY	
TOTAL	167300 CY	
MOB/DMOB	$250,000 / 167300	$1.49
DREDGING		$3.00 PER CY
SPREAD AND SHAPE		$1.31 PER CY
	TOTAL	$5.80 PER CY
CHANGE $5.19 TO		$5.80 PER CY

A2 FOR ALL OTHER A ALTERNATIVES, THE ANALYSIS IS SIMILIAR.

POOL A	125900 CY	
MOB/DMOB	$250,000 / 125900	$1.99
DREDGING		$3.00 PER CY
SPREAD AND SHAPE		$1.31 PER CY
	TOTAL	$6.30 PER CY
CHANGE $5.52 TO		$6.30 PER CY

A3 FOR ALL OTHER A ALTERNATIVES, THE ANALYSIS IS SIMILIAR.

POOL A	66700 CY	
MOB/DMOB	$250,000 / 66700	$3.75
DREDGING		$3.00 PER CY
SPREAD AND SHAPE		$1.31 PER CY
	TOTAL	$8.06 PER CY
CHANGE $5.52 TO		$8.06 PER CY

SINCE THIS IS HIGHER THAN FILL FROM FOUNTAIN CITY AT $7.61 PER CY,
SEE PAGE 7b, HYDRAULIC DREDGING MAY NOT BE COST EFFECTIVE FOR

THIS SMALL QUANTITY.

A4 FOR ALL OTHER A ALTERNATIVES, THE ANALYSIS IS SIMILIAR.

POOL A	94800 CY	
MOB/DMOB $250,000 /	94800	$2.64
DREDGING		$3.00 PER CY
SPREAD AND SHAPE		$1.31 PER CY
	TOTAL	$6.95 PER CY
CHANGE $5.52 TO		$6.95 PER CY

A5 FOR ALL OTHER A ALTERNATIVES, THE ANALYSIS IS SIMILIAR.

POOL A	125900 CY	
ISLANDS	6500 CY	
TOTAL	132400 CY	
MOB/DMOB $250,000 /	132400	$1.89
DREDGING		$3.00 PER CY
SPREAD AND SHAPE		$1.31 PER CY
	TOTAL	$6.20 PER CY
CHANGE $5.52 TO		$6.20 PER CY

A6 FOR ALL OTHER A ALTERNATIVES, THE ANALYSIS IS SIMILIAR.

POOL A	125900 CY	
MOB/DMOB $250,000 /	125900	$1.99
DREDGING		$3.00 PER CY
SPREAD AND SHAPE		$1.31 PER CY
	TOTAL	$6.30 PER CY
CHANGE $5.52 TO		$6.30 PER CY

ALTERNATIVES FOR POOL C AND E DIKES
SAND PRICES FOR ALL POOL C & E ALTERNATIVES ARE BASED ON OBTAINING SAND FROM FOUNTAIN CITY AND ARE NOT DEPENDENT ON THE QUANTITY OF THE MATERIAL.

CONTINGENCIES

ADD 10% TO ALL CONTINGENCIES TO COVER UNCERTAINTIES IN UNIT PRICING (5%) AND UNANTICIPATED ITEMS OF WORK (5%).

RIPRAP AND ROCKFILL

THE COST DEVELOPED IN CASES HAVE BEEN REVIEWED AND ARE REASONABLE. MATERIAL COSTS ARE BASED ON A QUOTE FROM KREAMER & SONS, OF $17.55 PER CY, DELIVERED TO A STOCKPILE ON SITE. COSTS WERE ADDED FOR HAULING FROM THE STOCKPILE TO THE LEVEE (ASSUMING THE SAME TRUCK IS USED, IT IS NOT ACTUALLY UNLOADED AT THE STOCKPILE) AND FOR PLACEMENT ASSUMING A PRODUCTION RATE OF 30 CY/HR.

MATERIAL	17.55 +	6.00%	$18.60	
HAUL			$0.65	
PLACEMENT			$9.17	
		TOTAL	$28.42 PER CY	
		PLUS INDIRECT COSTS	$37.01 PER CY	30.21%

IF A LESS EXPENSIVE MATERIAL CAN BE USED, THE $18.60 CAN BE REDUCED.

CONTACT JOEL FACE FOR ROCK REQUIREMENTS, JOEL FACE, 656

POLANDER USED A LOWER PRICED MATERIAL, IN POOL 5A.

ORIGINAL ESTIMATE	$38.00 PER CY
VE PROPOSAL	$25.00 PER CY
SAVINGS	$13.00 PER CY

ALL THIS IS MATERIAL SAVINGS IF PLACEMENT IS THE SAME AND IF THE SOURCE IS THE SAME DISTANCE AWAY.

MATERIAL	4.55 +	6.00%	$4.82	
HAUL			$0.65	
PLACEMENT			$9.17	
		TOTAL	$14.64 PER CY	
		PLUS INDIRECT COSTS	$19.07 PER CY	

SAVINGS $17.94 PER CUBIC YARD
THIS LOOKS UNREALISTIC.

ASSUME THAT INDIRECT COSTS AND PLACEMENT COSTS ARE THE SAME. THEN THE COST FOR TREMPEALEAU WOULD BE:

POLANDER GRADED RIPRAP	$38.00
TREMPEALEAU GRADED RIPRAP	$37.01
POLANDER REDUCED ROCK	$25.00
TREMPEALEAU REDUCED ROCK	$24.35

THIS SEEMS MORE REASONABLE.

VERIFY THE COST WITH KRAEMER.

JOEL WILL SEND A GRADATION FOR THE CHEAPER MATERIAL. (12/4/92).
I WILL CALL KRAEMER AND GET A REVISED PRICE.
THIS MATERIAL WOULD BE USED IN LIEU OF ALL RIPRAP.
LETTER AND GRADATION FAXED ON DEC 16, 1992.
FOLLOW UP CALL MADE 22 DEC 1992, CALL NOT RETURNED.
FOLLOW UP CALL MADE 23 DEC 1992, ED BETTINGER ON VACATION.
TALKED TO KRAEMER, SAID ED BETTINGER WOULD CALL ON 4 JAN 1993.
ED BETTINGER, KRAEMER & SONS, 608-546-2311

O&M SUGGEST THE FOLLOWING:
O&M COST TYPICALLY VARY FROM .5% TO 5% OF CONST COST, PRESENT VALUE
HIGH COST O&M ARE FOR JOBS SUCH AS ROCHESTER, LOTS OF MOWING, BUSHES, ETC.
FOR THIS JOB, EXPECT THE LOW END OF RANGE, PROBABLY LESS THAN 1%.
EXCEPT PUMP O&M WILL MAKE IT HIGHER.

UNIT FACTOR ADJUSTS THE UNIT COST TO REFLECT THE SMALL QUANTITY.

USING A2 AS AN EXAMPLE;

ITEM	QUANTITY	UNIT $	% RPL PER YR	UNIT $ FACTOR	ANN COST
SAND	125900	5.52	0.20%	2	2,780
RIPRAP	9100	37	0.20%	3	2,020
ROCK	0		0.20%	3	0
GRAVEL	1200	18	0.20%	2	86
TOPSOIL	6100	3.21	0.20%	3	117
SEED	7.6	2000	0.20%	1.5	46
INSPECT	1	250	100.00%	1	250
TURF	1	500	100.00%	1	500
PUMPS	1	4819	100.00%	1	4,819
					10,619

$122,810 PRESENT VALUE AT
50 TERM, YEARS
8.50% PERCENT

CONSTRUCTION COST $1,693,000
PERCENT OF CONSTRUCTION 7.25%
THIS LOOKS HIGH BUT MOST IS DUE TO PUMPS AND INSPECTION.

LOOK AT COSTS FOR ALTERNATIVES DU1 AND DU2, SAND.
REDUCE COSTS POSSIBLY DUE TO SHORTER HAUL DISTANCE.

FROM PAGE 7a		
	LOAD AND HAUL	1.85
FROM PAGE 1		
	SPREAD AND SHAPE	1.31
FROM PAGE 7b		
	HAUL IN REFUGE	
	1.5 FACTOR	
	2.25 MILES	
	0.52 COST/MILE	
		1.76
	TOTAL	$4.92 PER CY
	CHANGE $5.97 TO	$4.92

END

TO: PD-PF, D. Powell

February 28,1992

FROM: ED-C, G. Smith

SUBJECT: Trempealeau EMP, DPR, Formulation Estimate

The attached formulation estimate of alternatives for the Trempealeau EMP project incorporates your changes from the draft estimate dated January 17, 1992. If you have questions or need additional information, please contact Gary Smith, ext. 518.

Allen L. Geisen
Chief, Cost Engineering Branch

ITEM DESCRIPTION		UNIT COST	UNIT	ORIGINAL PROPOSAL QUANTITY	ORIGINAL PROPOSAL COST	ALTERNATIVE 1 QUANTITY	ALTERNATIVE 1 COST	ALTERNATIVE 2 20' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 20' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 15' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOP+CULVT QUANTITY	ALTERNATIVE 2 15' DIKE TOP+CULVT COST
POOL A - DIKE					$2,252,714		$1,811,385		$1,476,395		$1,444,493		$1,444,493
MOB AND DEMOB			LS	1	$0	1	$0	1	$0	1	$0	1	$0
SANDFILL, HAULED FROM 11 MI	1	9.78	CY	96150	$940,347								
SANDFILL, BEST OPTION W/ISLANDS		5.19	CY			96150	$499,019						
SANDFILL, BEST OPT W/O ISLANDS		4.09	CY					80100	$327,609	72300	$295,707	72300	$295,707
RIPRAP		37.01	CY	23200	$858,632	23200	$858,632	19300	$714,293	19300	$714,293	19300	$714,293
FILTER FABRIC		1.02	SY	42700	$43,554	42700	$43,554	35600	$36,312	35600	$36,312	35600	$36,312
TOPSOIL		3.21	CY	2300	$7,383	2300	$7,383	1900	$6,099	1900	$6,099	1900	$6,099
GRAVEL DIKE		17.86	CY	1100	$19,646	1100	$19,646	900	$16,074	900	$16,074	900	$16,074
GRAVEL ROAD		17.86	CY	700	$12,502	700	$12,502	300	$5,358	300	$5,358	300	$5,358
KEIP,S ISLAND (ALT B) ROCKFILL	8	31.53	CY	1400	$44,142	1400	$44,142	1400	$44,142	1400	$44,142	1400	$44,142
CAUSEWAY													
RIPRAP		37.01	CY	75	$2,776	75	$2,776	75	$2,776	75	$2,776	75	$2,776
GRAVEL		17.86	CY	10	$179	10	$179	10	$179	10	$179	10	$179
PUMP STATION AND GATEWELL		323553.21	LS	1	$323,553	1	$323,553	1	$323,553	1	$323,553	1	$323,553
POOL A - ISLANDS					$1,381,306		$700,872						
MOB AND DEMOB			LS	1	$0	1	$0						
SANDFILL, HAULED FROM 11 MI	2	13.98	CY	77410	$1,082,192								
SANDFILL, BEST OPTION		5.19	CY			77410	$401,758						
FINES (TOPSOIL)		3.21	CY	30725	$98,627	30725	$98,627						
RIPRAP		43.87	CY	4480	$196,538	4480	$196,538						
SEEDING		1974.81	AC	2	$3,950	2	$3,950						
POOL C					$1,303,140		$743,743		$500,661		$482,052		$520,973
MOB AND DEMOB			LS	1	$0	1	$0	1	$0	1	$0	1	$0
STABILIZATION FABRIC		3.52	SY	24900	$87,648	24900	$87,648	24900	$87,648	24900	$87,648	24900	$87,648
SANDFILL, HAULED FROM 11 MI	1	9.78	CY	62650	$612,717								
SANDFILL, BEST OPTION W/ISLAND		7.97	CY			62650	$499,321						
SANDFILL, BEST OPT W/O ISLANDS		4.09	CY					62650	$256,239	58100	$237,629	58100	$237,629
GRAVEL DIKE		17.86	CY	1500	$26,790	1500	$26,790	1500	$26,790	1500	$26,790	1500	$26,790

ITEM DESCRIPTION	UNIT COST	UNIT	ORIGINAL PROPOSAL QUANTITY	ORIGINAL PROPOSAL COST	ALTERNATIVE 1 QUANTITY	ALTERNATIVE 1 COST	ALTERNATIVE 2 20' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 20' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 15' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOP+CULVT QUANTITY	ALTERNATIVE 2 15' DIKE TOP+CULVT COST
TOPSOIL	3.21	CY	4900	$15,729	4900	$15,729	4900	$15,729	4900	$15,729	4900	$15,729
SEEDING	1974.81	AC	6.1	$12,046	6.1	$12,046	6.1	$12,046	6.1	$12,046	6.1	$12,046
CLEARING	3051.85	AC	0.75	$2,289	0.75	$2,289	0.75	$2,289	0.75	$2,289	0.75	$2,289
OUTLET CULVERT	38920.67	LS	1	$38,921	1	$38,921	1	$38,921	1	$38,921	1	$38,921
PIPELINE (30" DUCTILE IRON)	78.00	LF	6500	$507,000	0		0		0		0	
PORTABLE PUMP	61000.00	EA	0		1	$61,000	1	$61,000	1	$61,000	1	$61,000
TREMPELEAU CULVERT	38920.67	LS	0		0		0		0		1	$38,921
POOL E				$647,146		$586,258		$647,146		$622,696		$622,696
MOB AND DEMOB		LS	1	$0	1	$0	1	$0	1	$0	1	$0
SANDFILL, HAULED FROM 11 MI 1	9.78	CY	47200	$461,616								
SANDFILL, BEST OPTION W/ISLAND	8.49	CY			47200	$400,728						
SANDFILL, BEST OPT W/O ISLANDS	9.78	CY					47200	$461,616	44700	$437,166	44700	$437,166
GRAVEL DIKE	17.86	CY	1500	$26,790	1500	$26,790	1500	$26,790	1500	$26,790	1500	$26,790
TOPSOIL	4.80	CY	4900	$23,520	4900	$23,520	4900	$23,520	4900	$23,520	4900	$23,520
SEEDING	1974.81	AC	5.6	$11,059	5.6	$11,059	5.6	$11,059	5.6	$11,059	5.6	$11,059
CLEARING	3560.00	AC	4	$14,240	4	$14,240	4	$14,240	4	$14,240	4	$14,240
OUTLET CULVERT	38920.67	LS	1	$38,921	1	$38,921	1	$38,921	1	$38,921	1	$38,921
PORTABLE PUMP	71000.00	EA	1	$71,000	1	$71,000	1	$71,000	1	$71,000	1	$71,000
TOTAL PROJECT COST				$5,584,305		$3,842,258		$2,624,202		$2,549,240		$2,588,161
CULTURAL INVESTIGATION --- ADD THIS COST IF LOCAL EXCAVATION IS USED.						$50,000		$160,000		$160,000		$160,000
						$3,892,258		$2,784,202		$2,709,240		$2,748,161

ITEM DESCRIPTION	UNIT COST	UNIT	ORIGINAL PROPOSAL QUANTITY	ORIGINAL PROPOSAL COST	ALTERNATIVE 1 QUANTITY	ALTERNATIVE 1 COST	ALTERNATIVE 2 20' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 20' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 15' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOP+CULVT QUANTITY	ALTERNATIVE 2 15' DIKE TOP+CULVT COST
OUTLETS/INLETS/TREMP CULV				$38,921								
CONCRETE SLAB	122.33	CY	20.12	$2,461								
CONCRETE WALL	532.08	CY	12.31	$6,550								
CONCRETE BEAMS	532.08	CY	0.89	$474								
REINFORCING STEEL	0.58	LB	4331	$2,512								
30X30 SLIDE GATE, PAINTED	10000.00	EA	1	$10,000								
HANDRAIL, 2.5" DIA, GALV	1.02	LB	857	$874								
GRATING, GALV	19.77	SF	55	$1,087								
TRASHRACK, GALV	1.05	LB	4720	$4,956								
LADDER, GALV	57.87	LF	8	$463								
GRAB BAR, GALV	1.05	LB	34	$36								
STOP LOGS, AL	4.23	LB	450	$1,904								
STOPLOG GROOVES, CAST IRON	1.25	LB	320	$400								
STOPLOG HOOK, AL	4.23	LB	10	$42								
CHAINLINK FENCE, 8', GALV	12.00	LF	80	$960								
SWING GATE, 10', GALV	321.00	EA	1	$321								
30" RCP CL V	54.41	LF	100	$5,441								
30" RCP END SECTION	200.00	EA	1	$200								
EXCAVATION, UNDERSIRABLE MAT	1.44	CY	40	$58								
BACKFILL, COMPACTED SAND	4.56	CY	40	$182								

ITEM DESCRIPTION	UNIT COST	UNIT	ORIGINAL PROPOSAL QUANTITY	ORIGINAL PROPOSAL COST	ALTERNATIVE 1 QUANTITY	ALTERNATIVE 1 COST	ALTERNATIVE 2 20' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 20' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 15' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOP+CULVT QUANTITY	ALTERNATIVE 2 15' DIKE TOP+CULVT COST
PUMP STATION AND GATEWELL				$323,553								
DEWATERING	20000.00	LS	1	$20,000								
ELECTRICAL SERVICE	50000.00	LS	1	$50,000								
SUBMERSIBLE PUMPS	50000.00	EA	2	$100,000								
ELECTRICAL CONTROLS	40000.00	LS	1	$40,000								
MANIFOLD SYSTEM	25000.00	LS	1	$25,000								
CONCRETE SLAB	122.33	CY	42.01	$5,139								
CONCRETE WALL	532.08	CY	6.31	$3,357								
CONCRETE CAP	532.08	CY	6.22	$3,310								
REINFORCING STEEL	0.58	LB	7090	$4,112								
48X48 SLIDE GATE, STL, PAINTED	15000.00	EA	2	$30,000								
60X60 SLIDE GATE, STL, PAINTED	20000.00	EA	1	$20,000								
GRATING, GALV	19.77	SF	216	$4,270								
LADDER, GALV	57.87	LF	22	$1,273								
GRAB BAR, GALV	1.05	LB	70	$74								
CHAINLINK FENCE, 8' GALV	12.00	LF	150	$1,800								
SWING GATE, 10' GALV	321.00	EA	1	$321								
48" RCP, CL V	117.83	LF	100	$11,783								
48" RCP, END SECTION	230.00	EA	3	$690								
60" RCP, CL V	240.00	LF	8	$1,920								
EXCAVATION, UNDERSIRABLE MAT	1.44	CY	84	$121								
BACKFILL, COMPACTED SAND	4.56	CY	84	$383								

E-18

ITEM DESCRIPTION	UNIT COST	UNIT	ORIGINAL PROPOSAL QUANTITY	ORIGINAL PROPOSAL COST	ALTERNATIVE 1 QUANTITY	ALTERNATIVE 1 COST	ALTERNATIVE 2 20' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 20' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 15' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOP+CULVT QUANTITY	ALTERNATIVE 2 15' DIKE TOP+CULVT COST
PORTABLE PUMP POOL C				$61,000								
ELECTRICAL SERVICE	20000.00	LS	1	$20,000								
PORTABLE PUMPS	20000.00	EA	2	$40,000								
SITE WORK (PAD)	1000.00	LS	1	$1,000								
PORTABLE PUMP POOL E				$71,000								
ELECTRICAL SERVICE	30000.00	LS	1	$30,000								
PORTABLE PUMPS	20000.00	EA	2	$40,000								
SITE WORK (PAD)	1000.00	LS	1	$1,000								

61-19

ITEM DESCRIPTION	UNIT COST	UNIT	ORIGINAL PROPOSAL QUANTITY	ORIGINAL PROPOSAL COST	ALTERNATIVE 1 QUANTITY	ALTERNATIVE 1 COST	ALTERNATIVE 2 20' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 20' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 15' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOP+CULVT QUANTITY	ALTERNATIVE 2 15' DIKE TOP+CULVT COST
SANDFILL OPTION A, WITH ISLANDS ONLY				$1,850,825								
POOL A												
HYDRAULIC DREDGE AND PLACED 3	5.19	CY	96150	$499,019								
POOL A ISLANDS												
HYD DREDGE,STOCK,HAUL,PLACE 3	5.19	CY	77410	$401,758								
OR HAUL 11 MI,BARGED,LOAD, 2	13.98	CY										
POOL C												
HYD DREDGE,STOCK,HAUL,PLACE 4	7.97	CY	62650	$499,321								
OR HAULED IN 11 MI AND PLACED 1	9.78	CY										
POOL E												
HYD DREDGE,STOCK,HAUL,PLACE 4	8.49	CY	47200	$400,728								
OR HAULED IN 11 MI AND PLACED 1	9.78	CY										
CULTURAL INVESTIGATION				$50,000.00								
SANDFILL OPTION B, WITH ISLANDS				$2,118,872								
POOL A												
MECH EXC FROM LOCAL SITE 5	4.09	CY	96150	$393,254								
POOL A ISLANDS												
MECH EXC FROM LOCAL SITE 5	8.29	CY	41200	$341,548								
AND HAULED IN FROM 11 MI, PLACE 2	13.98	CY	36210	$506,216								
POOL C												
MECH EXC FROM LOCAL SITE 5	4.09	CY	62650	$256,239								
POOL E												
HAULED IN FROM 11 MI, PLACE 1	9.78	CY	47200	$461,616								
CULTURAL INVESTIGATION				$160,000								

ITEM DESCRIPTION	UNIT COST	UNIT	ORIGINAL PROPOSAL QUANTITY	ORIGINAL PROPOSAL COST	ALTERNATIVE 1 QUANTITY	ALTERNATIVE 1 COST	ALTERNATIVE 2 20' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 20' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 15' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOP+CULVT QUANTITY	ALTERNATIVE 2 15' DIKE TOP+CULVT COST
SANDFILL OPTION C, WITH ISLANDS				$2,107,478								
POOL A												
HAULED DREDGE DISP SITE LD6 7b	7.61	CY	96150	$731,702								
POOL A ISLANDS												
HAULED DREDGE DISP SITE LD6 7b	10.63	CY	77410	$822,868								
POOL C												
HAULED DREDGE DISP SITE LD6 7b	5.97	CY	62650	$374,021								
POOL E												
HAULED DREDGE DISP SITE LD6 7b	3.79	CY	47200	$178,888								

F-24

ITEM DESCRIPTION	UNIT COST	UNIT	ORIGINAL PROPOSAL QUANTITY	ORIGINAL PROPOSAL COST	ALTERNATIVE 1 QUANTITY	ALTERNATIVE 1 COST	ALTERNATIVE 2 20' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 20' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 15' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOP+CULVT QUANTITY	ALTERNATIVE 2 15' DIKE TOP+CULVT COST
SANDFILL OPTION A, WITHOUT ISLANDS				$1,516,575								
POOL A												
HYDRAULIC DREDGED AND PLACE 6	5.52	CY	96150	$530,748								
POOL C												
HYD DREDGE,STOCK,HAUL,PLACE 6	8.30	CY	62650	$519,995								
OR HAULED IN 11 MI AND PLACED 1	9.78	CY										
POOL E												
HYD DREDGE,STOCK,HAUL,PLACE 6	8.81	CY	47200	$415,832								
OR HAULED IN 11 MI AND PLACED 1	9.78	CY										
CULTURAL INVESTIGATION				$50,000								
SANDFILL OPTION B, WITHOUT ISLANDS				$1,271,108								
POOL A												
MECH EXC FROM LOCAL SITE 5	4.09	CY	96150	$393,254								
POOL C												
MECH EXC FROM LOCAL SITE 5	4.09	CY	62650	$256,239								
POOL E												
HAULED IN FROM 11 MI, PLACE 1	9.78	CY	47200	$461,616								
CULTURAL INVESTIGATION				$160,000								

F-22

ITEM DESCRIPTION	UNIT COST	UNIT	ORIGINAL PROPOSAL QUANTITY	ORIGINAL PROPOSAL COST	ALTERNATIVE 1 QUANTITY	ALTERNATIVE 1 COST	ALTERNATIVE 2 20' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 20' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOPWIDTH QUANTITY	ALTERNATIVE 2 15' DIKE TOPWIDTH COST	ALTERNATIVE 2 15' DIKE TOP+CULVT QUANTITY	ALTERNATIVE 2 15' DIKE TOP+CULVT COST
SANDFILL OPTION C, WITHOUT ISLANDS				$1,284,610								
POOL A												
HAULED DREDGE DISP SITE LD6 7b	7.61	CY	96150	$731,702								
POOL C												
HAULED DREDGE DISP SITE LD6 7b	5.97	CY	62650	$374,021								
POOL E												
HAULED DREDGE DISP SITE LD6 7b	3.79	CY	47200	$178,888								

F-23

27 January 1992

Trempealeau Environmental Management Program Project

TO: Don Powell, Project Manager

From: Sissel Johannessen, Cultural Resources

Subject: Estimate for Cultural Resources evaluation of two proposed borrow areas.

These borrow areas have not been surveyed for cultural resources. Since adjacent areas similarly situated (high ground overlooking the former Trempealeau River valley opening onto the Mississippi floodplain) have been found to be extremely rich in archaeological deposits, it is very likely that these borrow areas also contain cultural material. Therefore, the Wisconsin State Historic Preservation Office has directed that these areas be tested, evaluated, and, if necessary, excavated, before their use for borrow.

This will involve:

Phase I and II survey and testing: testing for the presence of cultural remains by surface and sub-surface examination, and further testing to evaluate the National Register eligibility of any cultural deposits encountered.

Contract, Phase I and II.
-Pedestrian survey, plus shovel tests at 15 meter intervals (ca. 180) shovel tests. (ca. 7 days for crew of 2)
- further evaluation consisting of the excavation of ca. 5 1X2 meter test pits. (10 days for crew of 2)
(high probablity of the recovery of abundant artifacts; therefore this contract must include time for artifact analysis) (5 days for crew of 2)
Cost estimate:..... $ 20,000.
Time estimate.....3 weeks

Coordination and contract administration..... $5,000.
Time estimate: man/days=10
calender time= 6-7 months (weather permitting)

In the event (highly likely given our knowledge of the area) that a site or sites eligible for the National Register is/are present, **Phase III mitigation** will be necessary.

Contract, Phase III.
-excavation of at least 10% of total site area.
(estimated 2 months for fieldwork).....$ 90,000.

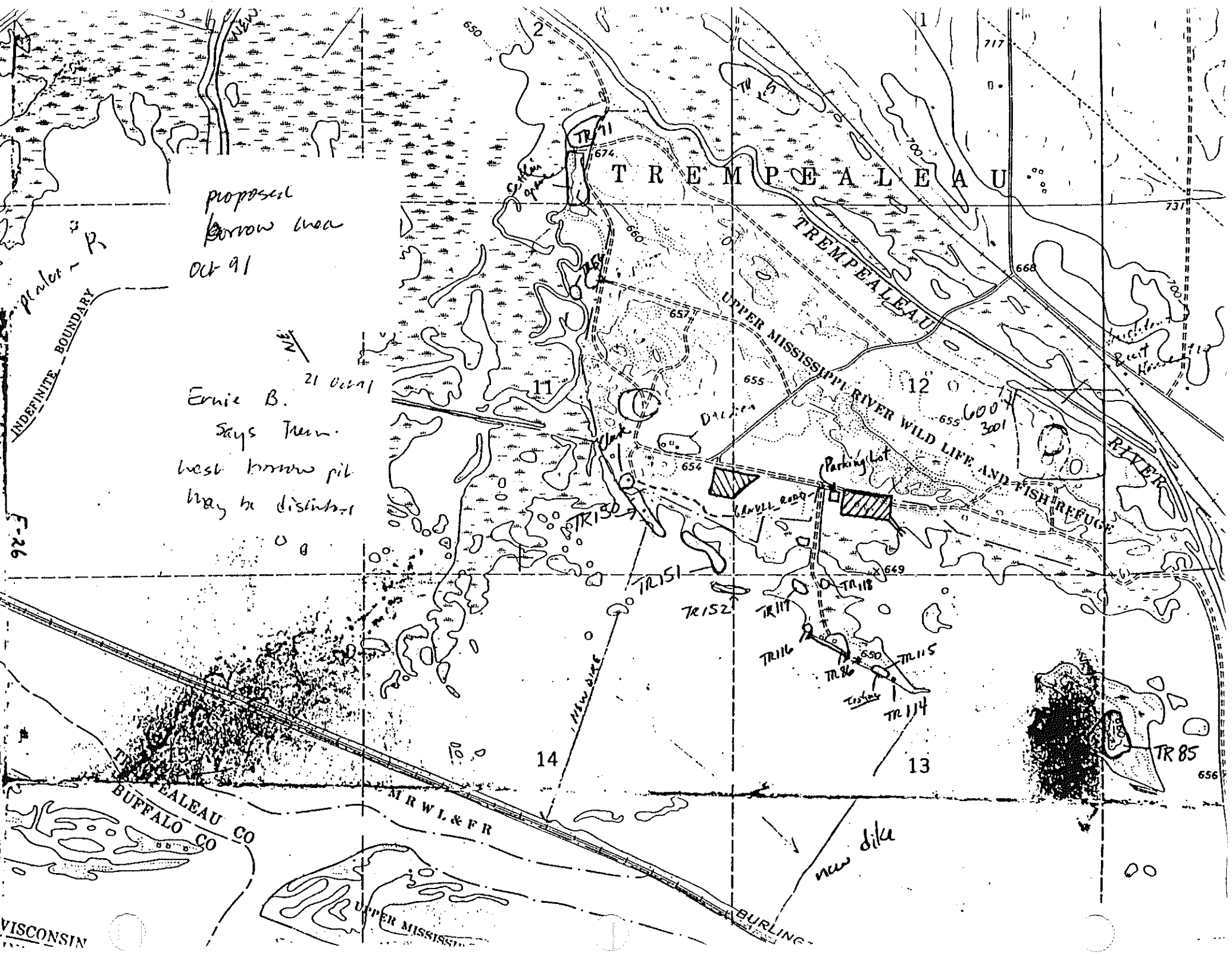
- analysis and write-up
  (estimated 2 months).....$ 32,000.

Cost estimate for contract..... 122,000.
Time estimate for contract.....4-5 months

Coordination and contract administration.....$10,000.
Calendar time .....12 months

Total overall costs for testing, evaluation, and mitigation:
$157,000.

Total calendar time: 18-20 months


proposed
borrow area
Oct 91
21 Oct 91
Ernie B.
Says Trem.
west borrow pit
may be disturbed
INDEFINITE BOUNDARY
TREMPEALEAU
TREMPEALEAU
UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE
RIVER
Parking Lot
GRAVEL ROAD
TR 91
TR 150
TR 151
TR 152
TR 117
TR 118
TR 116
TR 86
TR 115
TR 114
TR 85
NEW DIKE
new dike
TREMPEALEAU CO
BUFFALO CO
M R W L & F R
BURLING
VISCONSIN
1
2
11
12
13
14
650
660
657
655
654
649
668
717
731
700
656

US Army Corps of Engineers Saint Paul District	PROJECT TITLE: TREMPEALEAU EMP	COMPUTED BY: TIM PAULUS	DATE: 7-8-93	SHEET: 1	
	SUBJECT TITLE: O&M COSTS ON PUMP STATION	CHECKED BY:	DATE:	CONTRACT NO.:	

OPTION A1 — PERMANENT PUMP STATION
2 - 75 HP PUMPS

PUMPING EVERY 5 YEARS FOR 32 DAYS. 50 YEAR PROJECT

DEMAND CHARGE : $6/KW
ENERGY CHARGE : 5.2¢/KWHR

2 - 75 hp PUMPS = 150 KW demand

DEMAND CHARGE = 150 KW X $6/KW
= $900/MONTH

(ASSUME NO IRRIGATION RATE)
DEMAND CHARGES MONTHLY FOR YEAR

OPERATION CHARGE = 150 KW x 24 $\frac{HRS}{DAY}$
X 32 DAYS X .052
= $5990 (PER PUMP EVENT)

TOTAL DEMAND & OPERATION CHARGES FOR ONE PUMPING EVENT:
$900/MONTH X 12 MONTHS + $5990
= $16,790

ASSUME A PUMPING EVENT AT THE BEGINNING OF THE PROJECT AND EVERY 5 YEARS UP TO A 50 YEAR LIFE:

PW (PRESENT WORTH) = $16,790 + ($16,790 X 1.838)
= $47,650

(ASSUMING 9% INTEREST FACTOR)

US Army Corps of Engineers Saint Paul District	PROJECT TITLE: TREMPEALEAU	COMPUTED BY: TIM PAULUS	DATE: 7-23-92 8-93	SHEET: 2	
	SUBJECT TITLE:	CHECKED BY:	DATE:	CONTRACT NO.:	

OPTION A1

MAINTENANCE COSTS FOR PUMPING STATION

MAINTENANCE COSTS FOR PUMP STATION:
Assumptions:
2 Man-Days per year for general maintenance
8 additional man-days for pump maintenance required during a pumping event. This is based on 2 man-days to service the pumps and get the station running. 4 man-days to inspect,monitor,and perform any miscellaneous service while pumps are operating. 2 man-days to close down the station and service pumps.

Lubrication and spare parts requirements during non-pumping years are negligible.

From Means Mechanical Cost Code 1992, a general laborer wage rate is $30.00/hr with insurance, overhead, etc.

MAINTENANCE COST FOR YEAR WITH NO PUMPING:
= $30.00/hr * 8-hrs/day * 2-days/year
= $480

PUMP MAINTENANCE COST DURING PUMPING EVENT:
= $30.00/hr * 8-hrs/day * 8 man-days
= $1,920 plus $1000 in lubrication and spare parts.
TOTAL = $2,920

PW of ANNUALIZED COSTS (9% INTEREST)
= $480 × 10.96 = $5261

PW of PUMPING EVENTS (EVERY 5 YEARS OVER 50 YEARS)
= $2920 + (2920 × 1.838)
= $8287

TOTAL PW of MAINTENANCE
= $13,548

US Army Corps of Engineers Saint Paul District	PROJECT TITLE: TREMPEALEAU	COMPUTED BY: TIM PAULUS	DATE: 7-23-92 8-93	SHEET: 3	
	SUBJECT TITLE:	CHECKED BY:	DATE:	CONTRACT NO.:	

OPTION A1

PUMPING DRAWDOWN FOR KILLING FISH ONCE EVERY 15 YEARS

12 DAYS of PUMPING TOTAL PUMPING AT 0, 15, 30, & 45 YEARS

AS BEFORE, DEMAND CHARGES = $6.0/KW PER MONTH

PUMPING WILL BE SPREAD OVER 5 MONTHS (SEPT, OCT, NOV, DEC, JAN)

DEMAND CHARGE = $6.0 X 12 X 150

= $10,800

OPERATING CHARGES = .052 X 12 X 24 X 150

= $2246

TOTAL DEMAND & OPERATION CHARGES = $13,046

Pw = 13,046 + [13,046 X (.2745 + .0754 + .0226)]

= $17,905

MAINTENANCE COSTS: ASSUME SAME COST AS CALCULATED PREVIOUSLY

MAINTENANCE COST FOR PUMPING EVENT = $2920

Pw = $2920 + (2920 * .3725)

= $4008

US Army Corps of Engineers Saint Paul District	PROJECT TITLE: TREMPEALEAU	COMPUTED BY: TIM PAULUS	DATE: 7/23/93	SHEET: 4	
	SUBJECT TITLE:	CHECKED BY:	DATE:	CONTRACT NO.:	

OPTION A1 .. OPERATION & MAINTENANCE
AERATION of POOL A

ASSUME DEMAND AT $8.13/KW

15 (3/4 HP) AERATORS
= 11 KW

DEMAND CHARGES = $8.13 X 11 X 4 Months
= $358

OPERATING CHARGES
= $.025 X 11 KW X 120 DAYS X 24 HRS
= $792

TOTAL DEMAND & OPERATION CHARGES
= $1150 / YEAR

~~PROFIT~~ WILL NOT TAKE PRESENT WORTH of THIS VALUE AFTER ALL the other PRESENT WORTH VALUES ARE ANNUALIZED WILL ADD THIS ON.

MAINTENANCE COSTS PER YEAR:

HAVE 15 AERATORS, ASSUME 1 WEEK FOR 2 MEN TO SET-UP. 1 WEEK TO TAKE DOWN. 5 MAN-DAYS FOR INSPECTION & MONITORING

TOTAL - 25 MAN-DAYS

COST = $30/HR X 25 X 8 HRS/DAY
= $6000 + $300 PARTS
= $6300 / YEAR

US Army Corps of Engineers Saint Paul District	PROJECT TITLE: TREMPEALEAU EMP	COMPUTED BY: TM PAULUS	DATE: 7-8-93	SHEET: 5	
	SUBJECT TITLE: ANNUALIZING O&M COSTS	CHECKED BY:	DATE:	CONTRACT NO.:	

OPTION A1

ANNUALIZING ALL PW VALUES of OPERATION & MAINTENANCE COSTS:

PERIODIC PUMPING: PW OPERATION & DEMAND
= $47,650

PW MAINTENANCE
= $13,548

PUMPING DRAWDOWN FOR KILLING FISH: PW of O&D
= $17,905

PW of MAINTENANCE
= $4008

AERATION: O&D = $1150/YEAR
MAINTENANCE = $6300/YEAR

TOTAL PW = $47,650 + $13,548 + $17,905 + $4008
= $83,111

ANNUALIZED COST OVER 50 YEARS (9%)
= $83,111 × .09123 = $7582

TOTAL ANNUALIZED O&M COSTS
= 7582 + 1150 + 6300

= **$15,032**

US Army Corps of Engineers Saint Paul District	PROJECT TITLE: TREMPEALEAU EMP	COMPUTED BY: TIM PAULUS	DATE: 7-~~22-92~~ 8-23	SHEET: 6	
	SUBJECT TITLE:	CHECKED BY:	DATE:	CONTRACT NO.:	

OPTION A2

SAME PUMP STATION & OPERATION AS A1. NO AERATION

19 DAYS of Pumping

* ASSUME DEMAND CHARGES SAME AS A1

OPERATING CHARGES FOR PUMPING EVENT:

$150\ KW \times 24\ \frac{HRS}{DAY} \times 19\ DAYS \times .052$

$= \$3557$

TOTAL DEMAND & OPERATION CHARGES FOR PUMPING ONE EVENT = $10,800 (DEMAND)
+ 3557 (OPERATION)
= $14,357

PUMPING EVERY 5 YEARS OVER 50 YEARS

PW = $40,745

* ASSUME MAINTENANCE COSTS IDENTICAL TO OPTION A1

TOTAL PW of MAINTENANCE = $13,548

* ASSUME PUMPING DRAWDOWN FOR KILLING FISH IDENTICAL TO OPTION A1

PW (OPERATION & DEMAND) = $17,905

PW (MAINTENANCE) = $4008

TOTAL PW = $40,745 + 17,905 + 4008 + 13,548
= $76,206

TOTAL ANNUALIZED O&M COST = $6952

US Army Corps of Engineers	PROJECT TITLE: TREMPEALEAU EMP	COMPUTED BY: TIM PAULUS	DATE: 1-~~23~~ 8-93	SHEET: 7	
Saint Paul District	SUBJECT TITLE: ANNUALIZED O&M COST – OPTION A7	CHECKED BY:	DATE:	CONTRACT NO.:	

OPTION A7

ANNUALIZED O&M FOR PUMP STATION
= $6952 (OPTION A2)

ASSUME FOR added AERATION, 2/3 of COST of AERATION OPTION IN A1

10 AERATORS (OPTION A7) VS 15 AERATORS (OPTION A1)

ANNUALIZED O&M FOR AERATORS
$= \left(\frac{2}{3}\right) \times (\$1150 + \$6300)$

$= \$4967$

TOTAL ANNUALIZED O&M FOR OPTION A7 = $11,919

US Army Corps of Engineers Saint Paul District	PROJECT TITLE: TRUMPEALEAU	COMPUTED BY: TIM PAULUS	DATE: 7/8/93	SHEET: 8	
	SUBJECT TITLE:	CHECKED BY:	DATE:	CONTRACT NO.:	

POOL C

OPTION C1

TWO PORTABLE 4500 GPM PUMPS
31 DAYS PUMPING PER EVENT
PUMPING EVERY 9 YEARS

40 HP PUMPS X 2
= 80 KW

DEMAND CHARGES PER EVENT: $8.13/KW x 80KW
= $650/month x 3 months
= $1950

OPERATING CHARGES PER EVENT = $.025/KW-HR x 31 DAYS
x 24 HRS
x 80 KW
= $1488

MAINTENANCE CHARGES: ASSUME 10 MAN-DAYS (2 MEN CREW)
FOR SET-UP & TAKE-DOWN
5 MAN-DAYS FOR MONITORING, INSPECTION, ETC.

COST =
15 MAN-DAYS x $30/HR x 8 HRS/DAY
= $3600
+ 300 PARTS, LUBRICATION ETC.
= $3900

TOTAL COST PER PUMP EVENT = 1950 + 1488 + 3900
= $7338

ASSUME PUMP EVENTS AT
0, 9, 18, 27, 36, & 45 YEARS

PW = 7338 + [7338 (.4604 + .212 + .0976 + .045 + .0207)]

US Army Corps of Engineers Saint Paul District	PROJECT TITLE: TRUMPEALEAU	COMPUTED BY: TIM PAULUS	DATE: 7-23-93 8-9-93	SHEET: 9	
	SUBJECT TITLE:	CHECKED BY:	DATE:	CONTRACT NO.:	

OPTION C1

PW FOR OPTION C1 = $13,470

ANNUALIZED O&M COST

= $1230

US Army Corps of Engineers Saint Paul District	PROJECT TITLE: TRIMPEALEAU	COMPUTED BY: TM PAULUS	DATE: 7-8-93	SHEET: 10	
	SUBJECT TITLE:	CHECKED BY:	DATE:	CONTRACT NO.:	

OPTION C2

PUMPING FOR ONLY 5 DAYS - JUNE ONLY

DEMAND = $650 (ONE MONTH ONLY)

OPERATING COSTS = $240

MAINTENANCE = SAME AS C1
= $3900

TOTAL COST PER PUMP EVENT
= $4790

PW = 4790 + (4790 * .8357) = $8793

ANNUALIZED O & M COST
= $802

OPTION C4

9 LESS DAYS of PUMPING THAN C1
SAME DEMAND AS C1
SAME MAINTENANCE AS C1

ANNUALIZED O & M COST
= $1149