US Army Corps
of Engineers
St. Paul District
Mississippi Valley Division

DRAFT
SECTION 205 FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

ADA, MN.

WILD RICE AND MARSH RIVERS, MN

January 2009
Public Review

CERTIFICATION OF TECHNICAL AND LEGAL REVIEW

US Army Corps of Engineers
St. Paul District

PROJECT: Wild Rice and Marsh Rivers, Ada, Minnesota

PRODUCT: Section 205 Draft Feasibility Report and Environmental Assessment

SPECIFICATION NUMBER: N/A

I. Completion of Independent Technical Review

The District has completed the Section 205 draft feasibility report and environmental assessment for a flood risk management project located at Ada, Minnesota. Notice is hereby given that an independent technical review, that is appropriate to the level of risk and complexity inherent in the project, has been conducted as defined in the Project Management Plan. During the independent technical review of the draft report, compliance with established policy principles and procedures, utilizing justified and valid assumptions were verified. This included review of assumptions; methods, procedures, and material used in analyses; alternatives evaluated; the appropriateness of data used and level of data obtained; and reasonableness of the results, including whether the product meets the customer's needs consistent with law and existing Corps policy. The independent technical review was accomplished by an independent district team.

Joseph H Mose — Technical Review Team Leader

7-16-08 — Date

II. Certification of Independent Technical Review

Significant concerns and the explanation of the resolution are as follows:

DRChecks was used to track ITR comments, responses and resolutions. These comments are attached to the ITR endorsement memorandum. There are several issues either identified by the ITR team or the project delivery team that will need to be addressed in the final feasibility report, or during the design phase. These issues are as follows. Additional information is needed in the hydraulics and interior flood control appendices in the final report. A real estate plan and implementation cost estimate will be included in the final feasibility report. Additional cultural resources surveys and Hazardous, Toxic, and Radioactive Waste surveys will be needed during the design phase. Settlement factors must be considered during the design phase. Additional drawings will be provided in the final feasibility report.

Following certification, below, the draft feasibility report and environmental assessment will be forwarded to MVD for approval to distribute the draft report and environmental assessment to the public for review. It is anticipated that this public review of the draft report and environmental assessment will result in comments from the public, and from local, state and Federal agencies, which will be considered in preparation of the final report.

As noted above, all concerns resulting from independent technical review of the draft feasibility report and environmental assessment have been considered. The draft report and all associated documents required by the National Environmental Policy Act have been fully reviewed.

Project Manager	16 July 08 Date
Deputy for Project Management	16 July 08 Date
Chief, Engineering-Construction Division	22 July '08 Date
N/A Chief, Operations Division	Date
Chief, Real Estate Division	23 July '08 Date
N/A Chief, Contracting Division	Date

III. Certification of Legal Review

The draft feasibility report for Ada, Minnesota, including all associated documents required by the National Environmental Policy Act, has been fully reviewed by the Office of Counsel, St. Paul District and is approved as legally sufficient.

District Counsel	23 July 08 Date

Draft Feasibility Report
Ada, Mn - Section 205 Feasibility Study

January 2009

EXECUTIVE SUMMARY

This draft feasibility report documents the analysis that was performed to determine the economic feasibility of constructing a flood risk management project in the city of Ada, MN. under the authority of Section 205 of the Flood Control Act of 1948, as amended.

This draft report is being distributed for the purpose of coordinating the tentatively selected plan and draft environmental assessment with state and local agencies and the general public.

This draft report documents the identification of flooding problems in the City of Ada, Mn., the formulation and selection of alternatives to address flooding problems, the computation of benefits and costs, and the selection of a recommended plan. This draft report outlines the requirements for local cooperation. This draft report also includes an environmental assessment, in accordance with National Environmental Policy Act.

This report concludes that construction of a Federally-sponsored flood risk management project is feasible. This report further concludes that the National Economic Development plan (the plan which produces the maximum net benefits), includes relocation of a portion of Judicial Ditch 51 in the vicinity of Ada, and construction of a 200-year levee and appurtenant interior drainage facilities.

Comments made on this draft feasibility report will be considered in the preparation of the final feasibility report and environmental assessment. Pursuant to approval of the final feasibility report, the next phase will be design and implementation of the recommended plan, which includes preparation of plans and specifications, and construction of the project.

Following construction, the project would be turned over to the City of Ada for operation and maintenance.

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ADA, MINNESOTA – SECTION 205 FEASIBILITY STUDY
JANUARY 2009

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GENERAL

1. The U.S. Army Corps of Engineers, St. Paul District, conducted this study under the authority of Section 205 of the Flood Control Act of 1948 (Public Law 80-858), as amended, in response to a request from the city of Ada, Minnesota.

STUDY PURPOSE AND SCOPE

2. The purpose of this study is to determine the feasibility of a flood risk management project for the city of Ada. The project would reduce damages in the city caused by flooding on the Wild Rice and Marsh Rivers and Judicial Ditch 51. This report identifies the National Economic Development (NED) plan, which yields the maximum benefits.

STUDY AREA DESCRIPTION

3. Ada is in central Norman County in northwestern Minnesota approximately 210 miles northwest of Minneapolis-St. Paul, Minnesota, and approximately 32 miles northeast of Moorhead, Minnesota. Ada lies approximately 2 miles north of the Wild Rice River near the headwaters of the Marsh River, both tributaries of the Red River of the North. Judicial Ditch 51 (JD 51) flows around the northern limits of the city and provides an outlet for the city and agricultural lands north of the city, as well as occasional overflows from the Wild Rice River.

4. The study area is shown on Figures 1, 2 and 3.

Figure 1 - Location of Ada, Minnesota

Figure 2 - Location of Ada within Norman County, Minnesota

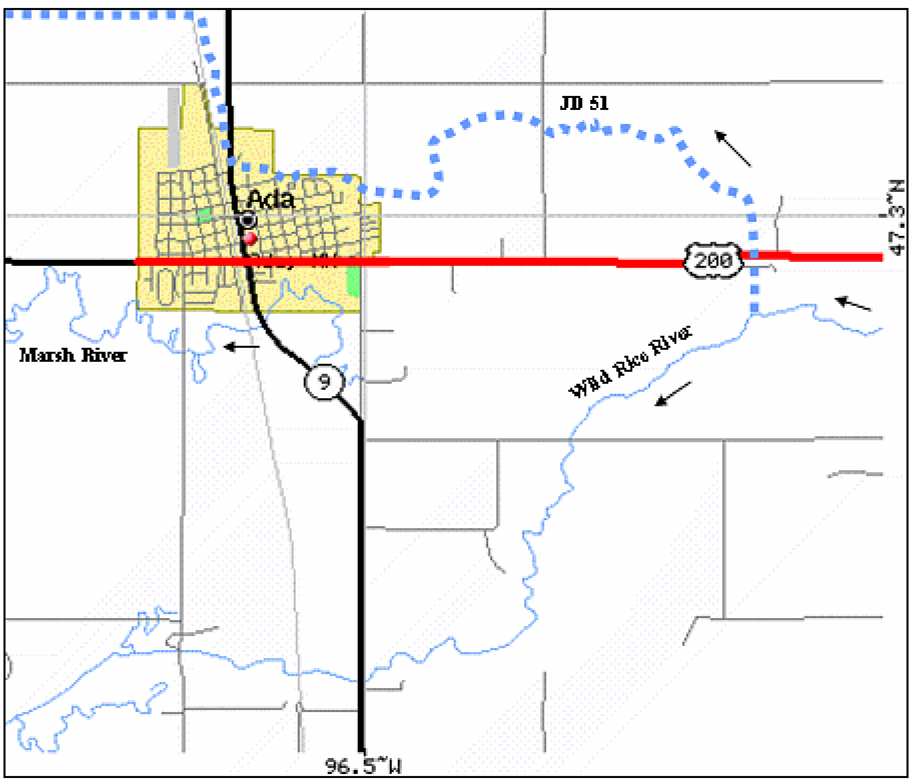


Figure 3 - Location of the Wild Rice River, the Marsh River and Judicial Ditch 51 in the vicinity of Ada

PRIOR STUDIES, REPORTS, AND EXISTING PROJECTS

5. The city of Ada received substantial damage during the 1997 flood. Following that flood, emergency levees were built and the hospital and high school were relocated to higher ground.

6. After the 1997 flood, the city of Ada asked the Corps of Engineers to conduct studies to determine the feasibility of developing a small flood control project at Ada. The feasibility study began on April 7, 2000. Several alternatives were studied. The preferred alternative was to raise the levees around Ada so that the entire city would be protected to the level of the 1997 flood. An economic analysis completed in February 2001 concluded that a project was not feasible. At the request of the local sponsor, the study was put on hold.

7. In June 2002, two record-breaking floods occurred in the basin. During the floods, weaknesses were observed in the existing levee system. As a result of the 2002 event, the Corps updated the discharge-frequency relationships and credit-to-levee analysis used in the prior feasibility analysis. This reanalysis indicated that the benefit-cost ratio had increased to a level suggesting economic feasibility.

8. While the study continued to remain on hold, the city of Ada made further improvements to the existing levee system with the assistance of the State of Minnesota.

9. On January 6, 2004, the city of Ada passed resolution 2004-01-01, authorizing reactivation of the study, which was forwarded to the Corps on March 28, 2004. A new feasibility cost share agreement was signed with the city on October 3, 2005; and the new study began.

10. Previous reports pertinent to this study include the following:

a. 1975 Design Memorandums 1 and 2, Flood Control, Twin Valley Lake, Wild Rice River, Minnesota.

b. December 1986 Section 205 Flood Control Reconnaissance Report – Wild Rice River at Ada, Minnesota.

c. March 1987 Design Memorandum No. 2, Flood Control, Twin Valley Lake, Wild Rice River, Minnesota.

d. May 1992, Feasibility Report and Environmental Assessment, Section 205 Flood Control, Wild Rice River, Hendrum and Lee Townships

e. August 1992, Feasibility Report and Environmental Assessment, Section 205 Flood Control, Wild Rice River, Lake Ida Township

f. Interim Report – Initial Section 205 Feasibility Study, Ada, Minnesota, 14 August 2001

g. Section 205 initial appraisal, Borup, Minnesota Minnesota, terminated 2007. May be pursued as a Section 206 study.

h. Section 205 Feasibility Study, Marsh Creek, Minnesota, October 2006. On hold pending outcome of Ada feasibility study.

11. Existing projects in the area include the following:

a. Judicial Ditch 51 diversion from the Wild Rice River – Constructed in 1895, by the Red River Drainage Commission.

b. In 1906, channel cutoffs were dredged along 5 miles of the Wild Rice River by the State of Minnesota.

c. Another channel-straightening project in the 1920s cut off more oxbows in the Wild Rice River downstream from Ada.

d. 1950's Wild Rice River channel straightening project – Constructed by the Corps of Engineers and Wild Rice-Marsh River Drainage and Conservancy District (WRMRDCD), straightened 15½ miles of the Wild Rice River, improved 24 miles of the Marsh River, cleared and snagged another 3 miles of the Marsh River, and constructed a dike and control structure between the Wild Rice River and old Marsh River channels southeast of Ada.

e. In 1964, the Corps and WRMRDCD cleared and snagged a 12-mile reach of the Wild Rice River downstream of the 15½-mile reach channelized in the 1950s.

f. Between 1966 and 1970, local interests enlarged and straightened the Wild Rice River channel downstream of the Marsh River diversion. In 1975, the Wild Rice Watershed District (WRWD), successor to the WRMRDCD, added an ice control structure at the mouth of the Marsh River diversion.

g. In 1977, the Soil Conservation Service constructed wing dams and levees at 14 locations along the Wild Rice River.

h. In 1977, the WRWD and Norman County rebuilt the Heiberg Dam on the Wild Rice River near Twin Valley. In June 2002, the Heiberg Dam failed; it was rebuilt in 2007.

i. In the early 1980s, the Corps and WRWD did about 2½ miles of debris removal and 14½ miles of channel improvement on the South Branch Wild Rice River and about 1 mile of debris removal, 16¼ miles of channel improvement, and 3 miles of levee construction along Felton Creek.

j. Following the 1997 floods, some additional levees were built in Ada. During the June 2002 flood emergency, the Corps raised those levees. The city has since incorporated much of that levee raise into a permanent system to protect against breakouts from the Wild Rice River and JD 51.

k. The WRWD’s Rural Ring Dike Program has constructed more than 40 ring dikes around farmsteads, homes, and outbuildings.

l. The WRWD’s Acquisition/Relocation Program has removed over 40 flood-prone homes since the 1997 flood.

m. The WRWD also assisted the city of Borup with levee improvements to protect against breakouts from the South Branch Wild Rice River.

n. The WRWD recently completed a combination flood damage reduction/ecosystem restoration project on Dalen Coulee, a tributary to the lower Wild Rice River.

o. The Corps has repeatedly made post-flood repairs to locally-built levees along the Wild Rice River riverbank under the authority of Public Law 84-99.

p. Congress recently authorized restudy of the upstream storage projects on the Wild Rice River (such as the Twin Valley Dam).

EXISTING CONDITIONS

CLIMATE

12. The climate of the Wild Rice-Marsh River basin varies seasonally, with hot, humid summers; freezing, cold winters; and moderate precipitation. Climatological data for Ada show the record high was 111°F on July 6, 1936, and the record low was -53°F on February 15, 1936. The mean annual temperature is 40°F and mean monthly temperatures vary from 70°F in July to 5°F in January. Average annual precipitation is 24 inches. The greatest annual precipitation observed was 33.39 inches at Ada in 1941, and the least observed was 10.25 inches at Mahnomen in 1936. Normal monthly precipitation for the basin ranges from a maximum of 4.3 inches in June to a minimum of 0.6 inch in February. Average snowfall is 40 inches and amounts to about 16 percent of the total annual precipitation. The most snowfall occurred in the winter of 1996-1997 with 104 inches. Construction seasons vary, depending upon the nature of work; many outdoor construction activities are limited to the period between May 1 and October 15, due to either spring road load limitations (hauling) or cold weather (paving).

TOPOGRAPHY

13. The topography of the Wild Rice River basin and of the upper portion of the Marsh River basin is divided into three distinct areas. The upstream areas are characterized by gently undulating to rugged terrain. The downstream areas are characterized by an extremely flat plain. Between those two areas exists a transition composed of a series of sandy ridges. Elevations range from more than 1500 feet msl (above mean sea level, 1929 adj.) near the source of the Wild Rice River to 818 feet msl at the mouth of the Marsh River. Riverward slopes throughout the entire area above the plain are sufficient for adequate drainage, but those in the lower reaches of the watershed are very flat and drainage is sluggish. About 60 percent of the upland area is cultivated, and about 94 percent of lower area is cultivated. The transition ridge area and the valleys in the upper portion of the basin contain substantial timber cover, and the upland area includes numerous small lakes.

GEOLOGY

14. The upper one-third of the basin is covered by glacial drift containing numerous deposits of sand and gravel. Loam or silty loams comprise the generally light soils of the glacial drift area. Immediately downstream from the glacial drift area and covering the transitional area described above are a series of beach ridges formed by the old glacial Lake Agassiz during successively lower recessional stages. Throughout these ridges the soils contain much fine sand, classified generally as silty sand. The remainder of the watershed downstream from the ridges is a nearly flat lacustrine plain that was the bed of the glacial lake. Lacustrine deposits extend to great depths over this plain, particularly in the vicinity of the Red River of the North.

DRAINAGE

15. The Wild Rice River starts at Upper Rice Lake in Clearwater County, Minnesota. The normal elevation of this lake is 1,503 feet msl. About 20 miles downstream the Wild Rice River

flows through Lower Rice Lake. The river then flows generally in a westerly direction until it joins the Red River of the North about 30 miles north of Moorhead, Minnesota. The total length of the river is about 185 miles. In the lower 50-mile reach, the river crosses the flat floor of the Red River Valley.

16. In the latter part of the 19^{th} century, JD 51 was constructed to divert a part of the Wild Rice River flood flows into the Marsh River. Before JD 51 was constructed, the source of the Marsh River was in the low, flat terrain just south of Ada. Construction of JD 51 expanded the drainage area of the Marsh River, so that its source is now about 3 miles east of Ada at the flow diversion structure. The ditch trends just north of Ada and generally westerly for about 10 miles to its junction with the Old Marsh River channel. From this point the Marsh River flows northwesterly about 35 miles to its confluence with the Red River of the North about 15 miles north of the mouth of the Wild Rice River.

17. The Marsh River drains an area of about 300 square miles, and the Wild Rice River drainage area is about 1,650 square miles. During times of high flow, a portion of the Wild Rice River flows may flow into the Marsh River, either through the JD 51 channel or from breakouts along the Wild Rice River.

18. The principal tributaries of the Wild Rice River are the White Earth River (mile 99), Marsh Creek (mile 72), South branch Wild Rice River (mile 29.5), and Felton Ditch (mile 20.5) with drainage areas of 202, 154, 253, and 144 square miles, respectively. The principal tributary of the Marsh River is Spring Creek which has a drainage area of 135 square miles.

19. Streamflow is small during the winter season. The Marsh River usually has no flow for long periods in the winter months. Streamflow usually rises in late March or in April, often reaching the highest flow of the year in April. Often the streamflow remains relatively high through June but usually recedes slowly in the summer, except after heavy rains. In the fall months the stream flow is rather low. The numerous lakes in the upper portion of the Wild Rice Basin tend to sustain the low flow on the mainstem during the dryer seasons of the year.

20. The JD 51 diversion ditch results in a portion of the flows being diverted from the Wild Rice River into the Marsh River when the river stage is high.

FLOODING

21. The city of Ada is subject to flooding from high stages on the Marsh and Wild Rice Rivers and on JD 51. Flooding occurs from both snowmelt and excessive summer rains. Sometimes snowmelt is made worse by spring rains. Spring rains following snowmelt may either extend the duration of high flows or result in additional high peak flows. During the early stages of snowmelt, rivers and ditches are often clogged by ice and snow. Ice jams have been known to increase river stage by several feet. The primary source of flooding is from the Wild Rice River overflow into JD 51 and the Marsh River. While some levees are along the Wild Rice River, high stages will occasionally break out, and overland flow will lead to flooding in Ada. JD 51, in addition to carrying local runoff, diverts a portion of the flow from the Wild Rice River. High

flows in JD 51 and the old Marsh River will cause flooding in Ada. The Marsh River lies directly to the south of Ada, between the city and the Wild Rice River.

<u>April 1997 Floods</u>

22. Significant flooding occurred in Ada in April 1997. The spring 1997 flood was a snowmelt runoff event. Flooding conditions were exacerbated by a wet autumn, which saturated the ground; heavy winter snowfall; cool temperatures during March and April that delayed snowmelt; ice jams on the Wild Rice River; and the addition of 2 to 3 inches of rainfall on top of the melting snow.

23. Flooding in the spring of 1997 occurred in two waves. The first wave was caused by the formation of ice jams on the Wild Rice River. The ice jams increased stages that sent massive flows into JD 51 and resulted in failure of the Wild Rice River dike systems, which sent flow overland toward Ada. The peak stage on the Wild Rice River during the first wave of flooding was 13.5 feet at the gage located near Ada, which fell short of the record stage by only 0.1 foot.

24. The second wave of flooding occurred when a powerful storm combined 2 to 3 inches of rainfall with freezing rain and snow. The rainfall quickly melted the remaining snowpack. This second wave of flooding overtopped levees in many locations throughout the basin. Road crossings downstream of the Heiberg Dam were overtopped. Highways 200 and 9 were overtopped. The South Branch of the Wild Rice River overflowed its banks. The railroad track that had been acting as a levee between the eastern and western portions of Ada was overtopped by about 6 inches. The city of Ada was evacuated. Some streets in Ada were under more than 5 feet of water. The peak stage on the Wild Rice River for the second wave of flooding was 16.5 feet at the gage located near Ada, which surpassed the flood of record by 2.9 feet.

25. Once water spilled over the levees, it flowed overland through Ada and continued overland downstream. Culverts between the 1-mile-square U.S. Geological Survey sections were not large enough to pass the overland flows. The sections acted like reservoirs, filling with water until they overtopped or breached roadways, spilling into the next section. Almost all of Hegne Township, Minnesota, was flooded. Water submersed fields in bands from 5 to 10 miles wide.

<u>June 2002 Floods</u>

26. The June 2002 floods were the result of heavy rainfall that swept across the region on June 9 and 10 and again on June 22 to 24 2002. Preflood precipitation had been below normal since late summer 2001 and as of June 1, 2002, the flooded area was in a moderate drought.

27. During the June 2002 floods, a peak discharge of 14,000 Cubic Feet per second (cfs) occurred June 9 on the Wild Rice River at Twin Valley, Minnesota. The peak discharge exceeded the previous peak that occurred in 1997 by 40-percent and had a recurrence interval of about 200 years. Flooding was extensive in the city of Ada just downstream of Twin Valley; however, flood fighting efforts prevented most damage.

28. A peak discharge of 20,300 cfs occurred June 24 on the Wild Ricer River at Twin Valley. The peak discharge exceeded the peak on June 9 by 36-percent and had a recurrence interval of about 1,000 years.

29. Numerous other floods have occurred in the basin. It should be noted that eight out of the highest nine flood peaks at Twin Valley occurred in the last 18 years. Other notable floods were in 1989, 1978, 1979, 2000, 2001, and 2006.

NATURAL RESOURCES

30. The project area, within the bed of glacial Lake Agassiz is extremely flat and, aside from stream courses, devoid of woody vegetation. It is located in the northern floodplain forest and prairie ecosystems but native prairie is rare and confined to small remnant patches, many of which are along railroad right-of-way. This is the result of almost complete conversion of the area to agricultural cultivation and to development of the city of Ada.

31. Water resources include JD 51, which drains to the west on the north side of the city of Ada, and the Marsh River, which borders the city to the south. A few small temporarily or seasonally flooded wetlands are within the project area. Wooded areas are limited primarily to riparian areas along the river and JD51.

32. Adverse effects on natural resources from the construction of this project would be minor. Wetlands are limited in the area and would be avoided. Terrestrial habitat is mostly absent in the city and would not be reduced. Riparian trees that would be removed would be replaced in an area that would be set aside as a natural area after construction. Interior stormwater ponds would be designed to have wetland attributes.

33. The project would have no adverse effect on endangered or threatened species.

CULTURAL RESOURCES

34. This portion of Minnesota contains numerous cultural resources indicating continual human occupation for approximately 12,000 years. Cultural resource sites within the region exist on a variety of landforms, including uplands, terraces, floodplains and glacial beach ridges. Precontact cultural resources include lithic and artifact scatters and burial mounds. Historic cultural resources include Euro-American structural ruins, standing structures, cemeteries, roads and trails.

35. Within the city of Ada, three historic structures are listed on the National Register of Historic Places (NRHP): the Ada City Hall/Fire Hall, Norman County Courthouse and the Ada Congregational Church. The Ada Public School has been determined eligible for listing on the NRHP. An additional 34 historic architectural properties have been identified in and around Ada. Two precontact sites are located within the construction limits of the proposed project. Site 259-1 consists of a single artifact find spot, and site 259-2 is a single piece of lithic debris (Florin 2008).

DEVELOPMENT AND ECONOMY

36. Population – The population of Ada as of the latest census (2000) was 1,657, which represents a continuation of population decline in recent decades. Population was 2,076 in 1970, 1,971 in 1980, and 1,708 in 1990. In contrast, Fargo, North Dakota-Moorhead, Minnesota, located 40 miles to the southwest, has experienced population growth in recent years increasing from 137,574 in 1980 to 174,367 in 2000.

37. Income – Per capita income for Norman County in 2005 was $27,414, which was lower than that for the state of Minnesota ($37,290) and for the nation as a whole ($34,471). Income growth since 1990 was also lower than State and national figures. From 1990 to 2005, per capita income for Norman County grew 56.0 percent while Minnesota's per capita income grew 87.5 percent and that of the U.S. grew 77.0 percent.

38. Employment – The largest employment sectors for Norman County are farm-related (21.8 percent), government (13.9 percent), health care/social assistance (12.2 percent), retail trade (9.7 percent), and finance and insurance (5 percent). Compared with State averages, the agricultural sector comprises a larger percentage of the local economy (21.8 percent versus 2.9 percent) while manufacturing plays a much lesser role (0.2 percent versus 10.4 percent).

EXISTING PROBLEMS AND OPPORTUNITIES

39. The city of Ada is subject to flood damages resulting from flooding on the Wild Rice River, the Marsh River and JD 51. Flooding may occur either as a result of snowmelt, rainfall or a combination of snowmelt and rainfall. Snowmelt flooding can be exacerbated by the formation of ice dams. The largest flooding events occurred April 1997 and June 2002. During extreme flooding, access routes in and out of Ada are cut off, with Trunk Highway 9 north of Ada being the last route to be inundated.

40. Problem 1: The city of Ada must contend with overland flooding from flows in JD 51, flows from the Marsh River, and breakout flows from the Wild Rice River, which flow into JD 51 and the Marsh River. The spoil bank levees that separate the city from flows in JD 51 are in very poor condition, and offer no protection to the city.

41. Problem 2: During extreme flooding, access routes in and out of Ada become flooded, limiting ingress to and egress from the city.

42. Problem 3: During extreme flood events, the gravity line to the existing wastewater treatment plant does not flow, meaning that untreated wastewater must be discharged directly into the floodwaters surrounding the city, which requires approval from the Minnesota Pollution Control Agency.

43. Problem 4: During extreme flood flows, stormwater cannot be discharged into JD 51, causing indirect flood damages from backup into the city's storm sewer.

44. Opportunity 1: The risk of flood damage in the city of Ada can be reduced by preventing flows from JD 51, the Marsh River and the Wild Rice River from entering the city and causing damages.

45. Opportunity 2: The risk of flood damage in the city of Ada can be reduced by providing a barrier between the damageable areas and the flood flows, by diverting the flood flows to a different area, or by removing or flood proofing flood-prone structures.

46. Opportunity 3: The lack of flow to the wastewater treatment plant during flooding can be addressed by providing a means to continue wastewater flow, such as changing the gravity line into a pressurized line.

47. Opportunity 4: Indirect flood damages can be reduced by providing areas to store and facilities to discharge interior drainage.

48. Opportunity 5: Ingress and egress out of the city of Ada can be improved during flooding, but may require a more integrated effort by State and county transportation authorities.

PLAN FORMULATION

PUBLIC INVOLVEMENT AND COORDINATION

49. As a result of the 1997, 2001 and 2002 floods, the city of Ada expressed interest in the Corps of Engineers investigating the feasibility of constructing a flood risk management project under the authority of Section 205 of the 1948 Flood Control Act, as amended.

50. The non-Federal sponsor (the city of Ada) is an equal partner in this cost-shared study. The city of Ada relied heavily on funding provided by the Minnesota Department of Natural Resources (MnDNR) through the Department of Waters to meet the local cost obligations. Close coordination was maintained throughout the study with the non-Federal sponsor and the MnDNR.

51. Meetings have been held with representatives from the city of Ada and its engineering firm. In turn, the city has discussed the study and its recommendations at its council meetings, which are open to the public, and documented for the public record. Initial meetings were conducted to determine the city's goals and objectives in constructing a flood risk management project. Further meetings were held to brief the city on the progress of the study. A public information meeting was held in Ada on October 1, 2008, to discuss the proposed project. A coordination meeting was held on October 2, 2008, with representatives from the Wild Rice Watershed, the Minnesota Department of Transportation and Norman County to discuss design aspects of the recommended plan.

52. It is intended that the draft feasibility report and environmental assessment be made available to the public for review as part of the National Environmental Policy Act (NEPA) process in January 2009. The public comments will be documented and considered prior to finalizing the report.

PLANNING CONSIDERATIONS

53. The formulation of alternatives for this study was influenced by the past history of flooding; the location of benefits within the proposed project area; current and projected land usage; and the locations of potential hazardous, toxic and radioactive waste (HTRW).

PLANNING GOALS AND OBJECTIVES

54. The goal is to manage the flood risk to the city of Ada from the Marsh River, JD 51 and the Wild Rice River. The proposed project should be acceptable to the city of Ada. The proposed project should address interior flood control within the city when flooding occurs in the landscape surrounding Ada. The objective of the study is to determine if there is a Federal interest in providing flood management measures to the city of Ada. If a Federal interest exists, the study then determines the NED plan, which maximizes net benefits.

55. The Federal objective of water and related land resources planning is to contribute to NED, consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

56. Direct flooding is defined as that flooding that is caused by overland flow. Indirect flooding is defined as that flooding that is caused by backup of the sewer system.

57. The objective of reducing the risk of flood damages to existing development within the city of Ada forms the basis for the formulation of alternative plans. The city also expressed interest in protecting an undeveloped area on the northwest quadrant of the city and two developed areas to the west and to the east of the city limits.

PLANNING CONSTRAINTS

58. The recommended plan must meet NED standards. The recommended plan must comply with NEPA. The recommended plan cannot induce flooding on the Red River of the North, which means that the JD 51 flow regime downstream of Ada cannot change. The recommended plan must not violate Executive Order (EO) 11988, in that first it must be determined if the proposed project is located in a floodplain (area subject to a 1- percent or greater chance of flooding in any given year) as defined by a Department of Housing and Urban Development (HUD) flood map and, second, if the project is located in a floodplain, that alternatives to avoid adverse impacts and incompatible development have been considered; that the proposed action has been coordinated with the agencies responsible for floodplain management; and that opportunities for public review have been provided . The city of Ada desires that the project provide protection to at least the level of the 1997 flood and would not be interested in implementing a lesser plan. The recommended plan must be within the city's means to operate and maintain. The city has condemnation rights only within 2 miles of the city. Basin-wide measures are being considered by the WRWD. The feasibility of these other measures may be affected by the construction of a flood control project at Ada.

59. The proposed project cannot change the hydraulic character of JD 51, the Wild Rice River or Marsh Creek, such as would make flooding worse for downstream communities. Small, localized hydraulic impacts may be unavoidable, and will be addressed in the takings analysis for real estate.

FORMULATION AND EVALUATION OF ALTERNATIVE PLANS

WITHOUT-PROJECT CONDITION

60. The without-project condition serves as the basis for evaluating other alternatives.

61. Without a flood risk management project, slow growth in residential development is expected to continue in the community of 1657 people. Development that does occur will require flood proofing, typically by elevating buildable lots with fill material. Annual flood damages are expected to continue at a rate of $704,000 per year. The city will continue to incur flood-fighting expenses and will continue to pay flood insurance on many structures. The WRWD will continue to maintain JD 51 along its current alignment, but it may take additional measures to stabilize the eroding slopes. The costs of maintaining JD 51 will continue to be assessed to the benefiting landowners, including the city of Ada. The city will continue to operate and maintain their existing levees.

62. The WRWD will continue to actively seek to study and construct other flood damage reduction projects in the Wild Rice River basin. These other projects may or may not yield benefits at Ada. Ongoing WRWD-sponsored Corps studies include the Section 205 project located at Marsh Creek, which is upstream of Ada on a tributary of the Wild Rice River. This project would produce some benefits at Ada, but it would not protect it in the same way as a local levee project would. The outcome of this study is uncertain at this time.

63. Studies and activities being conducted by the WRWD are numerous, and involve creating storage for floodwater, improving ditching to convey runoff, building ring dikes to protect farmsteads, and conducting maintenance and other improvements intended to provide flood damage reduction mostly to agricultural areas. Congress recently authorized a study of the Twin Valley Dam (and alternatives), which was previously studied by the Corps in the 1980s. This study may or may not result in a constructed mainstem flood retention project upstream of Ada on the Wild Rice River. Large dams have been opposed by the MnDNR.

WITH-PROJECT CONDITION

64. The with-project condition is that which exists with a project in place. The benefits of an alternative compare the with-project condition to the future without-project condition. A 50-year planning period is used. The with-project condition will vary, depending on the alternative under consideration. Alternatives may be nonstructural or structural in nature, or a combination of both. The with-project conditions are discussed later in this report under the “Evaluation of Alternatives” section.

NONSTRUCTURAL ALTERNATIVES

65. Nonstructural alternatives could include such measures as flood proofing, structure raising, relocation, ring dikes acquisition, and demolition. Nonstructural flood control features were considered wherever they would be more appropriate than a structural feature, as protection to isolated dwellings, or in areas in which structural measures were more expensive.

STRUCTURAL ALTERNATIVES

66. Structural alternatives are sometimes favored for densely populated areas, in which nonstructural measures are not practical or are more expensive. Structural measures could include flood walls, levees, ditches, pumping stations and diversion channels.

FORMULATION OF ALTERNATIVE PLANS

67. The first step in formulating plans was to determine what to do with the flows passing through JD 51. It was determined early in the study that the disposition of JD 51 flows, would affect the development of all other flood risk management features. Currently, JD 51 passes through the city of Ada, where it must flow through a narrow channel adjacent to a residential area and then through a concrete underpass beneath Highway 9. The JD 51 side slopes are nearly vertical in some areas, and the channel bank is sloughing. This portion of the JD 51 channel was included in a Corps' channel-improvement project in the mid 1950s. The channel was designed with 1 vertical on 3 horizontal side slopes. The easements for the 1950s channel improvement project extended 20 feet beyond the top edge of the channel. These channel side slopes are not stable. Based on current geological information, it is recommended that the JD 51 channel be designed with 1 vertical on 6 horizontal side slopes. The proposed project features would include stabilization of a portion of the JD 51 channel.

68. We considered four different alignments for JD 51. These four alignments are shown on the following figure. JD 51 flows from right to left on the figure shown.

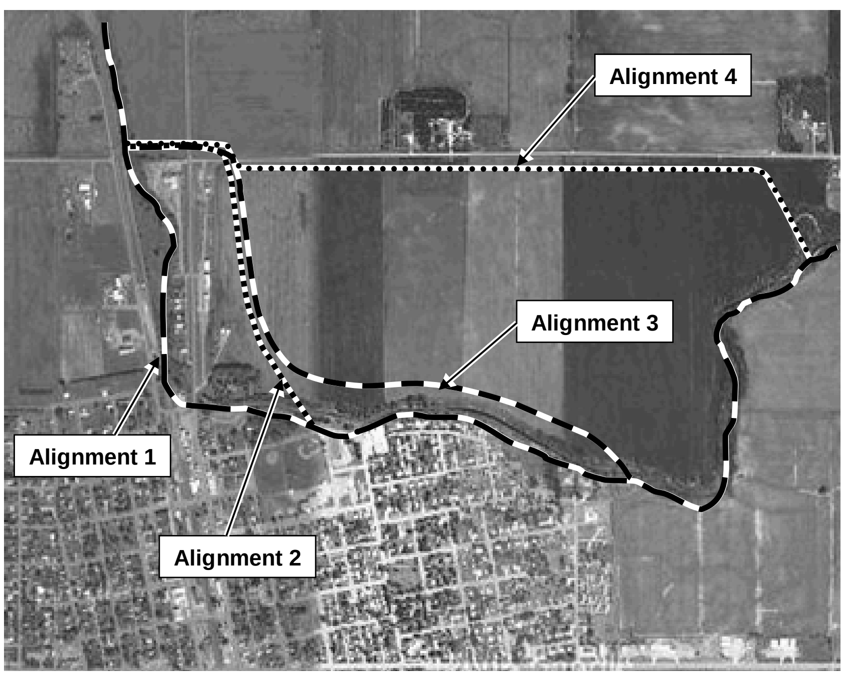


Figure 4 – JD 51 Ditch locations

69. The next step was to develop alternative plans that combined flood damage reduction features with each of the JD 51 alignments. The objective was to formulate alternative plans that yielded similar benefits so that the most economical JD 51 alignment could be chosen. Areas within the Ada city limits were targeted. For screening purposes, the 200-year flood level was used. Because of the extent of the area and the number of structures affected, use of nonstructural measures, such as flood proofing and relocations, was dismissed as a viable alternative. However, nonstructural measures are considered later in the analysis for several option areas.

70. For each JD 51 alignment, a corresponding primary levee was designed. Four alternatives, corresponding to the four alignments for JD 51 were developed. These alternatives are described below.

71. Alternative 1 includes levees and interior drainage structures to provide flood damage reduction to structures and facilities within the city of Ada corporate limits, combined with stabilization of JD 51 in its present location. JD 51 alignment 1 follows the current alignment for JD 51. The primary levee for alternatives 1, 2, 3 and 4 are similar, except for in the northeast quadrant (adjacent to JD 51). For Alternative 1, the northeast levee must be built on both sides of JD 51 to provide a flood barrier on the north and south sides of the ditch. This levee construction involves removing several dwellings to facilitate levee construction. Alternative 1 is shown in Figure 5 located at the end of the main section of this report.

72. Alternative 2 includes levees and interior drainage structures to provide flood damage reduction to structures and facilities within the city of Ada corporate limits, combined with relocation of JD 51 to alignment 2. JD 51 alignment 2 follows a portion of the current JD 51 alignment, then diverts JD 51 around the northeast portion of the city. For Alternative 2, the northeast levee is built so that JD 51 can remain in its present streambed until it is diverted northward. This levee alignment still involves removing several dwellings to facilitate levee construction. Alternative 2 is shown in Figure 6 located at the end of the main section of this report.

73. Alternative 3 includes levees and interior drainage structures to provide flood damage reduction to structures and facilities within the city of Ada corporate limits, combined with relocation of JD 51 to alignment 3. JD 51 alignment 3 diverts JD 51 farther northward than alignment 2, and beginning closer to the eastern city limits. For Alternative 3, the northeast levee and the proposed JD 51 channel are moved to the north side of the present JD 51 streambed, which preserves all of the houses on the south side, adjacent to JD 51. Alternative 3 is shown in Figure 7 located at the end of the main section of this report.

74. Alternative 4 includes levees and interior drainage structures to provide flood damage reduction to structures and facilities within the city of Ada corporate limits, combined relocation of JD 51 to alignment 4. JD 51 alignment 4 diverts JD 51 much farther northward from its current alignment, beginning further upstream on JD 51. For Alternative 4, the levee is identical to the levees used in Alternative 3. Only the location of JD 51 has changed. Alternative 4 is shown in Figure 8 located at the end of the main section of this report.

75. The interior drainage requirements for Alternatives 2, 3 and 4 would be identical. Much of the interior runoff would be stored in the abandoned JD 51 channel. Alternative 1 would require additional flap-gated outlet structures adjacent to JD 51 and pumping facilities to control interior runoff.

SCREENING OF ALTERNATIVES

76. Screening of alternatives was done in several steps. The first step was a screening to determine the most economical location for JD 51. The second step was to further evaluate the recommended alternative from step one at various flood levels to determine the NED plan. A final screening step will be performed to determine if several option areas are incrementally justified.

77. Screening Step 1 – JD 51 location: A preliminary cost screening was done on the four JD 51/primary levee alignments to determine the most economical location for JD 51. For screening purposes, the alternatives were evaluated at the 200-year flood level. The alternatives screening estimates are shown in Appendix G. These estimates show relative cost differences between the alternatives. They do not include costs for features that are common to all plans.

- Alternative 1: $8,532,000 + costs of common features
- Alternative 2: $6,377,000 + costs of common features
- Alternative 3: $4,333,000 + costs of common features
- Alternative 4: $4,767,000 + costs of common features

78. The lowest cost alternative is Alternative 3, which is roughly $434,000 less than Alternative 4, $2,044,000 less than Alternative 2, and $4,199,000 less than Alternative 1. Costs dropped dramatically for plans that moved JD 51 away from its current location, which passes through the city. Alternatives 1 and 2 were higher in cost because they involved removing many houses along the current JD 51 alignment.

79. Based on the above screening, Alternative 3 was determined to be the most economical alignment for JD 51. Alternative 4 costs are very similar to those of Alternative 3.

80. Based on this first screening, the second screening step would include the Alternative 3 levee and ditch alignment with the levee evaluated at several different flood levels. The end product of this second screening would be the NED plan. Further analysis would be done after the NED screening to evaluate several option areas to determine if they are incrementally justified.

81. Screening Step 2 – Design Flood Level (NED Analysis): Once the most economical location for JD 51 was determined, the next step is to evaluate the plan at different flood levels to determine the NED plan. Prior to performing the NED screening, some minor modifications were made to the basic levee/ditch plan. These changes do not affect the outcome of the alternatives screening, because they either would be common to all alternatives or would further reduce the cost of the chosen alignment. These changes include moving a portion of the levee in the northwest quadrant of the city northward to allow an area for interior ponding and moving the levee and JD 51 in the northeast quadrant of the city northward to compensate for slope

stability issues on JD 51 and to provide an area for disposal of excess material excavated from JD 51.

82. This modified alignment is shown in Figure 9 located at the end of the main section of this report.

83. In theory, both structural and nonstructural measures could be combined with the relocated JD 51 ditch to achieve the flood damage reduction goals in Ada. However, because there are existing levees around Ada, it was cost effective to upgrade these levees and extend them around the city to complete the flood barrier. Nonstructural measures, such as flood proofing and relocations, were not deemed to be practical, because the levees were already in place for most of Ada. Nonstructural measures are discussed further in the evaluation of the option areas.

84. The typical cross section of the levee used in the NED analysis is a trapezoidal section with 1 vertical on 4 horizontal side slopes, with a top-of-levee width of 10 feet. The top-of-levee elevation varies with the flood level being analyzed (either 50-year, 100-year, 200-year or 500-year elevations). The cross section of the relocated JD 51 is a trapezoidal excavation, with 1 vertical on 6 horizontal side slopes. The design for JD 51 is identical for all alternatives considered in the NED analysis. The relocated JD 51 ditch is intended to provide identical flow conveyance as the existing JD 51 channel, so as not to affect the flood characteristics upstream and downstream of Ada. The design for JD 51 is based on a bankfull discharge of 657 cfs which is equivalent to a 10-year event flow on the ditch. The JD 51 channel design is the same for all alternatives in the NED analysis.

85. The real estate interests included in the estimates assume that there would be fee title or permanent easements acquired for the levees and relocated JD 51, permanent easements for conducting maintenance and inspection, and temporary construction easements.

86. Alternative 3 was first evaluated at the 50-, 100- and 200-year flood levels. When the net benefits at the 200-year flood level were determined to be the greatest, an additional flood level (500-year) was added to the analysis to ensure that the NED plan was identified.

87. The following table summarizes the NED screening costs, in code of accounts format, for Alternative 3 at various flood levels. The NED screening estimates are shown in Appendix I.

Table 1 - NED Screening costs for Alternative 3 at various levels of protection (in $1000s)

Code of Accounts	Level of Protection	50-year	100-year	200-year	500-year
01	Lands and Damages	$ 819	$ 822	$ 826	$ 1,158
02	Relocations	$ 84	$ 104	$ 106	$ 110
08	Roads, Railroads, Bridges	$ 1,448	$ 1,575	$ 1,724	$ 1,856
09	Channel and Canals	$ 1,614	$ 1,387	$ 1,358	$ 1,115
11	Levees and Floodwalls	$ 1,912	$ 2,355	$ 2,560	$ 3,430
30	Planning, Engineering and Design	$ 607	$ 651	$ 690	$ 781
31	Construction Management	$ 354	$ 379	$ 402	$ 456
	Total*	$ 6,840	$ 7,270	$ 7,670	$ 8,910

* Total number rounded to the nearest $10,000

88. The following table summarizes the average annual flood damage reduction benefits, flood-proofing cost savings, and flood insurance savings associated with each flood level, yielding an average annual benefit for each.

Table 2 - Summary of average annual benefits for Alternative 3 at various flood levels

Category	50-Yr Levee	100-Yr Levee	200-Yr Levee	500-Yr Levee
Existing condition average annual flood damages	$704,000	$704,000	$704,000	$704,000
Residual damages with project in place	$157,100	$87,500	$44,600	$900
Flood damage reduction for each flood level	$546,900	$616,500	$659,400	$703,100
Flood proofing cost savings		12,700	12,700	12,700
Flood insurance savings		5,600	5,600	5,600
Total Avg Ann Benefits	546,900	634,800	677,700	721,400

89. The following table summarizes the average annual costs for Alternative 3 for each flood level:

Table 3 - Calculation of average annual costs of Alternative 3 at various flood levels				
	50-Yr Levee	100-Yr Levee	200-Yr Levee	500-Yr Levee
Project Costs	$6,840,000	$7,270,000	$7,670,000	$8,910,000
Interest During Const.*	$164,741	$175,098	$184,732	$214,597
Total Investment	7,004,741	7,445,098	7,854,732	9,124,597
Int & Amort Factor	0.05372	0.05372	0.05372	0.05372
Avg Ann Investment	$376,295	$399,951	$421,956	$490,173
Avg Ann O&M	25,286	27,107	28,741	32,552
Total Avg Ann Costs	$401,581	$427,058	$450,697	$522,725
* Based on 1-year construction schedule				

90.

91. The following table summarizes the average annual costs and benefits for Alternative 3 at the various flood levels.

Table 4 - Summary of benefits, costs, benefit-cost ratios, and net benefits for Alternative 3 at various flood levels				
	50-Yr Levee	100-Yr Levee	200-Yr Levee	500-Yr Levee
Average Annual Benefits	$546,900	$634,800	$677,700	$721,400
Average Annual Costs	$401,581	$427,058	$450,697	$522,725
Benefit-Cost Ratio	1.36	1.49	1.50	1.38
Net Benefits	$145,319	$207,742	$227,003	$198,675

92. This table shows that the plan designed to the 200-year flood level has the maximum net annual benefits and is, therefore, the NED plan.

93. Screening Step 3 – Option Areas: In addition to what is protected by the primary levee, the project non-Federal sponsor requested that flood protection be considered for several areas that were physically separate from the main benefit area.

94. These option areas are identified as the northwest, west and east option areas, according to their location in town. These option areas are shown in Figure 10 located at the end of the main section of this report.

95. The west option area includes two farmsteads, including dwellings and outbuildings. One farmstead contains a historically significant barn.

96. The northwest option area does not contain any structures, so the only benefit would be from a reduction in costs or an increase in benefits to the cropland.

97. The east option area has several commercial properties That lie outside the city limits of Ada but which may benefit from being included in the plan.

98. In evaluating the option areas, it seemed appropriate to consider structural as well as nonstructural measures. However, as the primary levee has been optimized at the 200-year flood level, any levee extensions around the option areas were evaluated only at the 200-year flood level.

99. West Option Area: The measures evaluated for the west option area include structural measures, such as extension of the basic levee, and nonstructural measures, such as provision of ring dikes and flood proofing of structures. Cost estimates were prepared for the west option alternatives. The incremental cost differences for the various western option area alternatives for various flood levels are shown on the following table:

Table 5 – Incremental costs for West Option Area alternatives at various flood levels

Incremental cost	100-year	200-year	500-year
Ring dike around Structures	$80,989	$101,155	$137,978
Raise the houses and ring dike some structures	$315,525	$325,571	$345,262
Extend main levee to encompass option area*	-	($10,000)	-

* Only the 200-year flood level was analyzed for the levee extension option. Because the NED plan for the main levee was the 200-year flood level, we would not provide a higher or a lower design for the option area encompassed by an extension of the main levee.

100. These cost estimates show that extension of the basic levee is the most cost-effective means of reducing the risk of floods to the west option area. Benefit analysis shows that the west option area costs $10,000 less than the basic levee plan. Extending the levee around the west option area actually reduces the overall cost of the project by reducing the cost of hauling excess material excavated from JD 51 and disposing of it in a different location. In addition to lowering the project construction cost, including the west option area yields an additional $1,220 in average annual benefits. Therefore, the west option with levees is incrementally justified. The NED-level cost estimate for the basic 200-year levee plan, plus the recommended west option area with levees, is shown in Appendix I.

101. Northwest Option Area: The primary levee at the northwest corner of the proposed project was realigned to follow the northwest levee alignment. The resulting cost estimate showed that the northwest levee option costs $20,000 less than the basic levee plan. Extending the levee around the northwest option area actually reduces the overall cost of the project due to being able to reduce the cost of hauling excess material excavated from JD 51 and disposing of it in a different location. The northwest option area would also yield a small amount of additional benefit. Nonstructural measures, such as flood proofing and ring dikes for the northwest option area were not evaluated, because no structures are located in this area. Because it results in a lower overall project cost, the northwest levee option is incrementally justified. The NED-level cost estimate for the basic 200-year levee plan, plus northwest option area, is shown in Appendix I.

102. East Option Area: The levee was extended around several commercial structures on the east end of town. The resulting cost estimate showed that the east levee option had the same cost as the basic levee plan. Extending the levee around the east option area, even though it is a longer levee, did not increase the cost of the project, because material costs were offset by reducing the cost of hauling excess material excavated from JD 51 and disposing of it in a different location. The east option area would also yield a small amount of additional benefit. Nonstructural measures, such as flood proofing and ring dikes, for the east option area were not evaluated, because they would obviously add to the cost (as shown in the evaluation of the west option area) rather than reduce it. Because it results in a lower overall project cost, the east option with levees is incrementally justified. The NED-level cost estimate for the basic 200-year levee plan, plus eastern area, is shown in Appendix I.

103. The following table shows the summary for incremental justification of the option areas.

Table 6 - Economic summary of adding option areas to 200-year levee plan			
	200-year levee plan plus option area		
	East	West	Northwest
First cost with option	$ 7,670,000	$7,660,000	$ 7,650,000
First cost - Basic 200-yr levee	7,670,000	7,670,000	7,670,000
Incremental Cost	0	-$10,000	-$20,000
Avg Ann Incremental Cost	0	--	--
Avg Ann O&M	28,700	28,700	28,700
Avg Ann O&M - Basic 200-yr levee	28,700	28,700	28,700
Avg Ann Incremental O&M	0	0	0
Total Avg Ann Incremental Cost	$0	$537	$1074
Avg Ann Incremental Benefit	> 0	1,350	> 0
Incremental BCR	> 1.0	1.25	>1.0

NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

104. Based on the preceding cost analysis, the NED plan is alternative 3, built to the 200-year flood level, plus option areas. The NED plan includes realignment of a portion of JD 51 (alignment 3) combined with levees constructed to the 200-year level. The NED plan includes the west, northwest and east option areas, as they have been shown to be incrementally justified.

TENTATIVELY SELECTED PLAN

105. The tentatively selected plan is Alternative 3 with the east, west and northwest option areas, built to the 200-year level. This plan includes realignment of approximately 7,500 feet of JD 51 (alignment 3) combined with approximately 34,500 feet of flood barrier, including levees, combined levee/road raises and incorporation of existing high ground.. The tentatively selected plan includes extending the levee around the west, northwest and east option areas, because they have been shown to be incrementally justified. The tentatively selected plan is shown in Figure 11 located at the end of the main section of this report.

106. The tentatively-selected plan's effectiveness in addressing the study goals, objectives and constraints and its comparison to other alternatives is discussed in the following section.

EVALUATION OF ALTERNATIVES

107. The purpose of this section is to describe the with-project conditions expected with each alternative plan and to compare how well each plan addresses the planning goals and objectives. One plan will be recommended as the selected plan, based on this comparison.

WITH-PROJECT CONDITIONS

Alternative 1

108. The with-project condition for Alternative 1 would be the city of Ada with reliable 200-year flood protection, including continuance of JD 51 in its present location (alignment 1). Such a scenario would result in potential growth in the community of Ada in the areas bounded by the levees, but some houses would be removed to construct stable levees along the JD 51 alignment, which would subtract from some of the benefits of the project. Flood damages would decrease from $704,000 per year to $44,600 per year. Flood proofing cost savings would be $12,700 per year. Mortgage companies may waive the requirement to carry flood insurance on mortgaged properties, saving $5,600 per year. The city of Ada will incur maintenance costs on the project, including the levees, interior drainage structures, and JD 51. During extreme flooding, access routes in and out of Ada will continue to be inundated, resulting in brief periods of isolation.

109. The Wild Rice Watershed District will continue to study and construct other flood damage reduction projects in the Wild Rice River basin. Benefits for other projects, based on flood damage reduction at Ada, will be decreased

Alternative 2

110. The with-project condition for Alternative 2 would be the city of Ada with reliable 200-year flood protection, including diversion of a portion of JD 51 along alignment 2. Such a scenario would result in potential growth in the community of Ada in the areas bounded by the levees, but some houses would be removed to construct stable levees along the JD 51 alignment, which would subtract from some of the benefits of the project. Some farmland would be lost in the construction of the rerouted JD 51. Flood damages would decrease from $704,000 per year to $44,600 per year. Flood proofing cost savings would be $12,700 per year. Mortgage companies may waive the requirement to carry flood insurance on mortgaged properties, saving $5,600 per year. The city of Ada will incur maintenance costs on the project, including the levees, interior drainage structures, and the rerouted portion of JD 51. During extreme flooding, access routes in and out of Ada will continue to be inundated, resulting in brief periods of isolation.

111. The WRWD will continue to study and construct other flood damage reduction projects in the Wild Rice River basin. Benefits for other projects, based on flood damage reduction at Ada, will be decreased.

Alternative 3

112. The with-project condition for Alternative 3 (tentatively-selected plan) would be the city of Ada with reliable 200-year flood protection, including diversion of a portion of JD 51 along alignment 3. Such a scenario would result in potential growth in the community of Ada in the areas bounded by the levees. Some farmland would be lost in the construction of the rerouted JD 51. Flood damages would decrease from $704,000 per year to $44,600 per year. Flood proofing cost savings would be $12,700 per year. Mortgage companies may waive the requirement to carry flood insurance on mortgaged properties, saving $5,600 per year. The city of Ada will incur maintenance costs on the project, including the levees, interior drainage structures, and the rerouted portion of JD 51. During extreme flooding, access routes in and out of Ada will continue to be inundated, resulting in brief periods of isolation.

113. The WRWD will continue to study and construct other flood damage reduction projects in the Wild Rice River basin. Benefits for other projects, based on flood damage reduction at Ada, will be decreased.

Alternative 4

114. The with-project condition for Alternative 4 would be the city of Ada with reliable 200-year flood protection, including diversion of a portion of JD 51 along alignment 4. Such a scenario would result in potential growth in the community of Ada in the areas bound by the levee. Some farmland would be lost in the construction of the rerouted JD 51, and a large swath of farmland would be more difficult for the landowner to access for farming. Flood damages would decrease from $704,000 per year to $44,600 per year. Flood proofing cost savings would be $12,700 per year. Mortgage companies may waive the requirement to carry flood insurance on mortgaged properties, saving $5,600 per year. The city of Ada will incur maintenance costs on the project, including the levees, interior drainage structures, and the rerouted portion of JD 51. During extreme flooding, access routes in and out of Ada will continue to be inundated, resulting in brief periods of isolation.

115. The WRWD will continue to study and construct other flood damage reduction projects in the Wild Rice River basin. Benefits for other projects, based on flood damage reduction at Ada, will be decreased.

Option Areas

116. The with-project condition for the west option area would be reliable flood protection for two farmsteads located on the west end of Ada. Annual flood damages would decrease by $1,220 per year. Annual costs of the overall project would decrease slightly.

117. The with-project condition for the northwest option area would be reliable flood protection to an undeveloped agricultural field on the northwest side of Ada. Annual flood damages would decrease slightly. Annual costs for the overall project would decrease slightly.

118. The with-project condition for the east option area would be reliable flood protection to several businesses located on the east side of Ada. Annual flood damages would decrease slightly. Annual costs of the overall project would decrease slightly.

COMPARISON OF PLANS BASED ON GOALS AND OBJECTIVES

119. This discussion documents the performance of each of the alternatives in meeting the planning goals and objectives and complying with the planning constraints. The planning goal is to provide more complete, efficient, effective and reliable flood risk management to the city of Ada. The recommended plan must be acceptable to the city of Ada. The planning objective is to determine if there is Federal interest in providing flood risk management measures to the city of Ada and, if there is Federal interest, to determine the NED plan. The planning constraints include compliance with NEPA, avoiding induced flooding on the Red River of the North or downstream communities, compliance with EO 11988, providing a minimal level of protection equal to the 1997 flood, and must be within the city of Ada's means to operate and maintain.

120. Alternative 1 meets the planning goal of providing more complete, efficient, effective and reliable flood risk management to the city of Ada. It is less acceptable than other plans because it will require relocating or demolishing several existing houses. It adheres to the planning constraints including compliance with NEPA, avoiding induced flooding on the Red River of the North or downstream communities, and compliance with EO 11988. Even though a small portion of the project area is within the 1-percent chance floodplain, this area is already fully developed, and there are no practicable alternatives to siting in the floodplain. However, there is no Federal interest in constructing this plan, because it costs roughly $4,199,000 more than other available alternatives that provide similar benefits (based on the alternatives screening cost estimates).

121. Alternative 2 meets the planning goal of providing more complete, efficient, effective and reliable flood risk management to the city of Ada. It is less acceptable than other plans because it will require relocating or demolishing several existing houses. It adheres to the planning constraints including compliance with NEPA, avoiding induced flooding on the Red River of the North or downstream communities, and compliance with EO 11988. Even though a small portion of the project area is within the 1-percent chance floodplain, this area is already fully developed, and there are no practicable alternatives to siting in the floodplain. However, there is no Federal interest in constructing this plan, because it costs roughly $2,044,000 more than other available alternatives that provide similar benefits (based on the alternatives screening cost estimates).

122. Alternative 3 (tentatively-selected plan) meets the planning goal of providing more complete, efficient, effective and reliable flood risk management to the city of Ada. It is thought to be acceptable to the majority of residents in the Ada area. It adheres to the planning constraints including compliance with NEPA, avoiding induced flooding on the Red River of the North or downstream communities, and compliance with EO 11988. Even though a small portion of the project area is within the 1-percent chance floodplain, this area is already fully developed, and there are no practicable alternatives to siting in the floodplain. There is Federal interest in constructing this plan, because it costs between $434,000 and $4,199,000 less than other alternatives (based on the alternatives screening cost estimates), it has a benefit-cost ratio higher than 1, and it is within the means of the city of Ada to operate and maintain.

123. Alternative 4 meets the planning goal of providing more complete, efficient, effective and reliable flood risk management to the city of Ada. It would be slightly less acceptable than

124. Inclusion of the west, northwest and east option areas meets the planning goal of providing more complete and reliable flood risk management. While the west, northwest and east option areas are not strictly within the city of Ada, they are part of the extended Ada community, and merit consideration. Inclusion of these option areas adheres to the planning constraints including compliance with NEPA, avoiding induced flooding on the Red River of the North or downstream communities, and compliance with EO 11988. The west, northwest and east option areas are not in the 1-percent chance floodplain. There is Federal interest in including these option areas as part of the selected plan, because they are all incrementally justified, and it is within the means of the city of Ada to operate and maintain the levee that will encompass these option areas.

SELECTED PLAN

125. It is recommended that Alternative 3 be the selected plan, because it meets all of the planning goals and objectives, while being the least-cost plan. Alternative 3 includes realignment of a portion of JD 51 along alignment 3. It is further recommended that the levees included in the selected plan be constructed to the 200-year flood level, because that has been determined to be the NED Plan. It is further recommended that the selected plan include the east, west and northeast option areas, because protection of these areas has been shown to be incrementally justified. This selected plan is consistent with the planning goal of providing more complete and reliable flood risk management to the city of Ada. This plan complies with NEPA, because it avoids, or offsets, adverse effects on natural, social and cultural resources. This plan will be designed to avoid induced flooding on the Red River of the North and downstream communities. This plan complies with EO 11988, because it does not encourage new development in the floodplain. The floodplain is defined as any lowland areas subject to a 1-percent or greater chance of flooding in any given year. While the recommended plan does encompass a large, undeveloped area, this area is not located in the defined floodplain. The selected plan is within the city of Ada's means to operate and maintain, because the city of Ada is already operating and maintaining similar levees and interior drainage structures. The added cost of annual maintenance for the new features is offset by savings in flood fighting and recovery costs.

126. The selected plan is shown on Plates C-001 and C-002 at the end of this section. (Overall plan and typical section sheets are provided for draft report. The final report will include more detailed plan and profile sheets).

RESIDUAL DAMAGES AND RISKS

127. Table 2 showed that, with the 200-year design level, average annual flood damages in the city of Ada would decrease from $704,000 to $44,600. This means that, even with levees designed to provide a 200-year design level, the city of Ada will still incur $44,600 in average annual flood damages. This is because, occasionally, a flood event larger than the 200-year event will occur and will cause damage in the city of Ada. The reality that the 200-year levee plan will not protect the city against all flooding was discussed at a meeting with representatives from the city of Ada on December 19, 2007. It was discussed that a higher design level could be pursued. However, in the case of Ada, increasing the design level to the 500-year flood event versus the 200-year flood event would have increased the average annual cost by $72,000, while only adding average annual benefits of $43,700. It was decided that, because the incremental cost of providing a higher level of flood risk reduction outweighed the incremental benefits, the 200-year design was the preferred plan. After this discussion, the recommended project was discussed at a city council meeting, and a resolution was passed supporting the proposed project with 200-year design.

128. While awareness of the project benefits and residual risks is high at this time, over time city leaders will change, and the residents may become less aware of the limitations of the project. To prevent this, measures will have to be taken to ensure that the community is aware of residual flood risk and has an emergency action plan for larger floods.

129. While the residents' risk of flood damage will be reduced to the point where their mortgage holders may not require flood insurance, each property owner within the project area will have to assess their willingness to accept the risk of not carrying additional flood insurance.

LOCALLY-PREFERRED PLAN

130. Based upon discussions with the city of Ada, the locally-preferred plan is the same as the Corps-recommended plan.

ENVIRONMENTAL AND CULTURAL RESOURCES

131. A draft Environmental Assessment and Section 404(B)(1) evaluation has been prepared and is attached to this feasibility report. The following is summary of the anticipated impacts of the proposed project.

132. <u>Natural Resources</u>. Minor adverse effects on natural resources would be caused by removal of riparian trees, required to construct the realigned JD 51 and levees. Potential adverse effects on wetlands associated with levee construction would be avoided by design of the levee alignment to avoid wetlands. There would be no effect on threatened and endangered species.

133. <u>Cultural Resources.</u> The proposed project would have no effect on cultural resources.

134. Social Resources. The proposed action would have a positive social effect on the residents within the project area, due to reduction in their risk of flood damages and cost of flooding and enhanced public safety.

135. The proposed action may have some negative social effects on landowners whose property must be purchased to construct the project features (such as levees, ponding areas and the relocated JD 51), because they will lose the use of the purchased property. The project will be designed to ensure that the property owners will retain access to their remaining property, if any accesses are removed as part of the project.

136. The project may have some negative social effects on property owners who are facing similar flooding challenges but are not within the project area. The levee will be a visible barrier between the community of Ada and properties located outside of the levee. However, the project will help to ensure that the commercial and government services provided by Ada remain available even during flood events to residents both inside and outside the project area.

137. The project would have a negative hydraulic impact on a limited area along the Marsh River on the south side of town, south of the proposed levee, between Hwy 9 and Jamison Avenue. The hydraulic analysis contained in Appendix B indicates an increase in flooding elevations for this area of 0.1 to 0.3 foot. An attorney's opinion of compensability is being prepared to determine if the effect is compensable. If there is a compensable interest, it will be included in the real estate plan and will be reflected in the implementation cost estimate. The real estate plan and implementation cost estimate will be included in the final report.

138. Communities downstream of Ada on JD 51 may be concerned about flows being conveyed more quickly down JD 51. However, it is intended that the realigned JD 51 be designed to ensure that the JD 51 flows downstream of Ada are not increased.

139. Ada residents and businesses may experience temporary inconvenience inherent in any construction project, such as the increased traffic, construction noise, and disruptions to daily routines.

WATER QUALITY

140. There would be no long-term water quality impacts.

FLOODPLAIN IMPACTS

141. Appendix B discusses the hydraulic analysis of the Wild Rice River, the Marsh River and JD 51 as they pertain to the proposed Ada project. The proposed project will not change the flow distribution between the Wild Rice River, Marsh River and JD 51. The proposed project will encroach on a small portion of the Marsh River flow limits, which may cause some localized increase in flood stage for floods greater than the 10-year event. Increases in flood stage for this area are on the order of 0.1 to 0.3 foot. The affected area is bounded by South Jamison Avenue on the west and Highway 9 on the east. It is bounded on the north by the proposed levee and on the south by the sewage treatment lagoons and high ground. One property (the UAP distribution facility) on the edge of the area would be affected. Further elevation surveys will be performed

during the design phase to verify if there are any quantifiable impacts on this facility that will require compensation.

MITIGATION MEASURES

142. No separate mitigation is required. Any effects on natural resources are expected to be minor and will be offset by natural resource attributes within the design of the other project features.

143. There would be little difference in natural resources effects among alternatives, because alternatives would vary primarily in the amount of agricultural land affected.

144. The Marsh River is an established watercourse with an adjacent existing levee. The levee is to be raised and expanded in an upland area between the city and the river. Minimal tree clearing would be required, and trees would be replaced in suitable locations at a rate of 2:1. The area identified as a disposal area for excess excavated material could be planted with trees or allowed to revert to natural conditions after construction.

145. According to the National Wetland Inventory, few wetlands are in the project area and most are remnant oxbows of the Marsh River. Because the levee alignment has been adjusted to avoid known wetlands and because the relocated JD 51 is passing entirely through upland areas, no wetlands would be affected by the proposed alignment. Any unidentified wetlands that might be affected by the final alignment would be mitigated within the project features, such as by allowing the abandoned section of JD 51 to revert to natural conditions.

RELOCATIONS OF UTILITIES

146. Utility relocations will typically be required when they are affected by construction of the project or where their continued presence is inconsistent with the operation of the flood risk management project features. Potential utility relocations include a water line, fiber optic cables, electric utility poles and the sewer line to the wastewater treatment plant. More detailed utility relocations will be identified in the design and implementation phase.

ROADS AND RAILROADS

147. Road raises are often required when the levees intersect roads. Sometimes road closures are acceptable if the height of the closure is less than 3 feet and the advance warning time is sufficient to allow for city workers to place the closure. The proposed levee in Ada crosses several major roadways. Because these roadways are main routes in and out of Ada and access is cut off as soon as a closure is installed, it is recommended that they be full-height road raises, rather than closures, or a partial road raise combined with a closure. The levee construction will require raising a portion of Highway 9 by 3.2 feet where the levee crosses it on the north side of town. The intersection of West Main Street and 210th Avenue will have to be raised by 4.7 feet where the levee crosses them on the north side of town. A portion of Highway 200 will have to be raised by 5.5 feet where the levee crosses it on the west side of town. A portion of Jamison Street (County Road 142) will have to be raised by 2 feet where the levee crosses it on the

southwest side of town. A portion of Highway 9 will have to be raised by less than 1 foot where the levee crosses it on the south side of town. A portion of County Road 180 will have to be raised by 3.9 feet where the levee crosses it on the southeast side of town. The realignment of JD 51 will require relocating the intersection of Norman County Road 163 (210th Street) with Highway 9, by moving it northward. The levee construction will require raising the grade of an abandoned Burlington Northern-Santa Fe (BNSF) Railroad line, presently being used as a recreational trail. This will be accomplished by ramping up and over the levee. Detailed design of the proposed project features will be discussed with the Minnesota Department of Transportation, the BNSF railroad, Norman County and other entities affected by road and railroad raises during the design and implementation phase. Identification of issues would be welcome during the review of this draft report.

REAL ESTATE REQUIREMENTS

148. The real estate interests required for construction of the recommended plan are estimated at roughly 62 acres of permanent easements for the levee, 33 acres of fee title interests for the relocated JD 51, 55 acres of occasional flowage easement, 15 acres for road easements, and 219 acres for temporary construction and disposal of excess excavated material. The approximate limits of the real estate that will be required for construction and future operation of the project are shown on Drawing C-003. The real estate plan will be prepared following public review of the draft report and will be included in Appendix H in the final report.

VALUE ENGINEERING CONSIDERATIONS

149. A formal value engineering study will be performed during the design and implementation phase.

RECREATION

150. At this time, no recreation features have been identified.

151. Any recreation features are cost-shared 50 percent non-Federal and 50 percent Federal.

CONSTRUCTION

152. Construction is estimated to last for approximately 1 year and will be supervised and administered by the St. Paul District's Western Area construction office in Fargo. Earthen material excavated from the relocation of JD 51, if suitable, will be used for the construction of the levees.

TECHNICAL ANALYSES

153. The hydrologic analysis is attached as Appendix A.

154. The hydraulic and interior flood control analysis is attached as Appendix B.

155. The geotechnical analysis is attached as Appendix C.

156. The structural analysis is attached as Appendix D.

157. The HTRW analysis is attached as Appendix E.

158. The economic analysis is attached as Appendix F.

159. The alternatives screening cost estimate is attached as Appendix G.

160. The real estate plan is attached as Appendix H (will be in final report).

161. The NED screening cost estimate is attached as Appendix I.

162. The implementation cost estimate is attached as Appendix J (will be in final report).

163. The project management plan is attached as Appendix K.

164. Pertinent correspondence is attached as Appendix L.

PLAN IMPLEMENTATION

165. The implementation responsibilities refer to actions and financial arrangements of Federal and non-Federal interests. The project management plan, contained in Appendix K, outlines the responsibilities of the Federal and non-Federal partners and the proposed schedule for implementing the recommended project. The following table shows the economic summary for the selected plan, based on the NED-level cost estimates. (The cumulative incremental cost adjustments for the east, west and northwest option areas are not included in this estimate, but would reflect a slightly lower cost. A more detailed cost estimate, including the option areas and final economic analysis will be shown in the final feasibility report. The result will be similar to what is shown below.

Table 7 – Cost summary for selected plan (200-year levee plan including east, west and northwest option areas)	
Project Costs	$7,670,000
Interest During Const.*	$184,732
Total Investment	$7,854,732
Int & Amort Factor	0.05372
Avg Ann Investment	$421,956
Avg Ann O&M	$28,741
Total Avg Ann Costs	$450,697
Average Annual Benefits	$677,700
Benefit-Cost Ratio	1.50
Net Benefits	$227,003

166. A breakdown of Federal and non-Federal implementation costs, based on a 35 percent non-Federal share are presented in the following table. (For the purposes of this draft report, the following table is based on the NED screening cost estimates. A detailed implementation cost estimate will be included in the final feasibility report and will be located in Appendix J).

Table 8

Breakdown of Fully-Funded Federal and Non-Federal Costs

Account	Description	Federal Cost	Non-Federal Cost	Total Cost
01	Lands and Damages	$ -	$ 825,942	$ 825,942
02	Relocations	$ 68,875	$ 37,086	$ 105,961
08	Roads, Railroads and Bridges	$ 1,120,467	$ 603,329	$ 1,723,796
09	Channels and Canals	$ 882,668	$ 475,283	$ 1,357,950
11	Levees and Floodwalls	$ 2,201,162	$ 359,299	$ 2,560,461
30	Planning Engineering and Design	$ 448,357	$ 241,423	$ 689,780
31	Administration	$ 261,542	$ 140,830	$ 402,372
	Interest during construction	$ 120,076	$ 64,656	$ 184,732
	Total	$ 5,103,146	$ 2,747,848	$ 7,850,994

ANNUAL COSTS

167. Annual operation and maintenance costs are anticipated at $28,700 (based on the NED screening cost estimate; a more accurate number will be provided in the final report). Annual operation and maintenance costs include maintenance of the relocated JD 51 channel, the levees and interior flood control features. These costs would be funded entirely by the project non-Federal sponsor.

JD 51 is currently operated and maintained by the WRWD. When maintenance or repair is performed on a judicial ditch, landowners are assessed for the cost. Because a portion of JD 51 will be relocated as a feature of the Section 205 flood control project, it is Corps' policy that the non-Federal sponsor (the city of Ada) will be responsible for future operation and maintenance of this feature. It is anticipated that this will relieve the WRWD and, thereby, other landowners of the cost of maintaining a portion of JD 51. There may need to be a memorandum of understanding among the city of Ada, the WRWD and the Corps regarding future maintenance of this portion of JD 51. The annualized Federal and non-Federal costs are summarized in the following table.

Table 9

Annualized Federal and Non-Federal Costs of Recommended Plan

Description	Federal Cost	Non-Federal Cost	Total Cost
Interest and Amortization incl. IDC	$274,271	$147,685	$421,956
Operation and Maintenance		$28,741	$28,741
Total	$274,271	$176,426	$450,697

PROJECT IMPLEMENTATION

168. Project implementation includes the preparation of design documents and completion of construction and project turnover.

169. The project non-Federal sponsor, proposed to be the city of Ada, will be responsible for a minimum of 35 percent of the project implementation costs, including acquisition of all lands, easements, rights-of-way and disposal areas (LERRDs), but no more than 50 percent of project costs if the cost of LERRDs exceed 35 percent of the project costs. At least 5 percent of the non-Federal sponsor share must be in the form of cash.

170. The project non-Federal sponsor shall be responsible for 100 percent of the project operation and maintenance costs.

171. Currently, no part of the project implementation is projected to be done as work-in-kind.

FEDERAL RESPONSIBILITIES

172. The Flood Control Act of 1936 provides that, in the interest of general public welfare, flood control is a proper activity of the Federal Government in cooperation with the States and local entities. Federal responsibilities for the recommended plan include engineering, design and construction of the proposed features. The project management plan, which details the remaining activities through design and construction, is presented in Appendix J.

NON-FEDERAL RESPONSIBILITIES

173. The non-Federal sponsor for this project is the city of Ada. Federal implementation of the recommended project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to:

a. Provide a minimum of 35 percent, but not to exceed 50 percent of total project costs as further specified below:

(1) Provide, during the design and implementation phase, a contribution of funds equal to 5 percent of total project costs.

(2) Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project.

(3) Provide, during the design and implementation phase, any additional funds necessary to make its total contribution equal to at least 35 percent of total project costs.

b. Provide, during the design and implementation phase, 100 percent of all costs of planning, design, and construction for the project that exceed $7,000,000.

c. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share therefor, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized by Federal law.

d. Not less than once each year, inform affected interests of the extent of protection afforded by the project.

e. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs.

f. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to prepare a floodplain management plan within 1 year after the date of signing a project cooperation agreement, and to implement such plan not later than 1 year after completion of construction of the project.

g. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the project.

h. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities that might reduce the level of protection the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function.

i. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-

4655), and the Uniform Regulations contained in 49 Code of Federal Regulations (CFR) Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

j. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government.

k. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project.

l. Hold and save the United States free from all damages arising from the design, construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors.

m. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 CFR Section 33.20.

n. Comply with all applicable Federal and State laws and regulations, including, but not limited to Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701-3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*).

o. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction.

p. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project.

q. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability and, to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA.

r. Provide, during the design and implementation phase, 35 percent of all costs that exceed $70,000 for data recovery activities associated with historic preservation for the project.

s. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

ABILITY TO PAY ANALYSIS

174. The city of Ada has indicated that it is financially capable of fulfilling the non-Federal sponsor requirements. Appendix K contains the city's self-certification of financial capability form.

RISK AND UNCERTAINTY

175. Expressions of uncertainty are among inputs to HEC-FDA; inputs affected include structure/content values, structure elevations, percent damages per depth of flooding, and frequency-discharge and stage-discharge relationships. Expression of the risk of levee overtopping will be presented in the final report.

176. The screening level estimates for the alternative design levels include a 25 percent contingency on all items of work to cover uncertainties in unit pricing, quantities, and unanticipated items of work.

177. Based on average annual benefits of $677,700 and average annual costs of $450,697 (including $28,741 for operation and maintenance costs), the average annual costs would have to

increase by $227,0000 to bring the benefit-cost ratio down to 1.0. Because the cost estimate used in the analysis already includes 25 percent contingencies to account for price uncertainty, it is unlikely that the benefit-cost ratio would drop below 1.0.

178. The proposed modifications to JD 51 will require coordination with the WRWD and may require a separate agreement to ensure that the watershed district does not make further changes to JD 51 in the project area without consultation with the city of Ada and the Corps.

179. Construction of the levee will require raising a portion of Highway 9 at the north and south ends of Ada. These road raises will require coordination with the Minnesota Department of Transportation.

180. The project team, including the non-Federal sponsor, anticipates some opposition by local landowners, which may require condemnation.

181. The non-Federal sponsor may request assistance from the State of Minnesota for the non-Federal share of the implementation costs. The State of Minnesota is on a 2-year funding cycle.

ENVIRONMENTAL COMPLIANCE

182. A draft Environmental Assessment and preliminary Section 404 (b) (1) Evaluation has been prepared along with this draft feasibility report, and will be made available for public and agency review. At the completion of the review it is expected that a finding of no significant impact (FONSI) will be signed. It is anticipated that a National Point Discharge Elimination Standard (NPDES) permit will be required. It is anticipated that a Section 401 Water Quality Certificate will be required. It is anticipated that the project will not require a protected waters permit.

VIEWS OF THE U.S. FISH AND WILDLIFE SERVICE

183. The U.S. Fish and Wildlife service has been consulted and has agreed with the tentative conclusions of the environmental assessment, including no adverse effect on threatened or endangered species. The MnDNR also agreed with the analysis.

OTHER PERMITS

184. It is anticipated that the proposed project will need to go through a Watershed District Improvement Hearing with regard to the JD 51 relocation.

SUMMARY

185. Ada has a history of flooding. Recent measures have been put in place by the city to reduce flood damages; however, these measures do not address flood risk management for the entire city of Ada.

186. Total expected annual damages to urban structures and other categories are approximately $704,000 under existing conditions. The recommended project would reduce these annual flood damages to $44,600. With a benefit-cost ratio of 1.50, the recommended project is economically justified.

CONCLUSIONS

187. The flood risk management project will provide flood damage reduction for the city of Ada. Estimated project costs are $7,850,994 and are within the Federal cost limitations of the Continuing Authorities Program established by the Flood Control Act of 1948, as amended.

NON-FEDERAL SPONSOR VIEWS

188. The non-Federal sponsor (city of Ada) has indicated that it wishes to construct the recommended project as described herein. A letter of intent is attached in Appendix K.

RECOMMENDATIONS

189. The above plan is recommended for construction under the authority of Section 205 of the Flood Control Act of 1948, as amended. Under Section 205, Congress has delegated to the Secretary of the Army, through the Chief of Engineers, the authority to plan, design and construct small flood risk management projects without specific congressional approval. There is a Federal cost limit, currently $7 million, to which the Federal Government can participate in such projects. Under this authority, the completed report will be submitted to the Mississippi Valley Division (CEMVD) for approval, and CEMVD will request from Headquarters funding for design and implementation.

190. I hereby recommend that the plan for flood risk management for Ada be authorized as a Federal project under Section 205 of the Flood Control Act of 1948, as amended, at a first cost to the United States of $5,103,146, and a first cost to the non-Federal sponsor of $2,747,848. This recommendation is contingent upon the provision that, prior to construction, the non-Federal sponsor provide the assurances of local cooperation as stated previously.

191. The recommendations contained herein reflect the policies governing formulation of individual projects and the information available at this time. They do not necessarily reflect program and budgeting priorities inherent in the local and State programs or the formulation of a national Civil Works construction program. Consequently, the recommendations may be modified prior to approval and implementation funding.

Jon L. Christensen
Colonel, Corps of Engineers
District Engineer

LIST OF ATTACHMENTS

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

FIGURES

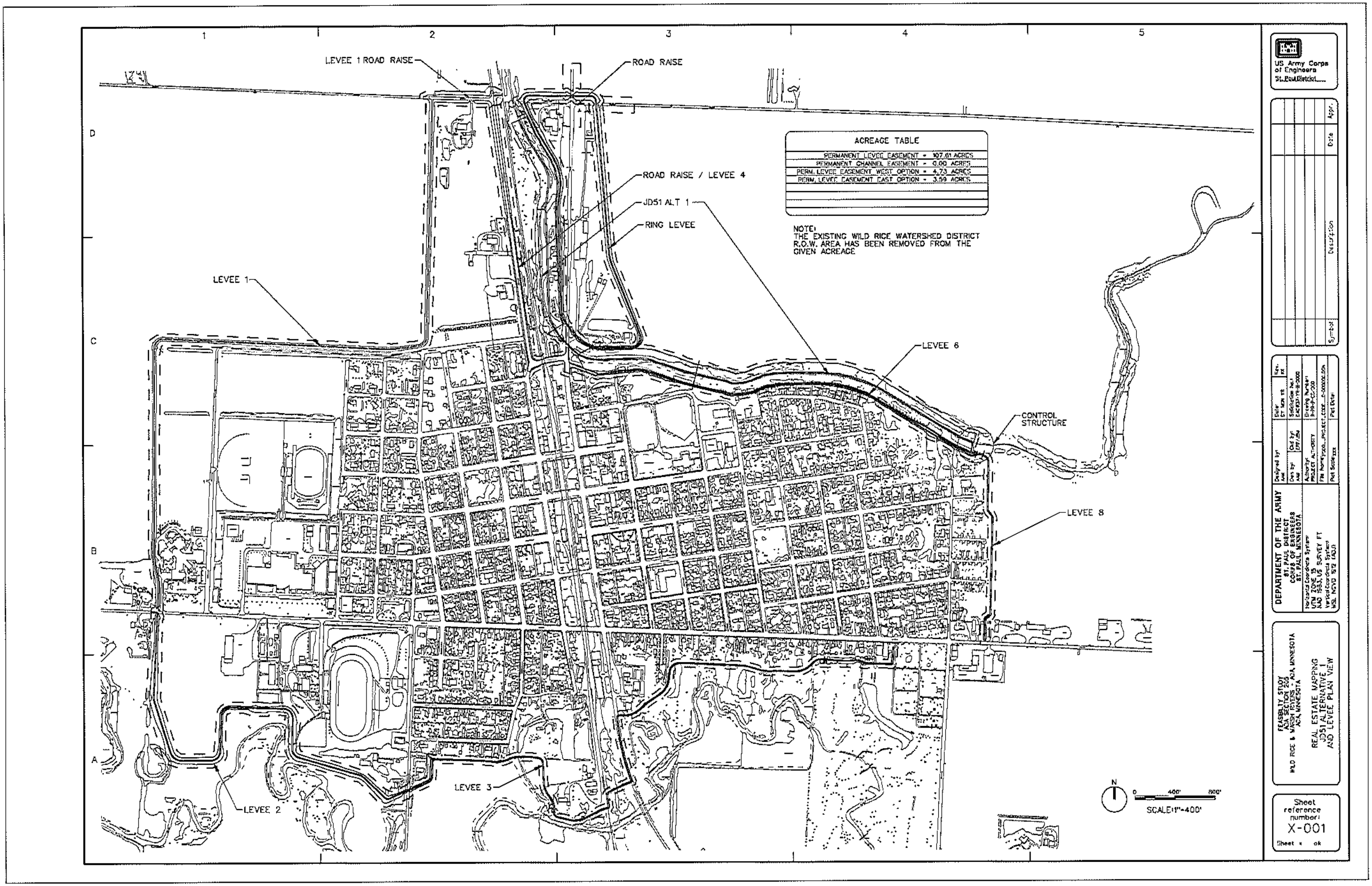


Figure 5 – Alternative 1

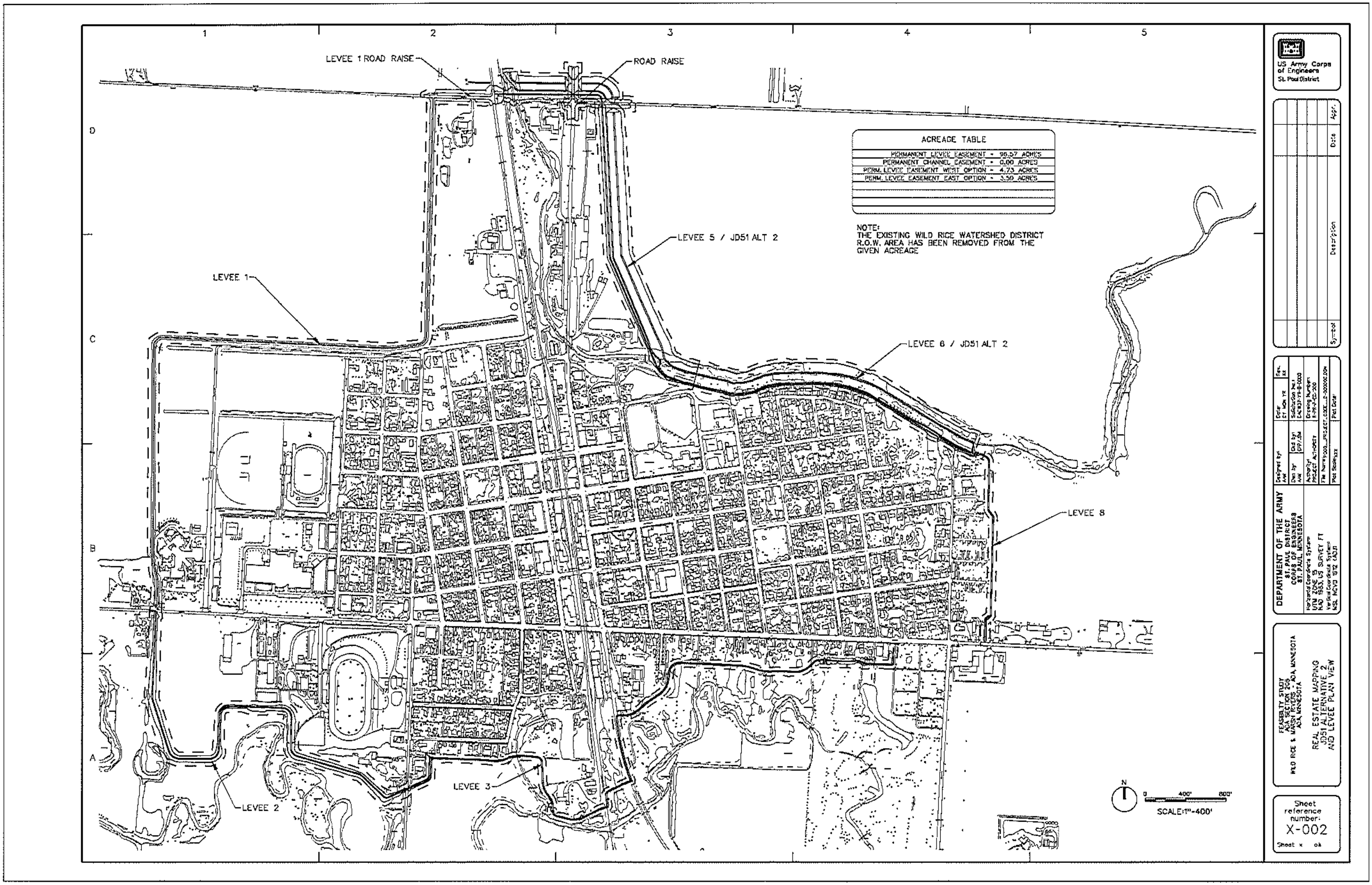


Figure 6 – Alternative 2

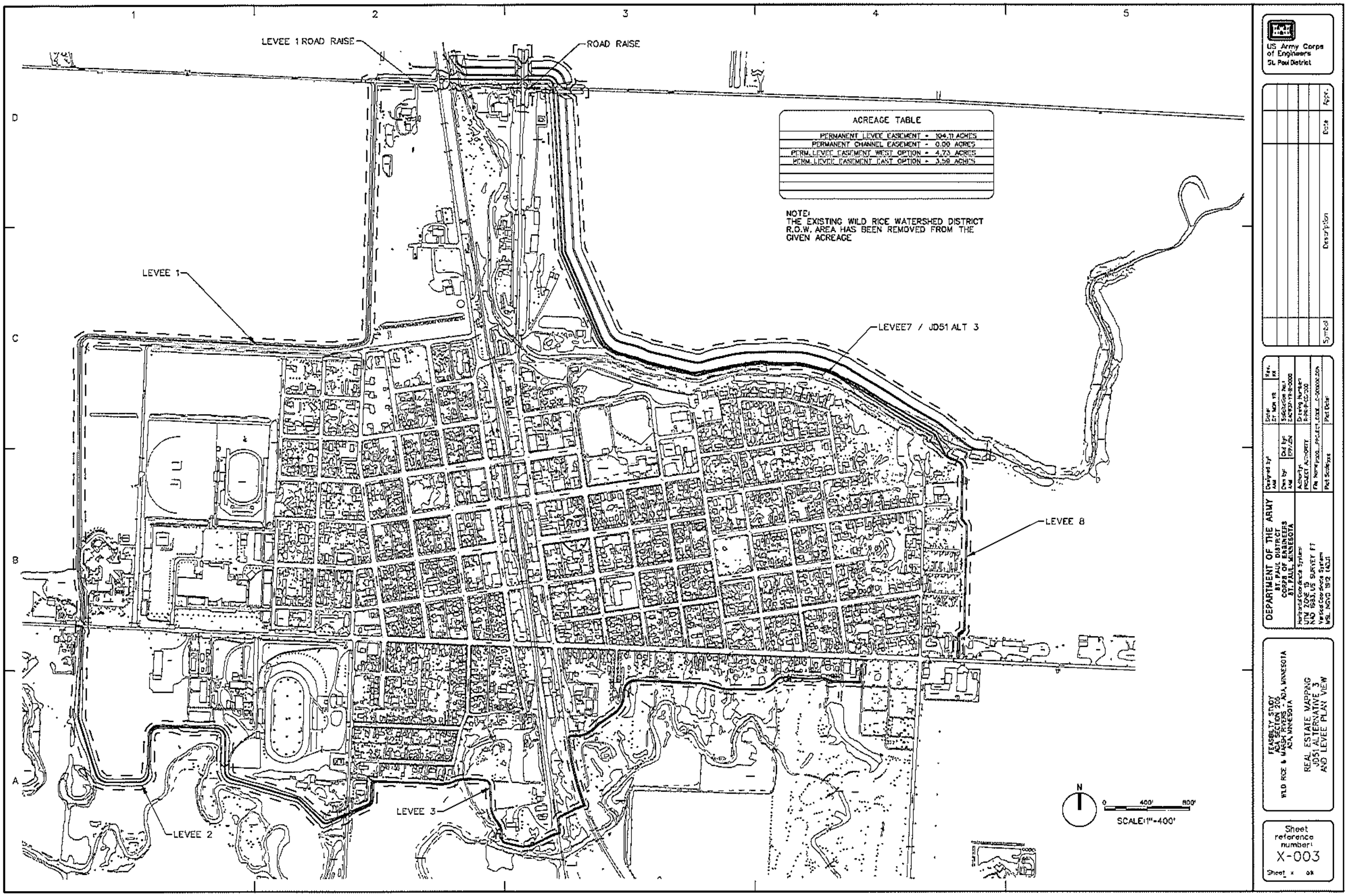


Figure 7 – Alternative 3

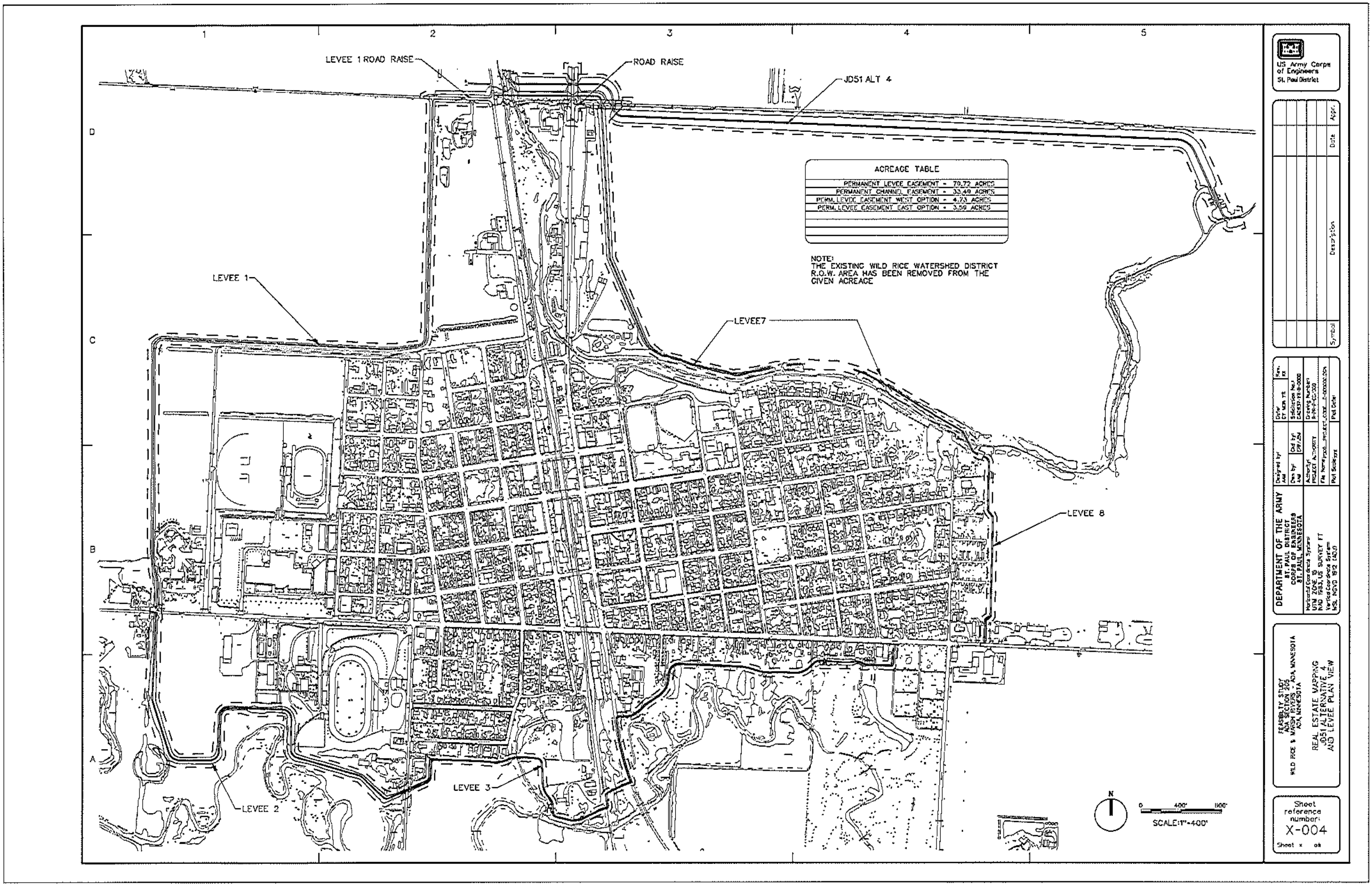


Figure 8 – Alternative 4

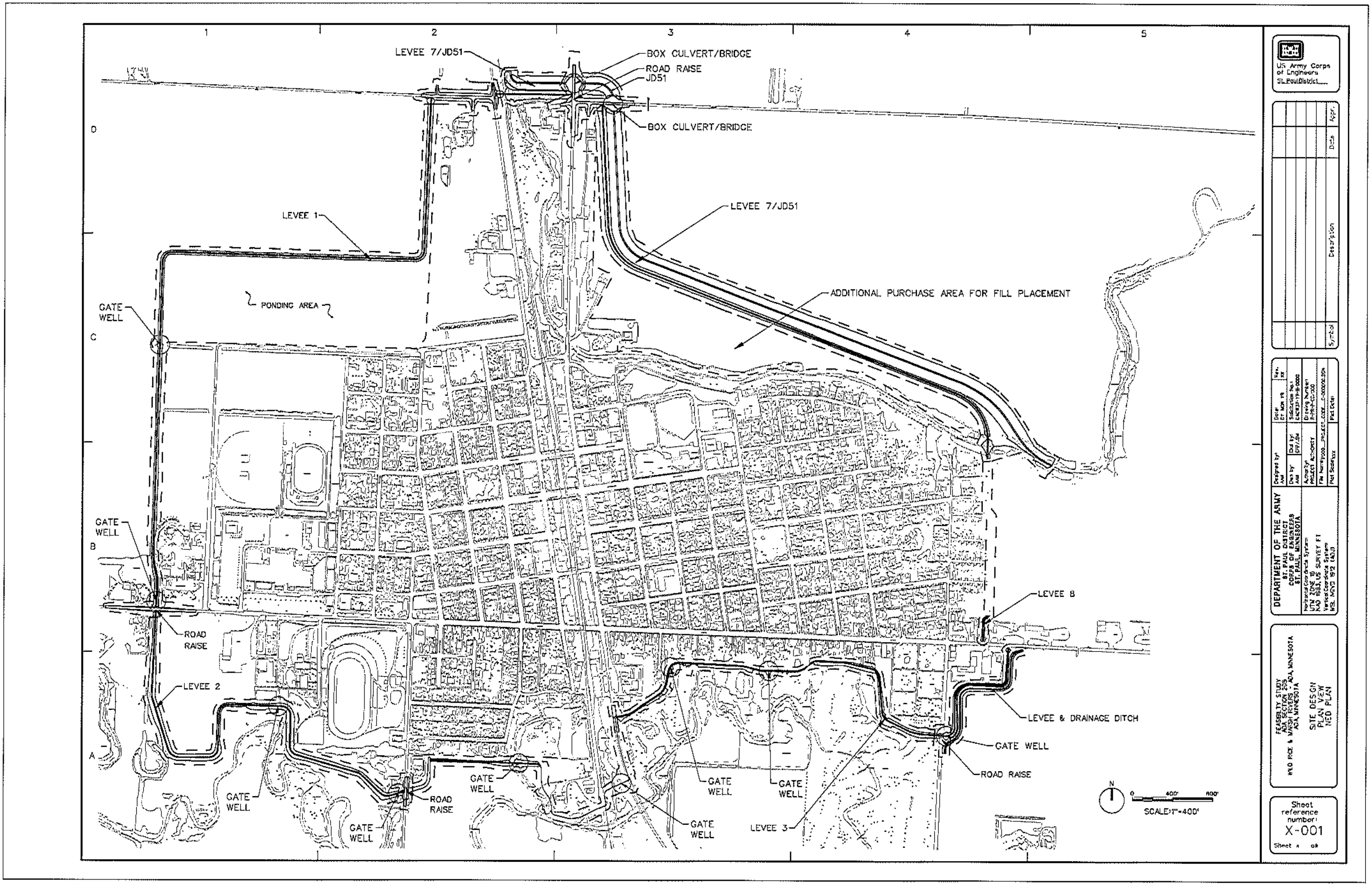


Figure 9 – Modified JD 51 and Primary Levee alignment used in the NED analysis

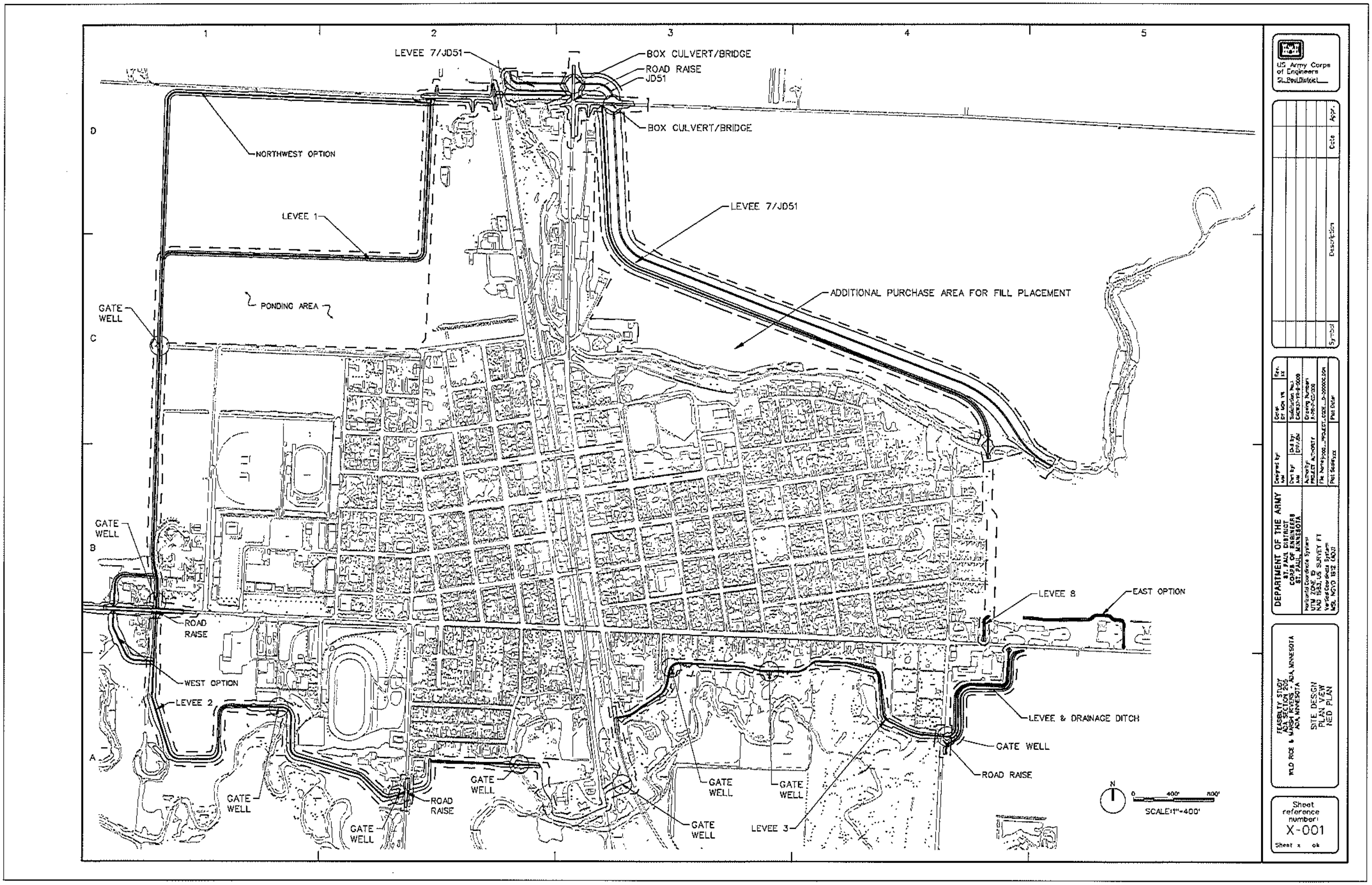


Figure 10 – Option Areas

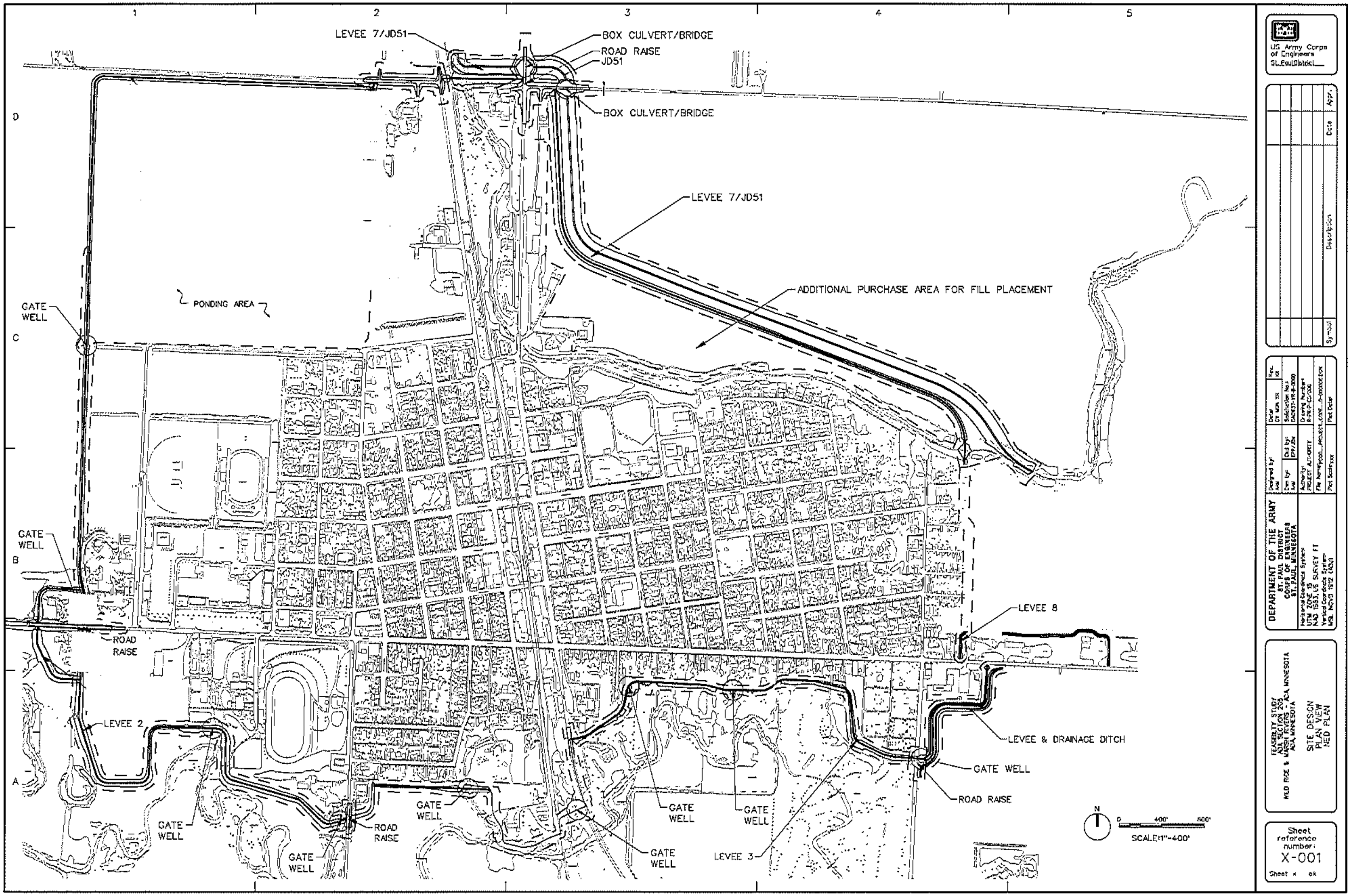


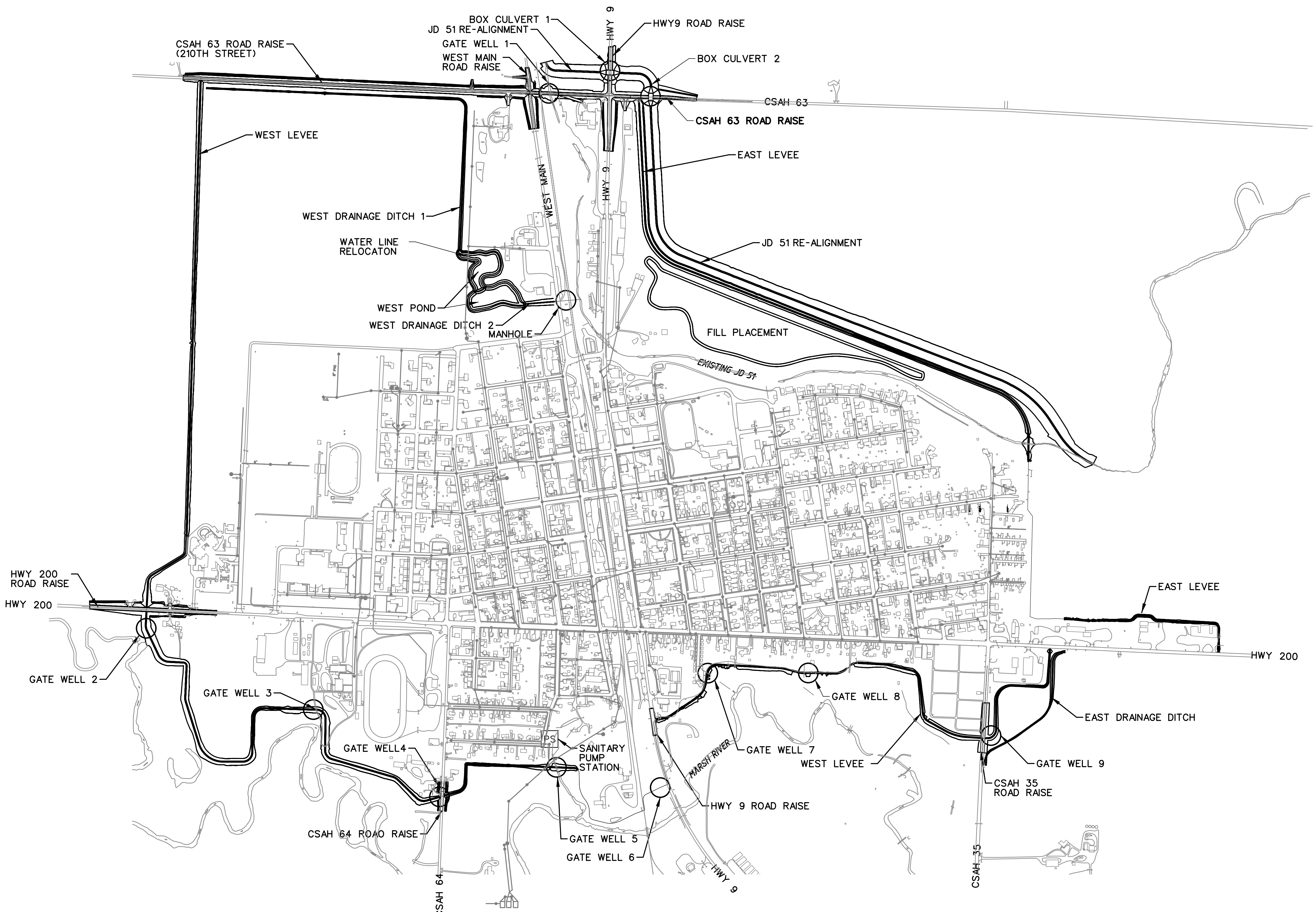
Figure 11 – Tentatively Selected Plan

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

DRAWINGS



GENERAL PLAN VIEW

0 500' 1000'

SCALE:1"=500'

US Army Corps of Engineers®
St. Paul District

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

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DWN BY: EPP
CKD BY: JBM
SUBMITTED BY:
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SIZE: ANSI B
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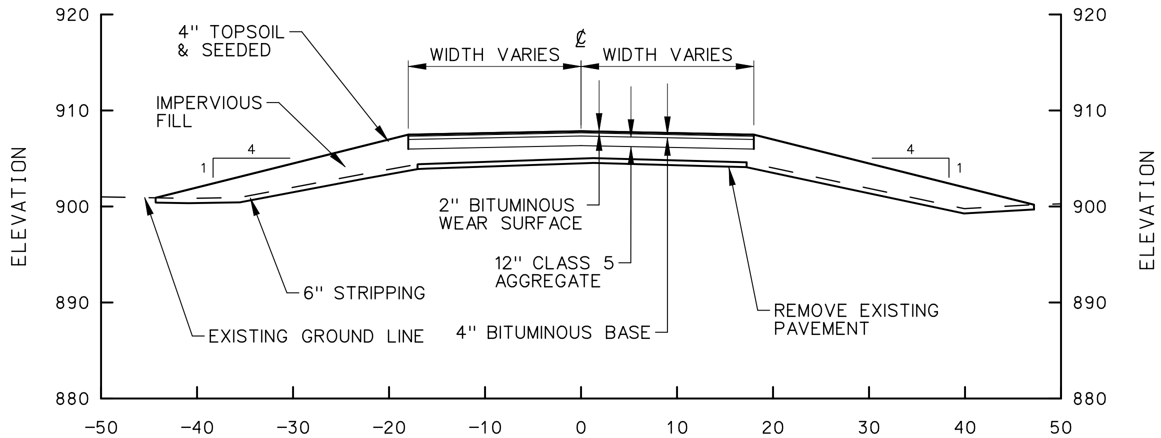
DATE: 2008/12/08
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:

SECTION 205 FEASIBILTY STUDY
WILD RICE AND MARSH RIVERS
ADA, MINNESOTA

SITE DESIGN
GENERAL PLAN

SHEET IDENTIFICATION
C-001



1 TYPICAL SECTION
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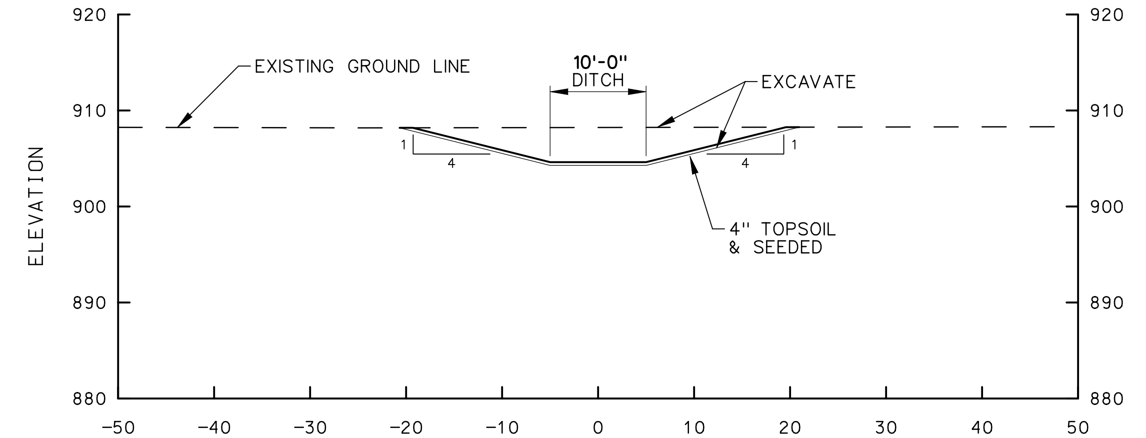
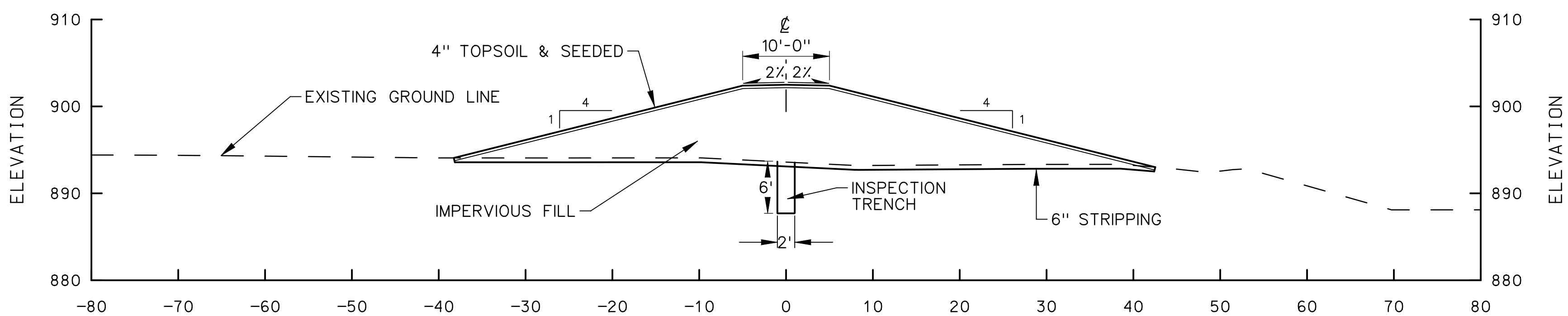
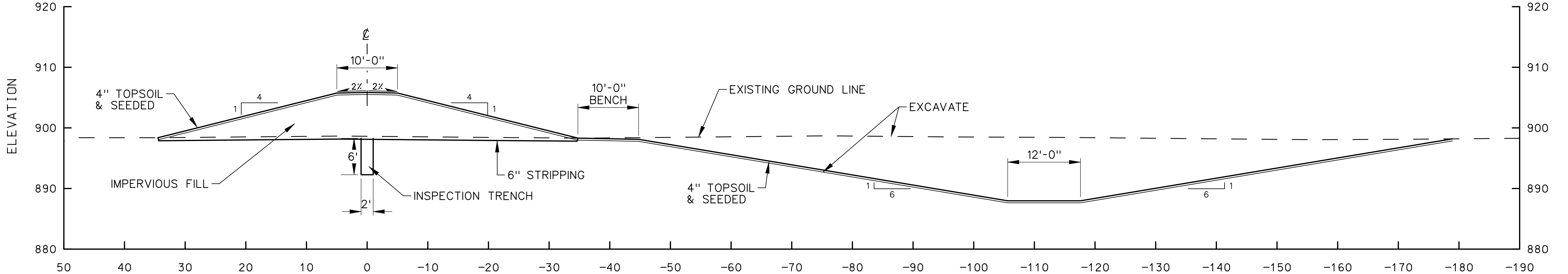


2 TYPICAL SECTION
DRAINAGE SITCH



3 TYPICAL SECTION
LEVEE



4 TYPICAL SECTION
LEVEE & DITCH

US Army Corps of Engineers® St. Paul District

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

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DWN BY: EPP
CKD BY: JBM
SUBMITTED BY:
PLOT SCALE:
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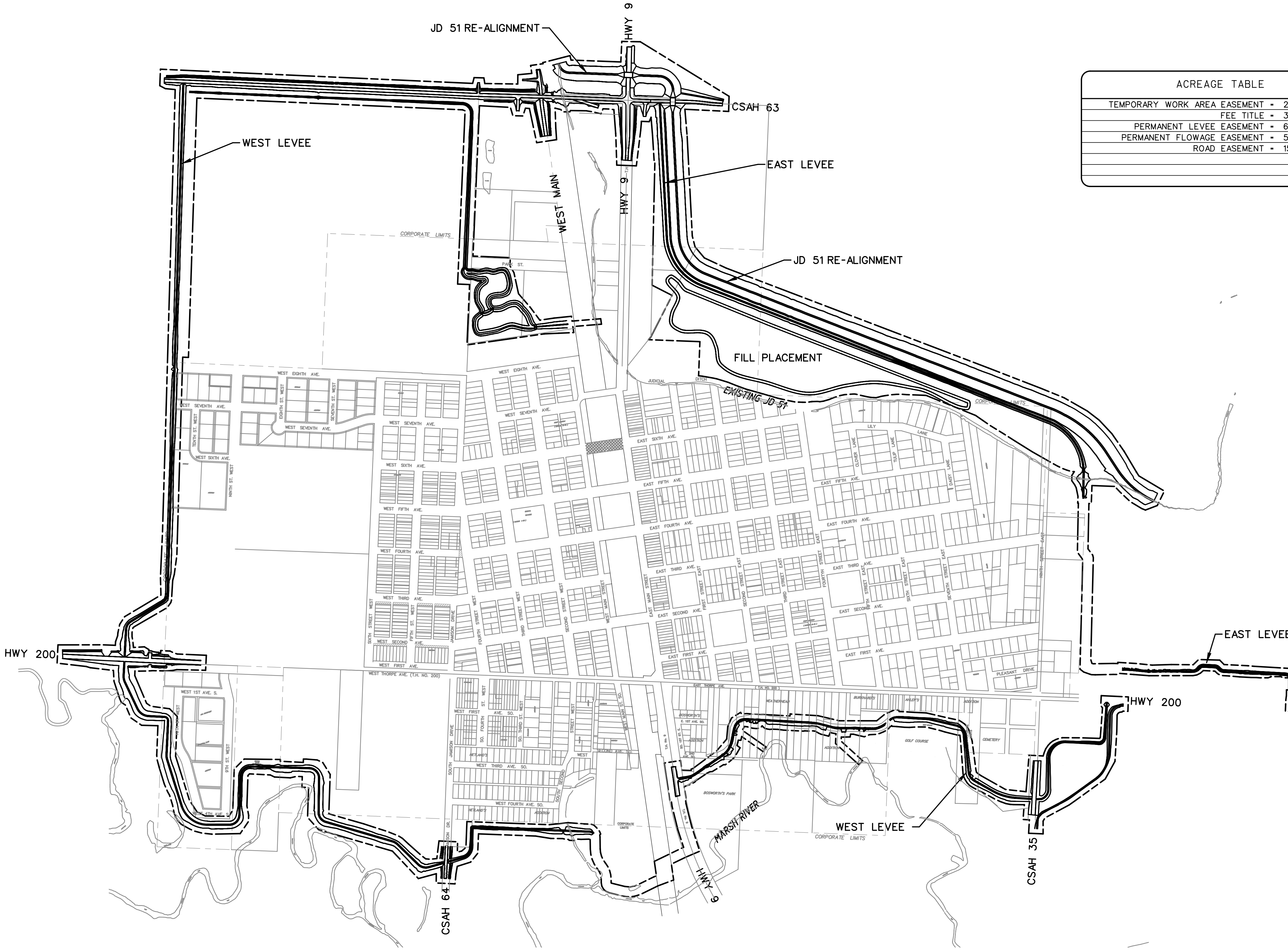
DATE: 2008/12/08
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:

SECTION 205 FEASIBILTY STUDY
WILD RICE AND MARSH RIVERS
ADA, MINNESOTA

SITE DESIGN
TYPICAL SECTIONS

SHEET IDENTIFICATION
C-002



ACREAGE TABLE

TEMPORARY WORK AREA EASEMENT -	228.29 ACRES
FEE TITLE -	33.23 ACRES
PERMANENT LEVEE EASEMENT -	62.32 ACRES
PERMANENT FLOWAGE EASEMENT -	54.65 ACRES
ROAD EASEMENT -	15.36 ACRES

GENERAL PLAN VIEW

0 500' 1000'

SCALE:1"=500'

N

US Army Corps of Engineers® St. Paul District

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: AAM		DATE: 2008/12/08
DWN BY: AAM	CKD BY: JBM	SOLICITATION NO.:
SUBMITTED BY:		CONTRACT NO.:
PLOT SCALE: 1" = 500'	PLOT DATE: No	FILE NUMBER:
SIZE: ANSI B	FILE NAME: ADA_draffeas___ROWcover.dgn	

SECTION 205 FEASIBILTY STUDY
WILD RICE AND MARSH RIVERS
ADA, MINNESOTA

REAL ESTATE
GENERAL PLAN

SHEET IDENTIFICATION
C-003

auto_time

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

ENVIRONMENTAL ASSESSMENT

DRAFT
ENVIRONMENTAL ASSESSMENT
ADA, NORMAN COUNTY, MINNESOTA
FLOOD RISK MANAGEMENT

INTRODUCTION

The St. Paul District, Corps of Engineers, has prepared this assessment of the environmental effects that may result from the proposed construction of flood protection measures at Ada, Minnesota. This assessment of the Corps of Engineers proposal is required by the National Environmental Policy Act of 1969 (NEPA), Council on Environmental Quality Regulations (40 CFR 1500-1508), and Corps of Engineers regulation ER 200-2-2.

PROJECT AUTHORITY

The authorization for the planning and design of the proposed actions was given in the Flood Control Act of 1948 (Public Law 80-858), as amended. This legislation allows the Corps of Engineers to provide flood protection to communities.

PROJECT LOCATION

The proposed action would be located in and around the city of Ada, Norman County, Minnesota. Ada is located in northwestern Minnesota 265 miles northwest of St. Paul, Minnesota, and 65 miles southeast of Grand Forks, North Dakota.

MAJOR FINDINGS AND CONCLUSIONS

The purpose of this environmental evaluation is to assess the impacts of various measures to provide improved flood risk management to the city of Ada in Norman County, Minnesota.

Alternatives considered to protect the city include various alignments and levels of protection and the selected plan.

An environmental review of the proposed action indicates that the project would not result in significant effects to the environment and that probable effects in the area would be short-term and minor. Therefore, an environmental impact statement will not be prepared. If the public review identifies significant issues, a revised NEPA document may be prepared. A 404(b)(1) evaluation has been prepared. A State Water Quality Certificate (Section 401) has been applied for and will be obtained before construction.

Relationship to Environmental Requirements

The proposed action would comply with 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, as amended; the Endangered Species Act of 1973, as amended; the Fish and

Wildlife Coordination Act of 1958, as amended; the Land and Water Conservation Fund Act of 1965, as amended; the National Historic Preservation Act of 1966, as amended; the National Environmental Policy Act of 1969, as amended; Executive Order 11988 - Floodplain Management; and Executive Order 11990 - Protection of Wetlands and Executive Order – 12898. The proposed action would not result in the conversion of farmland to nonagricultural uses. Therefore, the Farmland Protection Policy Act of 1981 does not apply to this project.

PURPOSE AND NEED FOR THE PROPOSED ACTION

The proposed action is necessary because the existing conditions leave the community of Ada subject to flooding from high stages on the Marsh and Wild Rice Rivers.

ALTERNATIVES

Alternatives considered for providing flood protection for the city of Ada included no action, nonstructural measures and variations of a structural plan.

No Action

The no-action alternative, or future without-project condition, depicts existing conditions in the area and assumes the continuation of existing trends. This includes the rate of housing development in the northwest part of town. Flooding blocks ingress to and egress from the city, causes isolation of the regional hospital and high school, results in discharge of untreated waste water into surrounding floodwaters, and blocks discharge of city storm sewers.

Nonstructural Alternatives

Nonstructural alternatives are measures that could include flood proofing, structure raising, relocation, ring dikes, and acquisition and demolition. Nonstructural flood control features were considered for the Ada project, but they were not found to be feasible because of their cost and because they would not prevent isolation of the city from the surrounding area nor would they prevent the interruption of wastewater treatment or stormwater discharge.

Structural Alternatives

It was determined early in the study that the disposition of Judicial Ditch (JD) 51 flows, would affect the development of all other flood risk management features. Currently, JD 51 passes through the city of Ada, where it must flow through a narrow channel adjacent to a residential area and then through a concrete underpass beneath Highway 9. The JD 51 side slopes are nearly vertical in some areas and the channel bank is sloughing. The proposed project features must include stabilization of JD 51 in its present location or relocating it to a more stable regime. All potential locations for JD 51 would encroach on farmland to varying degrees. All alignments would be equal in having minimal effects on natural resources because the project would be built where the land use is urban or agricultural. Four alignments for JD 51 were considered, as described below: Alternative 3, the most economical, was included in the selected plan.

1. Alignment 1 would follow the current alignment for JD 51.
2. Alignment 2 would follow a portion of the current alignment, and then divert JD 51 around the northeast portion of the city.
3. Alignment 3 would divert JD 51 northward, nearer to the eastern city limits.
4. Alignment 4 would divert JD 51 completely away from its current alignment.

Selected Plan

The proposed action includes: relocation of a portion of JD 51 on the northeast side of Ada, construction of a levee system designed to provide protection against the 200-year flood event and appurtenant interior and exterior drainage facilities including ponding areas, connective ditches and gated outlet structures.

a. Starting from a point approximately 600 feet east of the eastern Ada city limits, JD 51 would be diverted northwestward from its present course, through an existing agricultural field. The relocated JD 51 channel would turn northward as it nears the Norman County Maintenance facility. The relocated JD 51 would pass beneath County-State Aid Highway (CSAH 63) (210th Avenue) via three 12-foot by 12-foot box culverts and then turn westward, passing beneath Trunk Highway 9 via three additional 12-foot by 12-foot box culverts. The relocated JD 51 channel would rejoin the existing JD 51 channel near the northern Ada city limits. The portion of the old JD 51 that passes through the city of Ada would be abandoned as a judicial ditch but would still remain to handle stormwater runoff from the city of Ada. The upstream end of the abandoned ditch would be plugged near the eastern Ada city limits, where the proposed levee would cross the ditch alignment. Stormwater from the city would continue to empty into the abandoned portion of the ditch, which would be used as a temporary ponding area. A flap-gated culvert would be placed at the downstream end of the abandoned portion of the ditch where the proposed levee crosses the ditch alignment to allow for continued drainage of stormwater from the city of Ada.

b. The proposed levee system would incorporate both new and existing levees. Starting from a point on Highway 200, east of the current eastern city limits of Ada, the levee would run northward and then would turn westward, providing protection to several businesses adjacent to Highway 200. The levee would join an existing north-south levee that was constructed by the city of Ada in 1997, with additions constructed in 1998. The proposed levee would continue northward from this existing levee, where it would cross the existing JD 51 channel, effectively blocking flow from the existing JD 51 into the city of Ada. After crossing the existing JD 51 channel, the new levee would turn northwestward, running parallel and to the south and west of the newly relocated JD 51 channel, and to the east of the Norman County Maintenance facility. Near the northern city limits, the levee would turn westwards. A portion of CSAH 63 would need to be raised and would run coincident with the levee near its intersection with Highway 9. Highway 9 would also be raised so that it crosses over the levee. From Highway 9, continuing westward, the levee would be built coincident with a roadway across JD 51. Where it crosses the existing JD 51 channel, flap-gated culverts would pass beneath the levee to allow interior flows from the city of Ada to continue to drain into the downstream portions of JD 51. Continuing westward, the levee would cross an abandoned railroad bed. The railroad bed would be ramped over the levee to allow for recreational usage. The levee would continue west intersecting 210th Avenue, a portion of which would be raised to the desired levee height. Turning southward, the levee would run near the western city limits, passing between two agricultural fields. Near the health care facility, the levee would turn west to wrap around two farmsteads located near the western city limits, adjacent to Highway 200. Highway 200 would be raised so that it crosses over the levee. South of the second farmstead, south of Highway 200, the levee would meander eastward around the new industrial park and the fairgrounds until it meets up with Jamison Road. A small portion of Jamison Road would be raised over the levee. The levee would continue east of Jamison Road, turning northward briefly to align with the existing southern levee. The existing southern levee was originally constructed in 1997, with additions constructed in 1998, 2002 and 2003. Improvements in drainage were made in 2004. The proposed levee alignment would follow this existing levee alignment, tying into high ground on the east side of an existing oxbow. This portion of the existing southern levee would have to be raised slightly, and an existing field access would have to be ramped over the levee. On the east side of Highway 9, near the southern city limits, the levee would continue from high ground at Highway 9, and would follow the existing southern levee alignment, which passes to the north of Bosworth park and south of residences along the south side of Highway 200. The height of this levee will remain essentially the same, but the slopes may be flattened in some locations to ensure stability. This existing levee currently terminates near the cemetery. An additional portion of levee will be extended around the cemetery and will wrap around the south and east side of one commercial property located on the south side of Highway 200 near the eastern Ada city limits. The levee will tie into high ground at Highway 200, east of the eastern city limits.

c. In the northwestern portion of the protected area, a sediment-filtering stormwater retention pond would be constructed. Drainage from this pond would empty into the abandoned JD 51 channel, similar to other stormwater runoff from the city.

d. The existing gravity sanitary sewer line leading from the city to the wastewater pumping station, located south of the city on Jamison Avenue, would be modified to allow for continuity of operation during flooding. This will involve construction of a sanitary sewer pumping station within the levee alignment and modification to the city's existing sanitary sewer lines to direct flows towards the new sanitary pumping station.

e. All borrow material for construction of levees and road raises would be obtained from the excavation of the new alignment of JD 51. Material in excess of construction needs would be disposed of in an isolated upland area adjacent to the old JD 51. This area would be planted with native species that may include riparian trees. This area would then be allowed to revert to natural conditions.

f. Fill material, primarily riprap, would be placed around the outlets of nine gate wells that would convey interior drainage from inside the levee area during nonflood events.

ENVIRONMENTAL SETTING

The project area is located in northwest Minnesota near the Marsh River in the city of Ada, Norman County (Exhibit1). The existing conditions are described in the following paragraphs.

The project area, within the bed of glacial Lake Agassiz is extremely flat and, aside from stream courses, devoid of woody vegetation. Native prairie is rare and confined to small remnant patches, many of which are along railroad right-of-way. Water resources include JD 51, which drains to the west on the north side of the city of Ada and the Marsh River which borders the city to the south. A few small temporarily or seasonally flooded wetlands are within the project area.

Natural Resources

The city of Ada is within the northern floodplain forest and prairie ecosystems. Because of agricultural development, few prairie areas remain. Wooded areas are limited primarily to areas along the river. The most common tree species present are American elm, box elder, and green ash. Other species include cottonwood, basswood, and willow.

Terrestrial wildlife in the area includes white-tailed deer, fox, raccoon, squirrels, rabbits, and a variety of songbirds. Habitat is limited by agriculture to the riparian corridors of JD51 and the Marsh and Wild Rice rivers. Numerous waterfowl pass through the area during migration.

The Marsh River, adjacent to Ada on the south, receives excess flow from the Wild Rice River. Few fish are present because aquatic habitat is limited by low winter flows. The Wild Rice River, a short distance south of the city has primarily sand and silt substrates. Aquatic vegetation is sparse along the river, except in some oxbows. Northern redhorse, white sucker, carp and various minnows are the predominant fish species. Northern pike, walleye, and rock bass also occur, primarily in the deeper pools.

A few small temporarily or seasonally flooded wetlands are within the project area,; most are primarily remnant oxbows of the Marsh River

Based on a review of the Minnesota Natural Heritage Database and the Federal Endangered Species List, no Federally-listed or State-listed threatened or endangered species are present in the project area. However, the bald eagle (*Haliaeetus leucocephalus*) may be sighted occasionally in the area. Although no longer listed on the Endangered Species list, the bald eagle is protected by the Bald and Golden Eagle Protection Act.

Cultural Resources

This portion of Minnesota contains numerous cultural resources indicating continual human occupation for approximately 12,000 years. Cultural resource sites within the region exist on a variety of landforms, including uplands, terraces, floodplains and glacial beach ridges. Precontact cultural resources include lithic and artifact scatters and burial mounds. Historic cultural resources include Euro-American structural ruins, standing structures, cemeteries, roads and trails.

Interest in the archaeological record of northwestern Minnesota has been ongoing since the late 19th century, where antiquarians examined several burial mounds in Norman County (e.g., Winchell 1911). However, scientific investigations in Norman County were not initiated until the middle of the 20th century when the University of Minnesota investigated several sites (Johnson 1974). Most of the archaeological inquiry in the county has been focused along the Red River (e.g., Johnson 1973; Michlovic 1986, 1987). By the later part of the 20th century, several compliance driven cultural resource investigations have been conducted for various flood control projects along the Wild Rice and Marsh Rivers. Several of these surveys were completed in the vicinity of Ada (Streiff 1974; Michlovic 1976, 1977; Stevenson 1986; Withrow and O'Mack 1989; Kinney 1996; Nienow 2002). The Corps recently commissioned a survey specifically for the Ada flood risk management project (Florin 2008).

Within the city of Ada, three historic structures are listed on the National Register of Historic Places (NRHP): the Ada City Hall/Fire Hall, Norman County Courthouse and the Ada Congregational Church. The Ada Public School has been determined eligible for listing on the NRHP. An additional 34 historic architectural properties have been identified in and around Ada (Florin 2008). Two precontact sites are located within the construction limits of the proposed project. Site 259-1 consists of a single artifact find spot and site 259-2 is a single piece of lithic debris (Florin 2008).

Socioeconomic Resources

Population - The population of Ada as of the latest census (2000) was 1,657. This represents a continuation of population decline in recent decades. Population was 2,076 in 1970, 1,971 in 1980, and 1,708 in 1990. In contrast, the nearest MSA, Fargo, North Dakota-Moorhead, Minnesota, located 40 miles to the southwest, has experienced population growth in recent years increasing from 137,574 in 1980 to 174,367 in 2000.

Income - Per capita income for Norman County in 2005 was $27,414. This was lower than that for the State of Minnesota ($37,290) and for the nation as a whole ($34,471). Income growth since 1990 was also lower than State and national figures. From 1990 to 2005, per capita income for Norman County grew 56.0 percent, while Minnesota's per capita income grew 87.5 percent and that of the U.S. grew 77.0 percent.

Employment - The employment profile for Norman County is shown in Table 1. Figures for the

State of Minnesota are presented also for perspective. Compared with State averages, the agricultural sector comprises a larger percentage of the local economy while manufacturing plays a much lesser role.

Table 1 - Employment by Industry (2005)				
Industry	Norman Co.	% of Total	Minnesota	% of Total
Farm employment	894	21.8%	100,539	2.9%
Forestry, fishing	*		14,094	0.4%
Mining	*		6,708	0.2%
Utilities	*		12,673	0.4%
Construction	*		200,591	5.7%
Manufacturing	10	0.2%	362,545	10.4%
Wholesale trade	119	2.9%	143,110	4.1%
Retail trade	396	9.7%	381,567	10.9%
Transportation & warehousing	*		108,389	3.1%
Information	126	3.1%	68,386	2.0%
Finance and insurance	204	5.0%	184,916	5.3%
Real Estate	94	2.3%	116,798	3.3%
Professional/technical services	119	2.9%	119,926	3.4%
Management	0	0.0%	64,510	1.8%
Administrative, waste services	*		165,371	4.7%
Educational services	> 10		71,854	2.1%
Health care, social assistance	500	12.2%	399,535	11.4%
Arts, entertainment, recreation	61	1.5%	72,726	2.1%
Accommodation, food services	*		218,673	6.3%
Other private services	260	6.3%	190,542	5.4%
Government	572	13.9%	415,134	11.9%
Total	4103	100.0%	3,498,587	100.0%
* Not shown to avoid disclosure of confidential information; estimates included in totals				
Source: BEA - Regional Economic Accounts				

ENVIRONMENTAL EFFECTS

No significant adverse impacts would result from construction of the proposed project. As specified in Section 122 of the 1970 Rivers and Harbors Act, potential project impacts on the parameters listed in Table 2 were considered in arriving at a final determination. In compliance with Section 404 of the Clean Water Act, a 404(b)(1) evaluation has been prepared (Enclosure A).

Natural Resources

Aquatic Habitat

The Marsh River is an established watercourse with habitat limited by periods of low to no flow. An existing levee is adjacent to the Marsh River. The levee is to be raised and expanded, on the city side, in an upland area between the city and the river. The levee would not encroach on Marsh River aquatic habitat.

JD51 is an intermittent/seasonal watercourse. Because it is wet for some portion of the year, it shows some characteristics of a wetland. However, as a legal ditch it is subject to maintenance, cleanout and alteration. The proximity of JD51 to residences limited alternatives for relocation of the ditch. It would be necessary to alter the course of JD51 to accommodate levee construction without removing homes. The new ditch would replicate the old in size and shape and would be allowed to naturally revegetate. The upland areas along the ditch alignment would be revegetated with native species to stabilize soils after construction. A portion of the ditch would remain within the levee and continue to drain runoff from the city. Because it would be isolated from agricultural runoff, it would be expected that wetland characteristics would be maintained or improved. This would offset temporary adverse effects from construction of the new ditch.

Wetlands

A few small temporarily or seasonally flooded wetlands are within the project area. These wetlands are primarily remnant oxbows of the Marsh River. Wetlands would be avoided by design of levee alignments. No mitigation would be required. A new sewer line that would cross one of the oxbows would be constructed with trenchless techniques (e.g., horizontal directional drilling) to avoid any effect on wetland habitat. The old JD 51 section would retain wetland characteristics. The new ditch would not be excavated through any wetlands. The stormwater detention pond would be built with some wetland characteristics.

Terrestrial/Woodland

The project area, within the bed of glacial Lake Agassiz is extremely flat and, aside from water courses, devoid of woody vegetation. Native prairie is rare and confined to small remnant patches, many of which are along railroad right-of-way.

Areas to be disturbed by the project include residential and public property and agricultural fields in active cultivation. Levee alignments would primarily affect cultivated fields and would be oriented to follow roads and property boundaries to minimize disruption.

There would little difference in impacts on natural resources and mitigation requirements among alternatives, because alternatives would vary primarily in the amount of agricultural land affected.

Some land adjacent to the section of old JD 51 within the levee would be set aside for placement of excess fill. This area would be planted with native tree species and would also provide for replacement of trees removed during construction. The area would be isolated and would be allowed to develop as a natural riparian area.

Air Quality

The operation of construction equipment may result in a short-tem localized reduction in air quality. Contractors would be required to maintain their equipment in proper working order to minimize any adverse effect. As mentioned elsewhere in this document, the operation of this equipment would also result in an increased noise level during operations. Adverse effects would be limited and short-term because they are associated with construction.

Threatened and Endangered Species
As part of this analysis, it has been concluded that the project would have no adverse effects on any listed endangered or threatened species. The U.S. Fish and Wildlife Service concurred with this determination (Attachment B).

Cultural Resources

The proposed project will have no impact on the three historic structures listed on the NRHP (the Ada City Hall/Fire Hall, Norman County Courthouse and the Ada Congregational Church) or the Ada Public School which has been determined eligible for listing. These structures are within, or proximal to, the center of the city, and no direct or indirect impacts from the proposed project will occur.

The recent cultural resources survey completed for the project identified 34 historic architectural properties within the area of potential effects of the project, encompassing an area 100 meters adjacent to project features. Of these, seven are recommended for Phase II evaluation (Florin 2008).

The two precontact archaeological sites (sites 259-1 and 259-2) consist of single artifact find spots. At each location, a series of shovel tests were excavated, and no additional cultural materials or other phenomenon were encountered. Both sites appear to lack the potential to provide important information on the history of the region and are considered not eligible for listing on the NRHP (Florin 2008). Therefore, the proposed project will have no adverse impact to sites 259-1 and 259-2.

Because the Phase I cultural resources survey for the proposed project was completed before the final design was completed, an additional cultural resources survey is required. In addition, the survey of the historic architectural properties recommended for Phase II evaluations remain to be completed. It is anticipated that the Phase II evaluations and additional Phase I survey will be completed based on the final design in 2008. During the course of these additional investigations, additional cultural resources sites identified in the project construction limits will be evaluated for eligibility to the NRHP. Potential project impacts to eligible properties will be mitigated prior to construction, if said impacts cannot be avoided. If necessary, a Memorandum of Agreement (MOA) with the Minnesota State Historic Preservation Office (SHPO) will be negotiated to cover the St. Paul District's Section 106 responsibilities for this project. A copy of the signed MOA will be included in the final Environmental Assessment.

Socioeconomic Effects

Under the No Action alternative, flooding would continue until some action was taken by local units of government. Without action, there would be a high potential for continued flooding of the city, interruption of city services and isolation of the regional hospital and high school. One of the purposes of the levee project is to minimize the risk of flood damage and threat to public safety associated with the no-action alternative. Without a project in place, average annual flood damage is estimated at $704,000. The recommended levee project is intended to provide a 200-year level of protection. Without the project in place, a flood of this size would cause an estimated $25 million in damage and directly affect approximately 500 residential and 30 commercial structures.

Even though the proposed project will provide protection against the 200-year flood event, the community is still at risk from damages from larger floods. The 200-year level of protection provides the maximum net benefits, and Corps policy mandates that this be the recommended plan. A higher level of protection is feasible and would reduce residual risk, but the incremental costs are higher than the incremental benefits to implement the higher-level plan. This residual risk was discussed with the city of Ada on December 19, 2007, and those present are aware of the limitations of the project. After this discussion, the recommended project was discussed at a city council meeting, and a resolution was passed supporting the proposed project. While awareness of the project benefits and residual risks is high at this time, over time, city leaders will change, and the residents may become less aware of the limitations of the project. To prevent this, measures will have to be taken to ensure that the community is aware of flood risk and has an emergency action plan for larger floods.

Also discussed at the December 19, 2007, meeting were the anticipated social effects of the proposed project on local properties. It was felt that the project had positive effects for properties within the levee system, including several properties outside the city limits on the east end of town and two farmsteads outside the city limits on the west end of town, all abutting Highway 200, because they will be within the line of protection.

Ada residents and businesses may experience the usual temporary inconveniences inherent in any construction project, such as the increased traffic, construction noise, and disruptions to daily routines. This effect may be minimized through restrictions on construction work hours, added traffic control measures and a good plan for public awareness.

Landowners whose property must be purchased to construct the project features (such as levees, ponding areas and the relocated JD 51) will lose the use of the purchased property. However, through the acquisition process, they would receive monetary compensation including fair market value for the acquired property. The project will be designed to ensure that the property owners will retain access to their remaining property, should any access be removed as part of the project. The Federal land acquisition process was explained at a public information meeting that was held in the city of Ada on October 1, 2008. Additional meetings with landowners will be held prior to acquisition of lands for the project.

The project may have some negative social effects on property owners who are facing similar flooding challenges, but are not protected by the project. The levee will be a visible barrier between the community of Ada and properties located outside of the levee.

The project would have a negative hydraulic impact on a limited area along the Marsh River on the south side of town, south of the proposed levee, between Highway 9 and Jamison Avenue. The hydraulic analysis contained in Appendix B indicates an increase in flooding elevations for this area of 0.1 to 0.3 foot.

Communities downstream of Ada on JD 51 may be concerned about flows being conveyed more quickly down JD 51. However, it is intended that the realigned JD 51 be designed to ensure that the JD 51 flows downstream of Ada are not increased.

There may be other landowners whose property will be acquired for construction of the project that have not been separately enumerated in this discussion. These property owners will experience the inconvenience of losing use of a portion of their property. These losses will be mitigated via monetary compensation during the real estate acquisition process. The project will ensure that the property owners will retain access to their remaining property, should any accesses be removed as part of the project.

Among the benefits accounted for in the economic analysis, is the potential cost savings in flood insurance policies. While the residents' risk of flood damage will be reduced to the point where their mortgage holders may not require flood insurance, each property owner within the area of protection will have to assess his/her willingness to accept the risk of not carrying additional flood insurance.

Executive Orders

The provisions of Executive Orders 11988 (Activities in Floodplains) and 11990 (Wetland Protection) would be satisfied. The project would prevent damage to existing facilities rather than encourage floodplain development. This alternative does comply with Executive Order 11988, because it does not encourage new development in the floodplain. The floodplain is defined as any lowland areas subject to a 1-percent or greater chance of flooding in any given year. While the proposed levee does encompass a large, undeveloped area, this area is not located in the defined floodplain. With respect to Executive Order 11990, wetlands in the vicinity are limited and seasonal or temporary and most are remnant oxbows of the Marsh River. Levee alignments were designed to avoid disrupting wetlands. The new alignment of JD 51 would not be excavated through any wetlands. The provisions of Executive Order 12898 (Environmental Justice) would be satisfied because the project would not have adverse effects on any particular group but would benefit all local residents equally.

Cumulative Effects

In the city of Ada, emergency levees have been constructed and removed and permanent levees have been constructed. The proposed project supplements existing levees, and adds new sections along the same basic alignment.

COORDINATION

Coordination with the SHPO and appropriate Native American groups will be completed as needed. If cultural resources investigations are not completed prior to signing of the finding of no significant impact (FONSI), a MOA with the SHPO may need to be negotiated. With this agreement in place, project planning may move ahead before cultural resources investigations have been completed, although no construction would occur until all issues related to cultural resources have been addressed.

Coordination with the public and government agencies has been maintained during the planning process. The U.S. Fish and Wildlife Service and the Minnesota Department of Natural Resources were contacted (Enclosure B).

During the planning process, no special concerns were identified by the U.S. Fish and Wildlife Service or the Minnesota Department of Natural Resources.

This report was sent to interested citizens and the following agencies:

Federal
Environmental Protection Agency
U.S. Fish and Wildlife Service
Natural Resource Conservation Service

State of Minnesota
Department of Natural Resources
Pollution Control Agency
Board of Soil and Water Conservation
State Historic Preservation Officer
Department of Transportation

Others
City of Ada
Norman County Engineer
Wild Rice Watershed District
Ada Public Library
Norman County Index
Local utilities

Table 2. Environmental Assessment Matrix

Section 122 of the River and Harbor and Flood Control Act of 1970 (Public Law 91-611)														
	No Action Alternative							Preferred Alternative						
	BENEFICIAL				ADVERSE			BENEFICIAL				ADVERSE		
PARAMETER	SIGNIFICANT	SUBSTANTIAL	MINOR	NO EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT	SIGNIFICANT	SUBSTANTIAL	MINOR	NO EFFECT	MINOR	SUBSTANTIAL	SIGNIFICANT
A. SOCIAL EFFECTS				X							X			
1. Noise Levels				X								T		
2. Aesthetic Values				X							X			
3. Recreational Opportunities				X							X			
4. Transportation				X							X			
5. Public Health and Safety						X			X					
6. Community Cohesion (Sense of Unity)				X							X			
7. Community Growth and Development				X							X			
8. Business and Home Relocations				X							X			
9. Existing/Potential Land Use				X							X			
10. Controversy				X							X			
B. ECONOMIC EFFECTS														
1. Property Values				X							X			
2. Tax Revenue				X							X			
3. Public Facilities and Services						X			X					
4. Regional Growth				X							X			
5. Employment				X							X			
6. Business Activity				X							X			
7. Farmland/Food Supply				X							X			
8. Commercial Navigation				X							X			
9. Flooding Effects				X							X			
10. Energy Needs and Resources				X							X			
C. NATURAL RESOURCE EFFECTS														
1. Air Quality				X								T		
2. Terrestrial Habitat				X							X			
3. Wetlands				X							X			
4. Aquatic Habitat				X							X			
5. Habitat Diversity and Interspersion				X							X			
6. Biological Productivity				X							X			
7. Surface Water Quality				X							X			
8. Water Supply				X							X			
9. Groundwater				X							X			
10. Soils				X							X			
11. Threatened or Endangered Species				X							X			
D. CULTURAL RESOURCE EFFECTS														
1. Historic Architectural Values				X							X			
2. Prehistoric & Historic Archeological Values				X							X			

T: Temporary Effect

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Enclosure A

Section 404(b)(1) Evaluation

Preliminary
Section 404(b)(1) Evaluation
Flood Risk Management
Ada, Minnesota

I. PROJECT DESCRIPTION

A. Location - The proposed fill activity would take place in Judicial Ditch 51 (JD 51) in Norman County, Minnesota, in and near the northeast area of the city of Ada, Minnesota (Exhibit 1) and adjacent to the Marsh River on the south side of the city. JD 51, although excavated, appears to have originated as a natural watercourse upstream of Ada.[1]

B. General Description - This evaluation addresses the impacts resulting from the placement of fill material in waters of the United States in compliance with Section 404 of the Clean Water Act, as amended. The proposed fill activities would consist of placing material into Judicial Ditch 51 to provide levee protection for the city of Ada. A new ditch would be constructed outside the levee alignment, and the old ditch would continue to function within the levee, joining the new ditch, through a gate well, northwest of the city limits.

C. Authority and Purpose - Federal authority for this project is provided in Section 205 of the Flood Control Act of 1948 (Public Law 80-858), as amended. The purpose of the project is flood risk management. The fill is necessary to construct a continuous levee around portions of the city that are not adequately protected.

D. General Description of Dredged or Fill Material

1. General Characteristics of Material - In all cases, the fill material would consist of clean rock of various sizes and clay excavated from the alignment of the new ditch.

2. Quantity of Material - The fill material would be 4,045 cubic yards (downstream) and 9,770 cubic yards (upstream) of impervious fill placed within the channel of JD 51. The 10 gate wells would be armored with approximately 240 cubic yards of riprap and bedding each.

3. Source of Material - The fill for JD51 would be obtained from excavation of the new ditch. The riprap and bedding would be obtained from an existing quarry.

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1 A full jurisdictional review of JD51 has not been completed, but for purposes of this analysis, Section 404 jurisdiction is assumed.

E. Description of the Proposed Discharge Sites

1. Location - The proposed fill activities would take place along the alignment of JD 51 in the north and northeast portions of the city of Ada and along the outside of the levee alignment, near the Marsh River at Ada (Exhibit 2).

2. Size - The total area to be affected by the fill activities would be approximately 0.33 acre.

3. Type of Site - The fill activities would take place in a riverine setting. The material would be placed from above the waterline to the bottom of the riverbed approximately 10 to 15 feet. The top of the rock would be 5 to 15 feet from the top of the bank.

4. Types of Habitat - The habitat is ditch bank and bottom and levee side slopes with vegetative cover. The ditch is an intermittent/seasonal watercourse with limited habitat. No wetlands would be affected by the action.

5. Timing and Duration - Subject to approval, construction could begin in the year 2009.

F. Description of Disposal Method - The fill material would be moved and placed mechanically (Exhibit 3).

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations

1. Substrate Elevation and Slope - The fill material would be placed mechanically and constructed with side slopes of 1 vertical on 3 horizontal above existing ground. The fill material for the gate wells would extend around the outlet pipe to provide erosion protection.

2. Sediment Type - Sediment in the proposed fill area is clay.

3. Dredged/Fill Material Movement - The fill material would be placed directly into the ditch and on the levee side slopes around the pipe. No fill material movement would be expected.

4. Physical Effects on Benthos - Any organisms in the placement area would be covered but additional ditch area would be constructed and expected to recolonize rapidly.

5. Actions Taken to Minimize Impacts - Standard construction procedures in compliance with Federal and State requirements would be employed to minimize impacts.

Because the placement of the material would affect a small area and have minimal impacts, no special actions to minimize adverse impacts would be taken.

B. Water Circulation, Fluctuation, and Salinity Determinations

1. Water

a. Salinity - The fill activities would not affect salinity.

b. Water Chemistry - The use of clean fill material and mechanical placement procedures would preclude any significant impacts on water chemistry.

c. Clarity - Some minor, short-term decreases in clarity are expected from the proposed fill activities.

d. Color - The proposed fill activities should have no impact on water color.

e. Odor - The proposed fill activities should have no impact on water odor.

f. Taste - The proposed fill activities should have no impact on water taste.

g. Dissolved Gas Levels - The proposed fill activities should have no impact on dissolved gas levels in the water.

h. Nutrients - The proposed fill activities should have no impact on nutrient levels in the water.

i. Eutrophication - The proposed fill activities should have no impact on the level or rate of eutrophication of the water.

j. Temperature - The proposed fill activities would have little impact on water temperature.

2. Current Patterns and Circulation

a. Current Patterns and Flow - Because the proposed fill activities would take place at the shoreline and adjacent upland areas, they would have little long-term effect on current patterns and flow.

b. Velocity - The proposed fill activities would have no effect on water velocity.

c. Stratification - The proposed fill activities would have no effect on the development of stratified conditions in the river.

d. Hydrologic Regime - The proposed fill activities would have little impact on the hydrologic regime.

3. Normal Water Level Fluctuations - The proposed fill activities would have no effect on normal water level fluctuations.

4. Salinity Gradient - The fill activities would have no effect on the salinity gradient.

5. Actions Taken to Minimize Impact - Standard construction procedures in compliance with Federal and State requirements would be used. The material would be placed mechanically.

C. Suspended Particulate/Turbidity Determination - Turbidity and suspended solids may increase during construction. This effect would be short-term.

1. Expected Changes in Suspended Particulates and Turbidity Levels in the Vicinity of the Disposal Site - Although minor temporary increases in suspended particulates and turbidity would occur during project construction, the long-term effect would be to maintain the status quo.

2. Effects on Chemical and Physical Properties of the Water Column - No effects are expected on light penetration, dissolved oxygen, toxic metals and organisms, pathogens, or the aesthetics of the water column after the project is in place.

3. Effects on Biota - Biota would be lost or displaced during the placement of the fill material. The effects would be limited because the ditch is intermittent.

4. Actions Taken to Minimize Impacts - No special actions are anticipated. Fill would be placed by standard equipment such as backhoes, trucks, and loaders.

D. Contaminant Determinations - The fill material would be large and small clean rock and clean fill and would not introduce contaminants into the aquatic system. Neither the material nor its placement would cause relocation or increases of contaminants in the aquatic systems.

E. Aquatic Ecosystem and Organism Determinations - Approximately 0.33 acre would be covered by riprap.

1. Effects on Plankton - The proposed action would not affect plankton because the ditch is intermittent.

2. Effects on Benthos - Those benthic communities in the area of the proposed fill activities would be disturbed but would quickly colonize the newly added riprap.

3. Effects on Nekton - None expected.

4. Effects on Aquatic Food Web - The long-term effect on total productivity of the area is expected to be a minor increase, although the existing aquatic biota would be temporarily disrupted.

5. Effects on Special Aquatic Sites - No special aquatic sites would be affected by the project.

6. Threatened and Endangered Species - No Federal or State listed species would be affected by the project.

7. Other Wildlife - The fill activities would not result in the significant loss of aquatic or terrestrial habitat. The general diversity and productivity of the affected areas would be maintained or possibly increased by the creation of a more stable habitat.

8. Actions Taken to Minimize Impacts - No special actions are required.

F. Proposed Disposal Site Determinations

1. Mixing Zone Determination - The proposed fill activity would have a minimal mixing zone. The mixing zone would be small and would not constitute a significant problem because of the nature of the fill material and its placement by mechanical means. No liquid material would be discharged during construction. For these reasons, the mixing zone was not analyzed further.

2. Determination of Compliance with Applicable Water Quality Standards - The nature of the fill material and the type of construction should avoid violation of State water quality standards by project-related activities. The long-term environmental or water quality effects of the placement of fill material would be a reduction in erosion and associated turbidity.

3. Potential Effects on Human Use Characteristics - Because of the present and projected human use characteristics, the existing physical conditions, the proposed construction methods, and the nature of the fill material, this proposed action would have no significant effects on human use characteristics.

G. Determination of Cumulative Effects on the Aquatic Ecosystem - Implementation of the proposed action would cause no significant cumulative impact on the aquatic ecosystem.

H. Determination of Secondary Effects on the Aquatic Ecosystem - No significant secondary effects would be expected.

III. FINDING OF COMPLIANCE WITH RESTRICTIONS ON DISCHARGE

The proposed fill activity would comply with Section 404(b)(1) guidelines of the Clean Water Act, as amended. No significant adaptations of the guidelines were made for this evaluation. The placement of fill is required to provide the desired benefits. Other alternatives would vary in size and level of protection but would have essentially the same footprint and effects. The most cost-effective level of protection was selected. Nonstructural alternatives would not provide sufficient protection from flooding. The realignment of JD 51 was the most economical alignment but all alternatives had equivalent effects on natural resources, and no other practicable alternative is less environmentally damaging than the selected alternative.

The proposed fill activities would comply with all State water quality standards, Section 307 of the Clean Water Act, and the Endangered Species Act of 1973, as amended. The proposed fill activity would not have significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability and on recreational, aesthetic, and economic values would not occur. Stabilization of the eroded site would not harm any endangered species or their critical habitat.

The purpose of the action is to stabilize the bank and reduce the potential for erosion. Minor and short-term impacts are associated with the placement of the fill material. The long-term effects would be a reduction in erosion and turbidity. Since the proposed action would result in few adverse effects, no additional measures to minimize impacts would be required.

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

____
Date

Jon L. Christensen
Colonel, Corps of Engineers
District Engineer

Enclosure B

Correspondence

RECORD OF TELEPHONE CONVERSATION

March 04, 2008

PERSON CALLING: John T. Shyne	MVPPM-E	651-290-5270
PERSON CALLED: Paul Stolen	MNDNR	218-308-2672

Subject: Ada, Norman County Flood Risk Management

1. I described the nature of the proposed action to Mr. Stolen.

2. Mr. Stolen said that he was familiar with the proposed plan and supported it as a reasonable solution for flooding in Ada. He did not have any specific concerns at this time but will review the EA when it is provided for public and agency review.

RECORD OF TELEPHONE CONVERSATION

March 20, 2008

PERSON CALLING: John T. Shyne	MVPPM-E	651-290-5270
PERSON CALLED: Laurie Fairchild	USFWS	612-725-3548

Subject: Ada, Norman County, Section 205

1. I discussed the project with Ms. Fairchild.

2. She indicated that it is likely that she had no specific comments at this time but did concur with our determination that the project would have no effect on endangered or threatened species.

Enclosure C

Finding of No Significant Impact

DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT, CORPS OF ENGINEERS
SIBLEY SQUARE AT MEARS PARK
190 FIFTH STREET EAST, SUITE 401
ST. PAUL, MN 55101-1638

REPLY TO
ATTENTION OF

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

DRAFT
FINDING OF NO SIGNIFICANT IMPACT

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

FLOOD RISK MANAGEMENT,
ADA, NORMAN COUNTY, MINNESOTA

The intent of this project is to provide flood risk management in the city of Ada, Norman County, Minnesota. The proposed project involves the protection from flooding using levee raises and levee construction with associated interior and exterior drainage. This finding of no significant impact is based on the following factors: the project would have no adverse impacts on fish and wildlife resources or on air and water quality; the project would have short-term minor impacts on the social environment; the project would have no impact on the cultural environment; and continued coordination would be maintained with appropriate State and Federal agencies.

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

____
Date

Jon L. Christensen
Colonel, Corps of Engineers
District Engineer

Figure 1 - Location of Ada, Mn.

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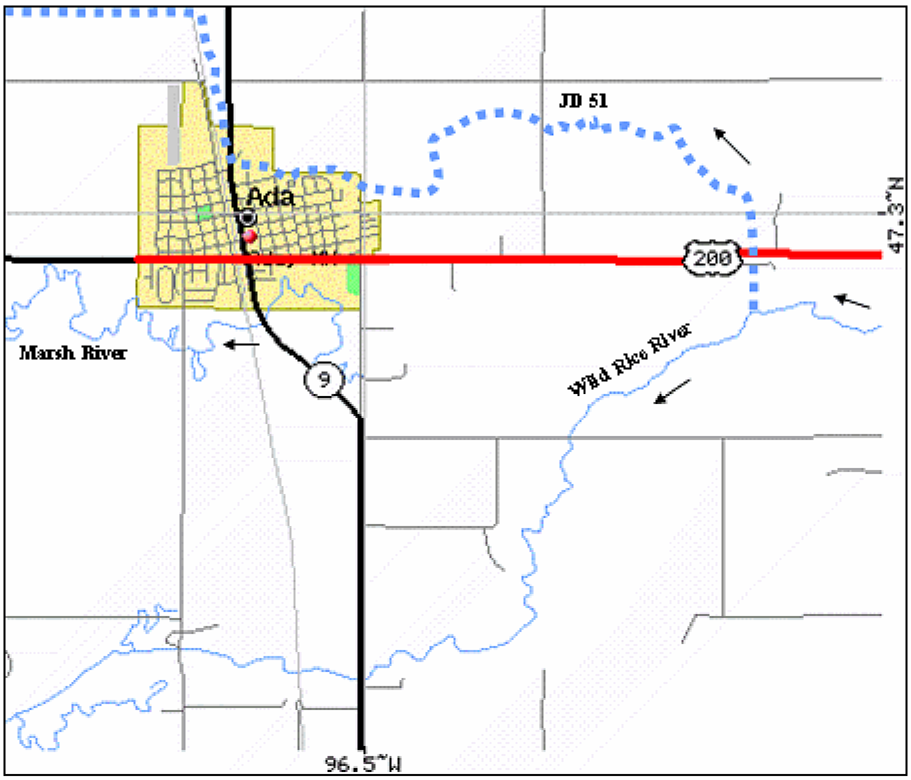
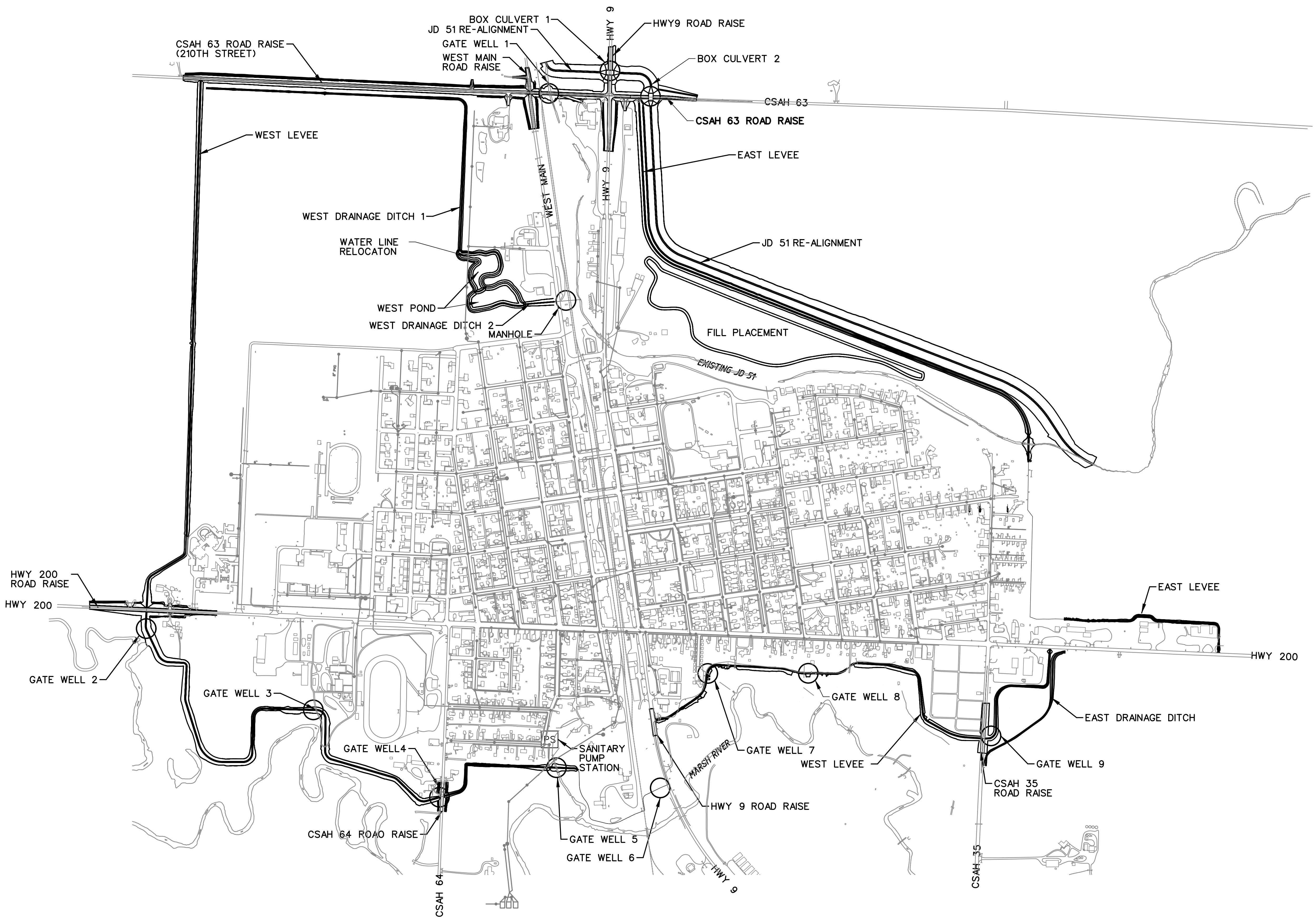


Figure 2 - Location of Judicial Ditch 51, Wild Rice River, and Marsh River



GENERAL PLAN VIEW

0 500' 1000'

SCALE:1"=500'

N

US Army Corps of Engineers®
St. Paul District

MARK	DESCRIPTION	DATE	APPR

MARK	DESCRIPTION	DATE	APPR

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DWN BY: EPP
CKD BY: JBM
SUBMITTED BY:
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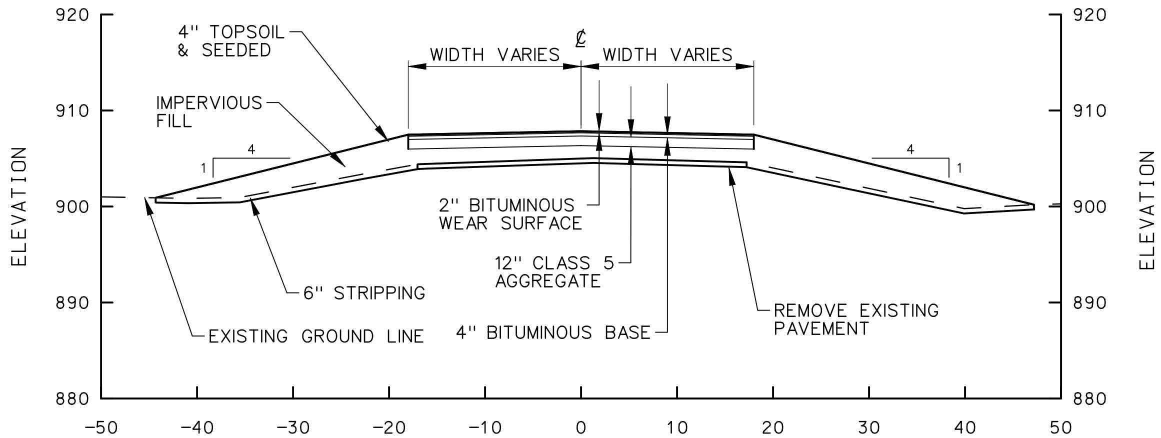
PLOT DATE: No
SIZE: ANSI B
FILE NAME: ADA_draftfiles__ove.dgn
DATE: 2008/12/08
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:

SECTION 205 FEASIBILTY STUDY
WILD RICE AND MARSH RIVERS
ADA, MINNESOTA

SITE DESIGN
GENERAL PLAN

SHEET IDENTIFICATION
C-001



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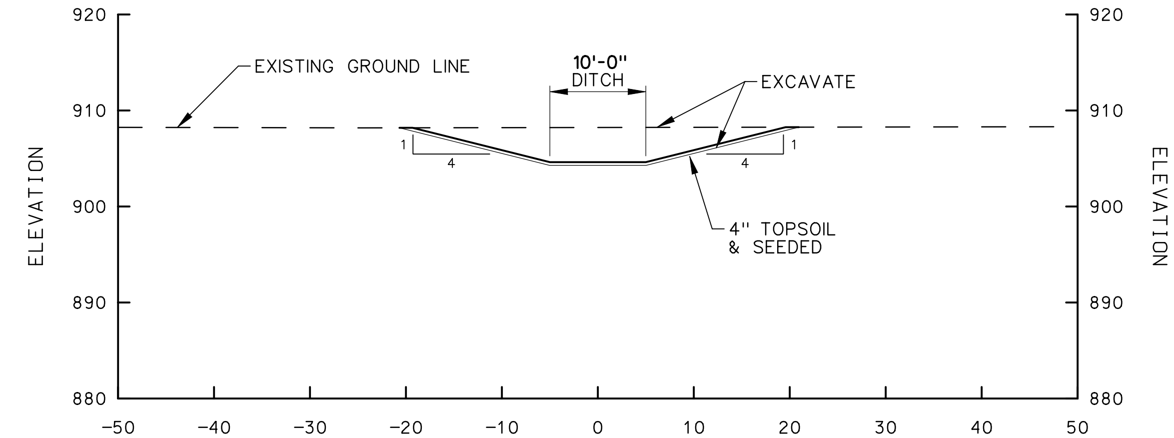
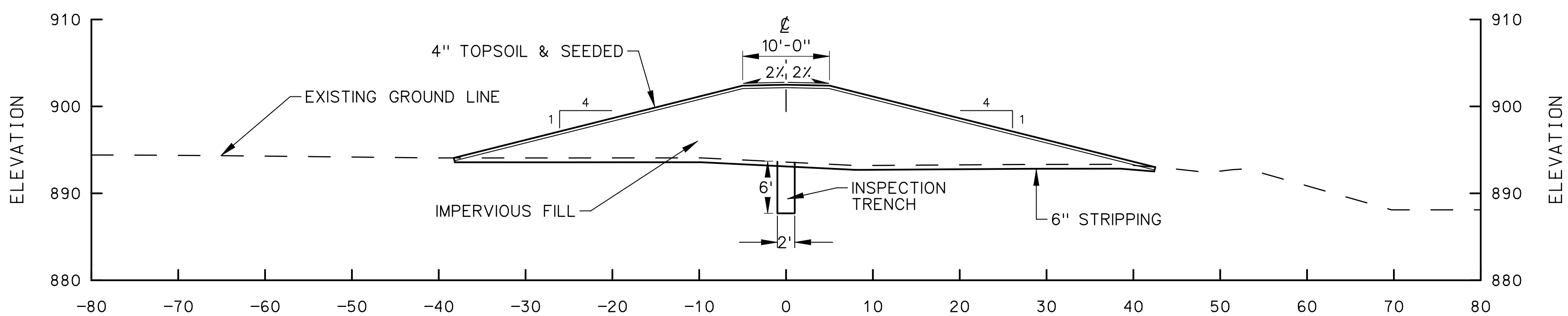
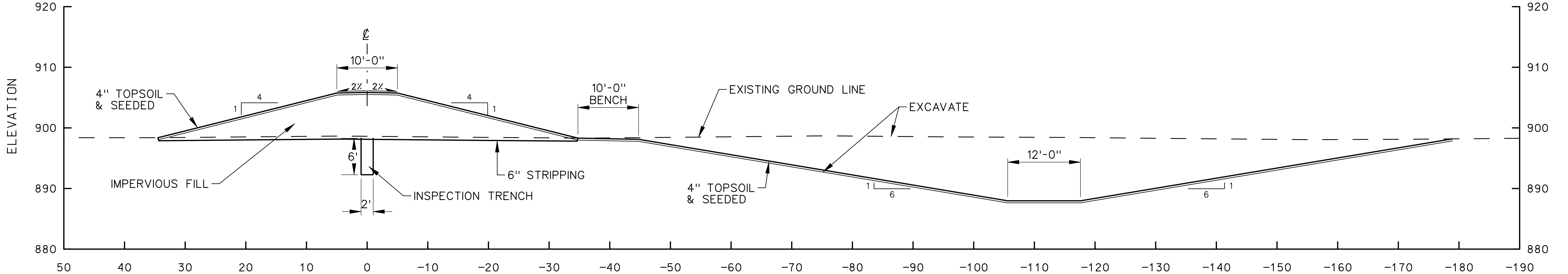


2 TYPICAL SECTION
DRAINAGE SITCH



3 TYPICAL SECTION
LEVEE



4 TYPICAL SECTION
LEVEE & DITCH

US Army Corps of Engineers®
St. Paul District

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

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DWN BY: EPP
CKD BY: JBM
SUBMITTED BY:
PLOT SCALE:
PLOT DATE: No
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DATE: 2008/12/08
SOLICITATION NO.:
CONTRACT NO.:
FILE NUMBER:

SECTION 205 FEASIBILTY STUDY
WILD RICE AND MARSH RIVERS
ADA, MINNESOTA

SITE DESIGN
TYPICAL SECTIONS

SHEET IDENTIFICATION
C-002

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 4/9/08
Name Of Project Ada Flood Control	Federal Agency Involved U.S. Army Corps of Engineers, St. Paul Dist.
Proposed Land Use Levees for Flood Control	County And State Norman County, MN
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 04/15/2008

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☒	No ☐	Acres Irrigated N/A	Average Farm Size 600
Major Crop(s) SMALL GRAINS/ROW CROPS	Farmable Land In Govt. Jurisdiction Acres: 546,630 % 97.5		Amount Of Farmland As Defined in FPPA Acres: 546,630 % 97.5	
Name Of Land Evaluation System Used LESA	Name Of Local Site Assessment System N/A		Date Land Evaluation Returned By NRCS 04/22/2008	

	Maximum Points	Alternative Site Rating Site A	Site B	Site C	Site D
PART III *(To be completed by Federal Agency)*					
A. Total Acres To Be Converted Directly		82.8			
B. Total Acres To Be Converted Indirectly		0.0			
C. Total Acres In Site		82.8	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information					
A. Total Acres Prime And Unique Farmland		80.4			
B. Total Acres Statewide And Local Important Farmland		.2			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted		7.01			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value		67			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*		~~0~~ 93	0	0	0
PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use	15	15			
2. Perimeter In Nonurban Use	10	10			
3. Percent Of Site Being Farmed	20	20			
4. Protection Provided By State And Local Government	20	20			
5. Distance From Urban Builtup Area	0	0			
6. Distance To Urban Support Services	0	0			
7. Size Of Present Farm Unit Compared To Average	10	10			
8. Creation Of Nonfarmable Farmland	25	0			
9. Availability Of Farm Support Services	25	25			
10. On-Farm Investments	20	20			
11. Effects Of Conversion On Farm Support Services	25	0			
12. Compatibility With Existing Agricultural Use	10	0			
TOTAL SITE ASSESSMENT POINTS	160	~~0~~ 120	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	~~0~~ 93	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	120	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	~~0~~ 213	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

This form was electronically produced by National Production Services Staff

Form AD-1006 (10-83)

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 4/9/08
Name Of Project Ada Flood Control	Federal Agency Involved U.S. Army Corps of Engineers, St. Paul Dist.
Proposed Land Use Levees for Flood Control	County And State Norman County, MN
PART II *(To be completed by NRCS)*	Date Request Received By NRCS

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☐	No ☐	Acres Irrigated	Average Farm Size
Major Crop*(s)*	Farmable Land In Govt. Jurisdiction Acres: %		Amount Of Farmland As Defined in FPPA Acres: %	
Name Of Land Evaluation System Used	Name Of Local Site Assessment System		Date Land Evaluation Returned By NRCS	

PART III *(To be completed by Federal Agency)*	Maximum Points	Alternative Site Rating			
		Site A	Site B	Site C	Site D
A. Total Acres To Be Converted Directly		82.8			
B. Total Acres To Be Converted Indirectly		0.0			
C. Total Acres In Site		82.8	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information					
A. Total Acres Prime And Unique Farmland					
B. Total Acres Statewide And Local Important Farmland					
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted					
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value					
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*		0	0	0	0
PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use					
2. Perimeter In Nonurban Use					
3. Percent Of Site Being Farmed					
4. Protection Provided By State And Local Government					
5. Distance From Urban Builtup Area					
6. Distance To Urban Support Services					
7. Size Of Present Farm Unit Compared To Average					
8. Creation Of Nonfarmable Farmland					
9. Availability Of Farm Support Services					
10. On-Farm Investments					
11. Effects Of Conversion On Farm Support Services					
12. Compatibility With Existing Agricultural Use					
TOTAL SITE ASSESSMENT POINTS	160	0	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	0	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	0	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	0	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side)

This form was electronically produced by National Production Services Staff

Clear Form

Form AD-1006 (10-83)

STEPS IN THE PROCESSING THE FARMLAND AND CONVERSION IMPACT RATING FORM

Step 1 – Federal agencies involved in proposed projects that may convert farmland, as defined in the Farmland Protection Policy Act (FPPA) to nonagricultural uses, will initially complete Parts I and III of the form.

Step 2 – Originator will send copies A, B and C together with maps indicating locations of site(s), to the Natural Resources Conservation Service (NRCS) local field office and retain copy D for their files. (Note: NRCS has a field office in most counties in the U.S. The field office is usually located in the county seat. A list of field office locations are available from the NRCS State Conservationist in each state).

Step 3 – NRCS will, within 45 calendar days after receipt of form, make a determination as to whether the site(s) of the proposed project contains prime, unique, statewide or local important farmland.

. Step '4 – In cases where farmland covered by the FPPA will be converted by the proposed project, NRCS field offices will complete Parts II, IV and V of the form.

Step 5 – NRCS will return copy A and B of the form to the Federal agency involved in the project. (Copy C will be retained for NRCS records).

Step 6 – The Federal agency involved in the proposed project will complete Parts VI and VII of the form.

Step 7 – The Federal agency involved in the proposed project will make a determination as to whether the proposed conversion is consistent with the FPPA and the agency's internal policies.

INSTRUCTIONS FOR COMPLETING THE FARMLAND CONVERSION IMPACT RATING FORM

Part I: In completing the "County And State" questions list all the local governments that are responsible for local land controls where site(s) are to be evaluated.

Part III: In completing item B (Total Acres To Be Converted Indirectly), include the following:

1. Acres not being directly converted but that would no longer be capable of being farmed after the conversion, because the conversion would restrict access to them.

2. Acres planned to receive services from an infrastructure project as indicated in the project justification (e.g. highways, utilities) that will cause a direct conversion.

Part VI: Do not complete Part VI if a local site assessment is used.

Assign the maximum points for each site assessment criterion as shown in § 658.5 (b) of CFR. In cases of corridor-type projects such as transportation, powerline and flood control, criteria #5 and #6 will not apply and will, be weighed zero, however, criterion #8 will be weighed a maximum of 25 points, and criterion #11 a maximum of 25 points.

Individual Federal agencies at the national level, may assign relative weights among the 12 site assessment criteria other than those shown in the FPPA rule. In all cases where other weights are assigned relative adjustments must be made to maintain the maximum total weight points at l60.

In rating alternative sites, Federal agencies shall consider each of the criteria and assign points within the limits established in the FPPA rule. Sites most suitable for protection under these criteria will receive the highest total scores, and sites least suitable, the lowest scores.

Part VII: In computing the "Total Site Assessment Points" where a State or local site assessment is used and the total maximum number of points is other than 160, adjust the site assessment points to a base of 160. Example: if the Site Assessment maximum is 200 points, and alternative Site "A" is rated 180 points:

$$\frac{\text{Total points assigned Site A}}{\text{Maximum points possible}} = \frac{180}{200} \times 160 = 144 \text{ points for Site "A."}$$

<u>Site Assessment Scoring for the Twelve Factors Used in FPPA</u>

The Site Assessment criteria used in the Farmland Protection Policy Act (FPPA) rule are designed to assess important factors other than the agricultural value of the land when determining which alternative sites should receive the highest level of protection from conversion to non agricultural uses.

Twelve factors are used for Site Assessment and ten factors for corridor-type sites. Each factor is listed in an outline form, without detailed definitions or guidelines to follow in the rating process. The purpose of this document is to expand the definitions of use of each of the twelve Site Assessment factors so that all persons can have a clear understanding as to what each factor is intended to evaluate and how points are assigned for given conditions.

In each of the 12 factors a number rating system is used to determine which sites deserve the most protection from conversion to non-farm uses. The higher the number value given to a proposed site, the more protection it will receive. The maximum scores are 10, 15 and 20 points, depending upon the relative importance of each particular question. If a question significantly relates to why a parcel of land should not be converted, the question has a maximum possible protection value of 20, whereas a question which does not have such a significant impact upon whether a site would be converted, would have fewer maximum points possible, for example 10.

The following guidelines should be used in rating the twelve Site Assessment criteria:

1. How much land is in non-urban use within a radius of 1.0 mile from where the project is intended?

More than 90 percent:	15 points
90-20 percent:	14 to 1 points
Less than 20 percent:	0 points

This factor is designed to evaluate the extent to which the area within one mile of the proposed site is non-urban area. For purposes of this rule, "non-urban" should include:

- Agricultural land (crop-fruit trees, nuts, oilseed)
- Range land
- Forest land
- Golf Courses
- Non paved parks and recreational areas
- Mining sites
- Farm Storage
- Lakes, ponds and other water bodies
- Rural roads, and through roads without houses or buildings
- Open space
- Wetlands
- Fish production
- Pasture or hayland

Urban uses include:

- Houses (other than farm houses)
- Apartment buildings
- Commercial buildings
- Industrial buildings
- Paved recreational areas (i.e. tennis courts)
- Streets in areas with 30 structures per 40 acres
- Gas stations

- Equipment, supply stores
- Off-farm storage
- Processing plants
- Shopping malls
- Utilities/Services
- Medical buildings

In rating this factor, an area one-mile from the outer edge of the proposed site should be outlined on a current photo; the areas that are urban should be outlined. For rural houses and other buildings with unknown sizes, use 1 and 1/3 acres per structure. For roads with houses on only one side, use one half of road for urban and one half for non-urban.

The purpose of this rating process is to insure that the most valuable and viable farmlands are protected from development projects sponsored by the Federal Government. With this goal in mind, factor S1 suggests that the more agricultural lands surrounding the parcel boundary in question, the more protection from development this site should receive. Accordingly, a site with a large quantity of non-urban land surrounding it will receive a greater
number of points for protection from development. Thus, where more than 90 percent of the area around the proposed site (do not include the proposed site in this assessment) is non-urban, assign 15 points. Where 20 percent or less is
non-urban, assign 0 points. Where the area lies between 20 and 90 percent non-urban, assign appropriate points from 14 to 1, as noted below.

Percent Non-Urban Land within 1 mile	**Points**
90 percent or greater	15
85 to 89 percent	14
80 to 84 percent	13
75 to 79 percent	12
70 to 74 percent	11
65 to 69 percent	10
60 to 64 percent	9
55 to 59 percent	8
50 to 54 percent	7
45 to 49 percent	6
40 to 44 percent	5
35 to 39 percent	4
30 to 24 percent	3
25 to 29 percent	2
21 to 24 percent	1
20 percent or less	0

2. How much of the perimeter of the site borders on land in non-urban use?

More than 90 percent:	l0 points
90 to 20 percent:	9 to 1 point(s)
Less than 20 percent:	0 points

This factor is designed to evaluate the extent to which the land adjacent to the proposed site is non-urban use. Where factor #1 evaluates the general location of the proposed site, this factor evaluates the immediate perimeter of the site. The definition of urban and non-urban uses in factor #1 should be used for this factor.

In rating the second factor, measure the perimeter of the site that is in non-urban and urban use. Where more than 90 percent of the perimeter is in non-urban use, score this factor 10 points. Where less than 20 percent, assign 0 points. If a road is next to the perimeter, class the area according to the use on the other side of the road for that area. Use 1 and 1/3 acre per structure if not otherwise known. Where 20 to 90 percent of the perimeter is non-urban, assign points as noted below:

Percentage of Perimeter Bordering Land	**Points**
90 percent or greater	10
82 to 89 percent	9
74 to 81 percent	8
65 to 73 percent	7
58 to 65 percent	6
50 to 57 percent	5
42 to 49 percent	4
34 to 41 percent	3
27 to 33 percent	2
21 to 26 percent	1
20 percent or Less	0

3. How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last ten years?

More than 90 percent:	20 points
90 to 20 percent:	19 to 1 point(s)
Less than 20 percent:	0 points

This factor is designed to evaluate the extent to which the proposed conversion site has been used or managed for agricultural purposes in the past 10 years.

Land is being farmed when it is used or managed for food or fiber, to include timber products, fruit, nuts, grapes, grain, forage, oil seed, fish and meat, poultry and dairy products.

Land that has been left to grow up to native vegetation without management or harvest will be considered as abandoned and therefore not farmed. The proposed conversion site should be evaluated and rated according to the percent, of the site farmed.

If more than 90 percent of the site has been farmed 5 of the last 10 years score the site as follows:

Percentage of Site Farmed	**Points**
90 percent or greater	20
86 to 89 percent	19
82 to 85 percent	18
78 to 81 percent	17
74 to 77 percent	16
70 to 73 percent	15
66 to 69 percent	14
62 to 65 percent	13
58 to 61 percent	12
54 to 57 percent	11
50 to 53 percent	10
46 to 49 percent	9
42 to 45 percent	8
38 to 41 percent	7
35 to 37 percent	6
32 to 34 percent	5
29 to 31 percent	4
26 to 28 percent	3

23 to 25 percent	2
20 to 22 percent percent or Less	1
Less than 20 percent	0

4. Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?

Site is protected:	20 points
Site is not protected:	0 points

This factor is designed to evaluate the extent to which state and local government and private programs have made efforts to protect this site from conversion.

State and local policies and programs to protect farmland include:

State Policies and Programs to Protect Farmland

1. Tax Relief:

A. Differential Assessment: Agricultural lands are taxed on their agricultural use value, rather than at market value. As a result, farmers pay fewer taxes on their land, which helps keep them in business, and therefore helps to insure that the farmland will not be converted to nonagricultural uses.

1. Preferential Assessment for Property Tax: Landowners with parcels of land used for agriculture are given the privilege of differential assessment.

2. Deferred Taxation for Property Tax: Landowners are deterred from converting their land to nonfarm uses, because if they do so, they must pay back taxes at market value.

3. Restrictive Agreement for Property Tax: Landowners who want to receive Differential Assessment must agree to keep their land in - eligible use.

B. Income Tax Credits

Circuit Breaker Tax Credits: Authorize an eligible owner of farmland to apply some or all of the property taxes on his or her farmland and farm structures as a tax credit against the owner's state income tax.

C. Estate and Inheritance Tax Benefits

Farm Use Valuation for Death Tax: Exemption of state tax liability to eligible farm estates.

2. "Right to farm" laws:

Prohibits local governments from enacting laws which will place restrictions upon normally accepted farming practices, for example, the generation of noise, odor or dust.

3. Agricultural Districting:

Wherein farmers voluntarily organize districts of agricultural land to be legally recognized geographic areas. These farmers receive benefits, such as protection from annexation, in exchange for keeping land within the district for a given number of years.

4. Land Use Controls: Agricultural Zoning.

Types of Agricultural Zoning Ordinances include:

A. Exclusive: In which the agricultural zone is restricted to only farm-related dwellings, with, for example, a minimum of 40 acres per dwelling unit.

B. Non-Exclusive: In which non-farm dwellings are allowed, but the density remains low, such as 20 acres per dwelling unit.

Additional Zoning techniques include:

A. Slidinq Scale: This method looks at zoning according to the total size of the parcel owned. For example, the number of dwelling units per a given number of acres may change from county to county according to the existing land acreage to dwelling unit ratio of surrounding parcels of land within the specific area.

B. Point System or Numerical Approach: Approaches land use permits on a case by case basis.

   LESA: The LESA system (Land Evaluation-Site Assessment) is used as a tool to help assess options for land use on an evaluation of productivity weighed against commitment to urban development.

C. Conditional Use: Based upon the evaluation on a case by case basis by the Board of Zoning Adjustment. Also may include the method of using special land use permits.

5. Development Rights:

   A. Purchase of Development Rights (PDR): Where development rights are purchased by Government action.

      Buffer Zoning Districts: Buffer Zoning Districts are an example of land purchased by Government action. This land is included in zoning ordinances in order to preserve and protect agricultural lands from non-farm land uses encroaching upon them.

   B. Transfer of Development Rights (TDR): Development rights are transferable for use in other locations designated as receiving areas. TDR is considered a locally based action (not state), because it requires a voluntary decision on the part of the individual landowners.

6. Governor’s Executive Order: Policy made by the Governor, stating the importance of agriculture, and the preservation of agricultural lands. The Governor orders the state agencies to avoid the unnecessary conversion of important farmland to nonagricultural uses.

7. Voluntary State Programs:

   A. California's Program of Restrictive Agreements and Differential Assessments: The California Land Conservation Act of 1965, commonly known as the Williamson Act, allows cities, counties and individual landowners to form agricultural preserves and enter into contracts for 10 or more years to insure that these parcels of land remain strictly for agricultural use. Since 1972 the Act has extended eligibility to recreational and open space lands such as scenic highway corridors, salt ponds and wildlife preserves. These contractually restricted lands may be taxed differentially for their real value. One hundred-acre districts constitute the minimum land size eligible.

      Suggestion: An improved version of the Act would state that if the land is converted after the contract expires, the landowner must pay the difference in the taxes between market value for the land and the agricultural tax value which he or she had been paying under the Act. This measure would help to insure that farmland would not be converted after the 10 year period ends.

B. Maryland Agricultural Land Preservation Program: Agricultural landowners within agricultural districts have the opportunity to sell their development rights to the Maryland Land Preservation Foundation under the agreement that these landowners will not subdivide or develop their land for an initial period of five years. After five years the landowner may terminate the agreement with one year notice.

   As is stated above under the California Williamson Act, the landowner should pay the back taxes on the property if he or she decides to convert the land after the contract expires, in order to discourage such conversions.

C. Wisconsin Income Tax Incentive Program: The Wisconsin Farmland Preservation Program of December 1977 encourages local jurisdictions in Wisconsin to adopt agricultural preservation plans or exclusive agricultural district zoning ordinances in exchange for credit against state income tax and exemption from special utility assessment. Eligible candidates include local governments and landowners with at least 35 acres of land per dwelling unit in agricultural use and gross farm profits of at least $6.000 per year, or $18,000 over three years.

8. Mandatory State Programs:

   A. The Environmental Control Act in the state of Vermont was adopted in 1970 by the Vermont State Legislature. The Act established an environmental board with 9 members (appointed by the Governor) to implement a planning process and a permit system to screen most subdivisions and development proposals according to specific criteria stated in the law. The planning process consists of an interim and a final Land Capability and Development Plan, the latter of which acts as a policy plan to control development. The policies are written in order to:

      - prevent air and water pollution;
      - protect scenic or natural beauty, historic sites and rare and irreplaceable natural areas; and
      - consider the impacts of growth and reduction of development on areas of primary agricultural soils.

   B. The California State Coastal Commission: In 1976 the Coastal Act was passed to establish a permanent Coastal Commission with permit and planning authority The purpose of the Coastal Commission was and is to protect the sensitive coastal zone environment and its resources, while accommodating the social and economic needs of the state. The Commission has the power to regulate development in the coastal zones by issuing permits on a case by case basis until local agencies can develop their own coastal plans, which must be certified by the Coastal Commission.

   C. Hawaii's Program of State Zoning: In 1961, the Hawaii State Legislature established Act 187, the Land Use Law, to protect the farmland and the welfare of the local people of Hawaii by planning to avoid “unnecessary urbanization”. The Law made all state lands into four districts: agricultural, conservation, rural and urban. The Governor appointed members to a State Land Use Commission, whose duties were to uphold the Law and form the boundaries of the four districts. In addition to state zoning, the Land Use Law introduced a program of Differential Assessment, wherein agricultural landowners paid taxes on their land for its agricultural use value, rather than its market value.

   D. The Oregon Land Use Act of 1973: This act established the Land Conservation and Development Commission (LCDC) to provide statewide planning goals and guidelines.

Under this Act, Oregon cities and counties are each required to draw up a comprehensive plan, consistent with statewide planning goals. Agricultural land preservation is high on the list of state goals to be followed locally.

If the proposed site is subject to or has used one or more of the above farmland protection programs or policies, score the site 20 points. If none of the above policies or programs apply to this site, score 0 points.

5. How close is the site to an urban built-up area?

The site is 2 miles or more from an urban built-up area	15 points
The site is more than 1 mile but less than 2 miles from an urban built-up area	10 points
The site is less than 1 mile from, but is not adjacent to an urban built-up area	5 points
The site is adjacent to an urban built-up area	0 points

This factor is designed to evaluate the extent to which the proposed site is located next to an existing urban area. The urban built-up area must be 2500 population. The measurement from the built-up area should be made from the point at which the density is 30 structures per 40 acres and with no open or non-urban land existing between the major built-up areas and this point. Suburbs adjacent to cities or urban built-up areas should be considered as part of that urban area.

For greater accuracy, use the following chart to determine how much protection the site should receive according to its distance from an urban area. See chart below:

Distance From Perimeter of Site to Urban Area	Points
More than 10,560 feet	15
9,860 to 10,559 feet	14
9,160 to 9,859 feet	13
8,460 to 9,159 feet	12
7,760 to 8,459 feet	11
7,060 to 7,759 feet	10
6,360 to 7,059 feet	9
5,660 to 6,359 feet	8
4,960 to 5,659 feet	7
4,260 to 4,959 feet	6
3,560 to 4,259 feet	5
2,860 to 3,559 feet	4
2,160 to 2,859 feet	3
1,460 to 2,159 feet	2
760 to 1,459 feet	1
Less than 760 feet (adjacent)	0

6. How close is the site to water lines, sewer lines and/or other local facilities and services whose capacities and design would promote nonagricultural use?

None of the services exist nearer than 3 miles from the site	15 points
Some of the services exist more than one but less than 3 miles from the site	10 points
All of the services exist within 1/2 mile of the site	0 points

This question determines how much infrastructure (water, sewer, etc.) is in place which could facilitate nonagricultural development. The fewer facilities in place, the more difficult it is to develop an area. Thus, if a proposed site is further away from these services (more than 3 miles distance away), the site should be awarded the highest number of points (15). As the distance of the parcel of land to services decreases, the number of points awarded declines as well. So, when the site is equal to or further than 1 mile but less than 3 miles away from services, it should be given 10 points. Accordingly, if this distance is 1/2 mile to less than 1 mile, award 5 points; and if the distance from land to services is less than 1/2 mile, award 0 points.

Distance to public facilities should be measured from the perimeter of the parcel in question to the nearest site(s) where necessary facilities are located. If there is more than one distance (i.e. from site to water and from site to sewer), use the average distance (add all distances and then divide by the number of different distances to get the average).

Facilities which could promote nonagricultural use include:

- Water lines
- Sewer lines
- Power lines
- Gas lines
- Circulation (roads)
- Fire and police protection
- Schools

7. Is the farm unit(s) containing the site (before the project) as large as the average-size farming unit in the county? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage of Farm Units in Operation with $1,000 or more in sales.)

As large or larger:	10 points
Below average: Deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more is below average	9 to 0 points

This factor is designed to determine how much protection the site should receive, according to its size in relation to the average size of farming units within the county. The larger the parcel of land, the more agricultural use value the land possesses, and vice versa. Thus, if the farm unit is as large or larger than the county average, it receives the maximum number of points (10). The smaller the parcel of land compared to the county average, the fewer number of points given. Please see below:

Parcel Size in Relation to Average County Size	Points
Same size or larger than average (l00 percent)	10
95 percent of average	9
90 percent of average	8
85 percent of average	7
80 percent of average	6
75 percent of average	5
70 percent of average	4
65 percent of average	3
60 percent of average	2
55 percent of average	1
50 percent or below county average	0

State and local Natural Resources Conservation Service offices will have the average farm size information, provided by the latest available Census of Agriculture data

8. If this site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?

Acreage equal to more than 25 percent of acres directly converted by the project	10 points
Acreage equal to between 25 and 5 percent of the acres directly converted by the project	9 to 1 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project	0 points

This factor tackles the question of how the proposed development will affect the rest of the land on the farm The site which deserves the most protection from conversion will receive the greatest number of points, and vice versa. For example, if the project is small, such as an extension on a house, the rest of the agricultural land would remain farmable, and thus a lower number of points is given to the site. Whereas if a large-scale highway is planned, a greater portion of the land (not including the site) will become non-farmable, since access to the farmland will be blocked; and thus, the site should receive the highest number of points (10) as protection from conversion

Conversion uses of the Site Which Would Make the Rest of the Land Non-Farmable by Interfering with Land Patterns

Conversions which make the rest of the property nonfarmable include any development which blocks accessibility to the rest of the site Examples are highways, railroads, dams or development along the front of a site restricting access to the rest of the property.

The point scoring is as follows:

Amount of Land Not Including the Site Which Will Become Non-Farmable	Points
25 percent or greater	10
23 - 24 percent	9
21 - 22 percent	8
19 - 20 percent	7
17 - 18 percent	6
15 - 16 percent	5
13 - 14 percent	4
11 - 12 percent	3
9 - 11 percent	2
6 - 8 percent	1
5 percent or less	0

9. Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?

All required services are available	5 points
Some required services are available	4 to 1 point(s)
No required services are available	0 points

This factor is used to assess whether there are adequate support facilities, activities and industry to keep the farming business in business. The more support facilities available to the agricultural landowner, the more feasible it is for him or her to stay in production. In addition, agricultural support facilities are compatible with farmland. This fact is important, because some land uses are not compatible; for example, development next to farmland cam be dangerous to the welfare of the agricultural land, as a result of pressure from the neighbors who often do not appreciate the noise, smells and dust intrinsic to farmland. Thus, when all required agricultural support services are available, the maximum number of points (5) are awarded. When some services are available, 4 to 1 point(s) are awarded; and consequently, when no services are available, no points are given. See below:

Percent of Services Available	**Points**
100 percent	5
75 to 99 percent	4
50 to 74 percent	3
25 to 49 percent	2
1 to 24 percent	1
No services	0

10. Does the site have substantial and well-maintained on farm investments such as barns, other storage buildings, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?

High amount of on-farm investment	20 points
Moderate amount of non-farm investment	19 to 1 point(s)
No on-farm investments	0 points

This factor assesses the quantity of agricultural facilities in place on the proposed site. If a significant agricultural infrastructure exists, the site should continue to be used for farming, and thus the parcel will receive the highest amount of points towards protection from conversion or development. If there is little on farm investment, the site will receive comparatively less protection. See-below:

Amount of On-farm Investment	**Points**
As much or more than necessary to maintain production (100 percent)	20
95 to 99 percent	19
90 to 94 percent	18
85 to 89 percent	17
80 to 84 percent	16
75 to 79 percent	15
70 to 74 percent	14
65 to 69 percent	13
60 to 64 percent	12
55 to 59 percent	11
50 to 54 percent	10
45 to 49 percent	9
40 to 44 percent	8
35 to 39 percent	7
30 to 34 percent	6
25 to 29 percent	5
20 to 24 percent	4
15 to 19 percent	3
10 to 14 percent	2
5 to 9 percent	1
0 to 4 percent	0

11. Would the project at this site, by converting farmland to nonagricultural use, reduce the support for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?

Substantial reduction in demand for support services if the site is converted	10 points
Some reduction in demand for support services if the site is converted	9 to 1 point(s)
No significant reduction in demand for support services if the site is converted	0 points

This factor determines whether there are other agriculturally related activities, businesses or jobs dependent upon the working of the pre-converted site in order for the others to remain in production. The more people and farming activities relying upon this land, the more protection it should receive from conversion. Thus, if a substantial reduction in demand for support services were to occur as a result of conversions, the proposed site would receive a high score of 10; some reduction in demand would receive 9 to 1 point(s), and no significant reduction in demand would receive no points.

Specific points are outlined as follows:

Amount of Reduction in Support Services if Site is Converted to Nonagricultural Use	**Points**
Substantial reduction (100 percent)	10
90 to 99 percent	9
80 to 89 percent	8
70 to 79 percent	7
60 to 69 percent	6
50 to 59 percent	5
40 to 49 percent	4
30 to 39 percent	3
20 to 29 percent	2
10 to 19 percent	1
No significant reduction (0 to 9 percent)	0

12. Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of the surrounding farmland to nonagricultural use?

Proposed project is incompatible with existing agricultural use of surrounding farmland	10 points
Proposed project is tolerable of existing agricultural use of surrounding farmland	9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland	0 points

Factor 12 determines whether conversion of the proposed agricultural site will eventually cause the conversion of neighboring farmland as a result of incompatibility of use of the first with the latter. The more incompatible the proposed conversion is with agriculture, the more protection this site receives from conversion. Therefor-, if the proposed conversion is incompatible with agriculture, the site receives 10 points. If the project is tolerable with agriculture, it receives 9 to 1 points; and if the proposed conversion is compatible with agriculture, it receives 0 points.

CORRIDOR - TYPE SITE ASSESSMENT CRITERIA

The following criteria are to be used for projects that have a linear or corridor - type site configuration connecting two distant points, and crossing several different tracts of land. These include utility lines, highways, railroads, stream improvements, and flood control systems. Federal agencies are to assess the suitability of each corridor-type site or design alternative for protection as farmland along with the land evaluation information.

For Water and Waste Programs, corridor analyses are not applicable for distribution or collection networks. Analyses are applicable for transmission or trunk lines where placement of the lines are flexible.

(1) How much land is in nonurban use within a radius of 1.0 mile form where the project is intended?

(2) More than 90 percent	(3) 15 points
(4) 90 to 20 percent	(5) 14 to 1 point(s).
(6) Less than 20 percent	(7) 0 points

(2) How much of the perimeter of the site borders on land in nonurban use?

(3) More than 90 percent	(4) 10 point(s)
(5) 90 to 20 percent	(6) 9 to 1 points
(7) less than 20 percent	(8) 0 points

(3) How much of the site has been farmed (managed for a scheduled harvest or timber activity) more than five of the last 10 years?

(4) More than 90 percent	(5) 20 points
(6) 90 to 20 percent	(7) 19 to 1 point(s)
(8) Less than 20 percent	(9) 0 points

(4) Is the site subject to state or unit of local government policies or programs to protect farmland or covered by private programs to protect farmland?

Site is protected	20 points
Site is not protected	0 points

(5) Is the farm unit(s) containing the site (before the project) as large as the average - size farming unit in the County? (Average farm sizes in each county are available from the NRCS field offices in each state. Data are from the latest available Census of Agriculture, Acreage of Farm Units in Operation with $1,000 or more in sales.)

As large or larger	10 points
Below average deduct 1 point for each 5 percent below the average, down to 0 points if 50 percent or more below average	9 to 0 points

(6) If the site is chosen for the project, how much of the remaining land on the farm will become non-farmable because of interference with land patterns?

Acreage equal to more than 25 percent of acres directly converted by the project	25 points
Acreage equal to between 25 and 5 percent of the acres directly convened by the project	1 to 24 point(s)
Acreage equal to less than 5 percent of the acres directly converted by the project	0 points

(7) Does the site have available adequate supply of farm support services and markets, i.e., farm suppliers, equipment dealers, processing and storage facilities and farmer's markets?

All required services are available	5 points
Some required services are available	4 to 1 point(s)
No required services are available	0 points

(8) Does the site have substantial and well-maintained on-farm investments such as barns, other storage building, fruit trees and vines, field terraces, drainage, irrigation, waterways, or other soil and water conservation measures?

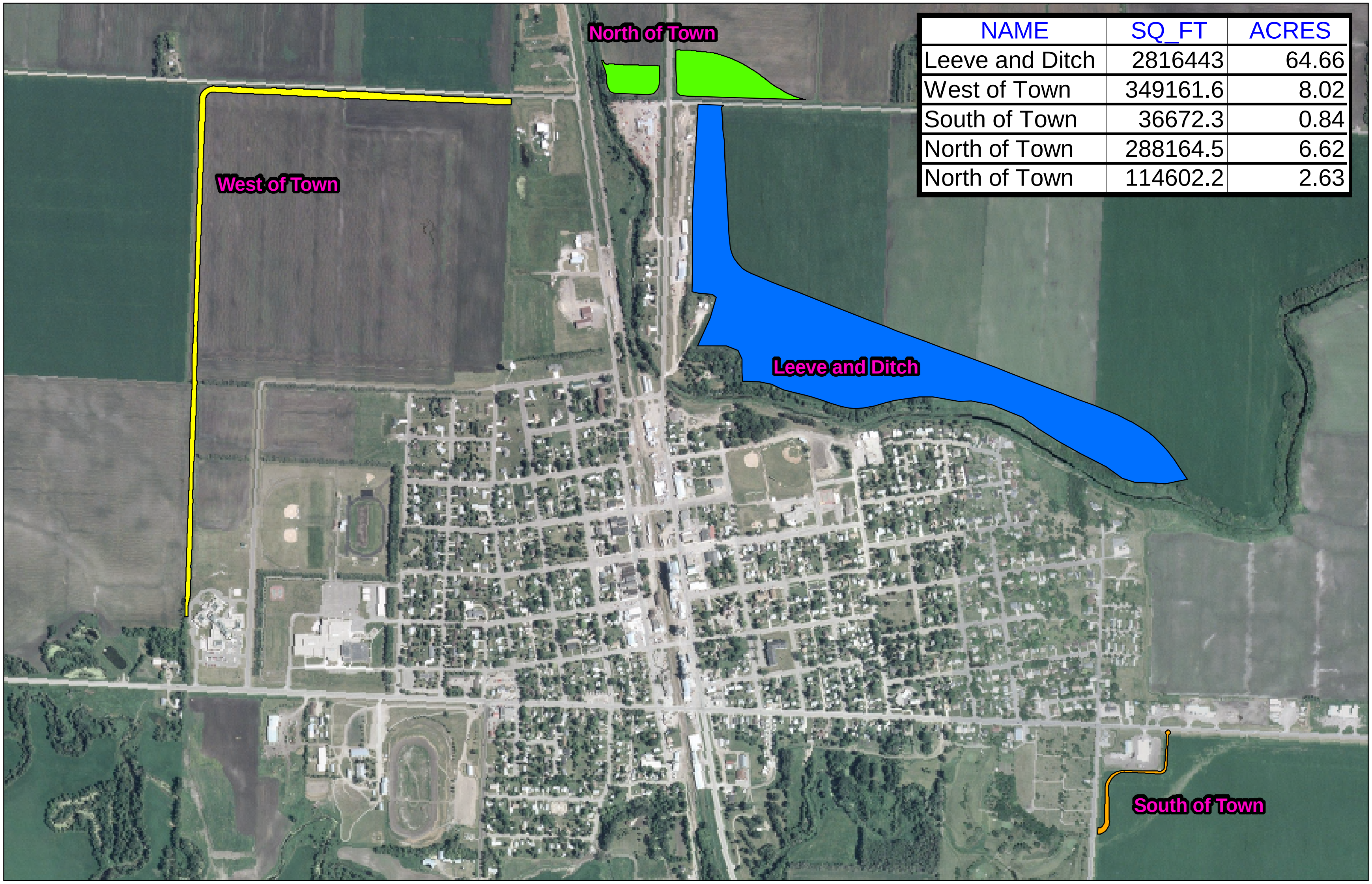
High amount of on-farm investment	20 points
Moderate amount of on-farm investment	19 to 1 point(s)
No on-farm investment	0 points

(9) Would the project at this site, by converting farmland to nonagricultural use, reduce the demand for farm support services so as to jeopardize the continued existence of these support services and thus, the viability of the farms remaining in the area?

Substantial reduction in demand for support services if the site is convened	25 points
Some reduction in demand for support services if the site is convened	1 to 24 point(s)
No significant reduction in demand for support services if the site is converted	0 points

(10) Is the kind and intensity of the proposed use of the site sufficiently incompatible with agriculture that it is likely to contribute to the eventual conversion of surrounding farmland to nonagricultural use?

Proposed project is incompatible to existing agricultural use of surrounding farmland	10 points
Proposed project is tolerable to existing agricultural use of surrounding farmland	9 to 1 point(s)
Proposed project is fully compatible with existing agricultural use of surrounding farmland	0 points



NAME	SQ_FT	ACRES
Leeve and Ditch	2816443	64.66
West of Town	349161.6	8.02
South of Town	36672.3	0.84
North of Town	288164.5	6.62
North of Town	114602.2	2.63

City of Ada - Norman County - Impacted Farmland

St. Paul District
GIS CENTER
US Army Corps of Engineers®

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0.25 0 0.25 0.5 Miles

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SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX A

HYDROLOGIC ANALYSIS

Appendix A. Hydrology

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Study Area

Location

The Wild Rice River Basin lies in the northwestern portion of Minnesota. The basin is located principally in Mahnomen and Norman Counties but includes a portion of Clearwater, Becker, and Clay Counties. The City of Ada is located in central Norman County, approximately 32 miles northeast of Moorhead, Minnesota. Ada lies approximately 2 miles north of the Wild Rice River, near the headwaters of the Marsh River, both of which are tributaries of the Red River of the North. Judicial Ditch 51 (JD 51) flows around the northern limits of the city, and provides an outlet for the city and agricultural lands north of the city, as well as occasional overflows from the Wild Rice River. JD 51 flows into the Marsh River 3 miles northwest of Ada. **Figure 1** shows the location of Ada, Minnesota.

The population of the community in 2000 was estimated at 1657. The community is principally engaged in agricultural-related business. The city is located very close to the 100-year floodplain.

Drainage Areas

Drainage basin divides in some places are indefinite because of the relatively flat land, numerous small lakes, and swamps with no channel or drainage courses shown on the maps. As a result, precise drainage area values are not available. Runoff from the upper one-third of the Wild Rice River Basin may be delayed because of the numerous small lakes and swamps in that area. During times of high flow, the discharges below the diversion do not represent flows originating on the drainage areas shown because of the diversion of part of the flow from the Wild Rice River to the Marsh River.

Drainage areas at pertinent locations are shown in **Table 1**. The drainage area upstream of the Wild Rice River at Ada is approximately 1050 square miles. The Marsh River drains an area of about 300 square miles and the Wild Rice River drainage area is about 1,650 square miles. At the point of diversion (42.8 river miles above the mouth of the Wild Rice River) the Wild Rice River drains an area of 1,090 square miles.

Table 1. Drainage Ares on Wild Rice and Marsh Rivers

Location	Drainage Area Square Miles
Wild Rice River @ Twin Valley	934
Wild Rice River @ diversion above Ada	1,090
Wild Rice River south of Ada	1,100
Wild Rice River @ Hendrum	1,560
Wild Rice River @ mouth	1,650
Marsh River near Shelly	220
Marsh River @ mouth	300

Topography

The topography of the Wild Rice River Basin above mile 55 and of the upper portion of the Marsh River Basin along Spring Creek is gently undulating to rugged. West of a north-south line crossing the Wild Rice River at about mile 43 lays an extremely flat plain. Between those two areas exists a transition composed of a series of sandy ridges. Elevations range from more than 1,500 (msl 1929 adj.) feet near the source of the Wild Rice River to 818 feet at the mouth of the Marsh River. Riverward slopes throughout the entire area above the plain are sufficient for adequate drainage but those in the lower reaches of the watershed are very flat and drainage is sluggish. About 94 percent of the area lying below the transition is under cultivation. The remainder includes municipalities, farmsteads, small wood lots, and roadways. The transition ridge area and the valleys in the upper portion of the basin contain substantial timber cover, and the upland area includes cultivation, scattered wood lots, and numerous small lakes. Nearly 60 percent of the upland area is under cultivation. **Figure 2** shows a map of the land use/land cover of the watershed.

The entire Wild Rice-Marsh River Basin has been modified by glacial action. The upper one third of the basin is covered by glacial drift containing numerous deposits of sand and gravel. Loam or silty loams comprise the generally light soils of the glacial drift area. Immediately downstream from the glacial drift area and covering the transitional area described above, exists a series of beach ridges formed by the old glacial Lake Agassiz during successively lower recessional stages. Throughout these ridges the soils contain much fine sand, classified generally as silty sand. The remainder of the watershed downstream form the ridges is a nearly flat lacustrine plain which was the bed of the glacial lake. Lacustrine deposits extend to great depths over this plain, particularly in the vicinity of the Red River of the North.

Streams

The Wild Rice River starts at Upper Rice Lake in Clearwater County. The normal elevation of this lake is 1,503 feet above mean sea level. About 20 miles downstream the Wild Rice River flows through Lower Rice Lake. The river then flows generally in a westerly direction until it joins the Red River of the North about 30 miles north of Moorhead, Minnesota. The total length of the river is about 185 miles. In the lower 50-mile reach, the river crosses the flat floor of the Red River Valley. The normal low water elevation of the Red River of the North at the junction with the Wild Rice River is 832 feet.

In the latter part of the 19th century, a 10-mile long ditch was constructed by local interests to divert a part of the Wild Rice River flood flows into the Marsh River. Before the diversion channel was constructed, the source of the Marsh River was in the low, flat terrain just south of Ada. That stream now heads about 3 miles east of Ada at the flow diversion structure on Marsh River Ditch. The ditch trends just north of Ada and generally westerly for about 10 miles to its junction with the Old Marsh River channel.

From this point the Marsh River flows northwesterly about 35 miles to its confluence with the Red River of the North about 15 miles north of the mouth of the Wild Rice River. **Figure 3** shows the stream and ditch network within the Wild Rice River Basin.

The principal tributaries of the Wild Rice River are the White Earth River (mile 99), Marsh Creek (mile 72), South branch Wild Rice River (mile 29.5), and Felton Ditch (mile 20.5) with drainage areas of 202, 154, 253, and 144 square miles, respectively. The principal tributary of the Marsh River is Spring Creek which has a drainage area of 135 square miles.

Climatology

Weather observations are currently being obtained by the National Weather Service (NWS) at three stations within the Wild Rice and Marsh River Basin, Mahnomen 1W, Twin Valley 3 SW, and Ada. At Mahnomen, daily precipitation records are available since August 1924 except for several months of no records in the early years. Temperature records are available since 1959. Hourly precipitation records have been obtained at or near Twin Valley since December 1940. At Ada, daily precipitation records are available for most of that period. Daily precipitation and temperatures are available at Beaulieu from 1900 until 1912, when the station was discontinued. Records of Beaulieu have been combined by the National Weather Service with records at Mahnomen, eight miles west of Beaulieu, in order to extend the period of Mahnomen records. Temperature and precipitation records obtained at Halstad, outside of the basin on the Red River of the North, from 1905, to 1916 have been combined with Ada records (14 miles southeast) by the National Weather Service in order to extend the length of the Ada records. Halstad was resumed as a precipitation station in 1956 (**reference 1 & 2).**

Temperature

The Wild Rice-Marsh River Basin has a continental climate which is characterized by extreme variations in temperature and moderate precipitation. Normal mean temperature for the basin is 40 degrees F and normal mean monthly temperatures vary from 70 degrees F in July to 5 degrees F in January. National Weather Service records show temperature extremes of 111 degrees at Ada on 6 July 1936 and -53 degrees F at Ada on 15 February 1936. **Table 2** summarizes temperature values for the National Weather Service station 220018 at Ada

The growing season between the last frost in the spring and the first frost in the fall averages 137 days at Ada. **Table 3** lists the length of the growing seasons.

Precipitation

Normal annual precipitation for the Wild Rice-Marsh River Basin averages about 24 inches, with greater precipitation in the eastern portion of the basin and slightly less in the western portion. The greatest annual precipitation observed was 33.39 inches at Ada in 1941, and the least observed was 10.25 inches at Mahnomen in 1936. Normal monthly precipitation for the basin ranges from a maximum of 4.3 inches in June to a minimum of 0.6 inch in February. Approximately 67 percent of the annual precipitation occurs during the 5-month growing season, May through September.

Up until the renowned June 2002 storm, the maximum 1-day rain was 5.83 inches on 07 August 1941. The maximum monthly rain was also in August of 1941 with 10.72 inches. The highest monthly rain may have been exceeded in June of 2002 based on unofficial estimates. As much as 10 inches fell during the 3-day storm of 9 to 11 June. According to the NWS, six or more inches of rain fell in less than twelve hours in northeastern Clay, southeastern Norman, and western Mahnomen counties. More than nine inches of rain was reported near Twin Valley in Norman County.

Less than two weeks later on 22 and 23 June rains exceeding four inches fell in an arc from already hard-hit Norman and Mahnomen counties, east to St. Louis County. Portions of Norman, Mahnomen, Becker, Clearwater, Itasca, and St. Louis counties reported more than six inches of rain in the two-day event. Rainfall amounts topping eight inches were observed in small areas of Mahnomen and St. Louis County. **Table 4** summarizes precipitation values for the NWS station 220018 at Ada.

Snowfall, which amounts to about 16 percent of the total annual precipitations, averages about 40 inches per year. The most snowfall occurred in the winter of 1996 – 1997 with 104 inches. **Table 5** lists snowfall averages and extremes for the period-of-record.

Table 2. Temperature Extremes and Summary, Ada, MN

	Temperature Summary NCDC Normals POR: 1971-2000			Temperature Extremes Period of Record: 1892-2001							
Month	Max °F	Min °F	Mean °F	High Mean°F	Year	Low Mean°F	Year	1-Day Max°F	Date	1-Day Min°F	Date
JAN	14.3	-5.4	4.5	20.9	1990	-8.3	1937	53	1/24/1981	-43	1/18/1994
FEB	21.4	2.3	11.9	27.3	1987	-12.4	1936	65	2/25/1958	-53	2/15/1936
MAR	34	16.3	25.2	38.4	1973	8.2	1893	78	3/30/1967	-39	3/10/1948
APR	53.1	31.3	42.2	52.1	1987	29	1893	100	4/21/1980	-12	04-02-1899
MAY	68.5	44.7	56.6	67.4	1977	45.5	1924	107	5/30/1939	12	5/12/1918
JUN	76.3	55	65.7	73.3	1988	56.9	1969	104	6/18/1933	26	6/1/1917
JUL	80.7	58.9	69.8	80	1936	65.1	1992	111	7/6/1936	37	7/3/1967
AUG	80.1	56.7	68.4	76.8	1983	62.2	1946	104	8/18/1976	31	08-31-1895
SEP	69.2	45.5	57.4	65.2	1897	49.6	1965	101	9/22/1936	17	09-30-1895
OCT	55.4	33.3	44.4	54.5	1953	32.8	1917	95	10/3/1922	-6	10/26/1919
NOV	34.2	17.8	26	39.5	2001	9.8	1896	74	11/17/1953	-35	11-30-1896
DEC	20	2.7	11.4	25.5	1939	-2.6	1927	60	12/6/1939	-42	12/13/1901
Annual	50.6	29.9	40.3	47.4	1931	31.3	1893	111	7/6/1936	-53	2/15/1936

Table 3. Length of Growing Season, Ada, MN

Length of Growing Season (Days) Derived from 1971-2000 Averages					
Base Temp °F	Median	Shortest	10%	90%	Longest
32	137	120	122	151	170
30	143	121	128	166	171
28	157	129	137	180	186
24	177	150	151	200	224
20	205	150	168	222	233
16	216	176	191	232	242

Table 4. Precipitation Extremes and Summary, Ada, MN

Month	Precipitation NCDC Normals POR: 1971-2000 (in)	Precipitation Extremes Period of Record: 1892-2001 High (in)	Year	Low (in)	Year	1-Day Max (in)	Date
JAN	0.83	2.21	1969	0	1952	1.05	1/1/1921
FEB	0.59	1.56	1948	0	1952	1.1	2/6/1946
MAR	1.03	2.95	1966	0	1918	1.24	3/3/1970
APR	1.69	6.01	1986	0	1949	2.41	4/21/1964
MAY	3.05	9.19	1985	0.22	1901	4.51	5/22/1981
JUN	4.32	8.22	1925	0.54	1929	3.6	6/4/1902
JUL	3.4	8.49	1962	0.18	1930	3.8	7/20/1952
AUG	2.84	10.72	1941	0.23	1949	5.83	8/7/1941
SEP	2.37	8.06	1973	0.04	1974	2.98	9/24/1973
OCT	2.03	7.49	1971	0.03	1992	2.65	10/17/1971
NOV	1.08	4.87	1977	0	1916	1.58	11/1/1974
DEC	0.7	1.87	1921	0.03	1944	1.36	12/2/1982
Annual	23.93	33.39	1941	12.25	1936	5.83	8/7/1941
Winter		5.02	1969	0.18	1931	1.36	12/2/1982
Spring		13.16	1985	1.06	1980	4.51	5/22/1981
Summer		19.58	1944	2.23	1929	5.83	8/7/1941
Fall		12.42	1977	0.71	1963	2.98	9/24/1973

Table 5. Snowfall Extremes and Summary, Ada, MN

Month	Snowfall Summary 1971-2000 Averages Snow (in)	Snowfall Extremes Period of Record: 1892-2001 High (in)	Year	1-Day Max	Date
JAN	11.4	29	1989	10	1/22/1982
FEB	5.7	15.8	1955	8	2/20/1955
MAR	6.9	26	1966	12	3/3/1966
APR	1	12.5	1970	9	4/19/1970
MAY	0	2.5	1954	2.5	5/2/1954
JUN	0	0	-	-	-
JUL	0	0	-	-	-
AUG	0	0	-	-	-
SEP	0	0	-	-	-
OCT	0.6	6.5	2001	6	10/30/1972
NOV	5.8	21	1985	10	11/28/1960
DEC	8.5	23.1	1996	12	12/30/1972
Season (Jul-Jun)	39.9	103.9	1996-1997	12	12/30/1972

Notable Storms.

July 1897

A storm during 18-22 July 1897 (UMV 1-2) was among the most severe storms which extended over the basin. The center was at Lambert, Minnesota, 27 miles north of Mahnomen, Minnesota. The total rainfall depth at the center was 8.2 inches of which 6.5 inches fell in the maximum 24-hour period. At Ada the total rainfall was 4.87 inches with 3.28 inches measured in 1 day.

July 1901

Another large storm in the vicinity (UMV 1-8)) occurred during 1-6 July 1901 and centered at Newfolden, Minnesota, located 75 miles north of twin Valley. Rainfall at the center totaled 10.1 inches in 4 days, of which 7.6 inches fell within 24 ours. During this storm 3.89 inches of rainfall were measured at Ada and 1.90 inches at Beaulieu.

July 1909

The greatest known storm in the basin (UMV 1-11(a)) occurred during 18-23 July 1909 and centered at Beaulieu, Minnesota, in the eastern part of the basin. This storm was one of the greatest storms in Minnesota for 6 hours duration over a few hundred square miles. At the storm center 10.75 inches of rainfall were measured on 20 July 1909 over a 24-hour period. Studies indicate that 10.5 inches of this rainfall occurred in the maximum 6 hours. Rainfall at Beaulieu totaled 12.07 inches in 4 days.

July 1972

More recently, on 21 and 22 July 1972, a very intense storm occurred on the central part of Minnesota. This storm had the greatest 24-hour official rainfall amount ever recorded in Minnesota. The 24-hour rainfall was 10.84 inches at Fort Ripley, which is located about 120 miles southeast of Twin Valley. Total storm rainfall at Fort Ripley was 12.10 inches. Several unofficial measurement exceeding 13 inches for the storm were obtained in Morrison and Todd Counties. The heavy rain covered a large area; the eight inch or greater rainfall extended 90 miles with an average width of 16 miles for an area of nearly 1,500 square miles. During this storm about 1 inch to 2 ½ inches of rain fell on the Wild Rice Basin.

June 1975

The rainfall of 28-29 June1975 produced one of the most significant rain events in Southeastern North Dakota and Northwestern Minnesota. **Figure 4** shows an isohytal map of the portion of rain that covered the Wild Rice Basin.

July 1993

Two major rain events occurred within 1 week of each other in July of 1993. The first storm was on 15-16 July and the second occurred on 24-25 July. **Figure 5** and **6** shows isohyetal maps for these events.

June 2000

Again in June of 2000 an event with more than 4 inches of rain occurred on 19 and 20 June. An isohyetal map of this event is shown in **Figure 7**.

June 2002

Flooding during June 2002, however, was not caused by factors usually associated with major flooding in the Red River Basin. In fact, precipitation had been below normal since late summer 2001 and as of 01 June 2002, the flooded area was in a moderate drought based on the Palmer Drought severity Index. The June 2002 floods were the result of heavy rainfall that swept across the region on 9-10 June and again on 22-24 June 2002.

During the early morning of 09 June 2002, a strong low-pressure system was located in southwestern South Dakota with a warm front extending northeastward across southeastern North Dakota and into Minnesota. Very warm and unstable air transported by a southerly low-level jet stream was located south of the warm front. A low-level jet stream located about 5,000 feet above ground surface with southerly wind speeds of 60 miles per hour is a common feature in the Great Plains during the summer. Very moist and unstable air located south of the warm front was pushed north by the jet stream. As the air was lifted over the front, moisture condensed and helped fuel the continuous thunderstorm development during the early morning of 09 June. The almost stationary low-pressure system produced a second round of storms on 10-11 June. Precipitation totals from the 3-day storm were greater than 5 inches in many areas, and the maximum storm total was about 10 inches.

Similar meteorological conditions occurred on 22-24 June, when warm and unstable air transported by the southerly low-level jet was pushed up and over a warm front that was draped across west-central Minnesota. Two waves of thunderstorms occurred. The first wave began during the evening on Saturday, 22 June and ended during the day on Sunday, 23 June. The second wave developed during the evening on Sunday and tapered off on Monday, 24 June. The largest rainfall totals in the first wave occurred in the northern two-thirds of the Red River Valley and northern Minnesota, and the largest rainfall totals in the second wave in the Red River basin occurred in the Wild Rice River basin and in the headwaters of the Clearwater River basin.

June 2002 rainfall totals exceeded historical averages by more than six inches in many areas, and by more than 10 inches in some locations. In the study area, the June 2002 rainfall exceeded one-half of the normal annual precipitation. When compared against all other historical June data, June 2002 precipitation totals ranked at or above the 99^{th} percentile for nearly all of northwestern Minnesota, large areas of north central Minnesota, and some sections of northeastern, central and southeastern Minnesota. Almost 20-percent of al surface area in Minnesota was at or above the 99th percentile for June rainfall. **Figures 8 and 9** show isohyetal lines of the June 2002 storm for selected durations.

Hydrology

Stream Flow Records

Streamflow data are being obtained by the U.S. Geological Survey at four regular gaging stations in the Wild Rice and Marsh River Basins. Three other gaging stations have been maintained in the past and have been discontinued. **Table 6** shows the stream gages within the Wild Rice and Marsh River Basin. **Table 7** compares the year 2002 peaks with previous peaks at selected gaging stations. The source for **Table 7** is a USGS publication (**reference 3**) which gives pertinent data on the stations and shows maximum and minimum observed flow. During high stages a portion of the flow of the Wild Rice River is diverted into the Marsh River at a point 3 ½ miles east of Ada and has affected the flow at downstream gaging stations since they were established. A breakout formed 1 ½ miles southeast of Ada in 1947 and diverted some of the flow from the Wild Rice River at all stages into the Marsh River. Until the breakout was closed in November 1951 it also affected flows at downstream gaging stations.

Runoff Characteristics

Stream flow is small during the winter season. The Marsh River usually has no flow for long periods in the winter months. Streamflow usually rises in late March or in April, often reaching the highest flow of the year in April. Often the streamflow remains relatively high through June but usually recedes slowly in the summer, except after heavy rains. In the fall months the stream flow is rather low. The numerous lakes in the upper portion of the Wild Rice Basin tend to sustain the low flow on the main stem during the dryer seasons of the year.

Average annual runoff for 85 years of record at Twin Valley amounts to 150,600 acre-feet or 3.02 inches depth of runoff on the 934 square-miles drainage area. This runoff may have been reduced slightly by evaporation from the numerous lakes in the basin. The maximum annual runoff occurred in 2002 at 475,300 acre-ft. Minimum runoff occurred in 1997 at 16,430 acre-ft.

Runoff depths on the basin above the Hendrum and Shelly gages cannot be determined individually because of the diversion of flows above those stations. Approximately 62 percent of the annual flow at Twin Valley occurs in the 3 months of April through June.

The diversion ditch and weir, which were built in the latter part of the 19th century, result in a portion of the flows being diverted from the Wild Rice River into the Marsh River when the river stage is high. This diversion has been in existence during the entire period of downstream gaging stations and, at times of high flows, has reduced the discharge of the Wild Rice River at Hendrum and has increased the flow of the Marsh River near Shelly. During the period 1966-1970 local interests improved the Wild Rice channel below the diversion. Following this silt deposited in the Marsh River ditch to a depth of about 2 feet above the concrete crest of the weir. Consequently, considerably less flow is now diverted into the Marsh River at high stages than occurred before 1966.
The Hydraulics Appendix shows the main stem – diversion flow relationships used for this study.

Table 6. Stream Gauges within Wild Rice and Marsh River Basin

Agency	Site Number	Site Name	Period of Record		
			Begin Date	End Date	Peaks
USGS	05062280	MOSQUITO CREEK NEAR BAGLEY, MN	1961-04-18	1985-03-24	25
USGS	05062470	MARSH CREEK TRIBUTARY NEAR MAHNOMEN, MN	1961-03-17	1985-05-12	25
USGS	05062500	WILD RICE RIVER AT TWIN VALLEY, MN	1909-07-22	2006-03-31	85
USGS	05062700	WILD RICE RIVER TRIBUTARY NEAR TWIN VALLEY, MN	1961-05-14	1985-05-12	25
USGS	05062800	COON CREEK NEAR TWIN VALLEY, MN	1962-06-08	1984-06-09	23
USGS	05062850	COON CREEK TRIBUTARY NEAR TWIN VALLEY, MN	2000-06-20	2001-04-08	2
USGS	05062900	WILD RICE RIVER ABOVE ADA, MN	1985-05-14	1990-04-01	6
USGS	05063000	WILD RICE RIVER NEAR ADA, MN	1948-04-09	1953-07-04	6
USGS	05063200	SPRING CREEK TRIBUTARY NEAR OGEMA, MN	1963-06-02	1989-04-03	27
USGS	05063398	S. BR. WILD RICE RIVER AT CO. RD. 27 NR FELTON, MN	2004-10-30	2006-03-31	2
USGS	05063500	SOUTH BRANCH WILD RICE RIVER NEAR BORUP, MN	1944-07-12	1984-06-11	19
USGS	05063850	STATE DITCH 45 TRIBUTARY NEAR ULEN, MN	2002-06-09	2007-06-17	6
USGS	05064000	WILD RICE RIVER AT HENDRUM, MN	1944-07-15	2006-04-03	63
USGS	05067000	MARSH RIVER BELOW ADA, MN	1948-04-16	1973-03-05	6
USGS	05067050	MARSH RIVER DITCH NR ADA MN	1985-05-13	2007-03-22	23
USGS	05067500	MARSH RIVER NEAR SHELLY, MN	1944-07-11	2006-04-03	63

Table 7. Historical Peak Discharges and Stages[1]

Station Name and Number	Drainage Area (square miles)	Period of previously known peaks	Maximum peaks previously known From period of record				Maximum peaks during June 2002				
			Date	Stage (feet)	Date	Discharge (ft^3/s)	Date	Stage (feet)	Date	Discharge (ft^3/s)	Recurrence Interval (years)
Wild Rice River at Twin Valley, MN 05062500	934	1909-1917 1931-2001	07-22-1909 04-06-1997 04-07-2001	16.00 15.91 12.63[b]	07-22-1909 04-06-1997 04-08-2001	9,200 10,000 5,250	06-09-2002 06-24-2002	17.40[c] 18.00	06-09-2002 06-24-2002	14,000 19,000[a]	100-200 500
Wild Rice River at Hendrum, MN 0506400	1,560	1944-2001	-- 04-21-1979 04-18-1997 04-14-2001	-- 32.30 33.85[d] 31.62[d]	04-10-1978 -- 04-18-1997 04-10-2001	9,350 -- 10,600 9,720	06-13-2002 06-28-2002	28.02[b] 26.48	06-13-2002 06-28-2002	8,520 8,770[e]	10-25 10-25
Red River of the North at Halstad, MN 05064500	21,800	1936-1937 1942-2001	04-22-1979 04-19-1997 04-15-2001	39.00 40.74 38.44	04-22-1979 04-19-1997 04-14-2001	42,000 71,500 37,900	06-14-2002	20.46	06-13-2002	12,300	2-5
Marsh River Ditch near Ada, MN 05067050	--	1985-2001	04-06-1989	16.74	04-06-1989	1,070	06-10-2002	19.02	06-10-2002	1,700	ND
Marsh River near Shelly, MN 05067500	220	1944-2001	04-19-1979 04-18-1997 04-10-2001	23.36[c] 25.45[c] 19.24	04-19-1979 04-18-1997 04-10-2001	4,880 4,300[d] 2,380	06-12-2002 06-26-2002	24.92[b] 24.34	06-12-2002 06-26-2002	4,750 5,520	10-25 10-25

1. From USGS listed in Reference 3.
a. Flood peak later revised by USGS to 20,300 cfs.
b. Backwater from aquatic vegetation, ice debris, or other water source.
c. From floodmark/high watermark.
d. Backwater from Red River of the North.
e. Flood peak later revised by USGS to 8,690 cfs.

Flood Characteristics

Floods on the Wild Rice and Marsh River usually occur in the months of April through June, although floods have occurred in all months from March through July. Most of the floods result from snowmelt runoff which is often increased by spring rains. During the early stages of snowmelt runoff the river channel may be clogged by hard-packed snow and ice which increases river stages. During some years, ice or ice jams may increase the stages several feet. When conditions are favorable to runoff, spring rains following snowmelt may either extend the duration of high flows or result in additional high peak flows. Floods during the summer season can follow heavy widespread storms although high-river stages rarely occur after July.

Flood Problems

The City of Ada is subject to flooding from high stages on the Marsh and Wild Rice Rivers and on JD 51. Flooding occurs from both snowmelt and excessive summer rains. During the early stages of snowmelt, rivers and ditches are often clogged by ice and snow. Ice jams have been known to increase river stage by several feet. The primary source of flooding is from the Wild Rice River overflow to JD 51 and the Marsh River. While there are some levees along the Wild Rice River, high stages will occasionally break out, and overland flow will lead to flooding in Ada. JD 51 is a 9.8 mile diversion ditch that begins at a point on the Wild Rice River, 3-1/2 miles upstream of Ada. JD 51 runs along the northern edge of Ada and eventually connects to the Marsh River, west of Ada. In addition to carrying local runoff, under certain conditions, this ditch will divert a portion of the flow from the Wild Rice River. High flows in JD 51 and the Old Marsh River will cause flooding in Ada. The Marsh River lies directly to the south of Ada, between the city and the Wild Rice River. The location of JD 51, the Marsh River and the Wild Rice River is shown on **Figure 3.**

Historic Floods

March 1882

In March of 1882, 4 feet of snow fell in about 2 weeks. This snow melted so rapidly that the Wild Rice River was reported to have risen 12 to 20 feet in 1 day near Hendrum. Much damage occurred but no data are available on stages reached or area flooded. The Red River of the North at this time was at the highest stages known to pioneer settlers. At Hendrum the unfortunate persons lacking two-story homes were obliged to seek refuge in a nearby log church.

Spring and Summer 1896-1897

Several severe blizzards during the winter of 1896-97 produced heavy snowfall as evidenced by drifts as deep as 20 to 30 feet which nearly covered many houses. Warm weather came suddenly the following spring, ice jammed in the rivers, and water rushed into the rivers. The early spring flood was followed by another major flood during July of the same year. Many farms were vacated following the floods of 1897 and remained unoccupied for a number of years thereafter. As few graded roads traversed the basin at that time, the floodwaters flowed unimpeded over the land. If a flood of similar magnitude to the 1897 flood were to occur under present conditions, much greater damage would result.

July 1909

Until years 1997 and 2002, the greatest known flood caused by rainfall was that of July 1909. This flood was caused by the storm of 18-23 July 1909, which centered at Beaulieu, Minnesota, in the eastern part of the Wild Rice River Basin. This was the greatest storm recorded until recently in the Red River Basin and also one of the most intense storms ever to occur within the State. The estimated maximum 24-hour rainfall at Beaulieu was 11.5 inches while the storm totaled 12.07 inches in 72 hours. In the lower part of the basin much less rainfall occurred, as evidenced by the total precipitation of 2.14 inches recorded at Halstad. The Wild Rice River rose rapidly following the heavy rain. At Twin Valley, the river rose more than 12 feet in 24 hours on 19-20 July, with a further rise of 2 feet in the next 48 hours. The computed peak flow on 22 July was 9,200 cfs which is almost twice any discharge observed since that time until 1997 and 2002. During the slow flood recession overbank stages persisted for about a month. This flood inundated much of the lower basins of the Wild Rice and Marsh Rivers, including the entire community of Ada.

April 1943

Two periods of high flow occurred during 1943. The first, resulting from the rapid melting of snow, produced a maximum flow of 2,030 cfs at Twin Valley on 1 April. High stages, which delayed seeding and other normal spring activities, prevailed in the vicinity of Ada for about 3 weeks. The second and larger flood occurred in June and produced a maximum discharge of 4,120 cfs on 4 June at Twin Valley. This flood resulted from the cumulative effect of heavy rains of about 1 inch on 15 and 16 May and a total of 4 to 5 inches from 23 May to 3 June. At that time ground conditions were favorable for a high rate of runoff as the spring was cooler and wetter than usual. The flood made many acres which had been flooded earlier in the season unfit for cultivation during the remainder of the year in addition to destroying a large acreage already in crop. Minor damage to roads and bridge approaches was experienced in this flood.

April 1947

The flood of April 1947 resulted from the melting of a heavy snow cover combined with rainfall. During the period 3-6 April precipitation, largely in the form of snow, was heavy throughout the basin, particularly in the eastern part of the basin. Mahnomen reported 1.97 inches of precipitation during that time. Subsequent near – freezing temperatures occurred which averaged about 0.75 inch over the basin. The rain was accompanied by rising temperatures. The combination of snowmelt and rainfall runoff produced overbank flow in many places. At Twin Valley the Wild Rice River peaked at 2,510 cfs on 15 April. Maximum flows at downstream gaging stations were 4,410 cfs on 15 and 16 April at Hendrum and 4,150 cfs on 14 April on the Marsh River near Shelly. The flows at the two latter locations were probably affected by the breakout 1 1/2 miles southeast of Ada which diverted flow from the areas of cropland from which the water receded slowly. Thus, the normal spring crop planting was delayed appreciably in the area. Other damages sustained included washouts of road grades and damages from erosion.

Spring 1950

Three floods occurred in 1950 with peaks in April, May and June. A snow survey near the middle of March indicated water contents ranging between 2 and 3 inches over the basin. Additional precipitation, mostly snow, in the latter half of March and early April totaled about 1 1/2 inches. Limited melting of snow occurred early in April but the major runoff from snowmelt started on 14 April.

A peak flow occurred on 18 April along much of the river with peak flows of 2,940 cfs at Twin Valley, 990 cfs near Ada below diversion, 2,940 cfs at Hendrum, and 3,680 cfs near Shelly. The water spread overbank downstream from Ada to flood farmlands more than a mile from the channel. Some basements in Ada were flooded by overflow water when the Wild Rice Rive overtopped its banks east of town and moved across country, uniting with the Marsh River. The crest receded slowly and traffic in the area was hampered for more than a week.

During the last 7 days of April, rainfall averaged approximately 1 inch over the basin. Approximately 3 inches of additional rain fell from 2 to 9 May. Although this rainfall was distributed over several days, conditions were favorable for high runoff and flood conditions resulted. Peak flows at Twin Valley on 9 May, at Ada below the diversion on 9 May, at Hendrum on 10 May, and near Shelly on 11 May were 3,530 cfs, 1,180 cfs, 3,150 cfs, and 4,660 cfs, respectively.

The peak flow at Shelly is the largest recorded during the entire record of over 20 years. The Hendrum discharge was the highest of the year. During this flood a peak mean daily flow of 1,750 cfs was observed on the Marsh River below Ada, and most of this flow was diverted from the Wild Rice to the Marsh River at the breakout of 1 1/2 miles southeast of Ada. Additional flow was diverted into the Marsh River ditch, 3 1/2 miles east of Ada. This flood contributed to the May 1950 flood on the Red River of the North which was the greatest since 1897 and until 1966 at Grand Forks and downstream. Flows receded well below bankfull stage early June and remained at moderate flows until the last week of June.

Heavy rains and severe thunderstorms occurred on 24-25 June, with the greatest rainfall in the northwestern portion of the basin. Mahnomen reported 4.10 inches of rain in 24 hours, Twin Valley recorded 4.05 inches in 30 hours, and Ada had 3.10 inches in 24 hours. Near Leonard, 20 miles outside the northeast corner of the basin, 7.60 inches of rain was measured in 4 days, with 6.50 inches in 1 day. Flood flows resulted with instantaneous peaks of 4,380 cfs at Twin Valley on 26 June, 1,720 cfs near Ada below the diversions on 26 June, 2,040 cfs at Hendrum on 28 June, and 4,060 cfs on the Marsh River near Shelly on 29 June. This flood was the greatest of the year at Twin Valley and at Ada but was exceeded by spring peak flows at locations farther downstream.

Spring 1965

The fall and winter of 1964-65 were considerably colder than normal, resulting in deep frost penetration. Snowfall was above normal during the winter months. A snow survey in the latter part of March indicted an average of about 2 inches of water content, with the greatest amount in the upper portion of the basin. Temperatures remained generally below freezing throughout March. Beginning on 4 April temperatures above freezing prevailed as a rule. A series of rains from 3 to 11 April added from 2 more than 3 inches of water added to the snowmelt runoff. Flood flows resulted with peak flows of 3,160 cfs at Twin Valley on 12 April, 6,800 cfs at Hendrum on 14 April, and 3,120 cfs on the Marsh River at Shelly on 13 April.

Spring 1969

The flood of April 1969 followed a severe winter with heavy snow cover. Rainfall in September and October 1968 was considerably above normal on the basin. Snowfall in December and January was 2 to 3 times the normal amount for those months. February snowfall was well above normal on the basin, although there was not much snowfall in March. Temperatures averaged colder than normal in December, January, and March. Snow surveys in March showed water content of the snow cover averaging nearly 4 inches on the basin with greater depths in the upper portion. After the first few days of April, the temperature rose well above the melting point in the daytime. Then more than an inch of rainfall occurred on 8 and 9 April, which added to the snowmelt runoff, and caused severe flooding.

The peak flow at Twin Valley was 4,850 cfs on 10 April 1969. This was the largest discharge in the period of record, except for that of July 1909. Downstream at Hendrum the peak flow was 8,300 cfs on 15 April and was the largest flow during the period of record there. The Marsh River near Shelly had a maximum flow of 3,910 cfs on April 12. This flow at Shelly was exceeded by the flood of May 1950, when flow from the breakout near Ada added substantially to the Marsh River flow.

April 1997

Significant flooding occurred in Ada in April 1997. The spring 1997 flood was a snowmelt runoff event. The flooding on the Wild Rice River was exacerbated by 2-3 inches of rainfall on top of the melting snow. Heavy autumn precipitation contributed to spring flooding conditions. Snow depths for the area in January were ranked in the 99th percentile relative to the historical record. (Minnesota State Climatology Office). Due to cool temperatures in March and April 1997, there was a relatively late runoff period.

The flooding on the Wild Rice River in the spring of 1997 occurred in two waves. The first wave was caused by ice jams that developed on the Wild Rice River. Ice jams formed at the junction of Judicial Ditch 51, at the junction with the Old Marsh River channel and at Highway 9, just south of Ada. Ice jams increased stages on the Wild Rice River resulting in failure of the Wild Rice River dike systems and sent additional flow overland toward Ada, Minnesota. The ice jams sent massive flows up Judicial Ditch 51. The peak stage on the Wild Rice River during the first wave of flooding was 13.5 feet at the gage located near Ada, which fell short of the record stage by only 0.1 feet.

The Wild Rice River was nearing a peak condition when a powerful storm combined 2 to 3 inches of rainfall with freezing rain and snow. The rainfall quickly melted the remaining snowpack. This caused a second wave of flooding which overtopped levees in many locations in Ada. Road crossings downstream of the Heiberg Dam were overtopped. Highway 200 and Highway 9 were overtopped. The South Branch of the Wild Rice River overflowed its banks. The railroad track which had been acting as a levee between the eastern and western portions of Ada was overtopped by about six inches. The City of Ada was evacuated. Some streets in Ada were under more than 5 feet of water. The peak stage on the Wild Ricer River for the second wave of flooding was 16.5 feet at the gage located near Ada, which surpassed the flood of record by 2.9 feet.

Once water spilled over the levees it flowed overland through Ada and continued overland downstream. Culverts between the sections were not large enough to pass the overland flows. Sections filled like reservoirs until the water overtopped or breached roadways, spilling into the next section. Almost all of Hegne Township was flooded. Water submersed fields in bands from 5 to 10 miles wide.

There are two USGS gages currently in use on the Wild Rice River. The first is USGS gage, number 05062500, is located at Twin Valley, Minnesota. The second USGS gage, number 05064000, is located at Hendrum, Minnesota. Ada, Minnesota lies along the Wild Rice River between these gage locations. At the gage at Twin Valley, the instantaneous peak discharge was recorded at 10,000 cfs on 06 April. This discharge has a recurrence interval of approximately 70 years. It is estimated that the 1997 flood had a recurrence interval of 500 years, with extreme plugging conditions and ice jams.

June 2002

Flooding during June 2002, however, was not caused by factors usually associated with major flooding in the Red River Basin. In fact, precipitation had been below normal since late summer 2001 and as of 01 June 2002, the flooded area was in a moderate drought based on the Palmer Drought severity Index. The June 2002 floods were the result of heavy rainfall that swept across the region on 9-10 June and again on 22-24 June 2002.

Several streamflow gaging stations recorded peak stages and peak discharges during the June 2002 floods on the Wild Rice. A peak discharge of 14, 000 cfs occurred 09 June on the Wild Rice River at Twin Valley, Minnesota. The peak discharge exceeded the previous peak that occurred in 1997 by 40-percent and had a recurrence interval of about 200 years. Flooding was extensive in the City of Ada, Minnesota, just downstream of Twin Valley; however, flood fighting efforts prevented most damage. Flood discharges attenuated downstream of Twin Valley, but a significant peak discharge of 8,520 cfs occurred on 13 June on the Wild Rice River at Hendrum, Minnesota.

A peak discharge of 20,300 cfs occurred 24 June on the Wild Ricer River at Twin Valley, Minnesota. The peak discharge exceeded the peak on 09 June by 36-percent and had a recurrence interval of about 1,000 years. The peak discharge of 8,690 cfs that occurred

28 June on the Wild Rice River at Hendrum was slightly greater than the peak discharge that occurred 13 June.

Other Floods

Numerous other floods have occurred in the basin. It should be noted that eight out of the highest nine flood peaks occurred at Twin Valley in the last 18 years. Other notable floods were: 1989, 1978, 1979, 2000, 2001, and 2006. Their magnitude and corresponding rank is shown in **Table 8**.   Documentation for some of them is described in **reference 2.**

Wild Rice River Discharge-Frequency

Twin Valley

An annual, instantaneous, peak, discharge-frequency relationship was developed at the USGS gage (05062500) at Twin Valley, MN. At this location the contributing drainage area is 934 square miles. This gage has 84 years of broken record (1909 to 1917, 1931 to 2006). **Table 8** lists the instantaneous, peak discharge values, corresponding dates, and rank of each event based on Water Year. The 1979 event was tagged by the USGS as being the largest event known to occur since 1909. Therefore, the top 4 events (2002, 1997, 1909 and 1978,as part of the 85 years of systematic record, are treated as high outliers resulting in a historic period length of 98 years.

The frequency curve was developed in accordance with the US Water Resource Council, Bulletin 17B **(reference 4)**. Computed probability was selected for the discharge frequencies to facilitate risk and uncertainty analysis. Events were plotted with the analytical curve for comparison of fit with the Log Pearson Type III distribution using the Median plotting positions. Median plotting positions are known to fit computed probability curves better than Weibull plotting positions which better fit expected probability curves. **Figure 10** shows the discharge-frequency plot.

The adopted skew was determined by weighting the computed station skew with the regional skew value of -0.37. The regional skew was obtained from the USGS publication for generalized skew coefficients for Minnesota dated 1997 **(reference 5)** with a mean square error of 0.182**. Table 9** lists the three moments of the frequency curve distribution; mean logarithm, standard deviation, and skew along with the computed probability values.

Comparison with Previous Studies

Two recent studies for the Ada flood control project were developed in 1999 and 2001 **(reference 6 & 7**). The primary differences in the resulting discharge-frequency values from these studies was due to the addition of years to the period of record and more specifically the significant events that occurred during the later part of the period of record. The Wild Rice River basin received two record-setting rainfall events in June of 2002. On 9 and 10 June, rainfall accumulations topped eight inches in portions of Norman and Mahnomen County. More than nine inches of rain was reported near Twin Valley. Later on 22 and 23 June torrential rain exceeding four inches and up to 5.5 inches fell in Mahnomen County. These rains generated a peak discharge at the Twin Valley gage of 20,300 cfs. Based on the most recent discharge-frequency curve, this event has a return period of approximately 1,000 years.

Table 10 lists the discharge-frequency estimates that were made in the past. The 100-yr discharge value increased by 3,870 cfs from 7,730 to 11,600 cfs. **Figure 11** shows the discharge-frequency curve based on a period-of-record up to 1997. **Figure 12** shows a comparison of the discharge-frequency curves. **Table 11** lists the corresponding frequency values and statistics.

Table 8. Annual Peak Discharges, Rank, & Plotting Positions

WILD RICE RIVER-TWIN VALLEY, MN-FLOW-ANNUAL PEAK

Events Analyzed				Ordered Events			
Day	Mon	Year	FLOW CFS	Rank	Water Year	FLOW CFS	Median Plot Pos
22	Jul	1909	9,200	1	2002	20,300*	0.71
26	Apr	1910	1,610	2	1997	10,000*	1.73
22	Apr	1911	473	3	1909	9,200*	2.74
12	May	1912	758	4	1978	6,470*	3.76
02	Apr	1913	1,610	5	1979	6,010	4.86
10	Jun	1914	1,120	6	2006	5,400	6.04
29	Jun	1915	2,340	7	2000	5,340	7.22
01	Jun	1916	1,670	8	1989	5,260	8.40
03	Apr	1917	719	9	2001	5,250	9.58
21	May	1931	112	10	1969	4,850	10.75
09	Apr	1932	358	11	1950	4,380	11.93
23	May	1933	450	12	1943	4,120	13.11
12	Apr	1934	266	13	1985	4,100	14.29
14	Jul	1935	216	14	1993	3,980	15.47
14	Apr	1936	2,490	15	1974	3,890	16.65
03	May	1937	301	16	1996	3,700	17.83
12	May	1938	836	17	1975	3,660	19.01
30	Mar	1939	459	18	1965	3,160	20.19
09	Apr	1940	1,100	19	2005	3,140	21.37
03	Apr	1941	828	20	1998	3,020	22.55
03	May	1942	1,550	21	1962	2,760	23.73
04	Jun	1943	4,120	22	1947	2,510	24.91
08	Jul	1944	1,560	23	2004	2,500	26.09
02	Apr	1945	1,520	24	1995	2,500	27.27
24	Mar	1946	1,490	25	1936	2,490	28.45
15	Apr	1947	2,510	26	1999	2,480	29.62
09	Apr	1948	916	27	1915	2,340	30.80
08	Jul	1949	1,610	28	1972	2,220	31.98
26	Jun	1950	4,380	29	1966	2,120	33.16
09	Apr	1951	1,820	30	1986	1,960	34.34
08	Apr	1952	1,810	31	1951	1,820	35.52
04	Jul	1953	1,170	32	1994	1,810	36.70
10	Apr	1954	1,390	33	1952	1,810	37.88
04	Apr	1955	927	34	1970	1,740	39.06
12	Apr	1956	1,380	35	1967	1,710	40.24
21	Apr	1957	814	36	1963	1,680	41.42
07	Jul	1958	294	37	1973	1,670	42.60
06	May	1959	451	38	1916	1,670	43.78
15	Apr	1960	716	39	1964	1,640	44.96
17	May	1961	847	40	1949	1,610	46.14
09	Jun	1962	2,760	41	1913	1,610	47.32
30	May	1963	1,680	42	1910	1,610	48.49
17	Apr	1964	1,640	43	1944	1,560	49.67
12	Apr	1965	3,160	44	1942	1,550	50.85

TABLE 8. (continued)

02 Apr 1966	2,120	45	1945	1,520	52.03
01 Apr 1967	1,710	46	1946	1,490	53.21
30 Mar 1968	594	47	2003	1,400	54.39
10 Apr 1969	4,850	48	1954	1,390	55.57
30 Apr 1970	1,740	49	1956	1,380	56.75
10 Apr 1971	1,060	50	1984	1,370	57.93
21 Mar 1972	2,220	51	1987	1,280	59.11
04 Sep 1973	1,670	52	1976	1,250	60.29
12 Apr 1974	3,890	53	1982	1,200	61.47
01 Jul 1975	3,660	54	1953	1,170	62.65
29 Mar 1976	1,250	55	1914	1,120	63.83
21 Apr 1977	146	56	1940	1,100	65.01
07 Apr 1978	6,470	57	1990	1,090	66.18
18 Apr 1979	6,010	58	1980	1,080	67.36
03 Apr 1980	1,080	59	1971	1,060	68.54
06 Sep 1981	295	60	1955	927	69.72
19 Apr 1982	1,200	61	1948	916	70.90
07 Mar 1983	635	62	1961	847	72.08
11 Jun 1984	1,370	63	1938	836	73.26
13 May 1985	4,100	64	1941	828	74.44
13 May 1986	1,960	65	1957	814	75.62
24 Jul 1987	1,280	66	1992	791	76.80
05 Apr 1988	711	67	1912	758	77.98
05 Apr 1989	5,260	68	1917	719	79.16
03 Apr 1990	1,090	69	1960	716	80.34
06 May 1991	682	70	1988	711	81.52
25 Aug 1992	791	71	1991	682	82.70
28 Jul 1993	3,980	72	1983	635	83.88
21 Jun 1994	1,810	73	1968	594	85.05
15 Mar 1995	2,500	74	1911	473	86.23
14 Apr 1996	3,700	75	1939	459	87.41
06 Apr 1997	10,000	76	1959	451	88.59
21 Jun 1998	3,020	77	1933	450	89.77
14 May 1999	2,480	78	1932	358	90.95
22 Jun 2000	5,340	79	1937	301	92.13
08 Apr 2001	5,250	80	1981	295	93.31
24 Jun 2002	20,300	81	1958	294	94.49
26 Jun 2003	1,400	82	1934	266	95.67
28 Mar 2004	2,500	83	1935	216	96.85
01 Nov 2004	3,140	84	1977	146	98.03
31 Mar 2006	5,400	85	1931	112	99.21

Note: Plotting positions based on historic period (H) = 98
Number of historic events plus high outliers (Z) = 4
Weighting factor for systematic events (W) = 1.1605

* Outlier

Ada

The discharge-frequency relationship for the Wild Rice River upstream of Judicial Ditch 51 was estimated by transferring the frequency estimate for Twin Valley by using a drainage area ratio to the 0.6 power. This exponent has been used in all previous studies and was originally adopted based on the guidance provided in the USGS regional regression equations for ungaged drainage basins **(reference 8).** One deviation from previous estimates is the adopted drainage area for the gage at Twin Valley. Previous studies used 888 square miles; however, recently the USGS has modified this estimate to be 934 square miles. Estimates for the discharge-frequency curve at Ada are presented in **Table 10.**

Table 9. Discharge-Frequency Values, Wild Rice R. @ Twin Valley, MN; 1909-2006

Frequency Curve for: WILD RICE RIVER-TWIN VALLEY, MN-FLOW-ANNUAL PEAK

Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs	
			0.05	0.95
0.2	17,943	0	26,962	12,964
0.5	14,160	0	20,637	10,467
1.0	11,600	0	16,485	8,736
2.0	9,289	0	12,845	7,138
5.0	6,602	0	8,769	5,221
10.0	4,832	0	6,206	3,913
20.0	3,276	0	4,057	2,717
50.0	1,506	0	1,788	1,270
80.0	662	0	798	535
90.0	423	0	524	328
95.0	289	0	369	215
99.0	139	0	189	94

System Statistics

Log Transform: Flow,

Statistic	Value
Mean	3.1641
Standard Dev	0.4133
Station Skew	-0.1915
Regional Skew	-0.37
Weighted Skew	-0.2377
Adopted Skew	-0.2

Number of Events

Event	Number
Historic Events	0
High Outliers	4
Low Outliers	0
Zero Or Missing	0
Systematic Events	85
Historic Period	98

Table 10. Comparison of Discharge-Frequencies with Prior Studies

	Exceedence Frequency in%	COE July 1999, IA Historic Period 1909 - 1996 Q cfs	COE 2001 Interim Report Historic Period 1909 - 1999 Q cfs	Houston Eng. Study, 2002 Historic Period 1909 - 2002 Q cfs no high outliers	COE 2002 Ada Study Historic Period 1909 - 2002 Q cfs 5 high outliers	COE, 2006 Update Historic Period 1909 - 2005 Q cfs 4 high outliers	COE July 2007 Ada, Interim Report Historic Period 1909 - 2006 Q cfs 4 high outliers
	Wild Rice River at Twin Valley						
	0.2	10,800	12,900	18,500		17,900	17,943
	0.5		10,500	14,500		14,100	14,160
	1	7,730	8,860	11,900		11,500	11,600
	2	6,500	7,300	9,460		9,240	9,289
	4						
	5		5,400	6,680		6,560	6,602
	10	3,800	4,080	4,860		4,800	4,832
	20		2,860	3,270		3,260	3,276
	Wild Rice River upstream of JD51	Transfer by DA ratio 1,3	Transfer by DA ratio 1,3	Transfer by Hec-Ras unsteady 1,3	Transfer by DA ratio (Adopted) 1,3	Transfer by DA ratio (n = 0.6) 1,3	Transfer by DA ratio 2,3
	0.2	12,200	14,600		**19,800**	19,153	19,685
	0.5		11,865		**15,600**	15,087	15,535
	1	8,740	10,000	11,331	**12,800**	12,305	12,726
	2	7,350	8,250		**10,200**	9,887	10,191
	4			8,094			
	5		6,102		**7,240**	7,019	7,243
	10	4,300	4,610	5,875	**5,290**	5,136	5,301
	20		3,232		**3,580**	3,488	3,594
1	DA at Twin Valley =	888	sq. mi.				
2	DA at Twin Valley =	934	sq. mi.				
3	DA at Ada =	1,090	sq. mi.				
	Adopted for current study						

Table 11. Discharge-Frequency Values, Pre-1997; Wild Rice R. @ Twin Valley, MN

Frequency Curve for: WILD RICE RIVER-TWIN VALLEY, MN-FLOW-ANNUAL PEAK2				
Percent Chance Exceedance	Computed Curve Flow in cfs	Expected Prob. Flow in cfs	Confidence Limits Flow in cfs	
			0.05	0.95
0.2	10,707	11,401	15,643	7,934
0.5	8,975	9,435	12,801	6,768
1.0	7,706	8,029	10,770	5,897
2.0	6,476	6,689	8,848	5,037
5.0	4,917	5,026	6,491	3,917
10.0	3,792	3,847	4,858	3,083
20.0	2,715	2,736	3,363	2,254
50.0	1,347	1,347	1,599	1,137
80.0	615	608	739	498
90.0	394	386	488	305
95.0	268	259	342	198
99.0	124	115	171	83

System Statistics	
Log Transform: Flow,	
Statistic	Value
Mean	3.1037
Standard Dev	0.3859
Station Skew	-0.3688
Regional Skew	-0.37
Weighted Skew	-0.3692
Adopted Skew	-0.4

Number of Events	
Event	Number
Historic Events	0
High Outliers	2
Low Outliers	0
Zero Or Missing	0
Systematic Events	75
Historic Period	88

REFERENCES

1. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center.

2. U.S. Department of Defense, U. S. Army Corps of Engineers, St. Paul District, **Flood Control, Twin Valley Lake, Wild Rice River, Minnesota, Design Memorandum No. 1, Hydrology and Hydraulic Analysis,** January 1975.

3. U.S. Department of the Interior, Geological Survey, Open File Report 02-278, "***June 2002 Floods in the Red River of the North Basin in Northeastern North Dakota and Northwestern Minnesota***", 2002.

4. U.S. Department of the Interior, Geological Survey, **Guidelines for Determining Flood Flow Frequency, Bulletin # 17B**, Reston, VA, March 1982.

5. U.S. Department of the Interior, Geological Survey, **Generalized Skew Coefficients for Flood-Frequency Analysis in Minnesota, WRI Report 97-4089,** Mounds View, MN, 1997.

6. U.S. Department of Defense, U.S. Army Corps of Engineers, St. Paul District, "***Wild Rice River at Ada, Minnesota, Initial Appraisal***", 1999.

7. U.S. Department of Defense, U.S. Army Corps of Engineers, St. Paul District, **Interim Report – Final, Section 205 Feasibility Study, Ada, MN, Marsh River, JD 51 and Wild Rice River**, 14 August 2001.

8. U.S. Department of the Interior, Geological Survey, **Techniques for Estimating Peak Flow on Small Streams in Minnesota,** Mounds View, MN, 1997.

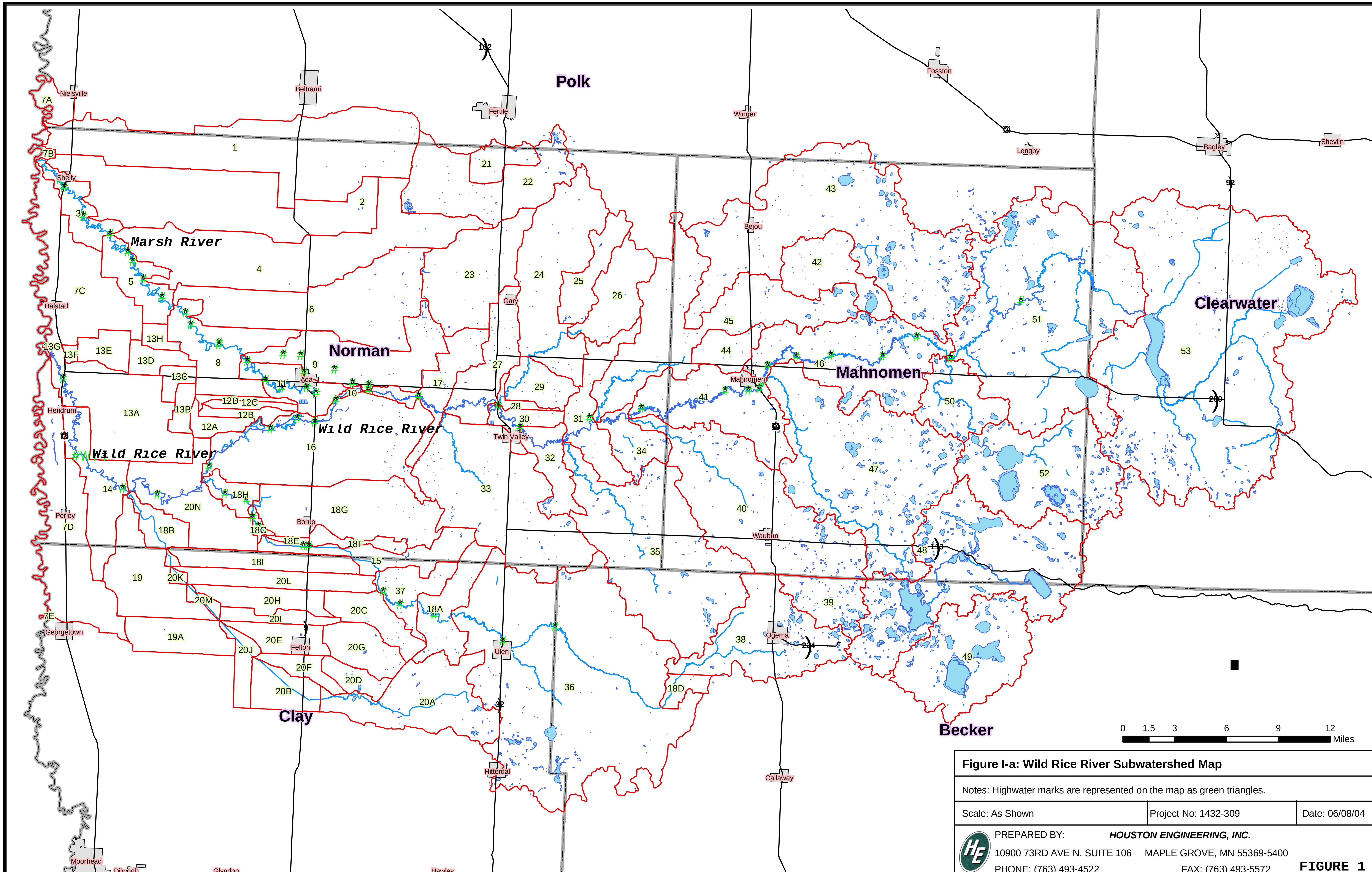

Figure I-a: Wild Rice River Subwatershed Map

Notes: Highwater marks are represented on the map as green triangles.

Scale: As Shown	Project No: 1432-309	Date: 06/08/04

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FIGURE 1

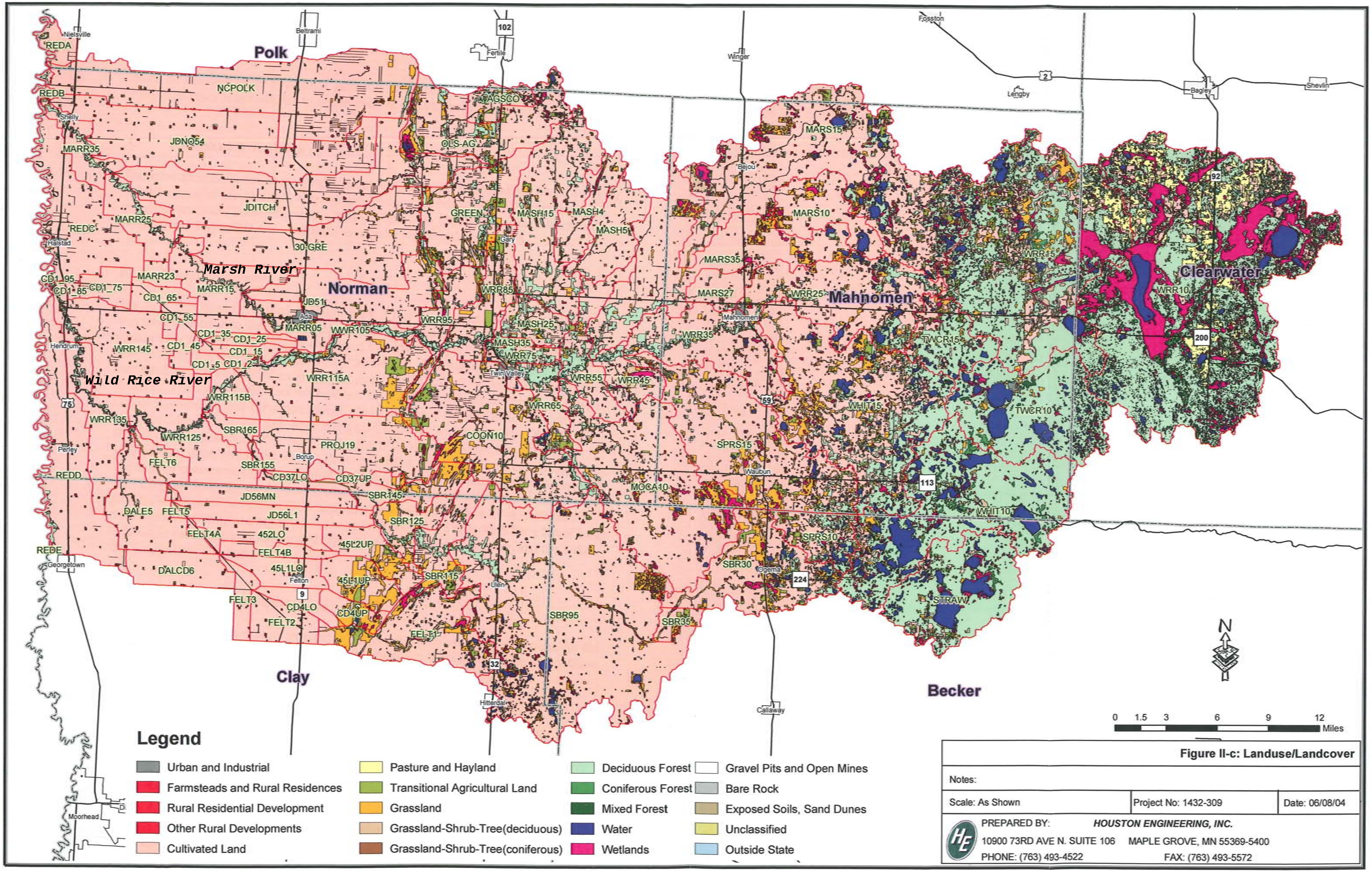
Polk
Norman
Mahnomen
Clearwater
Clay
Becker
Marsh River
Wild Rice River
Nielsville
Beltrami
Fertile
Fosston
Winger
Lengby
Bagley
Shevlin
Shelly
Halstad
Hendrum
Perley
Georgetown
Moorhead
Ada
Borup
Felton
Ulen
Hitterdal
Gary
Twin Valley
Bejou
Mahnomen
Waubun
Ogema
Callaway
Legend
Urban and Industrial
Farmsteads and Rural Residences
Rural Residential Development
Other Rural Developments
Cultivated Land
Pasture and Hayland
Transitional Agricultural Land
Grassland
Grassland-Shrub-Tree(deciduous)
Grassland-Shrub-Tree(coniferous)
Deciduous Forest
Coniferous Forest
Mixed Forest
Water
Wetlands
Gravel Pits and Open Mines
Bare Rock
Exposed Soils, Sand Dunes
Unclassified
Outside State
N
0 1.5 3 6 9 12 Miles
Figure II-c: Landuse/Landcover
Notes:
Scale: As Shown
Project No: 1432-309
Date: 06/08/04
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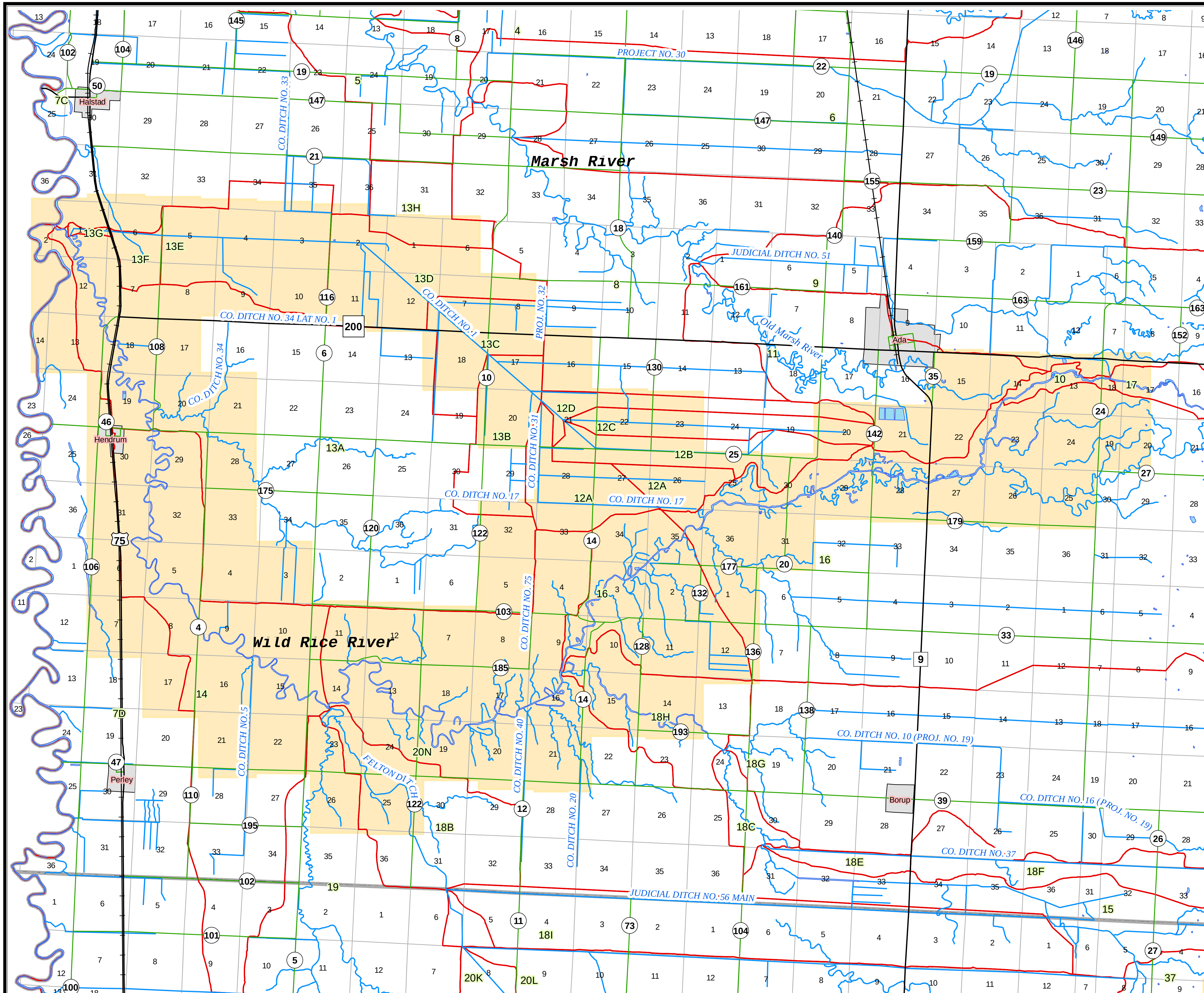
FIGURE 2

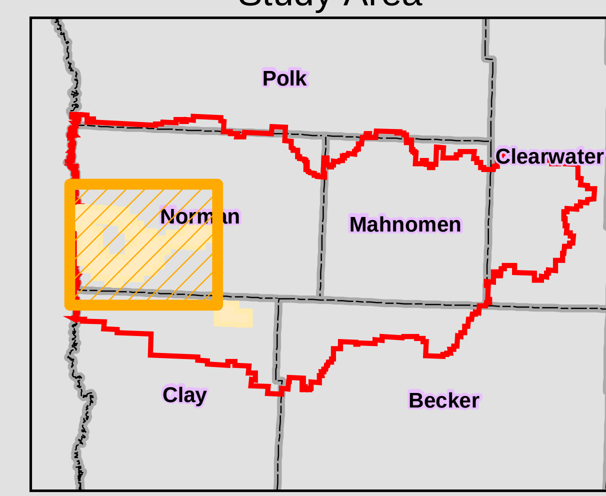


Wild Rice River

Legend

- Extent of LIDAR Coverage
- Waterbody
- Watercourse
- HE Subwatersheds
- Municipal Boundary
- County Boundary
- Interstates (MnDOT)
- US Hwys (MnDOT)
- State Hwys (MnDOT)
- County Roads (MnDOT)
- Rail Roads (MnDOT)

Study Area



N

0 0.5 1 2 3 4 Miles

Disclaimer: Houston Engineering, Inc. does not guarantee this data to be free from errors or inaccuracies, and disclaims any responsibility or liability for interpretations or decisions based on this data. Any errors found should be reported to the original data source provider.

Figure I-a: Wild Rice River - Hydraulic Model Location Map

Notes:		
Scale: As Shown	Project No: 1432-310	Date: 06/28/04

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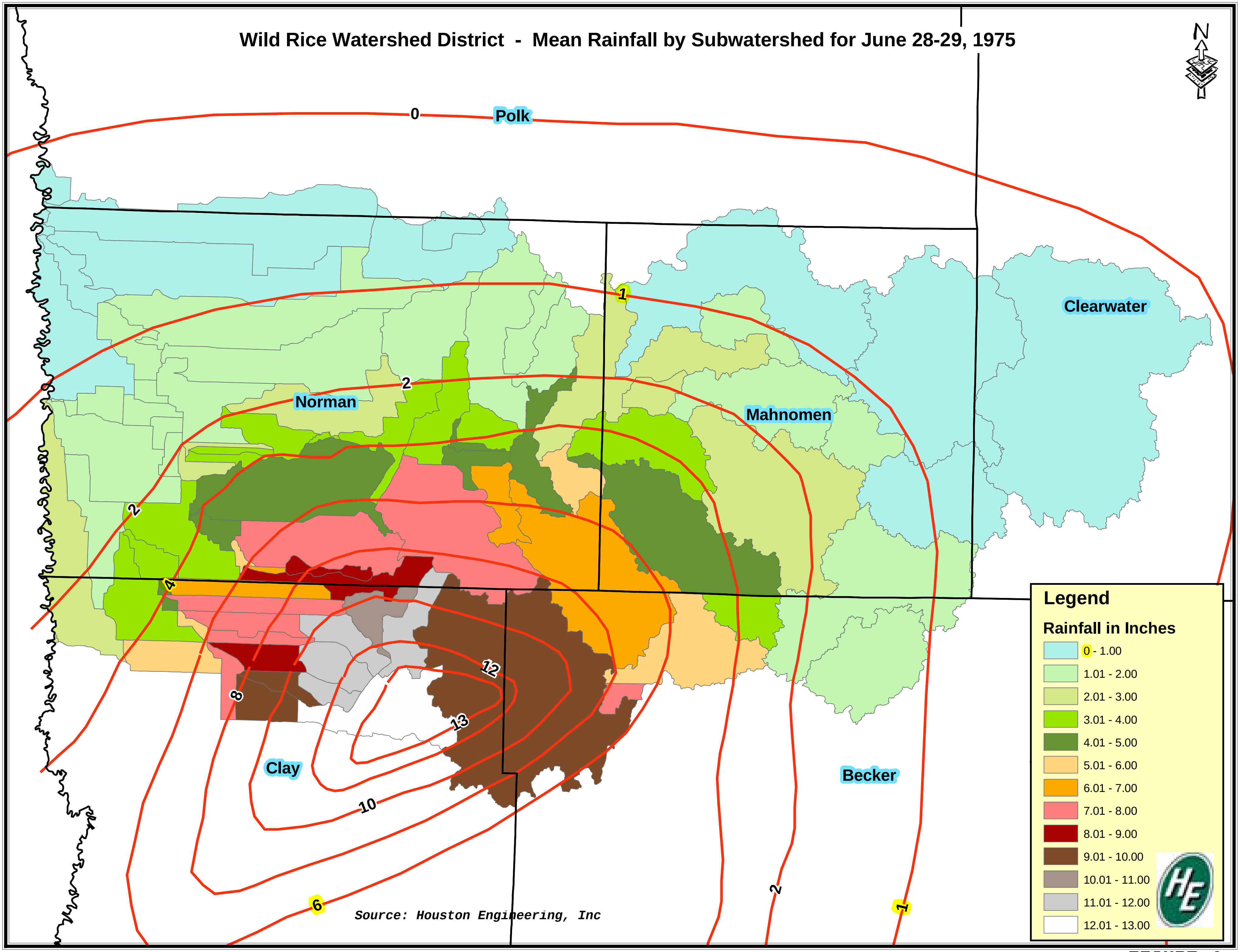
FIGURE 3



Wild Rice Watershed District - Mean Rainfall by Subwatershed for June 28-29, 1975
Polk
Norman
Mahnomen
Clearwater
Clay
Becker
0
1
2
4
6
8
10
12
13
Legend
Rainfall in Inches
0 - 1.00
1.01 - 2.00
2.01 - 3.00
3.01 - 4.00
4.01 - 5.00
5.01 - 6.00
6.01 - 7.00
7.01 - 8.00
8.01 - 9.00
9.01 - 10.00
10.01 - 11.00
11.01 - 12.00
12.01 - 13.00
Source: Houston Engineering, Inc

FIGURE 4

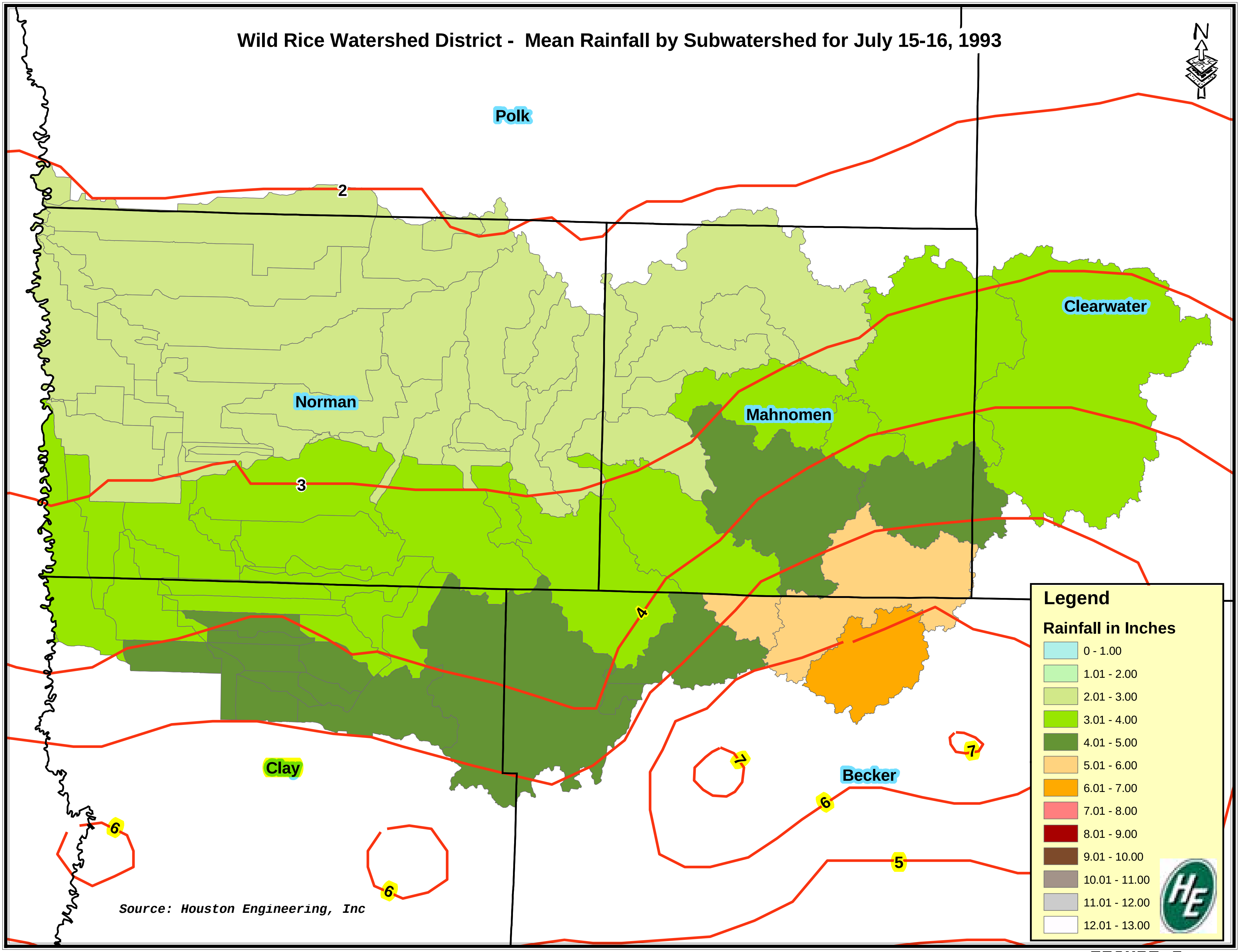

Wild Rice Watershed District - Mean Rainfall by Subwatershed for July 15-16, 1993
Polk
Norman
Mahnomen
Clearwater
Clay
Becker
2
3
4
5
6
6
6
6
7
7
N
Legend
Rainfall in Inches
0 - 1.00
1.01 - 2.00
2.01 - 3.00
3.01 - 4.00
4.01 - 5.00
5.01 - 6.00
6.01 - 7.00
7.01 - 8.00
8.01 - 9.00
9.01 - 10.00
10.01 - 11.00
11.01 - 12.00
12.01 - 13.00
Source: Houston Engineering, Inc

FIGURE 5

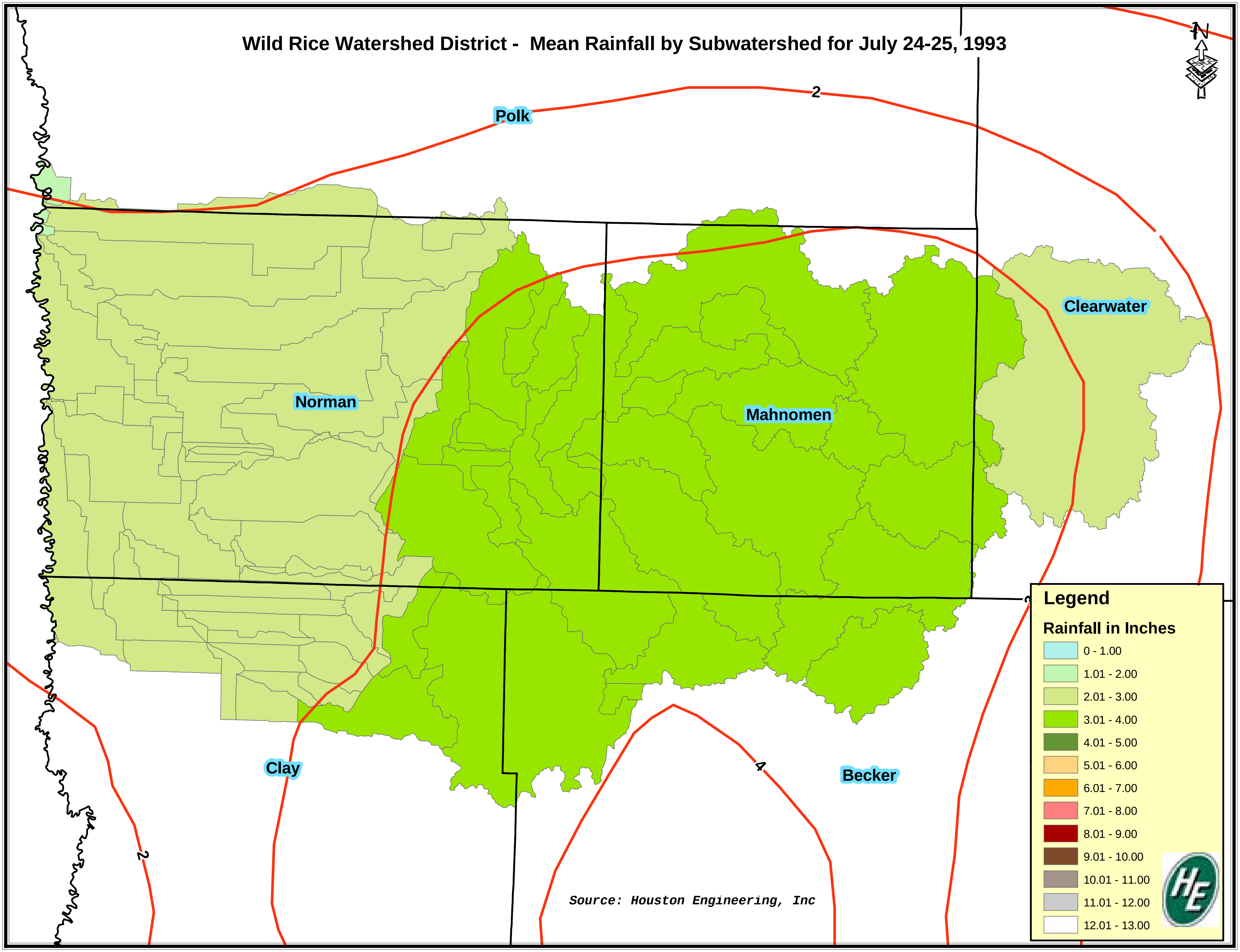

Wild Rice Watershed District - Mean Rainfall by Subwatershed for July 24-25, 1993
Polk
Norman
Mahnomen
Clearwater
Clay
Becker
2
4
Legend
Rainfall in Inches
0 - 1.00
1.01 - 2.00
2.01 - 3.00
3.01 - 4.00
4.01 - 5.00
5.01 - 6.00
6.01 - 7.00
7.01 - 8.00
8.01 - 9.00
9.01 - 10.00
10.01 - 11.00
11.01 - 12.00
12.01 - 13.00
Source: Houston Engineering, Inc

FIGURE 6

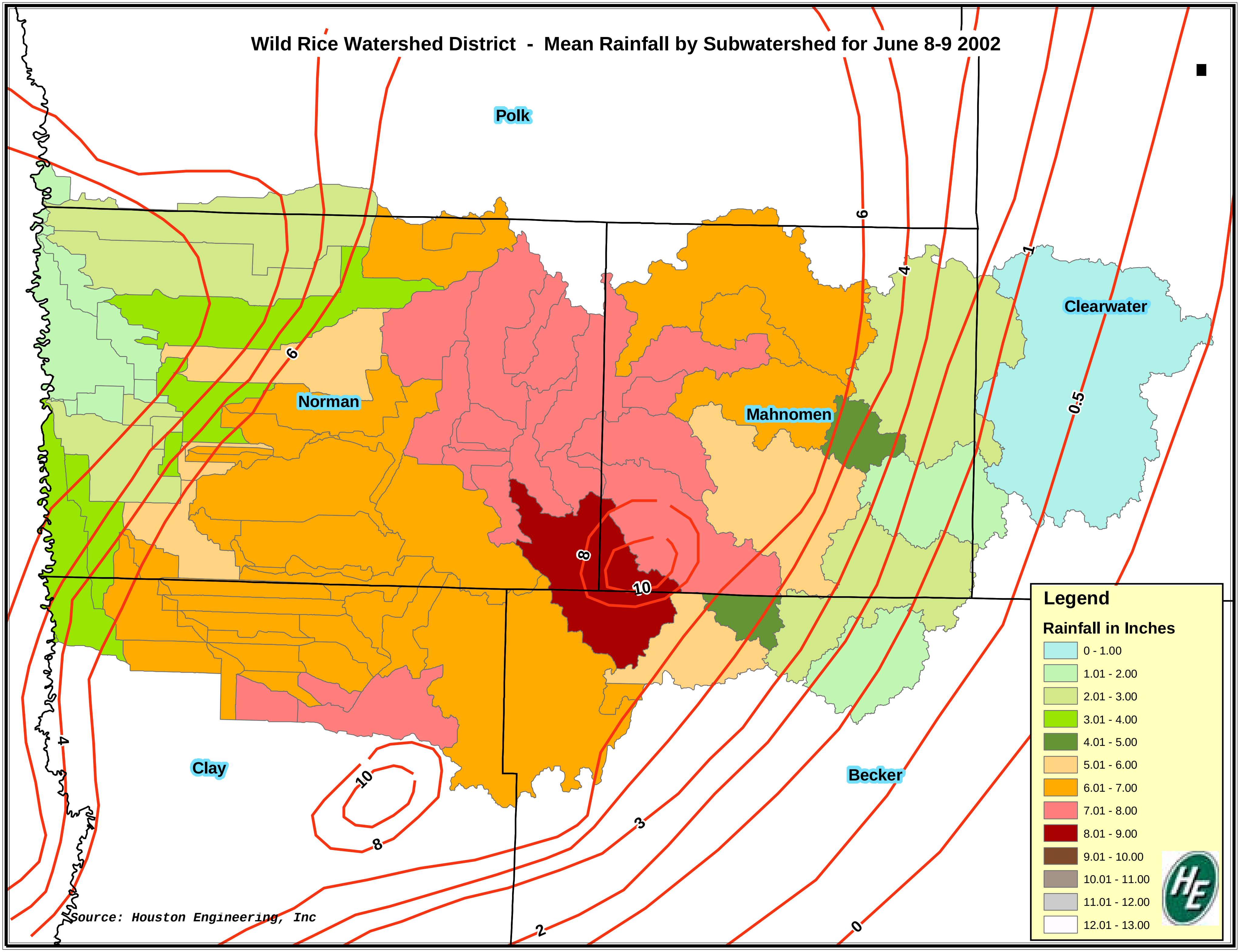
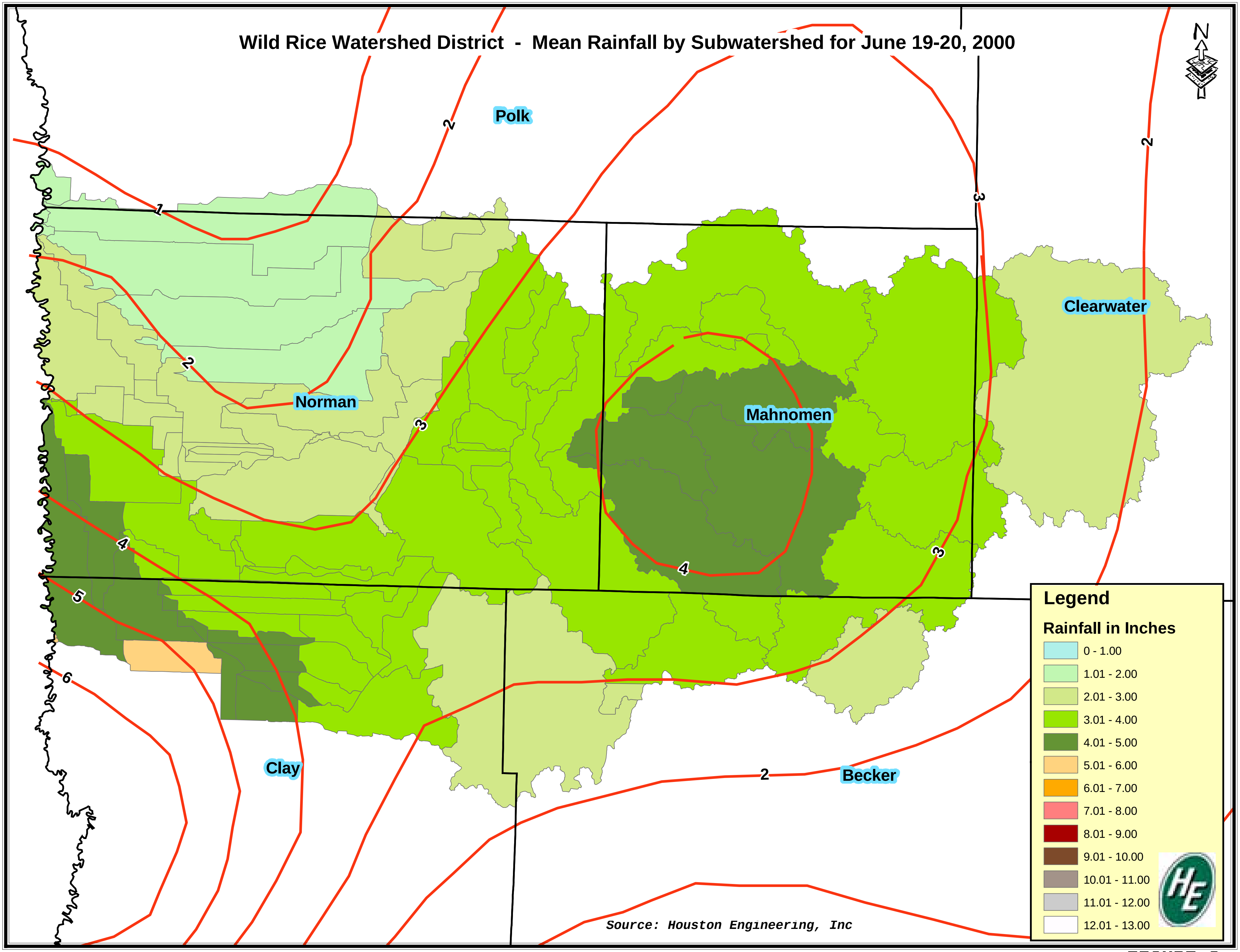

Wild Rice Watershed District - Mean Rainfall by Subwatershed for June 8-9 2002
Polk
Norman
Mahnomen
Clearwater
Clay
Becker
Legend
Rainfall in Inches
0 - 1.00
1.01 - 2.00
2.01 - 3.00
3.01 - 4.00
4.01 - 5.00
5.01 - 6.00
6.01 - 7.00
7.01 - 8.00
8.01 - 9.00
9.01 - 10.00
10.01 - 11.00
11.01 - 12.00
12.01 - 13.00
Source: Houston Engineering, Inc

FIGURE 7



Wild Rice Watershed District - Mean Rainfall by Subwatershed for June 19-20, 2000
Polk
Norman
Mahnomen
Clearwater
Clay
Becker
1
2
3
4
5
6
Legend
Rainfall in Inches
0 - 1.00
1.01 - 2.00
2.01 - 3.00
3.01 - 4.00
4.01 - 5.00
5.01 - 6.00
6.01 - 7.00
7.01 - 8.00
8.01 - 9.00
9.01 - 10.00
10.01 - 11.00
11.01 - 12.00
12.01 - 13.00
Source: Houston Engineering, Inc

FIGURE 8

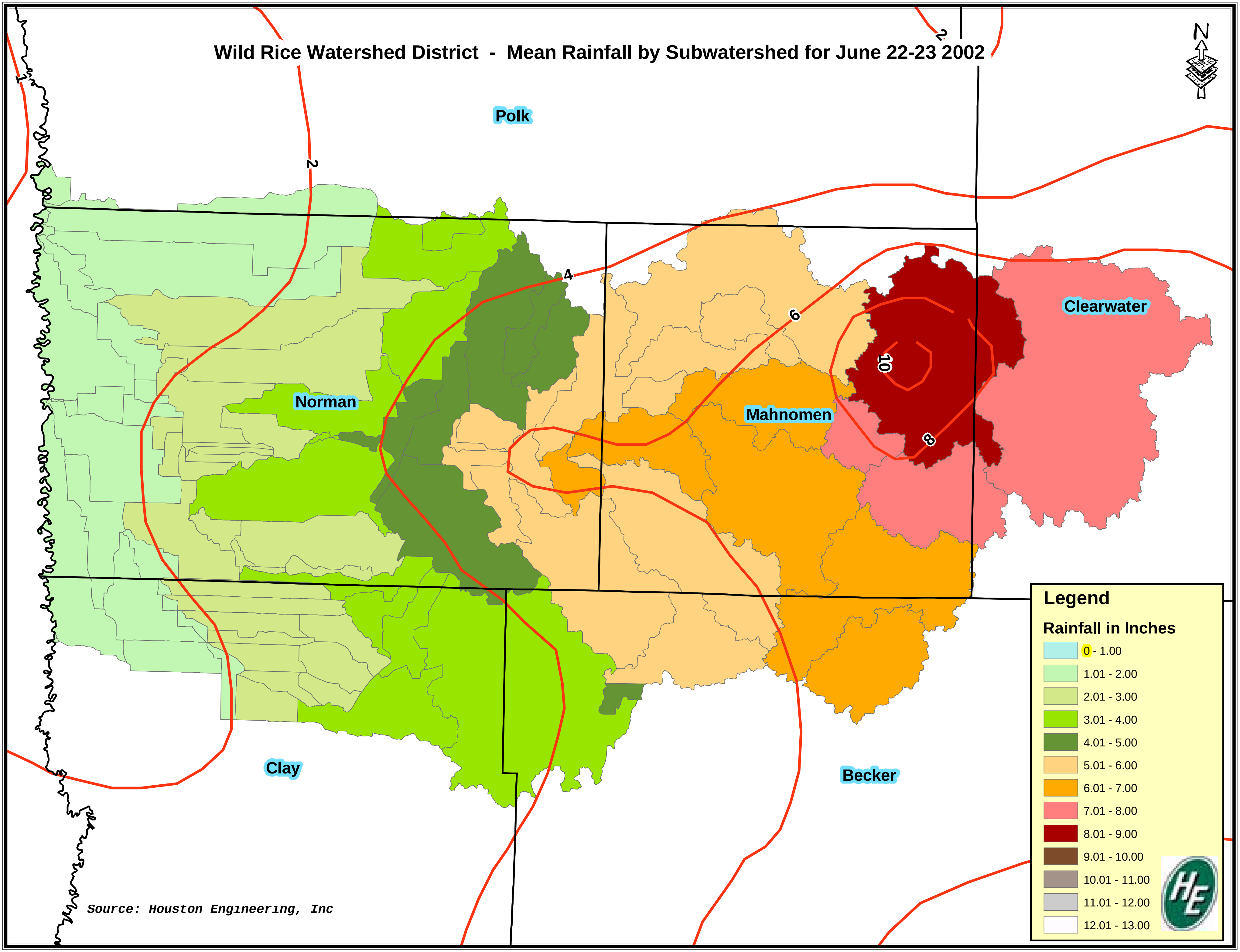
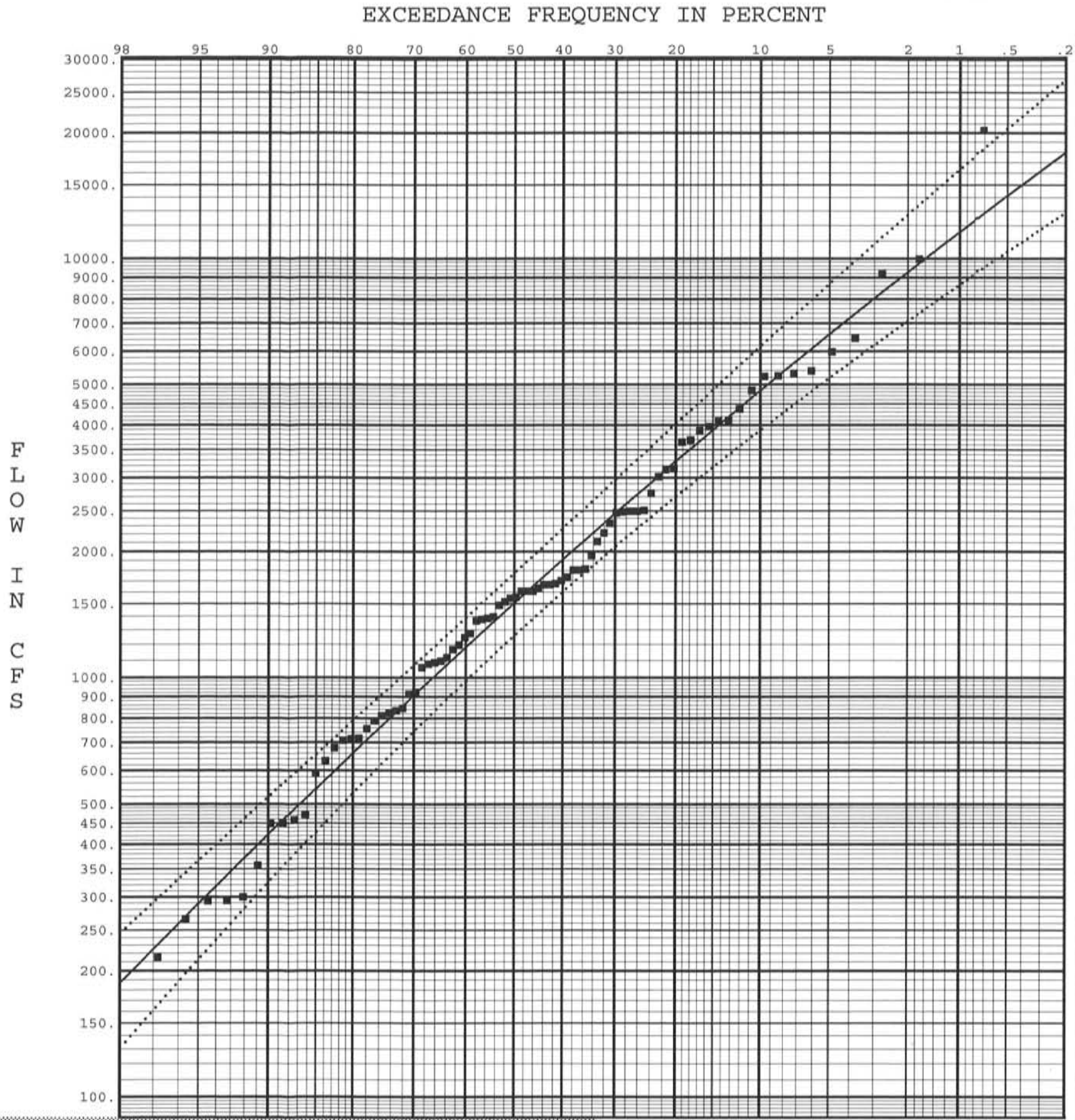

Wild Rice Watershed District - Mean Rainfall by Subwatershed for June 22-23 2002
Polk
Norman
Mahnomen
Clearwater
Clay
Becker
N
1
2
4
6
8
10
Legend
Rainfall in Inches
0 - 1.00
1.01 - 2.00
2.01 - 3.00
3.01 - 4.00
4.01 - 5.00
5.01 - 6.00
6.01 - 7.00
7.01 - 8.00
8.01 - 9.00
9.01 - 10.00
10.01 - 11.00
11.01 - 12.00
12.01 - 13.00
Source: Houston Engineering, Inc

FIGURE 9



— FLOW Frequency (without Exp. Prob.)
■ Median Plotting Positions
······· 5% and 95% Confidence Limits

FREQUENCY STATISTICS
LOG TRANSFORM OF FLOW, CFS

		NUMBER OF EVENTS	
MEAN	3.1641	HISTORIC EVENTS	0
STANDARD DEV	.4133	HIGH OUTLIERS	4
SKEW	-.1915	LOW OUTLIERS	0
REGIONAL SKEW	-.3700	ZERO OR MISSING	0
ADOPTED SKEW	-.2000	SYSTEMATIC EVENTS	85
		HISTORIC PERIOD(1909-2006)	98

WILD RICE RIVER @ TWIN VALLEY,
ANNUAL INSTANTANEOUS PEAK
DISCHARGE FREQUENCY
USGS GAGE 05062500
BASIN AREA = 934 SQ MI
WATER YEARS IN RECORD
1909-1917,1931-2006

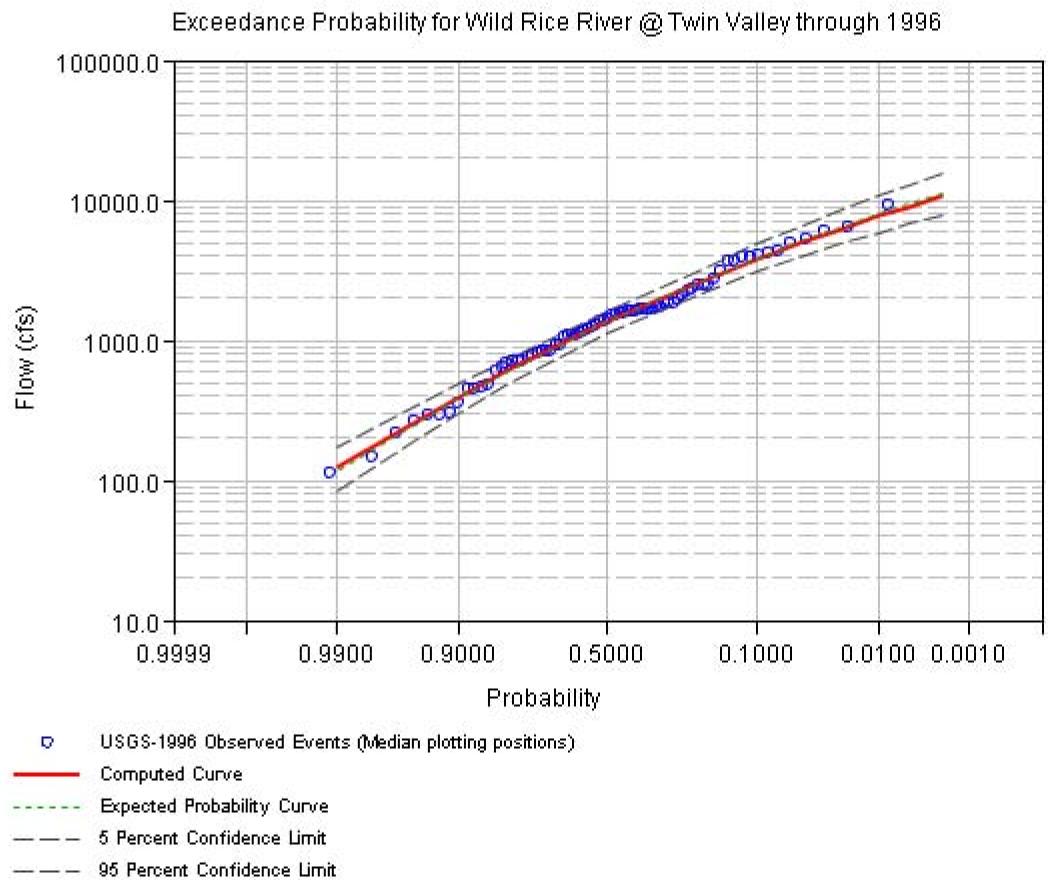


Figure 11. Twin Valley Discharge-Frequency; Pre-1997 Event

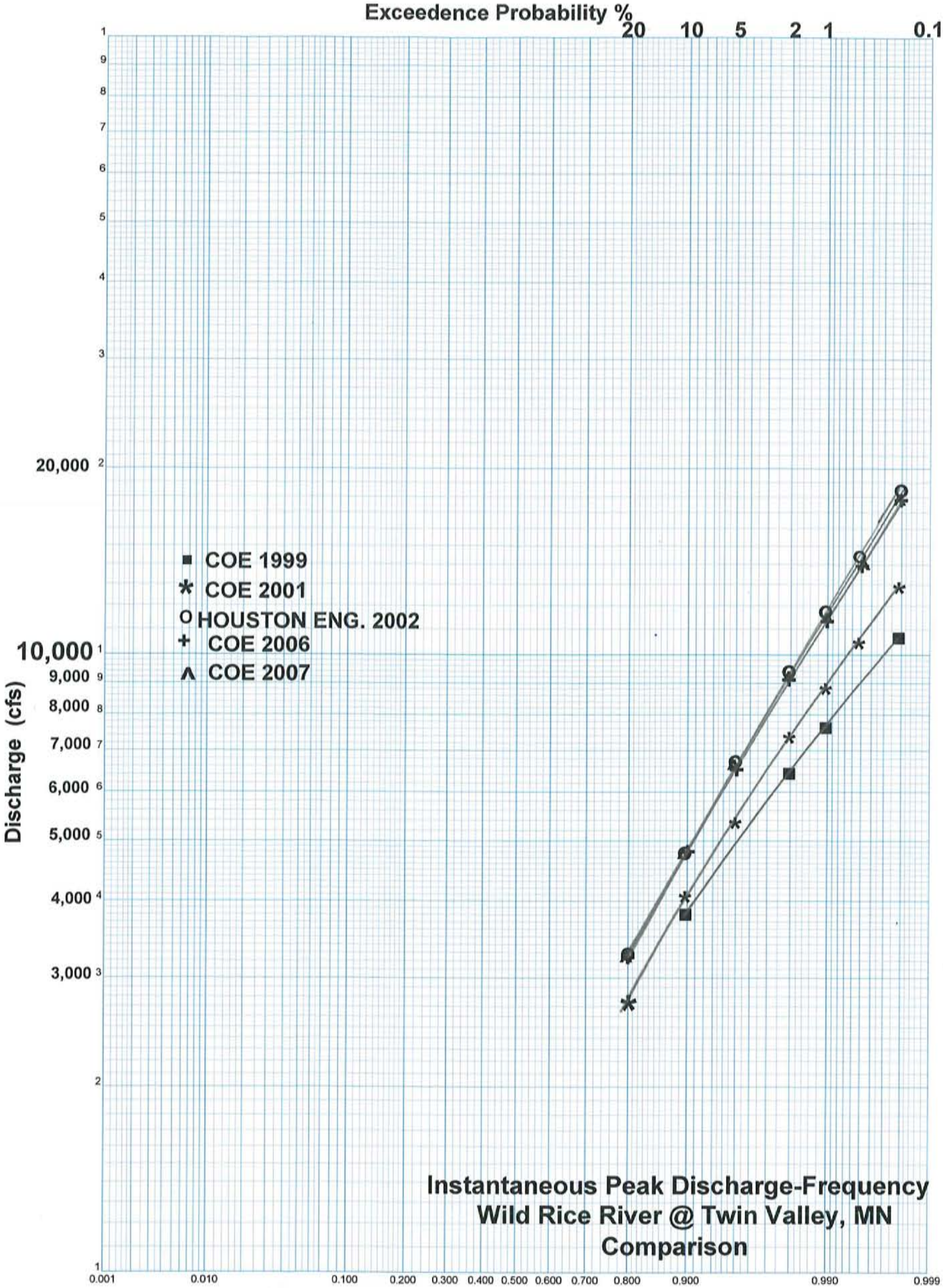

Exceedence Probability %
20
10
5
2
1
0.1
20,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
Discharge (cfs)
COE 1999
COE 2001
HOUSTON ENG. 2002
COE 2006
COE 2007
Instantaneous Peak Discharge-Frequency
Wild Rice River @ Twin Valley, MN
Comparison
0.001
0.010
0.100
0.200
0.300
0.400
0.500
0.600
0.700
0.800
0.900
0.990
0.999

Figure 12

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX B

HYDRAULIC ANALYSIS AND INTERIOR FLOOD CONTROL

HYDRAULIC ANALYSIS AND
INTERIOR FLOOD CONTROL DESIGN

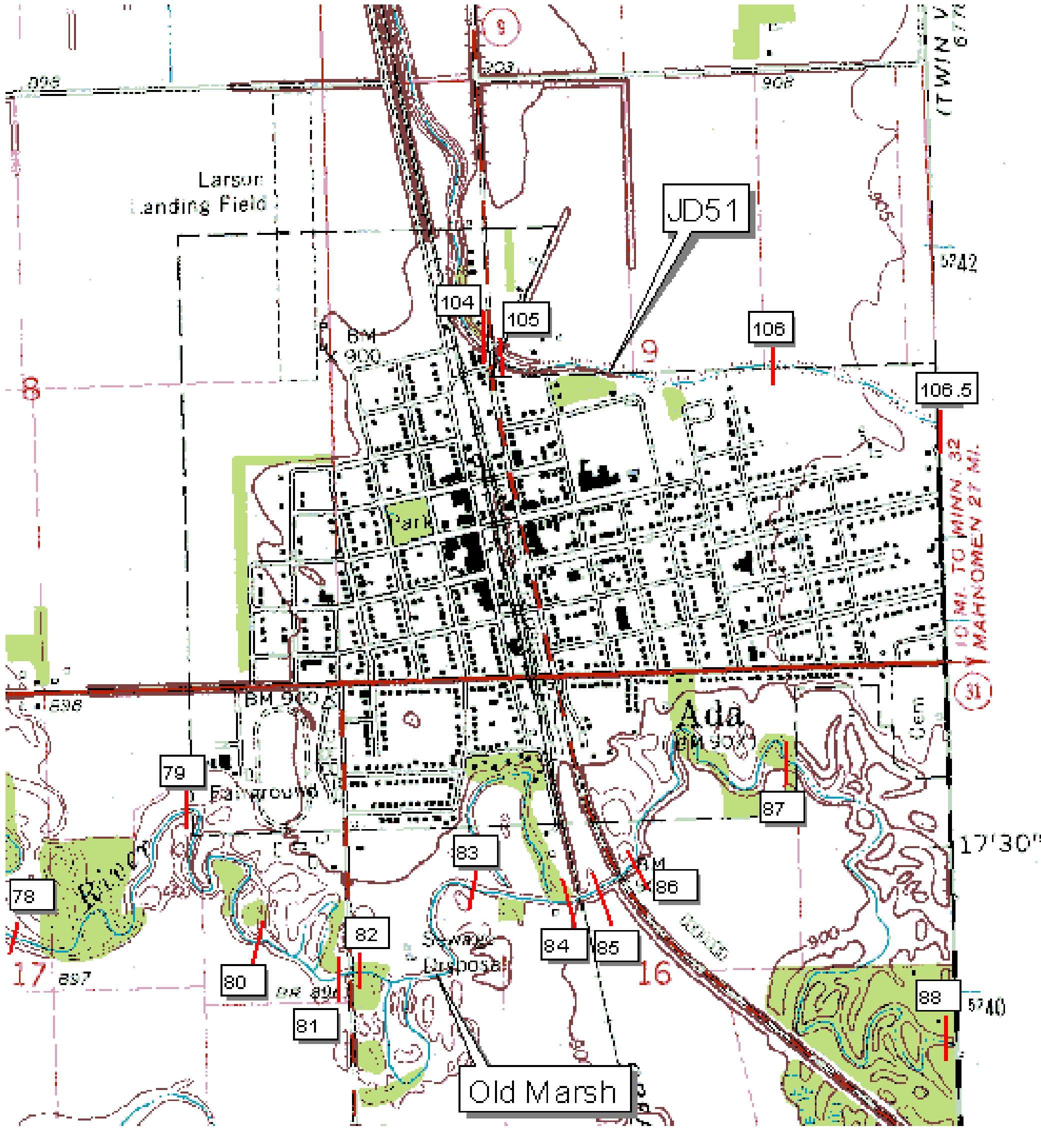
Introduction

Flooding within the town of Ada is caused Judicial Ditch 51 (JD51) flowing past the north side of Ada, and the Old Marsh River flowing along the south side of Ada. Ice jams are common during spring flood events, and debris jams complicate the flooding situation at Ada. The Hydraulics Section modified existing water surface profile models for the Marsh River and JD51 to produce water surface profiles that could be used to design a levee system for the City of Ada, and to determine the costs and benefits of the proposed levels of protection.

Hydraulic Models

The HEC-2 model, which was updated by Houston Engineering in 1998 and used for the Initial Assessment for Flood Damage Reduction in 1999, was converted to HEC-RAS. From this HEC-RAS model, three hydraulic models were prepared in order to assess the probable water surface profiles for a given flood. The models define the water surface profiles for three scenarios that are defined in the following paragraphs. Figure 1 shows the HEC-RAS cross-sections within the study area.

Figure 1
City of Ada – HEC-2 Cross Section Locations



<u>Minus 2 Standard Deviation Condition.</u> The HEC-RAS model was used directly to simulate an "unblocked average condition." The –2 standard deviation rating curve represents an optimistic flow condition with minimal constriction and obstructions. The HEC-RAS model for the –2 standard deviation was modified by decreasing Mannings "n" by 25 percent for each of the flood profiles.

Plus 2 Standard Deviation Condition. The +2 standard deviation rating curve was developed for a condition with a large degree of obstruction, including the effects of ice and debris jams. The 1997 flood event was greatly influenced by ice effects. The 1997 flood is considered to represent at +2 standard deviation condition for the 500-year flood. The HEC-RAS model was calibrated to USACE high water marks (Table 1) documented and surveyed at river crossings after the 1997 flood. The "+2 Standard Deviation" HEC-RAS model was modified as shown in Table 2.

Existing Condition. An unmodified HEC-RAS model was run to determine existing water surface elevations.

TABLE 1
1997 FLOOD – CORPS OF ENGINEERS HIGH WATER MARKS

Marsh River				**Judicial Ditch 51**		
Reference Point	HEC-RAS x-section	Elevation (ft)		Reference Point	HEC-RAS x-section	Elevation (ft)
15	50/51	885.07		18 Div	99/100	896.92
17	59/60	888.12		19 Div	99/100	898.60
19	67/68	892.16		20 Div	104/105	904.72
20	75/76	895.30		21 Div	108	912.01
23	85/86	902.73		22	111/112	902.52
24	89	905.12				

TABLE 2
CALIBRATION OF THE +2 STANDARD DEVIATION

	Wild Rice	Marsh	Old Marsh	JD 51
Mannings "n" was increased	+25%	+30%	+30%	+30%
Ice Cover	+2 feet (1)	2 feet	None	2 feet

Notes:
(1) The two feet of ice cover was applied from the downstream end up to x-section 82.

Water Surface Profiles for Flood Damages

Existing condition water surface profiles through the City of Ada were needed to determine the urban damages caused by flood events ranging from the 2-year to the 500-year flood. Determination of the water surface profiles within the city was complicated by the interaction of the two rivers passing Ada. Elevation frequency curves were plotted together for selected index stations on JD51 and the Old Marsh River to help sort out the relationship of flows between the two rivers.
Residents of several buildings within the City of Ada were contacted to relate approximate flood depths within town. The COE inventory of structure first floor and ground elevations was used to translate the flooding depths to an elevation. These spot elevations (Table 3) were used to get an understanding of the controlling water surface elevations caused by flow from the two rivers.

A profile baseline for overland flow was drawn across the City of Ada and five reference points were set (Figure 2). Reference sections were drawn north to south across the City of Ada to help determine a relationship between the overland flow profile baseline and the HEC-RAS cross sections (Figure 1) on JD51 and the Old Marsh River. Using the HEC-RAS water surface profiles and observed 1997 flood elevations, the overland flow profile was determined for the five reference points. The +2 standard deviation condition elevation frequency curves were plotted first. The +2 standard deviation elevation frequency curves illustrated that the Marsh River controlled up to about a 10-year event. Water surface elevations on JD51 controlled for events greater than a 10-year event. A tabulation of the controlling water surface elevations for the +2 standard deviation condition is included in Table 6. Figure 3 illustrates the water surface profiles through the City of Ada for events ranging from the 2-year to the 500-year event.

The existing condition elevation frequency curves were plotted and were evaluated in a similar way. Table 7 is a summary of the controlling water surface elevations for the existing condition. Figure 4 shows the water surface profiles through the City of Ada for events ranging from the 2-year to the 500-year event for the existing condition.

Finally, the –2 standard deviation condition elevation frequency curves were plotted. Table 8 summarizes the controlling water surface elevations for the –2 standard deviation condition. Water surface profiles through the City of Ada for the –2 standard deviation condition are shown in Figure 5.

TABLE 3
1997 OBSERVED FLOOD ELEVATIONS – CITY OF ADA

Description of Flooding	COE Invntry Point	Ground Elevation (Ref. COE)	First Floor Elevation (Ref. COE)	1997 Flood Elevation (Est.)	REF PT.
Al's Café/ Lana Jo's 2' deep		903.3	903.5	905.5	C
404 E 5th Avenue 2' in Garage. Not to 1st floor	827	906.5	908.0	907.5/908	C
Lowell Thompson, Main floor flooding	828	906.8	908.3	907.5/908	D
City Office 18" above floor	572	903.5	903.5	905.0	C
Sanitary sewer fills up. Backs up 2' on street	118 121 122 173	900.5 901.0 901.0 901.5	903.0 903.0 903.0 902.8	903	B
West side of Ada Street flooding, Basement flooding	17 18 19 20 21 23 27 28	902.0 902.0 901.5 904.0 901.5 899.0 899.0 900.0	904.0 904.5 897.0 906.5 898.5 896.0 902.5 901.5	900	A

Figure 2
City of Ada – Overland Flow Profile Baseline and Reference Points

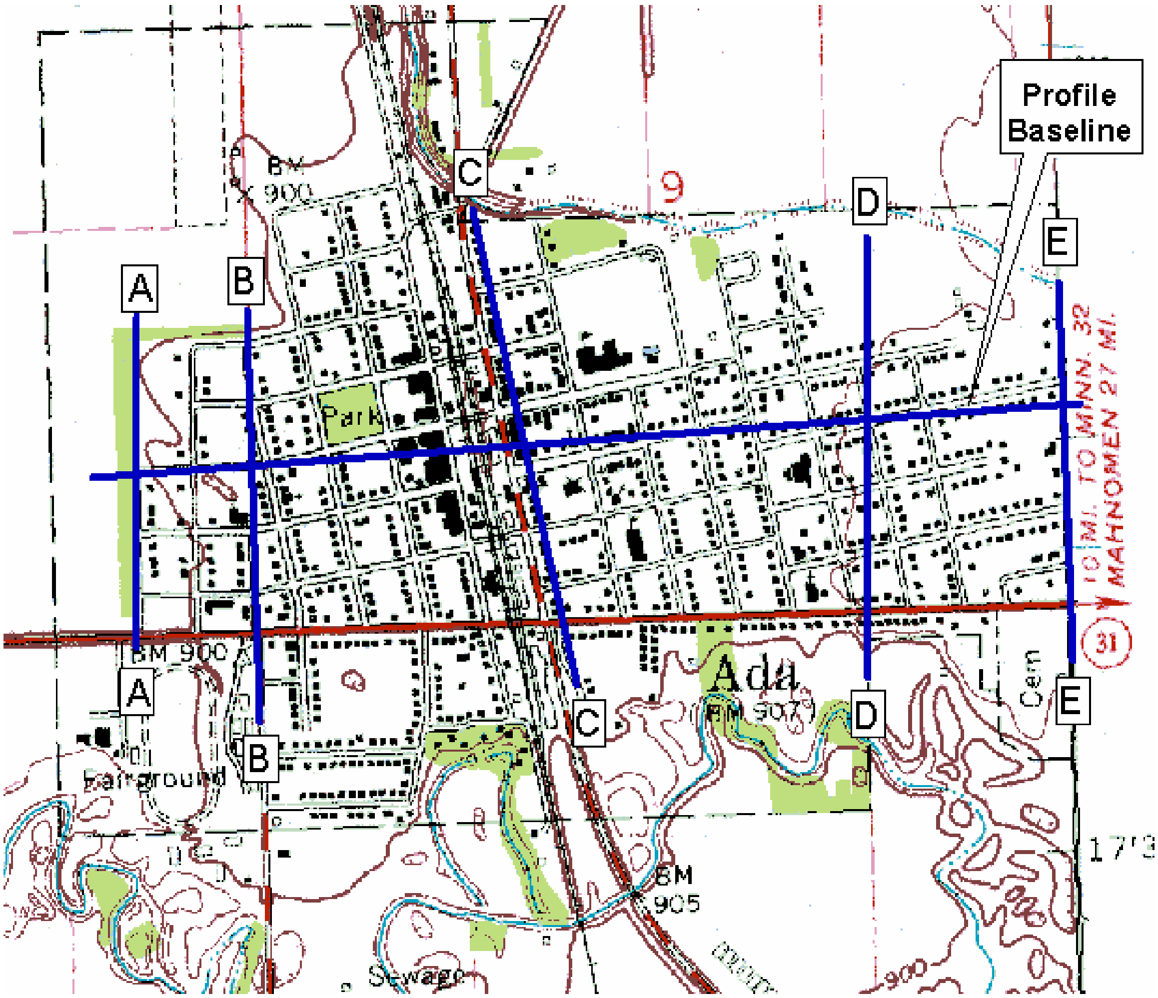
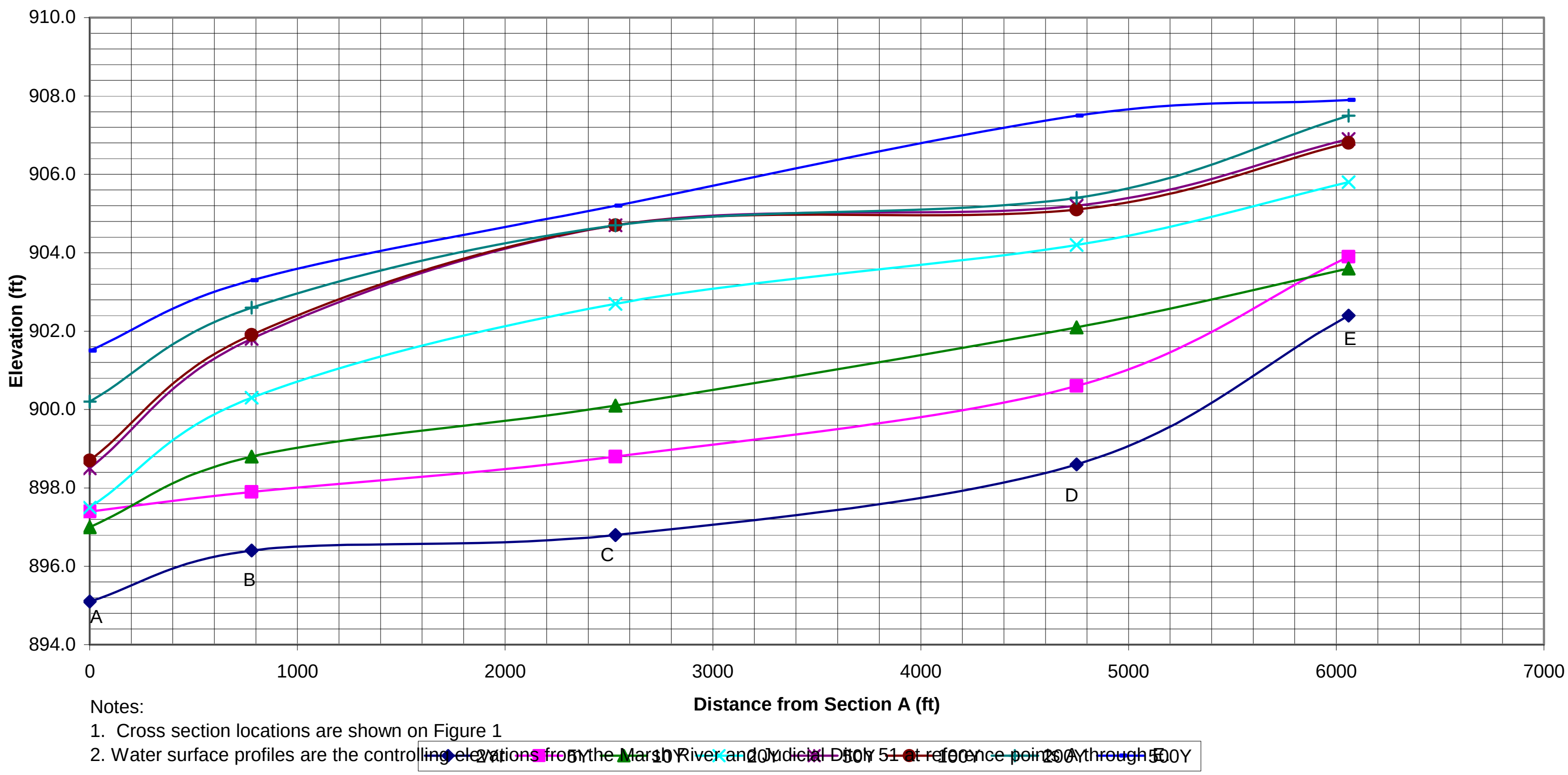


TABLE 4
ELEVATION-FREQUENCY CURVES IN ADA
+2 STANDARD DEVIATION

Reference Point	Levee Area	Frequency	Elevation (ft)	Source
A		5Y	897.4	Marsh Section 80
		10Y	897.0	Marsh Section 80
		20Y	897.5	Marsh Section 80
		50Y	898.5	Marsh Section 80
		100Y	898.7	Marsh Section 80
		200Y	900.2	Marsh Section 80
		500Y	901.5	Adjusted for 1997 High Water Marks
B	3	5Y	897.9	Interpolated between sections 82 & 105
	3	10Y	898.8	Interpolated between sections 82 & 105
	3	20Y	900.3	Interpolated between sections 82 & 105
	3	50Y	901.8	Interpolated between sections 82 & 105
	3	100Y	901.9	Interpolated between sections 82 & 105
	3	200Y	902.6	Interpolated between sections 82 & 105
	3	500Y	903.3	Adjusted for 1997 High Water Marks
C	2A & 1B	5Y	898.8	Marsh Section 86
	2A & 1B	10Y	900.1	JD51 Section 105
	2A & 1B	20Y	902.7	JD51 Section 105
	2A & 1B	50Y	904.5	JD51 Section 105
	2A & 1B	100Y	904.6	JD51 Section 105
	2A & 1B	200Y	904.7	JD51 Section 105
	2A & 1B	500Y	905.2	Adjusted for 1997 High Water Marks
D	1A & 2A	5Y	900.6	Marsh Section 87
	1A & 2A	10Y	902.1	JD51 Section 106
	1A & 2A	20Y	904.2	JD51 Section 106
	1A & 2A	50Y	905.2	JD51 Section 106
	1A & 2A	100Y	905.3	JD51 Section 106
	1A & 2A	200Y	905.4	JD51 Section 106
	1A & 2A	500Y	907.5	Adjusted for 1997 High Water Marks
E	4	5Y	903.9	Marsh Section 88
	4	10Y	903.6	Marsh Section 88
	4	20Y	905.8	JD51 Section 106.5
	4	50Y	906.9	JD51 Section 106.5
	4	100Y	907.0	JD51 Section 106.5
	4	200Y	907.5	JD51 Section 106.5
	4	500Y	907.9	Adjusted for 1997 High Water Marks

FIGURE 3

Water Surface Profiles Through Ada
+2 Standard Deviation Profiles

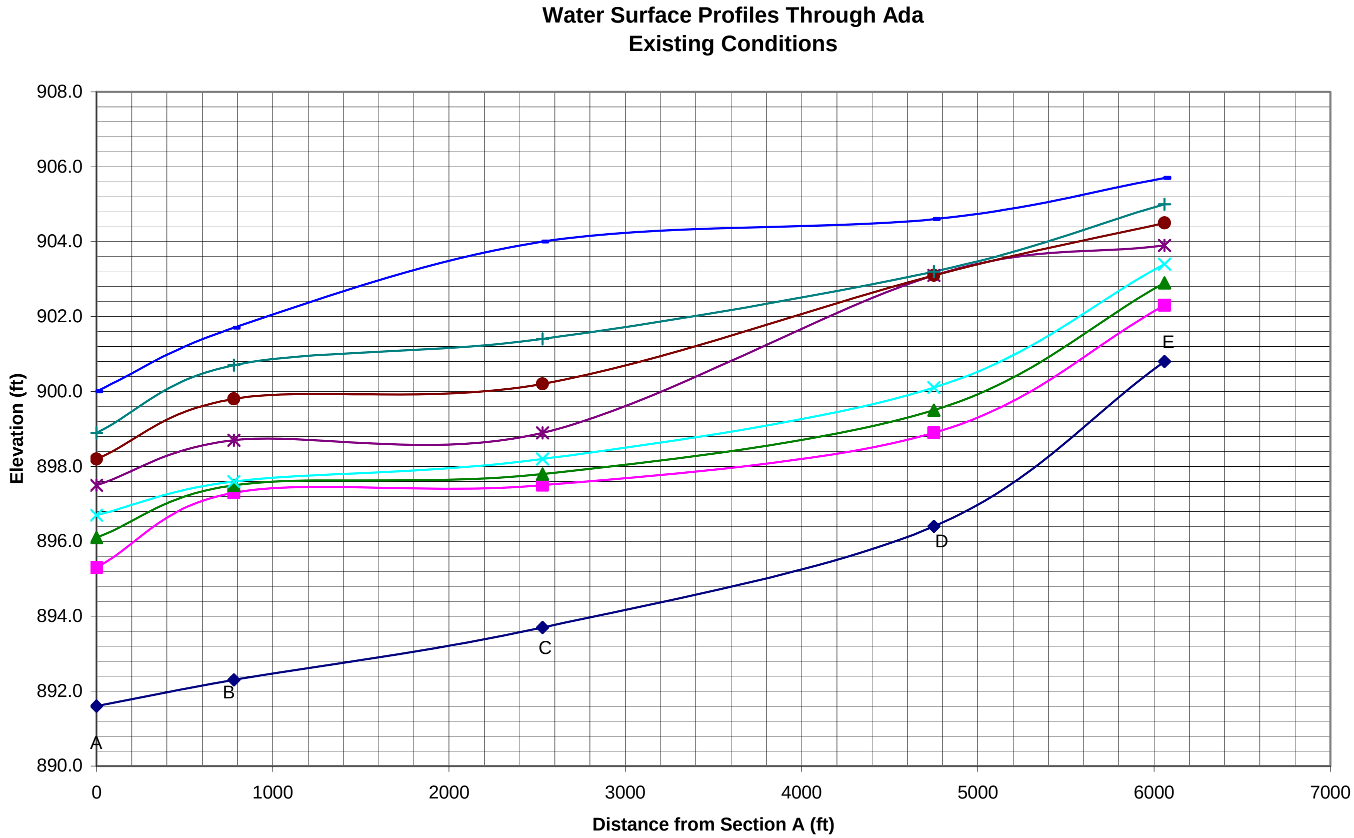


Notes:
1. Cross section locations are shown on Figure 1
2. Water surface profiles are the controlling elevations from the Marsh River and Judicial Ditch 51 at reference points A through E.

TABLE 5
ELEVATION-FREQUENCY CURVES IN ADA
EXISTING CONDITIONS

Reference Point	Levee Area	Frequency	Elevation (ft)	Source
A		5Y	895.3	Marsh Section 80
		10Y	896.1	Marsh Section 80
		20Y	896.7	Marsh Section 80
		50Y	897.5	Marsh Section 80
		100Y	898.2	Marsh Section 80
		200Y	898.9	Marsh Section 80
		500Y	900.0	Marsh Section 80
B	3	5Y	897.3	Marsh Section 82
	3	10Y	897.5	Marsh Section 82
	3	20Y	897.6	Marsh Section 82
	3	50Y	898.7	Interpolated between sections 82 & 105
	3	100Y	899.8	Interpolated between sections 82 & 105
	3	200Y	900.7	Interpolated between sections 82 & 105
	3	500Y	901.7	Interpolated between sections 82 & 105
C	2A & 1B	5Y	897.5	Marsh Section 86
	2A & 1B	10Y	897.8	Marsh Section 86
	2A & 1B	20Y	898.2	Marsh Section 86
	2A & 1B	50Y	898.9	Marsh Section 86
	2A & 1B	100Y	900.2	Marsh Section 86
	2A & 1B	200Y	901.4	Marsh Section 86
	2A & 1B	500Y	904.0	Marsh Section 86
D	1A & 2A	5Y	898.9	Marsh Section 87
	1A & 2A	10Y	899.5	Marsh Section 87
	1A & 2A	20Y	900.1	Marsh Section 87
	1A & 2A	50Y	903.0	JD51 Section 106
	1A & 2A	100Y	903.1	JD51 Section 106
	1A & 2A	200Y	903.2	JD51 Section 106
	1A & 2A	500Y	904.6	JD51 Section 106
E	4	5Y	902.3	Marsh Section 88
	4	10Y	902.9	Marsh Section 88
	4	20Y	903.4	Marsh Section 88
	4	50Y	903.9	Marsh Section 88
	4	100Y	904.5	Marsh Section 88
	4	200Y	905.0	Marsh Section 88
	4	500Y	905.7	Marsh Section 88

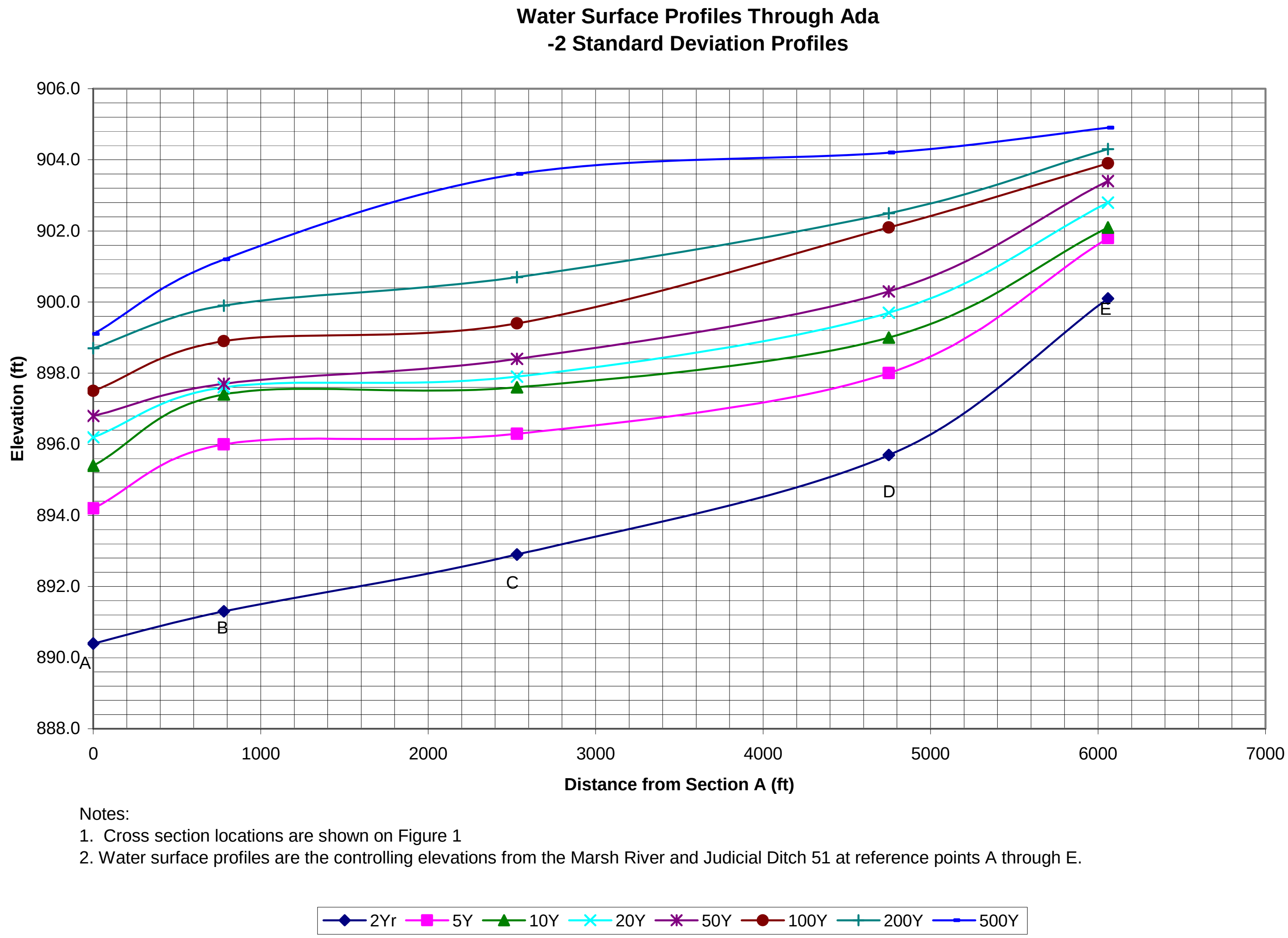
FIGURE 4



Notes:
1. Cross section locations are shown on Figure 1
2. Water surface profiles are the controlling elevations from the Marsh River and Judicial Ditch 51 at reference points A through E.

TABLE 6 ELEVATION-FREQUENCY CURVES IN ADA -2 STANDARD DEVIATION				
Reference Point	Levee Area	Frequency	Elevation (ft)	Source
A		5Y	894.2	Marsh Section 80
		10Y	895.4	Marsh Section 80
		20Y	896.2	Marsh Section 80
		50Y	896.8	Marsh Section 80
		100Y	896.8	Marsh Section 80
		200Y	898.7	Marsh Section 80
		500Y	899.1	Marsh Section 80
B	3	5Y	896.0	Marsh Section 82
	3	10Y	897.4	Marsh Section 82
	3	20Y	897.6	Marsh Section 82
	3	50Y	897.7	Marsh Section 82
	3	100Y	898.9	Interpolated between sections 82 & 105
	3	200Y	899.9	Interpolated between sections 82 & 105
	3	500Y	901.2	Interpolated between sections 82 & 105
C	2A & 1B	5Y	896.3	Marsh Section 86
	2A & 1B	10Y	897.6	Marsh Section 86
	2A & 1B	20Y	897.9	Marsh Section 86
	2A & 1B	50Y	898.4	Marsh Section 86
	2A & 1B	100Y	899.4	Marsh Section 86
	2A & 1B	200Y	900.7	Marsh Section 86
	2A & 1B	500Y	903.6	Marsh Section 86
D	1A & 2A	5Y	898.0	Marsh Section 87
	1A & 2A	10Y	899.0	Marsh Section 87
	1A & 2A	20Y	899.7	Marsh Section 87
	1A & 2A	50Y	900.3	Marsh Section 87
	1A & 2A	100Y	902.1	JD51 Section 106
	1A & 2A	200Y	902.5	JD51 Section 106
	1A & 2A	500Y	904.2	JD51 Section 106
E	4	5Y	901.8	Marsh Section 88
	4	10Y	902.1	Marsh Section 88
	4	20Y	902.8	Marsh Section 88
	4	50Y	903.4	Marsh Section 88
	4	100Y	903.9	Marsh Section 88
	4	200Y	904.3	Marsh Section 88
	4	500Y	904.9	Marsh Section 88

FIGURE 5

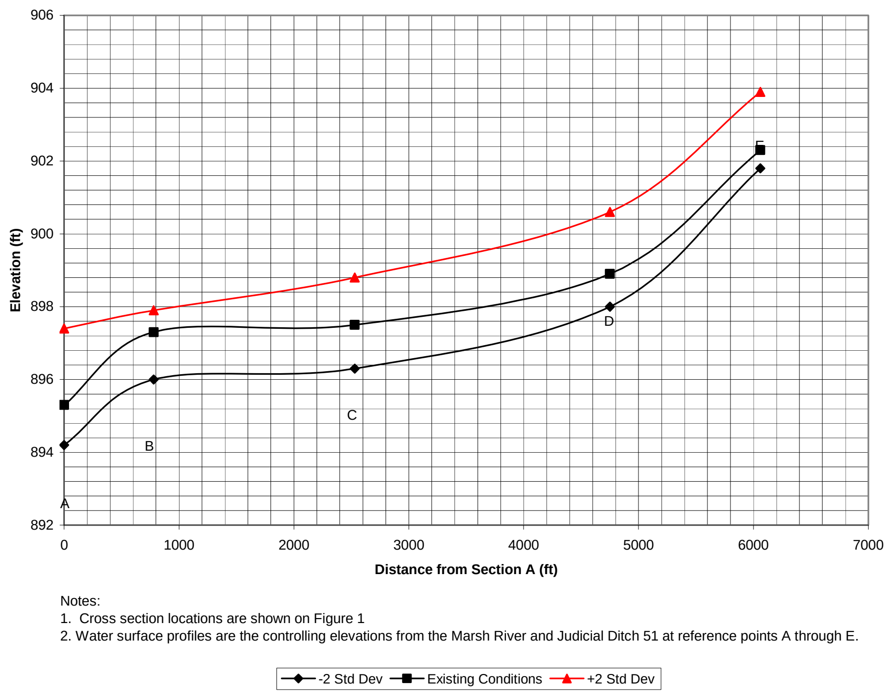


Notes:
1. Cross section locations are shown on Figure 1
2. Water surface profiles are the controlling elevations from the Marsh River and Judicial Ditch 51 at reference points A through E.

Figures 6 through 12 illustrate the existing, plus and minus 2 standard deviation water surface profiles through the City of Ada for each of the flood events. These water surface profiles were used by the Economics Section to determine the urban damages associated with flooding in Ada.

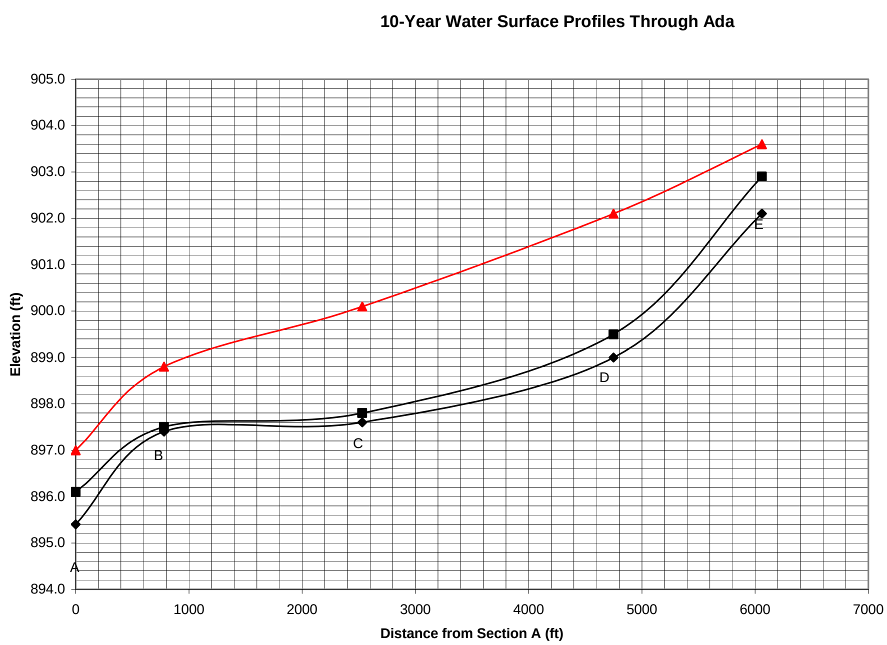
Figure 6

5-Year Water Surface Profiles Through Ada



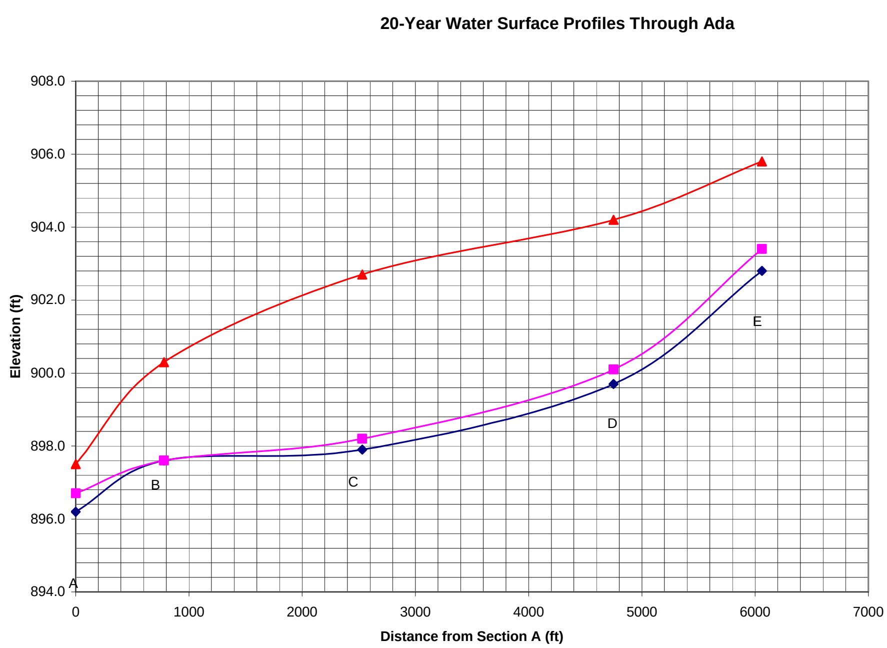
Notes:
1. Cross section locations are shown on Figure 1
2. Water surface profiles are the controlling elevations from the Marsh River and Judicial Ditch 51 at reference points A through E.

Figure 7



Notes:
1. Cross section locations are shown on Figure 1
2. Water surface profiles are the controlling elevations from the Marsh River and Judicial Ditch 51 at reference points A through E.

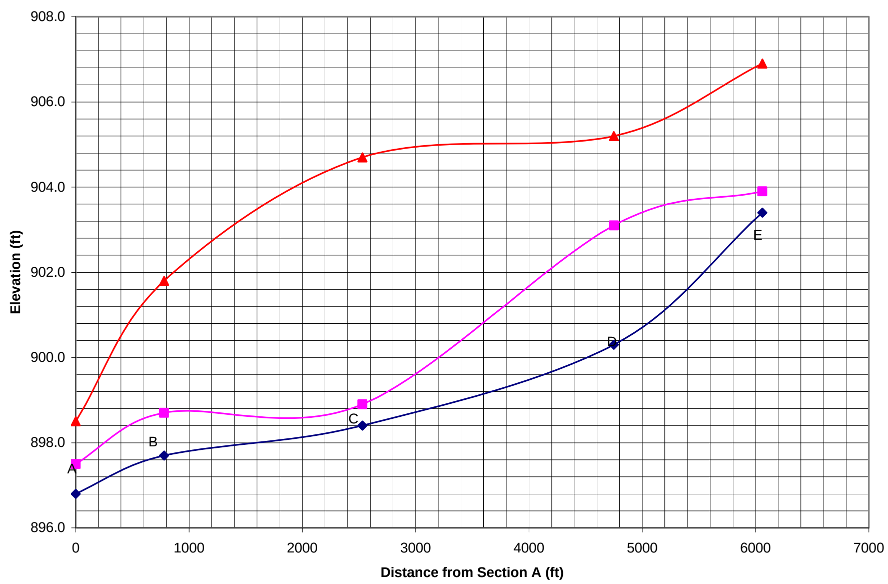
Figure 8



Notes:
1. Cross section locations are shown on Figure 1
2. Water surface profiles are the controlling elevations from the Marsh River and Judicial Ditch 51 at reference points A through E.

Figure 9

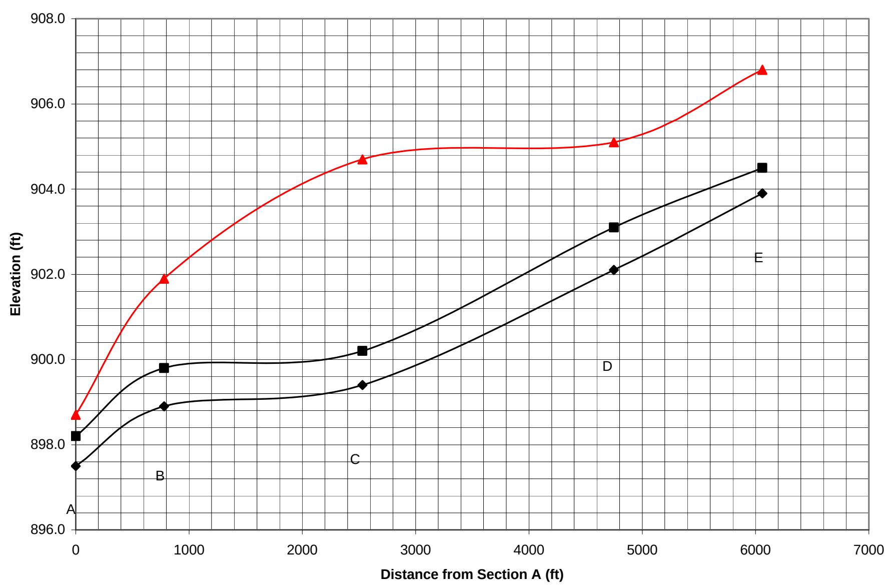
50-Year Water Surface Profiles Through Ada



Notes:
1. Cross section locations are shown on Figure 1
2. Water surface profiles are the controlling elevations from the Marsh River and Judicial Ditch 51 at reference points A through E.

Figure 10

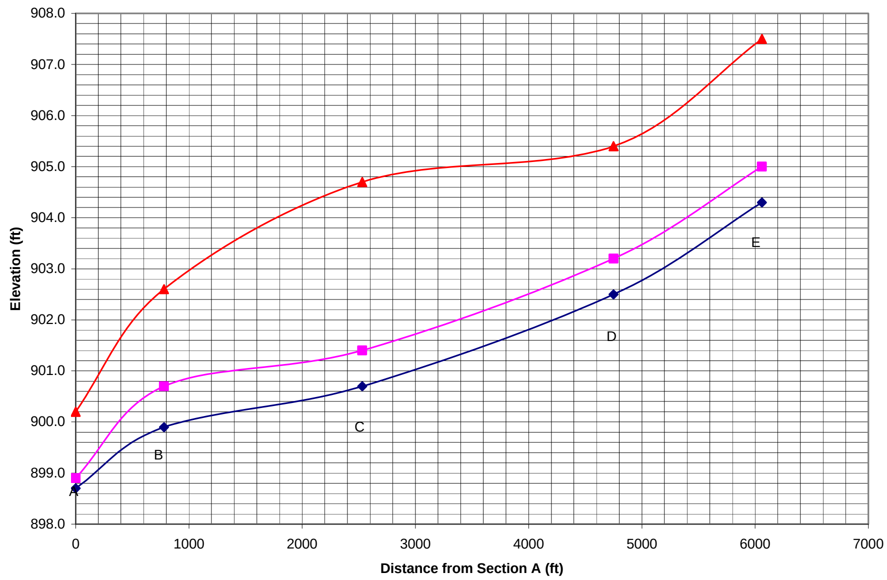
100-Year Water Surface Profiles Through Ada



Notes:
1. Cross section locations are shown on Figure 1
2. Water surface profiles are the controlling elevations from the Marsh River and Judicial Ditch 51 at reference points A through E.

Figure 11

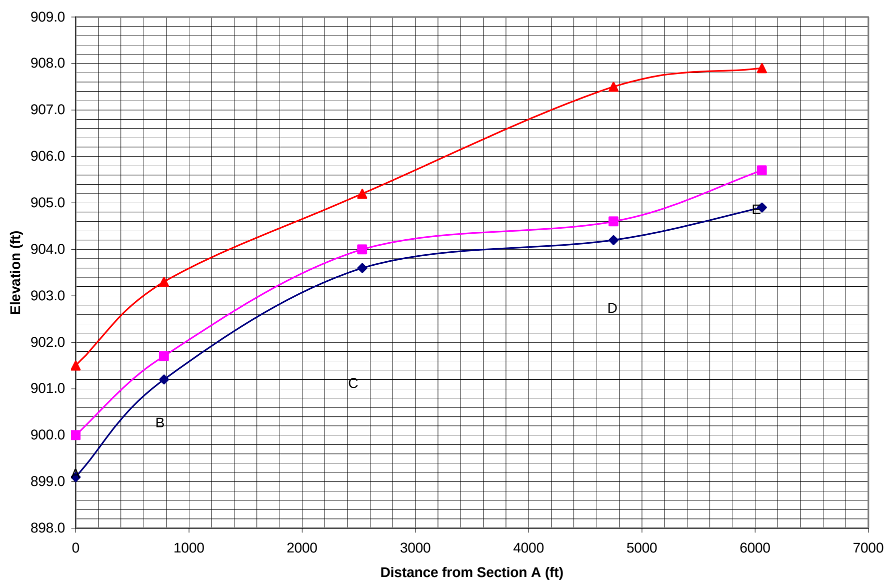
200-Year Water Surface Profiles Through Ada



Notes:
1. Cross section locations are shown on Figure 1
2. Water surface profiles are the controlling elevations from the Marsh River and Judicial Ditch 51 at reference points A through E.

Figure 12

500-Year Water Surface Profiles Through Ada



Notes:
1. Cross section locations are shown on Figure 1
2. Water surface profiles are the controlling elevations from the Marsh River and Judicial Ditch 51 at reference points A through E.

Water Surface Profiles for Levee Design

The Hydraulics Section developed levee design profiles for the Marsh River and Judicial Ditch 51 (JD51). Flood events were simulated using the HEC-RAS Water Surface Profile model. Two portions of the existing condition HEC-RAS model for the Marsh River were extracted to generate profiles for the City of Ada. The first model segment for Ada extended from Section 101 to 107 on Judicial Ditch 51 (JD51). The second segment for Ada extended from Section 79 to 90 on the Old Marsh River. Rating curves were plotted (Figures 14 and 15) for the average and +2 standard deviation flow conditions at the downstream section in the two Ada models. The average condition rating curves were extended graphically beyond the 500-year event. Four levee designs were determined from the rating curves. Three feet were added to the flood elevation and projected to the average condition rating curve. The corresponding discharges were then input to the HEC-RAS model. The results from the HEC-RAS runs are listed in Tables 7 and 8.

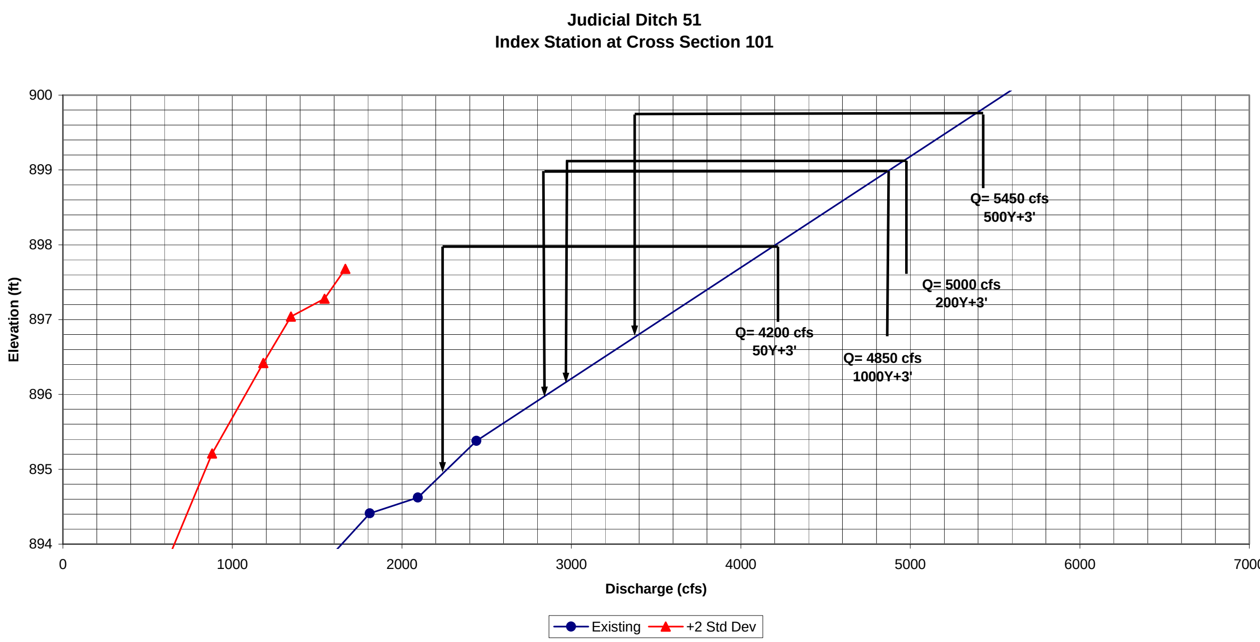


Figure 14

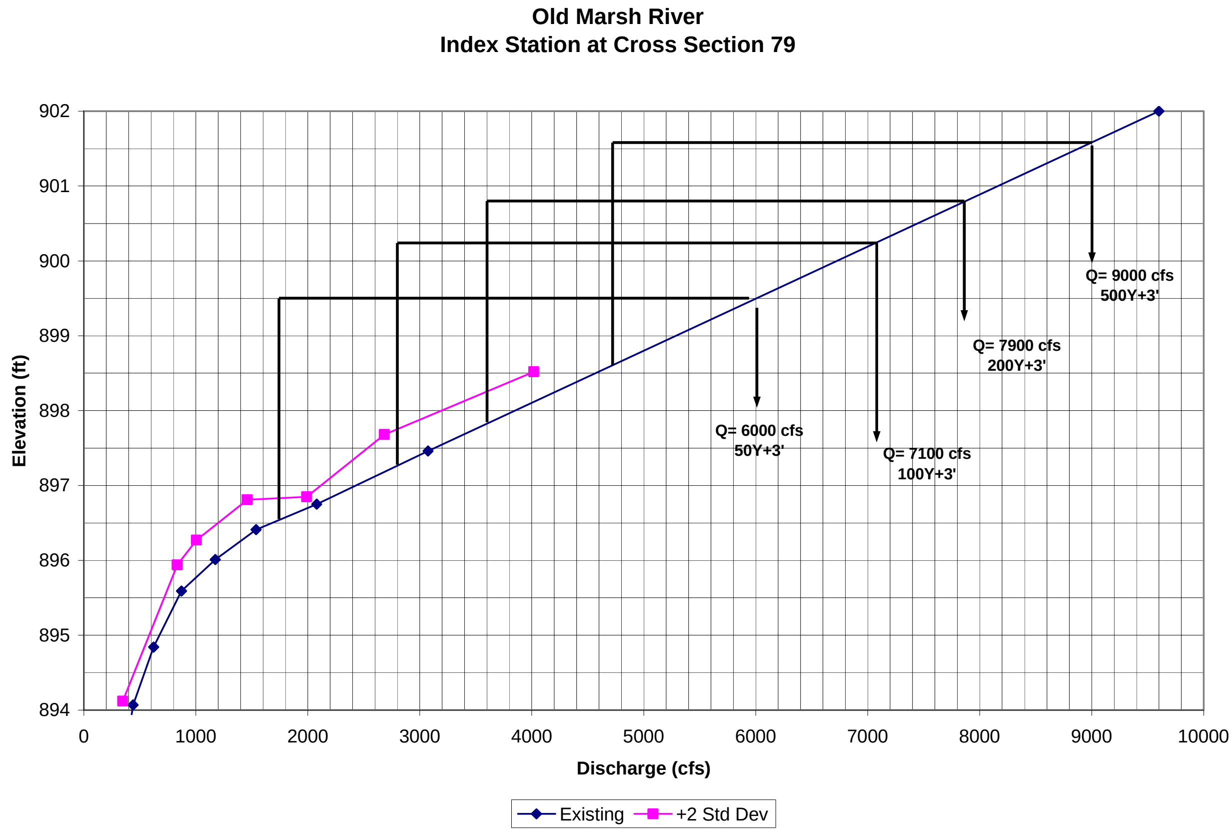

Old Marsh River
Index Station at Cross Section 79
Elevation (ft)
902
901
900
899
898
897
896
895
894
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
Discharge (cfs)
Q= 9000 cfs
500Y+3'
Q= 7900 cfs
200Y+3'
Q= 6000 cfs
50Y+3'
Q= 7100 cfs
100Y+3'
Existing
+2 Std Dev

Figure 15

Several reference points around the City of Ada were selected for the levee design. Figure 16 illustrates the levee reference points used to describe the levee profile. Since the proposed levee design does not follow the existing river alignment in the HEC-RAS model, the water surface profiles were projected and interpolated for the levee reference points. Tables 9 and 10 list the levee design elevations for the reference points.

Figure 16

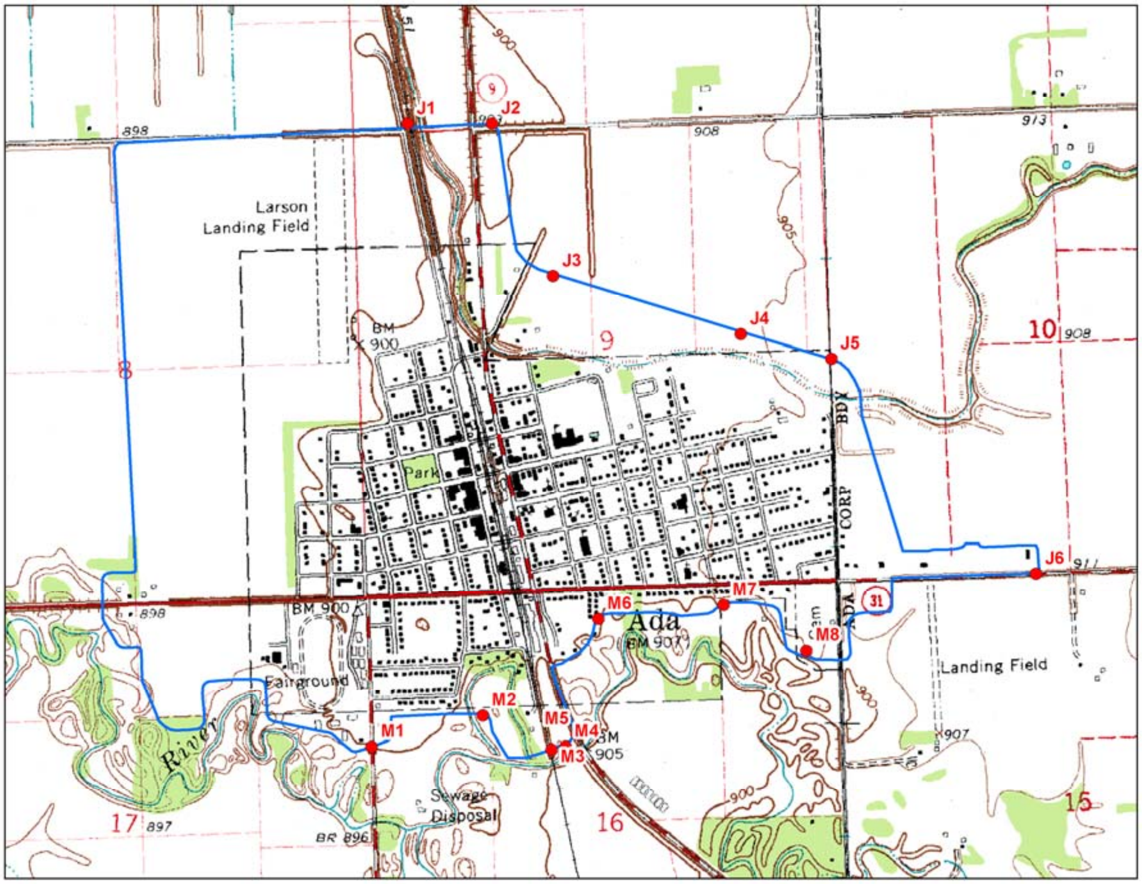

J1
J2
J3
J4
J5
J6
M1
M2
M3
M4
M5
M6
M7
M8
Larson
Landing Field
Park
Ada
Fairground
River
Sewage
Disposal
Landing Field
BDY
CORP
ADA
898
908
913
905
908
911
898
897
907
900
BM 900
BM 907
BM 905
BR 896
8
9
10
15
16
17

TABLE 7 OLD MARSH RIVER LEVEE DESIGN – WATER SURFACE PROFILES					
HEC-RAS SECTION NUMBER	**ELMIN Ch. Invt.**	**CWSEL Q=6000 50Y+3’**	**CWSEL Q=7100 100Y+3’**	**CWSEL Q=7400 200Y+3’**	**CWSEL Q=9000 500Y+3’**
79	886.80	899.55	900.23	900.73	901.63
80	888.40	900.51	901.30	901.94	903.08
81	888.60	900.88	901.66	902.31	903.47
81.1	888.60	900.88	901.66	902.31	903.48
81.2	888.60	900.88	901.68	902.30	903.50
82	888.10	900.96	901.74	902.36	903.53
83	890.30	901.27	902.07	902.72	903.90
84	889.90	901.41	902.21	902.86	904.06
84.1	891.30	901.33	901.97	902.29	902.81
84.2	891.30	901.48	902.25	902.87	904.71
85	891.00	901.87	902.95	904.13	906.75
85.1	891.40	902.02	903.07	904.22	906.58
85.2	891.40	902.04	903.13	904.29	906.83
86	891.40	902.06	903.32	904.65	907.36
87	892.80	904.01	904.88	905.81	907.72
88	898.00	907.26	907.89	908.46	909.13
88.1	898.00	907.37	907.94	908.50	909.18
88.2	897.70	908.36	908.68	909.03	909.43

TABLE 8 JUDICIAL DITCH 51 LEVEE DESIGN – WATER SURFACE PROFILES					
HEC-RAS SECTION NUMBER	**ELMIN Ch. Invert**	**CWSEL Q=4200 50Y+3'**	**CWSEL Q=4850 100Y+3'**	**CWSEL Q=5000 200Y+3'**	**CWSEL Q=5450 500Y+3'**
101	880.70	897.91	898.82	899.13	899.75
102	885.00	898.96	899.89	900.24	900.93
102.1	885.00	899.00	899.93	900.28	900.96
102.2	885.00	899.04	899.98	900.35	901.11
103	885.40	899.18	900.12	900.50	901.30
103.5	887.00	901.00	901.92	902.29	903.02
104.	888.20	901.47	902.34	902.64	903.36
104.1	888.20	901.50	902.37	902.68	903.40
104.2	887.10	902.67	904.06	905.23	906.13
105	887.10	902.70	904.15	905.33	906.20
106	889.40	905.70	906.41	906.46	906.85
106.5	892.00	907.53	908.24	908.43	909.00
107	896.80	911.32	912.08	912.37	913.02

TABLE 9 OLD MARSH RIVER LEVEE REFERENCE POINTS					
Control Point	50Y+3'	100Y+3'	200Y+3'	500Y+3'	Description
M1	900.96	901.74	902.36	903.53	Levee at Cnty Hwy 1
M2	901.27	902.07	902.72	903.90	
M3	901.41	902.21	902.86	904.06	DS side of RR
M4	902.02	903.07	904.22	906.58	Between Hwy 9 and RR
M5	902.04	903.13	904.29	906.83	US side of Hwy 9
M6	902.06	903.32	904.65	907.36	
M7	904.01	904.88	905.81	907.72	
M8	907.26	907.89	908.46	909.13	US end of levee at T Hwy 200

Notes:
M1 = Elevation at Section 82
M2 = Elevation at section 83
M3 = Elevation at Section 84
M4 = Elevation at section 85.1
M5 = Elevation at Section 85.2
M6 = Elevation at section 86
M7 = Elevation at Section 87
M8 = Elevation at section 88

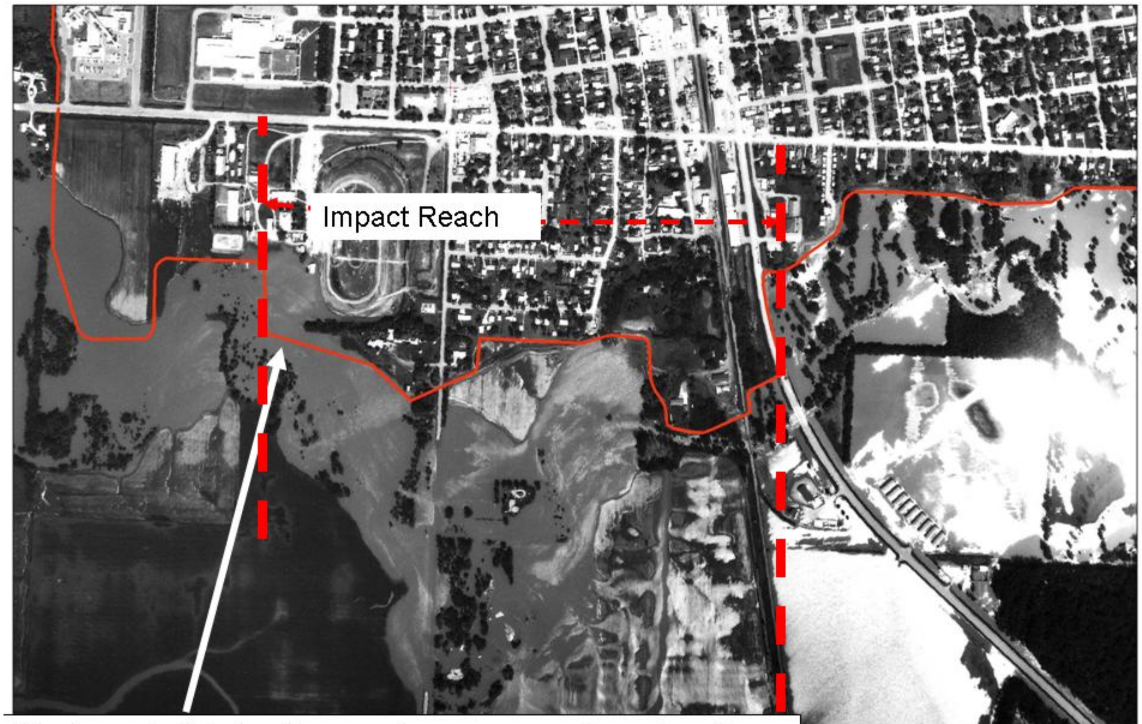
TABLE 10
JUDICIAL DITCH 51
LEVEE REFERENCE POINTS

Additional Comments

In looking at Alternative 2, the re-route of JD-51, a few assumptions were made in the analysis. These assumptions will be looked at in more detail during the plans and specifications phase. The first assumption is that the re-route of the ditch will allow for the same flow of water through JD 51. The cross-section that was used is the original cross-section from when JD 51 was first constructed. The cross-section would have a 12 foot base width with 1V:3H side slopes. Secondly, the location where the re-route will flow under Hwy 9, 2-12x12 box culverts will be constructed. These box culverts were chosen to match the box culverts located on the existing ditch where it flows under Hwy 9 just south of the new location.

Floodplain Impacts

Flow distribution during flood events will not change with the selected plan. Levees will be constructed outside the effective flow limits of the Marsh River, except is short reach near the baseball field West of south Jamison Drive. The area effect is bounded by South Jamison Ave on the West, Highway 9 on the East, The sewage treatment lagoons on the south, and the levee on the north. The levee in this reach creates an encroachment on the floodplain that will raise the water surface profile for all floods greater than a 10-year flood event by 0.1-feet to 0.3-feet. The impact reach extends from the encroachment upstream to HWY 9.



The levee in this location creates an encroachment on the floodplain that will raise the water surface profile for all floods greater than a 10-year flood event by 0.1-feet to 0.3-feet.

Project Performance

Given the uncertainty associated with the various hydraulic, hydrologic, and economic relationships used in the flood damage analysis, there is likewise some uncertainty regarding a project's ability to provide a given level of protection. FDA measures a project's performance by calculating the probability that flood stages will exceed the project's capacity. The project is generally designed so that there is a 90-95 percent probability it contains the design flood. Table 12 shows the probability that the 200-year levee project will contain selected flood levels. For example, the levee in Reaches 1a and 2a will contain the 100-year flood (1% event) with a probability of 98.61 percent. Because of the ranges of uncertainty, the 200-year project also has the ability to contain the 500-year flood (probability of 81.68 percent). On the other hand, there is some risk that the project may not necessarily contain the 200-year flood. There is still a 2.47 percent probability (1 – 0.9753) that the 200-year flood will overtop the 200-year project in Reaches 3 and 4.

Table X - Probability of Levee Overtop by Event						
	Top of Levee	Conditional Non-Exceedence Probability by Events				
Reach	Elevation	4.0%	2.0%	1.0%	0.5%	0.2%
1a, 2a	906.2	0.9995	0.9994	0.9861	0.9084	0.8168
1b, 2b	904.4	0.9998	0.9965	0.9618	0.7706	0.547
3, 4	903.7	0.9999	0.9999	0.9989	0.9753	0.9126

In addition to considering the probability of a particular event overtopping a levee as above, one can consider the probability of a levee being overtopped over a given period of time (say 10, 25, or 50 years). Table 13 presents project performance in this manner for the 200-year levee in each Reach. Based on the data presented in the table, the levee along Reaches 1b and 2b will have a 6.91 percent chance of being overtopped within a period of 25 years. As the period of time increases in length, the probability for an overtopping event for the levee increases.

Table X – Long-term Risk of 200-Year Levee Alternative				
	Expected Annual	Probability of Exceedance		
	Probability of Design	Over Indicated Time Period		
Reach	Being Exceeded	10 Years	25 Years	50 Years
1a, 2a	0.000	0.0090	0.0223	0.0440
1b, 2b	0.003	0.0282	0.0691	0.1335
3, 4	0.001	0.0032	0.0081	0.0161

INTERIOR FLOOD CONTROL

Introduction

The city of Ada experiences flooding from two sources; Judicial Ditch 51 and the Old Marsh River. Control of flooding from Judicial Ditch 51 is proposed to be from levees and interior flood control features, such as pumping or ponding. Flooding from the Old Marsh is to be controlled with levees. The interior drainage area has been divided into 9 sub-watersheds. Because of the alternative of moving JD 51 to the east, areas 1, 4, and 6, which are those areas that outlet into JD 51, need to be looked at as alternative 1 and alternative 2. Figure 1 and Figure 2 show the 7 sub-watersheds for alternatives 1 and 2, respectively. Table 1 gives the hydrologic description for each of these contributing sub-watersheds.

TABLE 1
DETERMINATION OF LAND USES, TIME OF CONCENTRATIONS, AND SCS CURVE NUMBERS

Location	Watershed Area		Flow Length (ft)	Outflow Location	Tc (min) (1)	Lag (hrs) (2)	Land Use (%)			SCS Curve Number (3)
	Acres	Sq. Mi.					Bus.	Resid.	Park	
1	186.0	0.291	5000	JD51	51.7	0.517	10	90	0	82.3
2a	54.0	0.084	2400	Old Marsh	30.0	0.300	20	80	0	83.6
2b	30.0	0.047	1200	Old Marsh	20.0	0.200	0	100	0	81.0
3	158.0	0.247	4400	Old Marsh	46.7	0.467	10	80	10	82.1
4	74.0	0.116	3200	JD51	36.7	0.367	10	90	0	82.3
5	149.0	0.233	4000	Old Marsh	43.3	0.433	20	10	70	82.2
6 – alt#1	11.0	0.017	2700	JD51	32.5	0.325	20	50	30	83.0
6 – alt #2	25.0	0.039	2700	JD51	32.5	0.325	20	30	50	82.6

Notes:

(1) Tc, the estimated time of concentration was obtained assuming a 10 minute travel time to the nearest inlet, plus an average flow rate of 2 feet per second in each storm sewer.

(2) The estimated lag time is equal to time of concentration in minutes, divided by 100.

(3) The study area consists of soils of Hydrologic Class Type C. The weighted SCS curve number was, therefore, obtained assuming an average curve number of:

94 for commercial and industrial areas
81 for residential areas (1/3 acre average lot size assumed)
79 for park and undeveloped areas (fair condition with grass cover 50% to 75%)

Gravity Outlets

The gravity outlets for both alternatives 1 and 2 are summarized in Table 2. The locations of the outlets from Table 2 are shown on Figures 1 and 2, in addition to the plan plates. The outlets were designed to keep the 100-year rainfall event from reaching the determined zero damage elevation for each sub-watershed area. Table 2a contains additional outlets that are needed to provide adequate drainage through the levee for street side ditches.

Alternative 1. This alternative evaluates the interior drainage issues if JD 51 is not re-routed.

Alternative 2. The relocation of JD 51 to the east allows for increased volume of interior ponding. This ponding can be used for storage of interior runoff for areas 1, 4, and 6. The gravity outlet for area 6 provides the capacity needed to handle the interior runoff that is routed from areas 1 and 4 through the ditch and combined with the runoff from area 6. Because of past history with interior flooding in area 4, the storm sewer capacity from this area to the JD 51 storage pond was increased from a 24" pipe to a 48" pipe.

TABLE 2
PROPOSED GRAVITY OUTLETS

Location	Outlet No.	Pipe Diameter (in)	Inlet Elevation (ft)	Outlet Elevation (ft)	Pipe Length (ft)	Ground Elevation (ft)	Outlet Location	Outlet Bottom Elevation (ft)
Area 1-alt #1	17	2-60	891.0	890.0	435	901.0	JD 51	888.0
Area 2a	12	48	894.6	894.1	325	901.0	OMR	892.1
Area 2b	13	48	895.3	894.8	290	900.0	OMR	892.8
Area 3	8	22-60	892.8	892.3	85	901.0	OMR	890.3
Area 4-alt #1	1	2-54	891.0	890.0	315	901.0	JD 51	888.0
Area 4-alt #2	2	48	891.0	890.0	315	901.0	JD 51	888.0
Area 5	5	48	890.8	889.8	175	900.0	OMR	886.8
Area 6-alt #1	14	24	890.0	889.0	315	901.0	JD 51	887.0
Area 6-alt #2	18	54	887.0	886.0	90	901.0	JD 51	887.0

TABLE 2A ADDITIONAL OUTLETS			
Outlet Number	Pipe Diameter (in)	Pipe Length (ft)	Location
3	24	90	Hospital Levee, North of Hwy 200
4	24	65	Hospital Levee, South of Hwy 200
6	24	40	South Levee, West of Jamison Drive
7	24	40	South Levee, East of Jamison Drive
9	24	50	South Levee, West of Railroad
10	36	75	South Levee, West of Hwy 9
11	36	75	South Levee, East of Hwy 9
15	24	45	North Levee, West of Hwy 9
16	24	20	North Levee, West of Hwy 9

Note: The inverts will be determined during the feasibility stage.

Pump Stations

It was determined that the 1997 rainfall was the most significant event on record and therefore was used to size the pumping stations. The summary for the pumping stations is summarized in Table 3. The proposed locations of the pumping stations are located on Figure 1. Due to the gain in storage in relocating JD 51, the pumping stations that were required for alternative 1 are eliminated for alternative 2. No pumping stations are required along the south levee where there is enough interior storage below the zero damage elevation to store runoff during blocked gravity conditions for both alternatives.

TABLE 3 PROPOSED PUMP STATIONS					
Location	Number of Pumps	Size of Pump (gpm)	Total Station Capacity (gpm)	Pump On Elevations (ft)	Pump Off Elevations (ft)
Area 1	2	5,000	10,000	897/898	895/895
Area 4	2	5,000	10,000	896/897	895/895

Interceptors

Interceptor sewer pipes are used to collect runoff from existing storm sewers or ditches and convey it to the proposed outlet. Interceptor sewer pipes are included in area 1. Alternative 1 interceptors propose 3,150 feet of interceptor sewers having a diameter of 24 inches. In addition to the interceptor sewers, this plan will require 5 manholes to connect the sewers. Alternative 2 interceptors propose 2,000 feet of interceptor sewers having a diameter of 24 inches. This plan requires 3 manholes to connect the sewers. The interceptor sewers are shown on Figures 1 and 2. The existing storm sewer inverts were not available and will need to be determined prior to any future efforts into this study. For this analysis, the inverts were calculated by determining existing ground elevation and subtracting an assumed 6 feet of cover and the pipe size.

Figure 1
Alternative #1 – Interior Flood Control Features

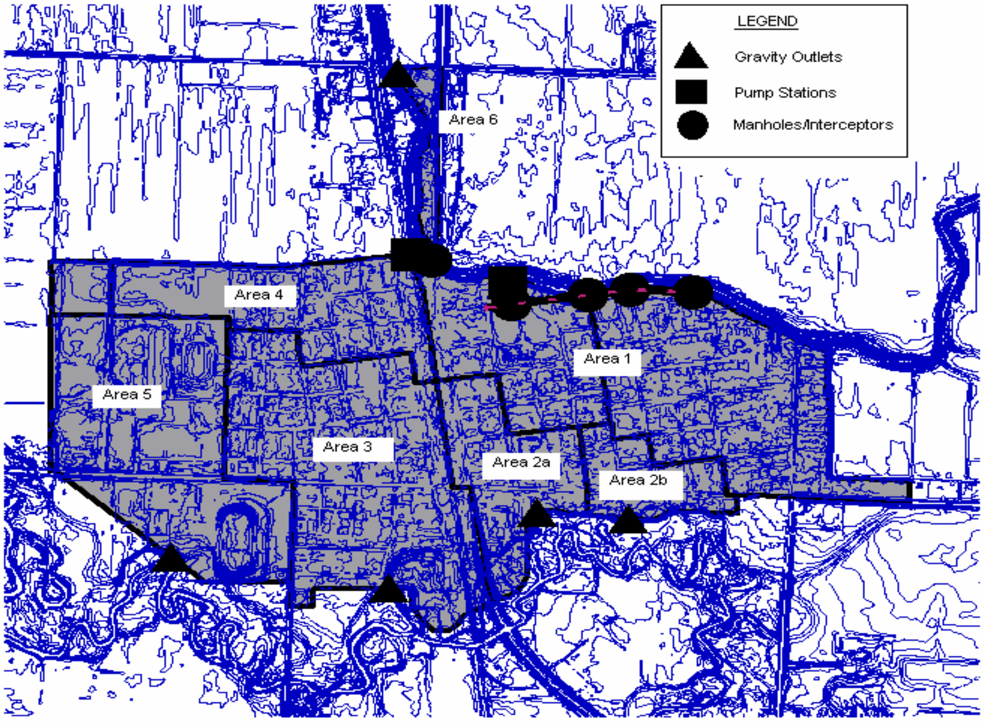
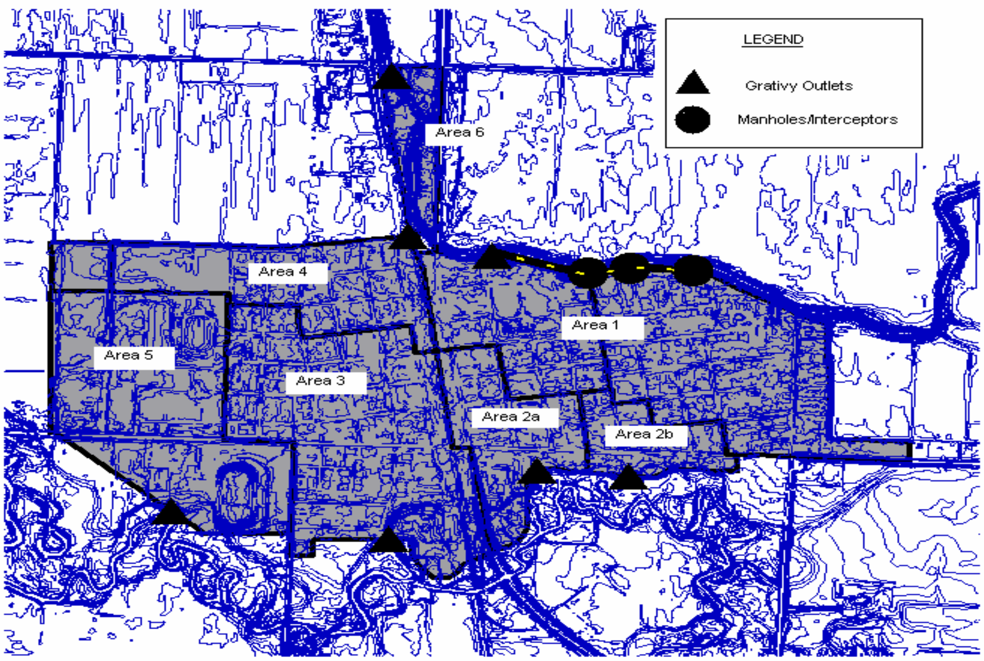
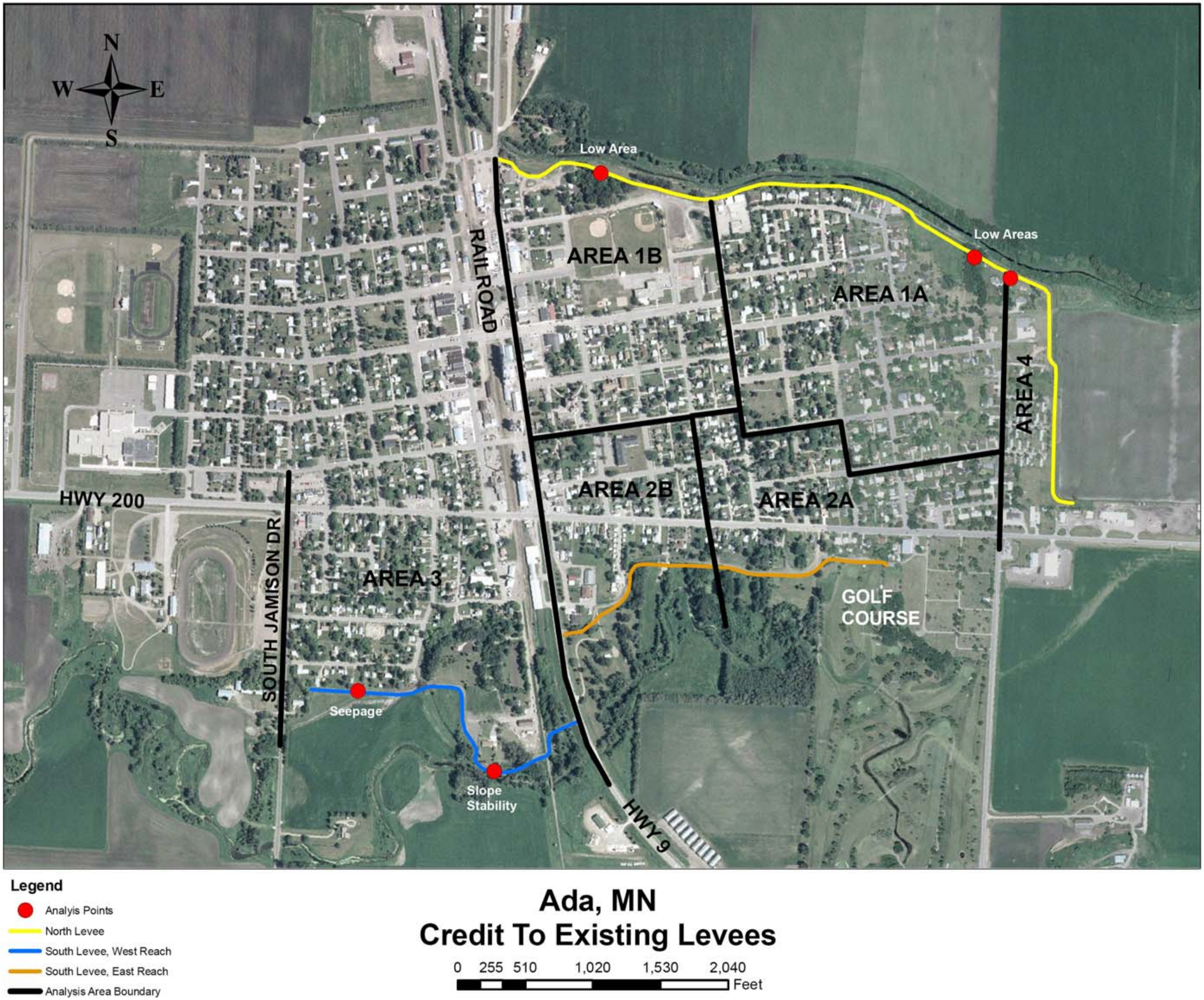


Figure 2
Alternative #2 – Interior Flood Control Features





Ada, MN
Credit To Existing Levees

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX C

GEOTECHNICAL ANALYSIS

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ADA, MINNESOTA SECTION 205
APPENDIX C
GEOLOGY AND GEOTECHNICAL DESIGN

1. PURPOSE:

This appendix presents the general geology and specific geotechnical analysis for the Ada, MN Flood Risk Management project.

2. TOPOGRAPHY and PHYSIOGRAPHY

The Red River of the North drainage basin is located within the Red River Valley Section of the Central Lowlands Physiographic Province of North America. Ada, Minnesota, the proposed project site, is centrally located between the Red River of the North and the eastern edge of the Red River Valley in central Norman County. Ada is located on the north bank of the Marsh River. Approximately 15 miles west of Ada lies the Red River of the North which marks the center of Lake Agassiz basin. The Pembina Escarpment marks the boundary between the Red River Valley and the Glaciated Plains sub-sections of the Central Lowlands Physiographic Province to the west in North Dakota.

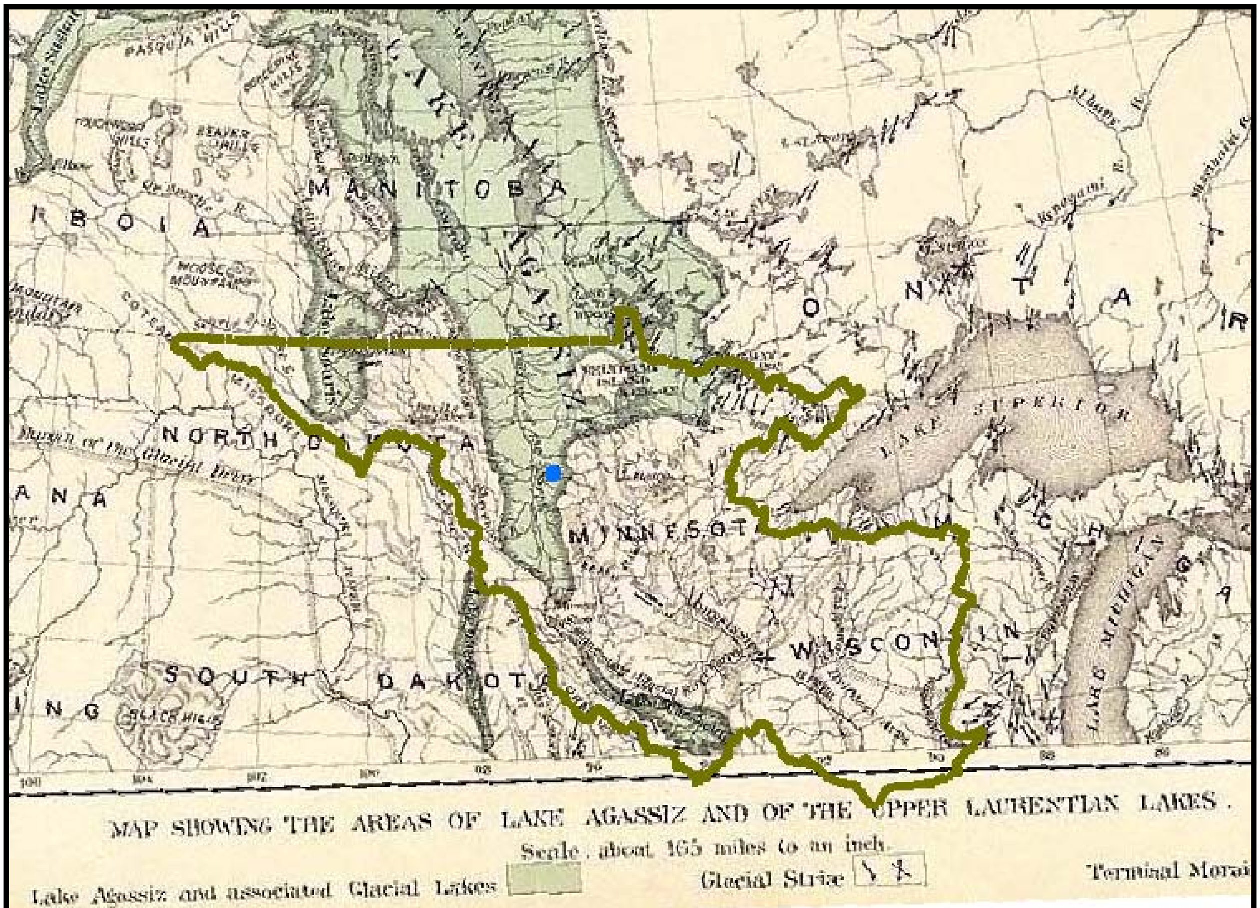

Figure C-1: Ada is shown by the blue dot.

The Red River valley is not a traditional “river valley” of erosional origin, but a nearly level featureless lake plain that was once the bottom of glacial Lake Agassiz. North-south trending, the plain extends approximately 245 miles within the United States, and is about 15 miles in width on the extreme southern end before rapidly widening to 60-70 miles. The plain is generally inclined northward with an average slope of less than 1 foot per mile. The Marsh River flows northwest where it joins the Red River of the North. The Red River of the North flows a tightly meandering course within this plain for about 400 river miles before arriving at the Canadian border, with a river surface elevation drop from approximately 945 feet (msl) to 740 feet. The Red River meander belt may be up to 1.5 miles wide. Ultimately the river flows into Lake Winnipeg, Manitoba, Canada. Drainage of Norman County via the Wild Rice and Marsh Rivers is mainly Westward, or perpendicular, to the trend of The Red River of the North.

3. REGIONAL GEOLOGY and STRATIGRAPHY

The geology influencing the Red River Valley Section is the legacy of glacial Lake Agassiz and recent fluvial/alluvial processes of the Red River and its tributaries. During the glacial period, the entire watershed was covered by a continental glacier. Periodically, as the glacial ice melted and retreated northward, huge ice dams were formed which blocked the natural northerly drainage pattern. Glacial Lake Agassiz, which covered approximately 200,000 square miles, resulted from the ice damming and subsequent ponding of meltwaters. The lake is believed to have existed from approximately 13,800 to 9,000 years before present (B.P.), during the Late Wisconsin Glacial Episode of the Pleistocene Epoch. As the glacier receded and advanced, fluctuations of the lake levels resulted in corresponding variations of the sediment types. After the glacial lake drained for the final time, the relatively youthful drainage pattern of the present Red River Valley of the North established itself on top of the lake sediments. The basis for most of the stability analysis prepared for this report is a direct result of the geologic setting. A brief history of the Pleistocene Epoch and related stratigraphy is presented, therefore, to establish background for discussions of the engineering characteristics of the various soil units. Much of this information has been previously detailed in:

North Dakota Geological Survey Miscellaneous Series No. 44 (Moran, 1972),
North Dakota Geological Survey Bulletin 57 (Bluemle et al, 1973),
North Dakota Geological Survey Miscellaneous Series 52 (Harris, Moran, & Clayton, 1974),
North Dakota Geological Survey Report of Investigation No. 60 (Arndt, 1977),
General Design Memorandum for Flood Control-East Grand Forks (Corps of Engineers, 1986).

The stratigraphic units will be discussed from bottom-most to ground surface.

Bedrock. Bedrock lies at an estimated depth greater than 200 feet beneath the glacial sediments in the region. The bedrock is likely composed of Paleozoic Era, Cretaceous Period sedimentary rock or granitic intrusive rocks. The bedrock lies well below the influence of the proposed project.

Red Lake Falls Formation. The lowest foundation unit of interest is the Red Lake Falls Formation. Typically, this is a very stiff to hard, sandy clay till. The formation was likely deposited by the Pre-Caledonian Advance of the Lostwood Glaciation (Wisconsin Episode) approximately 14,000 years BP. Locally the unit may be composed entirely of sand and gravel.

Brenna Formation. The second high-water phase (or Lockhart Phase) of Lake Agassiz occurred from approximately 11,600 to 11,000 years BP and resulted in the deposition of the Brenna Formation. The Brenna Formation is characterized as a uniform, wet, soft to very soft, dark grey, glacio-lacustrine clay, with little or no visible structure. The major source of sediment for this formation was eroded Pierre Shale bedrock. Slickensides are commonly observed on shear planes in freshly broken samples. Soft, calcareous silty nodules are common, increasing with depth. The Brenna Formation is notoriously unstable as a foundation material throughout the Red River of the North Valley. The contact with the overlying Sherack is an erosional unconformity. The upper 5 to 10 feet of the Brenna Formation may be variably harder and more consolidated, probably due to desiccation during sub-aerial exposure.

Sherack Formation. The third and final high-water phase (or Emerson Phase) of Glacial Lake Agassiz occurred from approximately 9,900 to 9,000 years BP and resulted in the deposition of the Sherack Formation. The Sherack Formation is typically characterized as laminated, medium stiff, glacio-lacustrine silty clay and clayey silt with minor amounts of sand. The upper portion of this unit is usually brown to yellow-brown with frequent iron oxide or calcareous concretions but the base is grey. Glacial material from the uplands, instead of shale bedrock, was the major source of sediment for the Sherack Formation. The contact with the overlying present period (Holocene Epoch) sediments is an erosional unconformity.

Present period sediments. As the northeastern outlets for the lake opened for the final time, it is estimated that Glacial Lake Agassiz retreated from Minnesota by about 9,000 years BP, and was wholly gone as a Pleistocene phenomenon by approximately 8,500 years BP. An immature drainage system developed along the floor of the glacial lake bed with tributary streams such as the Wild Rice and Marsh Rivers flowing from the high ground to the east. The present day Wild Rice and Marsh Rivers watershed is the result of this post-glacial erosional activity. Overland flood sediments from the Wild Rice and Marsh Rivers blanket the area surrounding the project. These surface sediments may be characterized generally as soft to medium stiff, fluvial or alluvial, silty clay or clayey silt. Near the Marsh River, the sediment contains some thick deposits of sand or organic matter. Adjacent to urban development, fill and rubble may be present in the upper sediments. The river exhibits no well defined flood plain. The depths of these surface sediments are highly variable and may range widely in thickness.

The Red Lake Falls, Brenna, and Sherack Formations may be combined geologically as part of an assemblage known the Coleharbor Group. All of these deposits are the result of processes directly related to Glacial Lake Agassiz and associated Wisconsin Age glacial deposition. The present period sediments may be classified geologically as the Walsh Formation. These soils are the result of post-glacial river, wind, or other erosional process.

4. SEISMIC RISK and EARTHQUAKE HISTORY

According to Corps of Engineers Regulation ER 1110-2-1806, Earthquake Design Analysis for Corps of Engineers Projects, Ada, Minnesota is located within earthquake Seismic Risk Zone 0. The Uniform Building Code of the International Conference of Building Officials assigns every location in the United States to a four-grade Seismic Risk Zone (0 = least risk, 3 = greatest risk).

The Ada area in the Red River Valley Section of the Central Lowlands Physiographic Province is one of the least seismically active places in the United States. The nearest continental basement fault to the west is the Thompson Boundary fault, which extends from the approximate Saskatchewan - Manitoba boundary southward through North Dakota, about 220 miles west of Ada The fault separates the stable Wyoming and Superior Cratons of the tectonically-inactive Canadian Shield. An earthquake occurred along this fault south of Bismarck, North Dakota, in 1968. It had a magnitude of 4.4 on the Richter Scale (IV-V Mercalli Intensity). Northwest of the project, an earthquake with an epicenter located in southeast Saskatchewan, Canada had a Mercalli Intensity of VI. No known reports of disturbances near the proposed project area resulted from either of these events.

In Minnesota there are few faults that could possibly affect the project. The Morris fault extends diagonally from the town of Morris, Minnesota to the Brainerd area in west-central Minnesota, roughly 110 miles southeast of Ada. The Morris fault, it is confined to the Precambrian bedrock and is not considered tectonically active, although some seismic activity has been associated with the Morris fault. In 1975, an earthquake with a Modified Mercalli Intensity of VI occurred near the town of Morris. This earthquake occurred about 10 miles west-northwest of Morris at a depth of 3-5 miles. It is one of the best documented earthquakes in Minnesota history, and possibly the largest. In Fargo and in Valley City, North Dakota, a Modified Mercalli Intensity of II (felt by persons at rest, on upper floors, or favorably placed) was assigned for this event. However, it was not felt north of Grand Forks, North Dakota. The Modified Mercalli Intensity Scale ranges from I (not felt) to XII (damage nearly total). Five other earthquakes have been linked to the Morris fault since the year 1860. The most recent earthquake in Minnesota occurred along the western edge of the Morris fault in 1993 near the town of Graceville. It had a magnitude of 4.1 on the Richter Scale and a Mercalli Intensity of V. The Graceville earthquake occurred at an estimated depth of 7 miles.

Eighteen recorded earthquakes have occurred in Minnesota since 1860. Some are associated with glacial isostatic rebound, particularly in the northeast region of the state near Duluth. No earthquake has exceeded the magnitude or intensity of the Morris event in 1975. An approximate frequency of between 10 and 30 years has been established for minor earthquakes in Minnesota. The seismic risk assessment for the Red River Valley region relies largely on earthquake history. The absence of major or catastrophic earthquakes, coupled with the infrequency of these earthquakes in general, implies an extremely low risk level for seismic activity in the vicinity of Ada, Minnesota.

5. SUBSURFACE INVESTIGATIONS

A total of thirteen machine and one hand auger soil borings were advanced by the St. Paul District in the project area in the year 2000 and 2006. The boring logs for the 14 COE borings are presented on Plates C-2 through C-5 of this appendix. The soil borings ranged in depth from 30 to 80 feet below ground surface. The boring locations are presented on Plate C-1.

Limited index testing was completed to delineate the contact between the different geologic units. Tests taken from samples consist of atterberg limits and natural moisture content. Results of the all the laboratory tests taken in the Ada area are shown on the boring log plates. Table C-1 below summarizes the soil testing results. Results confirm the borings, showing consistently higher LL, PL, PI, Liquidity, water content, C_c, and e_0 for the Brenna Formation (generally, existing at depths greater than 13 feet). The testing results on the samples taken from the subsurface investigation were as follows:

Table C-1: Testing Summary

Formation	LL	PL	PI	Liquidity	ω_0	C_c	e_o	γ_{sat}	γ_{moist}	γ_{sub}
Sherack	71.2%	25.4%	45.8%	0.42	37.1%	0.63	1.78	102	101	40
Brenna	108.4%	32.8%	75.6%	0.52	72.6%	1.16	2.06	98	98	36

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6. SITE STRATIGRAPHY

Most of the observed conditions that are the basis of this report are closely related to the geologic setting within the proposed project site. Although the general stratigraphic sequence in the Red River Valley Section is more or less understood, this sequence can be altered within the meander belt of a given tributary or main stem river. Material found in the project area is similar in characteristics and engineering properties with other regions of the Red River of the North basin. The borings show that the soils are comprised mostly of silts and clays. The proposed project would be founded on weak glacio-lacustrine sediments throughout its length. These glacio-lacustrine clays are referred to as the Brenna Formation and the Sherack Formation in the General Reevaluation Report for East Grand Forks Minnesota and Grand Forks North Dakota, 1986. This designation will be used for this report also. Some of the surface excavation will be in fluvial/alluvial deposits (present period sediments), which are the youngest in the region. These soils blanket the project area and are thickest in the meander belt of the Marsh River. The stratigraphic units will be discussed from bottom-most to ground surface.

Red Lake Falls Formation. The lowest unit of interest for any foundation work proposed thus far is the Red Lake Falls Formation. On the basis of soil borings this unit is characterized as a stiff to hard, variably pebbly or sandy, low plasticity, moist, silty clay till. No site specific testing is available, but testing elsewhere in the Red River Valley indicates that the plastic limits vary from 17 to 26, liquid limits from 29 to 35 and moisture contents between 20 and 32 percent. In the Red River Valley area caissons or piles are typically set into the Red Lake Falls Formation. The top of the Formation exhibits a gently undulating surface with an approximate elevation of 635 feet (+/ - 10 feet), (NGVD 1929 adj.). No soil boring taken for this project penetrated the entire unit so the total thickness of the unit at each specific site is unknown. All available literature indicates that the unit averages approximately 45 feet in thickness.

Brenna Formation. The next upper-most unit is the Brenna Formation. This glacio-lacustrine clay is notoriously unstable and is the acknowledged cause of most of the soil stability problems encountered in the Red River Valley Section. The sediment source for this formation was eroded Pierre Shale bedrock. On the basis of soil borings this unit has been classified as soft, mostly massive, highly plastic, wet, dark grey clay that often shears with a distinct slickensided appearance. Usually, the upper portion of the Brenna Formation has been exposed to sub-aerial weathering which has altered its physical characteristics. This upper desiccation zone does not exist everywhere, but is quite common and has an average thickness of about 3-5 feet throughout the project reach. The desiccation zone is variably harder and more consolidated than the bulk of the Brenna Formation, but is not thick enough to substantially alter the basic weakness inherent within the formation. The contact with the overlying Sherack Formation is a sharp, erosional unconformity. Laboratory testing in other areas of the valley indicate that plastic limits vary from 21 to 42 percent, liquid limits vary from 54 to 134 percent, and moisture content varies from 26 to 87 percent. Thickness of this unit is in the range of 60 to 70 feet. In the project area, the top of the Brenna Formation ranges in elevation from 896 feet at boring 06-13M to a low of 869.7 at boring 06-7M which is located near the Marsh River, (NGVD 1929 adj.) and exhibits a gently undulating surface dipping to the northwest. Nearer to the river course, the top elevation may be more variable due to the existence of erosional scars.

<u>Sherack Formation</u>. Typically, the stratigraphic unit encountered above the Brenna Formation is the Sherack Formation. Like the Brenna Formation, the Sherack Formation is a glacio-lacustrine deposit. The source material for the Sherack sediments was the glacial uplands, instead of shale bedrock. It is fairly stable when excavated, but is easily eroded where nonplastic silts are exposed. Almost all borings indicated a saturated nonplastic silt seam in the lower portion of this formation near the contact with the Brenna. This silt seam averages 1 to 2 feet in thickness. Based on the soil borings this unit can be classified as medium stiff, medium to high plasticity, laminated to medium bedded, wet to saturated, silty clay and clayey silt with minor amounts of fine sand, gypsum and calcite crystals, and organics. The unit is usually brown to yellow-brown with frequent iron oxide or calcareous concretions. Tests taken samples throughout the valley indicate that the plastic limits vary from 18 to 42, liquid limits from 24 to 84 and moisture contents between 14 and 53 percent. In the project area the unit thickness is approximately 10 feet. Nearer to the river course, the top elevation may be more variable or it may have been totally removed by scour.

<u>Present period sediments</u>. The ground surface sediments blanketing the area today are derived primarily from alluvial and/or fluvial sedimentary processes. Also found in the uppermost deposits within the proposed project area are weathered Sherack Formation with little to no cover, and fill or topsoil. These surface sediments may be characterized generally as soft to medium stiff, silty clay or clayey silt. Variably, the unit may contain sand, gravel, or organic matter and range from massive to weakly laminated. Moisture content ranges from dry to saturated. In the project area, present period sediment thickness is variable and can range from about 1 to 30 feet, with an average thickness of between 1-3 feet. The only practical method for evaluation is to reference a boring location.

7. STRUCTURE

Evidence of sliding along Judicial Ditch 51 is prevalent. Obvious surficial evidence of slide activity noted includes braking of drainage utilities, scarps and hummocky topography within the ditch, and leaning trees. The above evidence was used to determine which criteria were appropriate for any slope stability analysis in the project reach.

8. SITE HYDROGEOLOGY

The generally low permeability of the soils within the proposed project boundaries makes determination and prediction of groundwater levels challenging. Occasionally some fluvial seams near the river are sufficiently pervious to allow a confident measurement, however this does not yield much useful information about the interaction between the river water surface and the overbank groundwater conditions.

Currently insufficient data exists for a detailed site specific groundwater characterization at the Ada project site. Commonly, groundwater levels in the project area are high. Groundwater will be located within ten feet below the ground surface. Water levels fluctuate seasonally, with fall /winter conditions exhibiting the lowest measured water levels as might be expected. Water levels were most frequently, but not exclusively, measured in the silt portion of the Sherack Formation.

9. CONSTRUCTION MATERIALS

Concrete Aggregate, Riprap, and Bedding. Sources for fine and coarse concrete aggregate, bedding, and riprap should be available locally. Most commercial aggregates in the Ada vicinity are obtained from the beach ridges of Glacial Lake Agassiz east of the Red River. Additional material may be available from field stone piles in farm fields. The material consists primarily of rounded, wave-washed boulders, cobbles, and sand. If large quantities of riprap size material are required, producers will need adequate lead time in order to stockpile material. Outside sources of quarried, angular, stone should also be available approximately 200 miles east of the proposed project in western and central Minnesota. It is an established fact with local construction contractors that concrete aggregate may be obtained from beach ridges on eastern edge of Glacial Lake Agassiz. Additional investigations will be necessary prior to plans and specifications in order to accurately quantify the amount as well as the quality of stone product available within a reasonable radius of the area.

Levee Borrow. The levee borrow will be obtained from the excavation of the new ditch and should not be a problem. Archeological investigations must be completed before any borrow sites may be used for the project. Geotechnical parameters to be defined prior to approval include the thickness of topsoil, presence or absence of saline soils, thickness and suitability of alluvial/fluvial soils and their susceptibility to cracking, water bearing seams and water table conditions, natural moisture content, and Procter density. Much of the excavated soil to be used as borrow for the proposed levee will be from the Sherack Formation which is known to be susceptible to cracking. This cracking will have to be dealt with because adequate quantities of borrow from other non-cracking formations are not available within a reasonable haul distance.

10. GENERAL GEOTECHNICAL DESIGN:

The Geotechnical Design philosophy used for section 205 projects is no different than that used for other flood risk management projects.

11. SELECTED PLAN SUMMARY:

The selected plan is shown in the main report. Table C-2 below lists the quantities of the various features of the selected plan with its geotechnical aspect(s).

Table C-2

Feature	Quantity	Geotechnical Aspect
Topsoil	40,000 yd^2	-Locate borrow area
Stripping	31,000 yd^2	-Locate disposal area if excess
Reroute of Judicial Ditch No 51 Channel	360,000 yd^3	-Locate disposal area -Compute stable side slopes
Levee Fill	220,000 yd^3	-Compute stable side slopes -Compute possible settlement -Find and control areas of high gradients -Locate borrow or disposal area
Rock for Riprap/Rock Structures	1,000 yd^3	-Rock gradation -Rock source -Type and design of filter

12. SLOPE STABILITY:

A slope stability analysis was completed using criteria in EM 1110-2-1913 which describes the following Cases that could be analyzed:

a. Case I - End of construction. This case represents undrained conditions for impervious embankment and foundation soils; i.e., excess pore water pressure is present because the soil has not had time to drain since being loaded. Results from laboratory Q (unconsolidated-undrained) tests are applicable to fine-grained soils loaded under this condition while results of S (consolidated-drained) tests can be used for pervious soils that drain fast enough during loading so that no excess pore water pressure is present at the end of construction. The end of construction condition is applicable to both the riverside and landside slopes.

b. Case II - Sudden drawdown. This case represents the condition whereby a prolonged flood stage saturates at least the major part of the upstream embankment portion and then falls faster than the soil can drain. This causes the development of excess pore water pressure which may result in the upstream slope becoming unstable. This case is not considered because as a flood dissipates, the soils will have enough time to drain.

c. Case III - Steady seepage from full flood stage (fully developed phreatic surface). This condition occurs when the water remains at or near full flood stage long enough so that the embankment becomes fully saturated and a condition of steady seepage occurs. This condition was critical for levee landside slope stability.

d. Case IV - Earthquake. Earthquake loadings will not be considered in analyzing the stability of levees because, as mentioned earlier, the probability of an earthquake occurring in this locality is very low.

Soils parameters for various formations are shown below in Table C-3 for both the Grand Forks/East Grand Forks project and the Ada borings. The soils parameters used for the Grand Forks/East Grand Forks project are based on many more tests, so the unit weights were used in this analysis. However, strengths for the Upper Brenna Formation and levee fill from Ada project borings were used because they govern and they are site specific, for the Brenna case. In the case of levee fill, borrow for the Ada project will come entirely from Alluvial Deposits and the Sherack Formation, which have an insitu internal-angle-of-friction of 30 degrees. Stability required 21 degrees and having the compacted strength 10 degrees less then the insitu strength seemed overly conservative.

Table C-3

Grand Forks/East Grand Forks (Ada) testing results	UNIT WEIGHTS		Q-STRENGTHS (UU)		S-STRENGTH (CD)	
	MOIST	SATURATED	C in psf	ϕ in degrees	c' in psf	ϕ' in degrees
LEVEE FILL/SPOIL	122	122	700	0	0	20 (21)
ALLUVIAL DEPOSITS	122	122	1000	0	0	30
SHERACK FORMATION	102	103	1000	0	0	30
POPLAR RIVER FORMATION	112	112	1000	0	0	22
UPPER BRENNA FORMATION	97	97	720 (345)	0	0	13 (12.7)

Cases I and III apply to the new levee and only Case III (during low water which would be the normal and the worst case) applies to the rerouted Judicial Ditch No. 51 (JD 51). These were analyzed using the computer program SLOPE/W with the soil stratigraphy from the closes boring to the site being analyzed. Slope stability was done using the strengths shown in Table C-3 above. For Case I (end-of-construction), Q-strengths were used; for Case III (long-term-seepage), S-strengths were used for both the new levee side slopes and the JD 51 side slopes. Results of the stability analysis are shown on Plate C-6. The steepest stable slope computed for the levee was 1V:4H and for the excavated slope of JD 51 was 1V:6H both of which are not unusual in the Red River Valley. Currently, the slopes on JD 51 are not stable because they're steeper then 1V:6H. JD 51's existing alignment does not have adequate room for stable slopes which is why rerouting it was required. Various alignments were investigated to select the least costly. The factor-of-safety (FS) against stability failure for the both the levee and JD 51 slopes for applicable Cases are shown in Table C-4 below. These factors-of-safety were checked and confirmed by the computer program UTEXAS 4.

Table C-4

Levee Slopes			computed	required	JD 51			computed	required
A. Case I for 1V:4H slope	Q-strengths	FS=	4.8	1.3	A. Case I for 1V:6H slope	Q-strengths		Not Applicable	
B. Case III for 1V:4H slope	S-strengths	FS=	1.4	1.4	B. Case III for 1V:6H slope	S-strengths	FS=	1.4	1.4

13. SETTLEMENT AND DISPLACEMENT:

The potential settlement of the levee was estimated using two equations in the Second Edition of "Principles of Foundations" by Braja Das. In areas where the existing ground could be considered flat, the vertical stress increase caused by the construction of the levee was computed using equation 3.97 on page 179 and shown below. Using this stress increase, the one-dimensional consolidation settlement was computed with the equations on page 168 and shown below. This was computed for levee heights varying from two to 13 feet. The polynomial regression was then done, resulting in a sixth-degree polynomial which would yield the expected amount of settlement given the height of levee. The computer program CSETT was used to check the results and, also, to compute the settlement in areas where two-dimensional affects are large (where the existing ground is not flat). The five consolidation tests that were done for this project resulted in C_c and e_0 that varied by the formation sampled, as shown in the testing summary above in Paragraph 5 Table C-1 above. The values are consistent with testing done in other areas of the Red River valley. Soil stratigraphy from boring no. 06-11M was considered representative. The ultimate primary settlement was used with an over-consolidation-ratio of 5.0 for the Sherack Formation and 2.0 for the Brenna Formation which is less-then or equal to what was used for the East Grand Forks project, according to the DDR. The levee depth was taken as the maximum amount of fill added for a given reach of levee. When the fill depth for a reach resulted in an expected settlement of greater-than 4.1 inches, the levee height for the whole reach was overbuilt by 6-inches as shown in Table C-5 below. Less than 4.1 inches was considered a maintenance issue. Settlement was computed in this simplified way to compare costs of various plans at various levels of protection. Thus, settlement could be considered without spending large amounts of time required for a site specific analysis on many plans which would not be selected. Much of the foot print of the proposed levee alignment is either currently being farmed or has an existing levee on it. For this reason, it was assumed that no displacement would occur during the construction of this project.

Stress Increase Under an Embankment

Figure 3.39 shows the cross section of an embankment of height H. This is a two-dimensional loading condition. The vertical stress increase caused by the embankment loading condition can be expressed as

$$\Delta p = \frac{q_o}{\pi}\left[\left(\frac{B_1 + B_2}{B_2}\right)(\alpha_1 + \alpha_2) - \frac{B_1}{B_2}(\alpha_2)\right] \tag{3.97}$$

where $q = \gamma H$

γ = unit weight of the embankment soil

H = height of the embankment

$$\alpha_1 \text{ (radians)} = \tan^{-1}\left(\frac{B_1 + B_2}{z}\right) - \tan^{-1}\left(\frac{B_1}{z}\right) \tag{3.98}$$

$$\alpha_2 = \tan^{-1}\left(\frac{B_1}{z}\right) \tag{3.99}$$

$$S_c = \frac{C_c H_c}{1 + e_o} \log \frac{p_o + \Delta p_{av}}{p_o} \quad \text{(for normally consolidated clays)} \qquad (1.65)$$

$$S_c = \frac{C_s H_c}{1 + e_o} \log \frac{p_o + \Delta p_{av}}{p_o} \quad \text{(for overconsolidated clays with } p_o + \Delta p_{av} < p_c\text{)} \qquad (1.67)$$

$$S_c = \frac{C_s H_c}{1 + e_o} \log \frac{p_c}{p_o} + \frac{C_c H_c}{1 + e_o} \log \frac{p_o + \Delta p_{av}}{p_c} \quad \text{(for overconsolidated clays with } p_o < p_c < p_o + \Delta p_{av}\text{)} \qquad (1.69)$$

where p_o = average effective pressure on the clay layer before the construction of the foundation

Δp_{av} = average increase of pressure on the clay layer caused by the foundation construction

p_c = preconsolidation pressure

e_o = initial void ratio of the clay layer

C_c = compression index

C_s = swelling index

H_c = thickness of the clay layer

Table C-5 :Proposed Levee Overbuild

Levee Reach	50-yr.	100-yr.	200-yr.	500-YR.
1	NO Overbuild	NO Overbuild	NO Overbuild	NO Overbuild
2	6 inch Overbuild	6 inch Overbuild	6 inch Overbuild	6 inch Overbuild
3	NO Overbuild	NO Overbuild	NO Overbuild	NO Overbuild
4	NO Overbuild	NO Overbuild	NO Overbuild	NO Overbuild
5	NO Overbuild	NO Overbuild	NO Overbuild	NO Overbuild
6	NO Overbuild	NO Overbuild	NO Overbuild	NO Overbuild
7	NO Overbuild	6 inch Overbuild	6 inch Overbuild	6 inch Overbuild
8	NO Overbuild	NO Overbuild	NO Overbuild	NO Overbuild

14. SEEPAGE

Seepage is a concern in the area of boring no. 06-7M which is the only boring which contains sands. Seepage calculations are shown on Plate C-7. The FS against gradients exceeding the critical gradient is 1.4. Uncertainty’s in seepage parameters and the consequences of piping dictate that this FS be at least 3.0. Additions to the design of the levee to increase the FS, as mentioned by EM 1110-2-1913 chapter 5, include seepage control measures such as a (a) cutoff trench, (b) riverside impervious blanket, (c) landside seepage berm, (d) pervious toe trench, and (e) pressure relief well(s).

15. CONSTRUCTABILITY:

Excavation of the rerouted portion of JD 51 will have to be done carefully so as to not disturb the soil making up the side slopes and bottom of the ditch. This would weaken the insitu soils, reducing the FS against slope failure.

16. ROCK GRADATION:

The calculation of the minimum weight of the 50 percent-less-than-by-weight rock for the rockfill is explained in the Hydraulic Appendix. Layer thickness is 18-inches with the gradation shown on Plate C-8 and in the table below.

Table: C-6

Percent Less-than-by-Weight:	Maximum (lbs.)	Minimum (lbs.):
100	300	100
50	120	40
15	25	8

17. FUTURE WORK:

Now that a plan is selected and degree-of-protection established, the following will have to be done for plans and specifications:

1.) A site specific settlement analysis will have to be completed:
    a. Consolidation settlement will be accounted for in the final pipe grades of storm water outfalls through the levee.
    b. Consolidation settlement will be added to the levee height where needed, instead of by reaches of levee.
2.) Layout and complete additional borings to:
    a. More precisely define the extent of under seepage concern.
    b. Define the soil parameters at all structures.
    c. Investigate HTRW concerns.
3.) Design gradient control measures to increase the FS to 3.0 against exceeding the critical gradient.
4.) Additional investigations will be necessary prior to plans and specifications in order to accurately quantify the amount as well as the quality of stone product

available within a reasonable radius of the area.

5.) Work with Hydraulics to decide where to place of riprap.
6.) Decide what to use for a filter/bedding for riprap.

18. CREDIT TO EXISTING LEVEES

Ada, MN Feasibility Study

31 OCTOBER 2007

Introduction

1. This document is part of the Ada, MN Flood Risk Management Feasibility Study. The town of Ada currently has a system of levees protecting against the Marsh River on the south side of town and Judicial Ditch 51 (JD 51) on the north side of town. The purpose of this document is to assess the condition of the existing levees, and to determine the baseline level of protection that the existing levees provide to the town.

Existing Conditions

2. There are 2 levees protecting the town of Ada. For the purposes of this report, they will be called the south levee and the north levee. The south levee is broken into two reaches divided by Hwy 9. The west reach runs from high ground near South Jamison Dr on its west end to Hwy 9 on its east end. The east reach runs from Hwy 9 on its west end to the golf course on its east end. The north levee starts at high ground by Hwy 9 on its west end, runs east alongside JD 51 to just east of 9th St East, then turns south, terminating at high ground north of Hwy 200 behind some businesses. See Figure 1 after the appendix Plates for the location of the existing levees.

3. The south levees were initially constructed under flood emergency conditions. These levees have been improved in the time since their construction, with the most recent improvements made in 2003. Improvements consisted of adding fill to raise the levee crest and to flatten the levee side slopes to 1V:4H. The new levee has a top width of at least 10ft for its entire length. In 2004, existing culverts that were damaged in the 2002 flood were replaced with new sluice gate control structures. Flap gates were also installed on all new culvert outlets. At no time was an inspection trench constructed to help locate possible underground pipes or buried culverts below the footprint of the levee. Chapter 7-2.f of EM 1110-2-1913 discusses the need for inspection trenches prior to levee construction. Both reaches of this levee are well maintained.

4. The majority of the existing north levee was constructed in 1998. A portion of the levee, from the MNDOT shop building to the apartment building at the intersection of Lily Lane and Daisy Lane, consists of spoil material placed on top of the bank during the construction of Judicial Ditch 51. It is not known when the spoil material was placed on top of the bank here. It is also not known whether or not the portions of levee constructed in 1998 were built on existing

spoil material. The levee has 1V:4H side slopes and a 10ft top width. In 2004, 4 new control structures with sluice gates were constructed on this levee to replace old ungated culverts. The north levee has a few problems. The biggest problem is the presence of landslides in 2 different areas on the levee. One of the slides has a vertical drop of about 5ft or 6ft. The slides were most likely caused by placing too much fill on top of the bank near JD 51. The slide areas have affected 2 of the new control structures making them unable to perform as designed. The levee also runs through the backyards of private residences for a long stretch. In this area, the levee has many trees and private encroachments (sheds, gardens, fences, etc.) on it.

Analysis

5. The town was divided into 6 areas for the level of protection analysis, 3 for the north levee and 3 for the south levee. For simplicity, the areas were named similar to that for the economic analysis model. Figure 1 shows the town of Ada divided into the analysis areas. The following is a short description of each area:

Area 1A: North levee, between 4th St E and 9th St E, follows hydraulic reference pt D (from initial feasibility report dated 14 August 2001)
Area 1B: North levee, between Hwy 9 and 4th St E, follows hydraulic reference pt C
Area 2A: South levee, between 4th St E and 9th St E, follows hydraulic reference pt D
Area 2B: South levee, between Hwy 9 and 4th St E, follows hydraulic reference pt C
Area 3: South levee, between South Jamison Dr and Hwy 9, follows hydraulic reference pt B
Area 4: North Levee, east of 9th St E, follows hydraulic reference pt E

6. <u>North Levee.</u> To analyze the effectiveness of the north levee, the existing condition of the levee comes into play. As stated before, the levee has many deficiencies. The biggest concern is the presence of land slides as the levee follows the alignment of Judicial Ditch 51. Since landslides have occurred on this levee in the past, this means that no credit can possibly be given to the existing north levee. Because assigning a PNP/PFP elevation would imply some credit be given to levees 1A and 1B, a PNP/PFP elevation will not be assigned and levees 1A and 1B will be treated like they do not exist. For reference, PNP is the probable non-failure pt, or the elevation at which the levee is highly likely to not fail. The PFP, or probable failure point, is the elevation at which the levee is highly likely to fail.

7. To estimate the PFP, the existing topography was used to find the lowest point on the landward toe for Area 4. The PNP elevation will coincide with the PFP. See Figure 1 for locations of the low points for each area. The existing topography used for this analysis was the 1-foot contour aerial mapping obtained in 1999 for the initial feasibility study. No changes to the north levee have occurred since the mapping was obtained. The analysis yielded these results: Area 1B = el. 902.0ft, Area 1A = el. 904.0ft, and Area 4 = el. 905.0ft.

8. <u>South Levee.</u> Descriptions of the analysis for Areas 2A, 2B, and 3 on the south levee are described below. The geometry and foundation conditions for Areas 2A and 2B are considered

to be similar, so a combined analysis was conducted for these two areas.

9. Areas 2A and 2B. Areas 2A and 2B are both far enough away from the river channel that, by inspection, slope stability is not a concern. Also, reviewing the generalized stratigraphy developed from borings shows that no sand is present in the foundation in this area. During the 2002 flood, on-site Corps of Engineers personnel encountered no sand in the upper foundation of this area while constructing emergency levees. No seepage problems were encountered during the 2002 flood in this area either. For these reasons, there are no seepage concerns for these areas. The top of the levee in these areas is at el. 905.5ft. Assuming that there was some settlement of the levee crests after construction, and some variability in the top elevation of the levee, assume that the top of the levee is effectively at el. 905.0ft. Therefore the PFP for these areas is 905.0ft. It is assumed that the PNP for the existing levees in these areas will coincide with the PFP since no failure mode besides overtopping is reasonable.

10. Area 3. The existing conditions for Area 3 are a little different than those for Areas 2A and 2B. First, there is a short stretch where the existing levee is close to the bank of the Marsh River, which is a slope stability concern. Also, while constructing the emergency levee in 2002 across the farm field on the west side of Area 3, a sand seam was discovered below the ±1ft of topsoil that was being stripped. This sand seam could mean that seepage is an issue in this area.

11. For the stability analysis, the long-term (drained, steady state seepage) design condition was used, and phreatic surfaces were assumed to be fully developed between the design water level levee on the riverside, and the levee toe on the landside. The section was taken about 400ft west of the railroad tracks at a point where the existing levee is closest to the Marsh River. Soil parameters were assumed to be as follows (MLV = most likely value, V = coefficient of variation, σ = value of 1 standard deviation):

				ϕ (degrees)				
Material	**Top El., ft**	**γ_m (pcf)**	**γ_{sat} (pcf)**	**MLV**	**V[1] (%)**	**σ**	**MLV+σ**	**MLV-σ**
Clay Fill	903.0	111	116	30	9	2.7	32.7	27.3
Alluvium	900.0	123	123	30	9	2.7	32.7	27.3
Sherack Formation	898.0	115	116	30	9	2.7	32.7	27.3
Upper Brenna Formation	890.0	100	100	13	9	1.2	14.2	11.8

[1] The value of V was taken from ETL 1110-2-556, Appendix B, Table 1, pg. B-30
Note: The unit weight of soil was not varied as this parameter has little effect on the results of a stability analysis, plus we have good information for these soils from the abundance of Grand Forks testing data available.

12. Slope stability analysis on the landward side of the levee, using most likely values and a

water surface at the top of the levee on the riverward side, results in a factor of safety of 3.75. Based on this one result, the possibility of a slide on the landward side of the levee during a flood is almost non-existent. There is no need to look further at the landward toe. The location of the slope stability analysis is shown on Figure 1 after the appendix Plates.

13. A second analysis was run in the same location to simulate a slide on the riverward side of the levee during extreme low water conditions. This is a scenario that has caused many slides in the Red River valley, so it would not be surprising for the levee to experience a slide during a non-flood situation that would render it ineffective. The analysis was run using most likely values for phi angles, the water surface was put at el. 891.0ft, and the bottom of the Marsh River was set at el. 890.0ft. The analysis produced a critical slip surface with a factor of safety of 0.84, although the critical slip surface did not pass through the levee prism. However, there were a large number of slip surfaces that passed through the levee prism with factors of safety ranging from 0.95 to 1.0. For this reason, it is safe to assume that a slide through the levee at this location is likely if water in the Marsh River was at an extremely low stage. Based on this conclusion, the levee in this area should not receive any credit, and the ground elevation at the landward toe, el. 900.0ft, should be applied as the PNP/PFP elevation.

14. Before a final PNP/PFP for Area 3 can be determined, the seepage concerns in the area about 350ft from the west end of the levee need to be considered. However, since the ground elevation at the landward toe for the levee in this area, and for this entire east/west stretch of levee in general, is at or above el. 900.0ft, there is no need to perform the analysis since this is also the controlling elevation from the slope stability analysis. However, because of possible seepage concerns (location shown on Figure 1 which comes after the appendix Plates) in this Area, no credit will be assigned and it will be treated as nonexistent.

15. Looking at the topographic layout of the entire town of Ada, the railroad embankment serves as the elevation divide for the town. The lowest elevation on the railroad throughout town that would allow water from Area 3 to spill over to areas east of the railroad is roughly el. 903.0ft. At this elevation water from Area 3 would begin to spill into Areas 2B, and 2A, effectively lowering the PNP/PFP for these areas to el. 903.0ft. However, because all these areas are connected be storm sewers, no credit will be given to these levees either.

16. Reviewing the most current storm water system map for the city, there is a storm water connection under the railroad. This creates the possibility of flood waters traveling through the storm water system from Area 3 to areas east of the railroad. There also is a storm water connection from Area 1B to Area 2B that runs south along 2nd St E. The possibility exists that water entering the storm water system in Area 1B could travel to Area 2B using this conduit. This would effectively lower the credit given to levee 2B to no credit.

Summary

17. Summary of Analysis. The following table summarizes the credit to existing levees for each area shown on figure 1 after the appendix Plates.

AREA	PNP/PFP (ft)
1A	No Credit*
1B	No Credit*
2A	No Credit*
2B	No Credit*
3	No Credit*
4	No Credit*

* - Should be treated like they do not exist

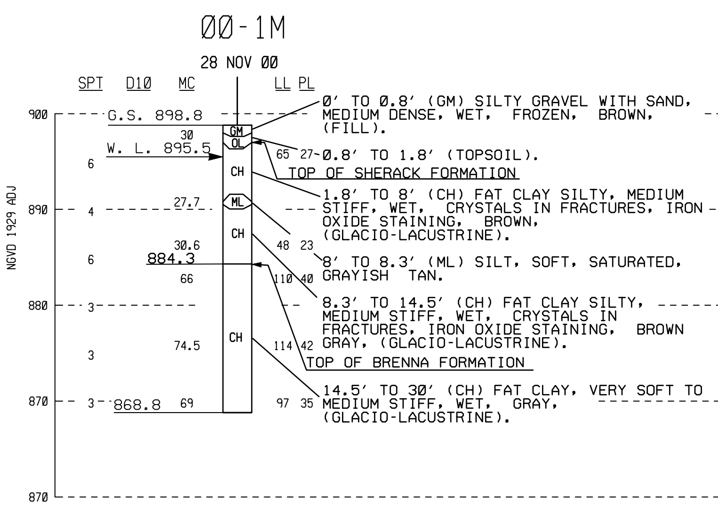
Ada Sec. 205 Flood Control Project

St. Paul District
US Army Corps of Engineers®

Boring Location Map

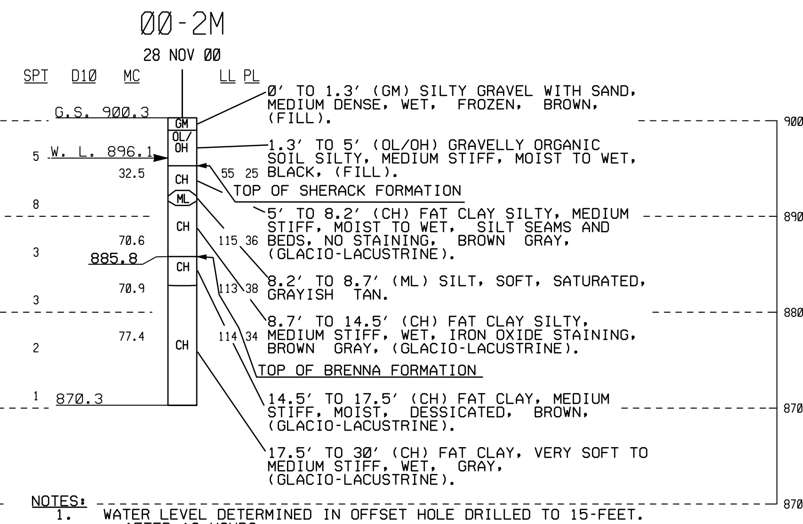
0 500 1,000 2,000 Feet

PLATE C-1



NOTES:

1. WATER LEVEL DETERMINED IN OFFSET HOLE DRILLED TO 15-FEET. AFTER 3 HOURS HOLE CAVED TO 4.9-FEET
2. 3 ¼ I.D. HOLLOW STEM AUGER SET TO ELEVATION 874.9.
3. BORING BACK FILLED WITH MEDIUM BENTONITE CHIPS.

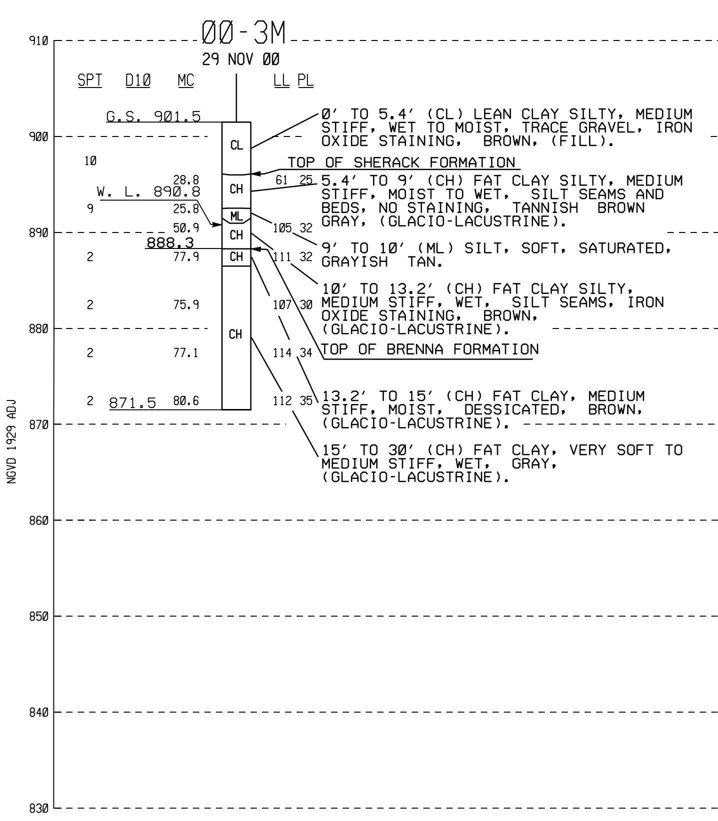


NOTES:

1. WATER LEVEL DETERMINED IN OFFSET HOLE DRILLED TO 15-FEET. AFTER 18 HOURS HOLE CAVED TO 6.8-FEET
2. PETROLEUM ODOR ENCOUNTERED FROM 1 TO 5 FEET.
3. 3 ¼ I.D. HOLLOW STEM AUGER SET TO ELEVATION 875.3.
4. BORING BACK FILLED WITH MEDIUM BENTONITE CHIPS.

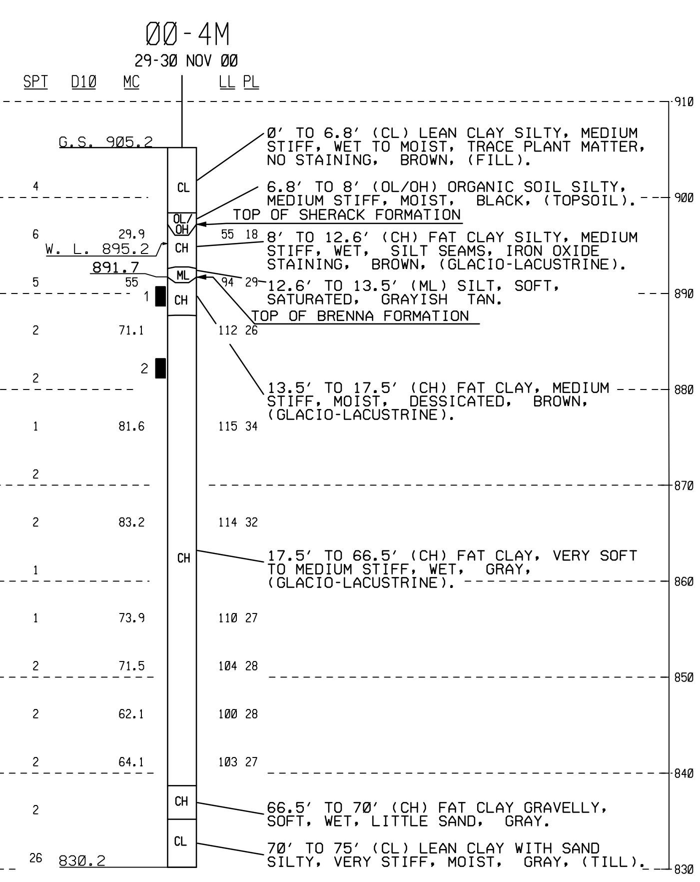
GENERAL BORING LEGEND

84-1M	YEAR OF BORING-BORING NUMBER, BORING TYPE (EG: M=MACHINE, A=AUGER, TP=TEST PIT, P=PIEZOMETER).
1 MAY 1984	DATE OF BORING
W.S. 1026.7	WATER SURFACE ELEVATION ON DAY OF BORING
G.S. 1020.2	GROUND SURFACE ELEVATION AT BORING
GW	WELL GRADED GRAVELS, GRAVEL - SAND MIXTURE, LITTLE OR NO FINES
GP	POORLY GRADED GRAVELS, LITTLE OR NO FINES
GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
SW	WELL GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SP	POORLY GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
SM	SILTY SANDS, SAND - SILT MIXTURES
SC	CLAYEY SANDS, SAND - CLAY MIXTURES
ML	INORGANIC SILTS, LIQUID LIMIT LESS THAN 50
MH	INORGANIC SILTS, LIQUID LIMIT GREATER THAN 50
CL	INORGANIC CLAYS, LOW TO MEDIUM PLASTICITY, LIQUID LIMIT LESS THAN 50
CH	INORGANIC CLAYS, HIGH PLASTICITY, LIQUID LIMIT GREATER THAN 50
OL	ORGANIC SILTS OR CLAYS, LOW PLASTICITY, LIQUID LIMIT LESS THAN 50
OH	ORGANIC SILTS OR CLAYS, MEDIUM TO HIGH PLASTICITY, LIQUID LIMIT GREATER THAN 50
PT	PEAT
SP-SM	BORDERLINE MATERIAL
SP&SM	STRATIFIED MATERIAL
1	LOCATION AND SAMPLE NUMBER FOR UNDISTURBED SAMPLE
	NO RECOVERY
W.L. 726.7	WATER LEVEL ON DATE OF BORING
700.1	ELEVATION AT BOTTOM OF BORING
(238.56)	ELEVATION IN METERS



NOTES:

1. WATER LEVEL DETERMINED IN OFFSET HOLE DRILLED TO 15-FEET. AFTER 2.5 HOURS HOLE CAVED TO 12.1-FEET
2. 3 ¼ I.D. HOLLOW STEM AUGER SET TO ELEVATION 876.5.
3. BORING BACK FILLED WITH MEDIUM BENTONITE CHIPS.



NOTES:

1. WATER LEVEL DETERMINED IN OFFSET HOLE DRILLED TO 15-FEET. AFTER 21 HOURS HOLE CAVED TO 12.6-FEET
2. 3 ¼ I.D. HOLLOW STEM AUGER SET TO ELEVATION 835.2.
3. BORING BACK FILLED WITH TREMIED CEMENT-BENTONITE GROUT.

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-INCHES. STANDARD BLOW COUNTS ARE FOR A STANDARD PENETRATION TEST (SPT) USING A 1⅜ X 2-INCH SAMPLER, 140 LB. HAMMER, AND A 30-INCH DROP. FOR NON-STANDARD BLOW COUNTS SAMPLER SIZE, HAMMER WEIGHT, AND HEIGHT OF DROP ARE AS SHOWN.

4. ATTERBERG LIMITS: LIQUID LIMIT (LL) AND PLASTIC LIMIT (PL) ARE SHOWN TO THE RIGHT OF THE BORING STAFF.

5. D 10 SIZE: THE GRAIN SIZE IN MILLIMETERS OF WHICH 10% OF THE SAMPLE IS FINER IS SHOWN TO THE LEFT OF THE BORING STAFF.

6. RQD: ROCK QUALITY DESIGNATION (RQD) IS SHOWN TO THE LEFT OF THE PERCENT RECOVERY COLUMN. RQD IS THE PERCENT RECOVERY CONSISTING OF UNBROKEN PIECES LONGER THAN 4-INCHES.

7. % RECOVERY: PERCENT CORE RECOVERY IS SHOWN TO THE LEFT OF THE BORING STAFF. PERCENT RECOVERY IS LENGTH OF CORE RECOVERED/LENGTH OF CORE CUT X 100. UNLESS SPECIFIED OTHERWISE, ALL CORE IS 4-INCH DIAMETER.

8. ELEVATIONS REFERENCED TO N.G.V.D. 1929 ADJ. UNLESS SPECIFIED OTHERWISE.

9. THE BORINGS SHOW SUMMARIES OF INFORMATION RECORDED ON THE ORIGINAL FIELD LOGS. THESE LOGS ARE AVAILABLE FOR INSPECTION AT THE ST. PAUL DISTRICT OFFICE. ARRANGEMENTS TO INSPECT LOGS CAN BE MADE BY CALLING (651) 290-5599.

US Army Corps of Engineers® St. Paul District

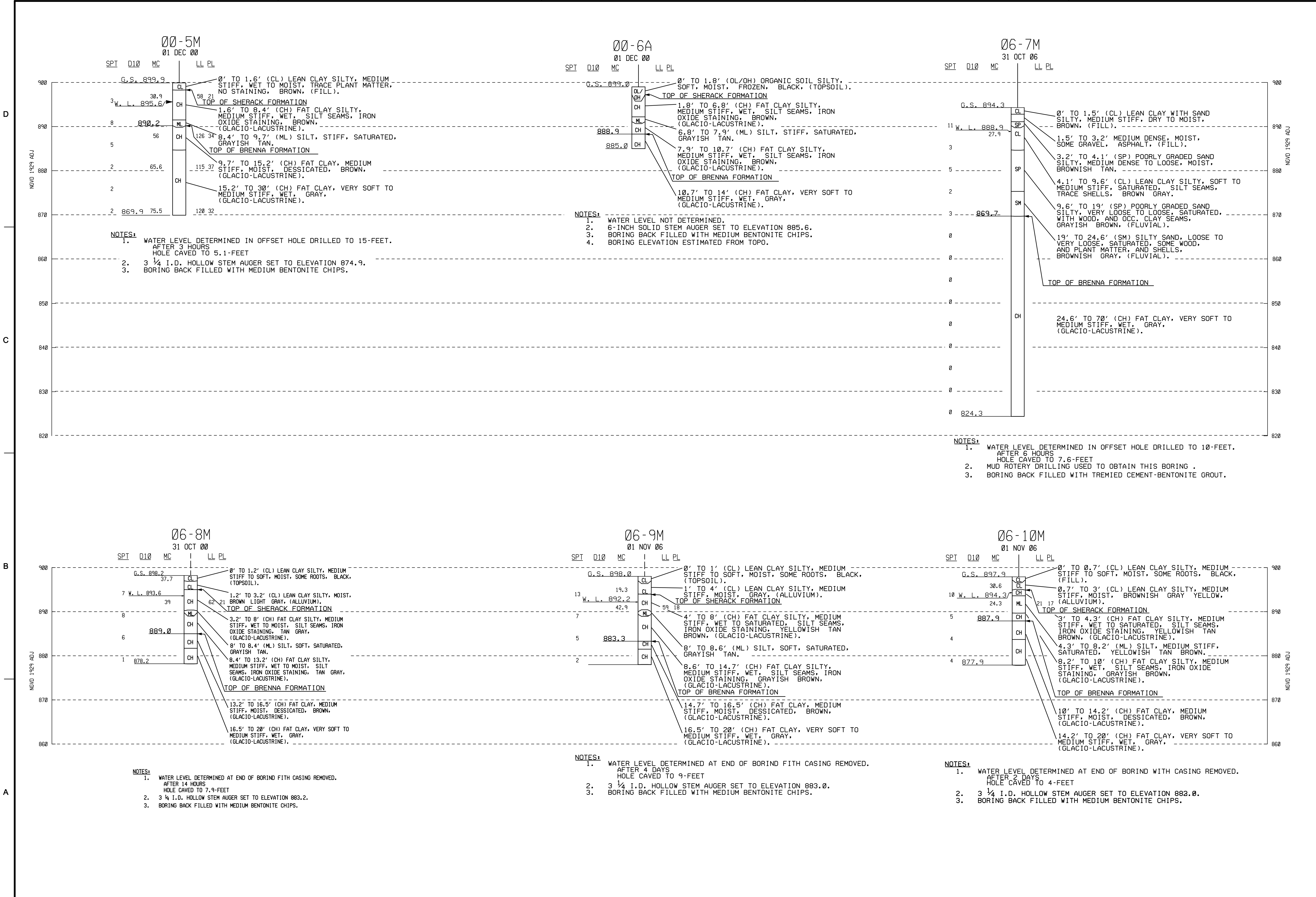
U.S. ARMY CORPS OF ENGINEERS ST. PAUL DISTRICT

DESIGNED BY: KSN | DWN BY: GRS | CKD BY: KSN/GAR | SUBMITTED BY: | PLOT SCALE: 1:1 | PLOT DATE: | SIZE: | FILE NAME: | DATE: 2006/03/21 | SOLICITATION NO.: | CONTRACT NO.: | FILE NUMBER:

FEASIBILTY STUDY - ADA, MINNESOTA
WILD RICE & MARSH RIVERS
ADA, MINNESOTA

BORING NOTES, LEGEND, & GENERAL BORING LOGS: 00-1M, 2M, 3M & 00-4M NED PLAN

SHEET IDENTIFICATION
B-002



US Army Corps of Engineers®
St. Paul District

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

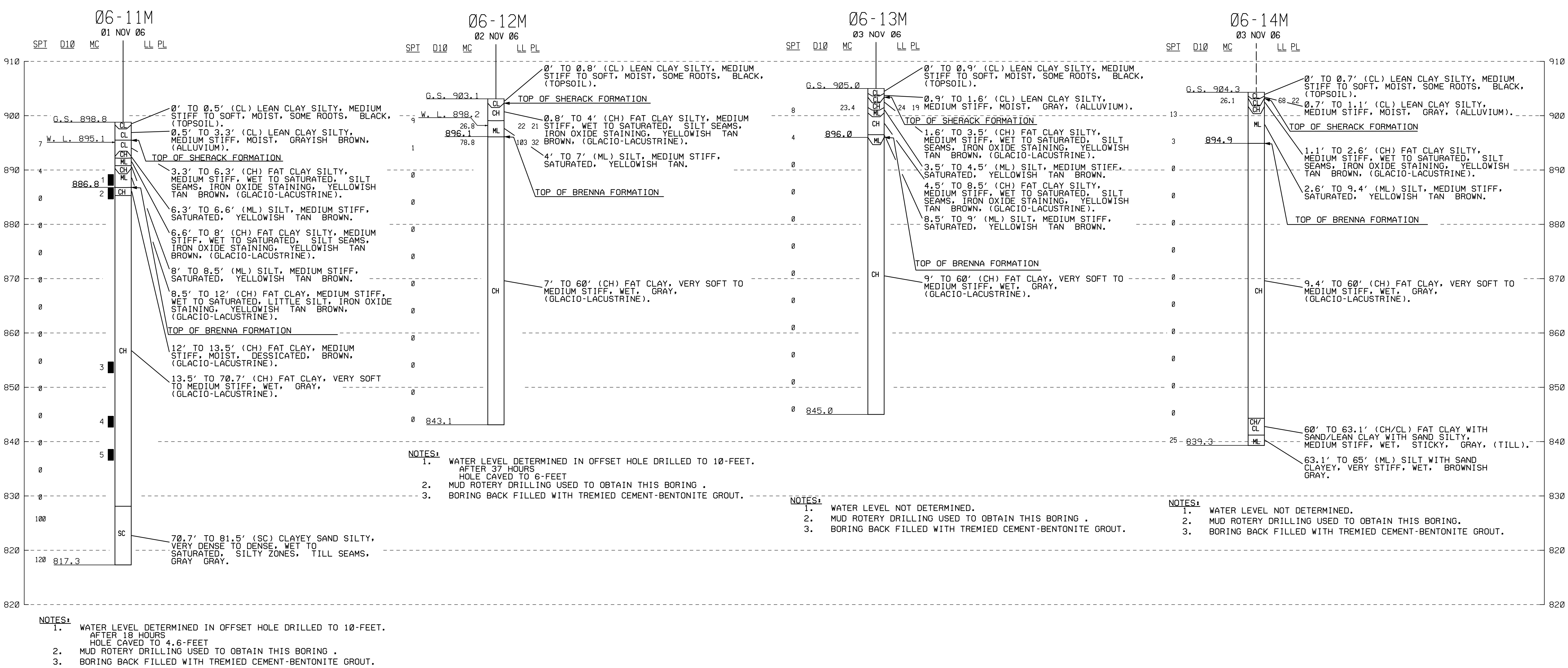
U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT

DESIGNED BY: KSN
DATE: 2008/03/21
DWN BY: GRS
CKD BY: KSN/GAR
SOLICITATION NO.:
SUBMITTED BY:
CONTRACT NO.:
PLOT SCALE: 1:1
PLOT DATE: No
FILE NUMBER:
SIZE:
FILE NAME: ADANED04B2003__B-200300.dgn

FEASIBILTY STUDY - ADA, MINNESOTA
WILD RICE & MARSH RIVERS
ADA, MINNESOTA

BORING LOGS: 00-5M, 6A, 06-7M, 06-8M, 9M, 10M & 11M
NED PLAN

SHEET IDENTIFICATION
B-003



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St. Paul District

MARK	DESCRIPTION	DATE	APPR.

MARK	DESCRIPTION	DATE	APPR.

DESIGNED BY: KSN | DATE: 2008/03/21
DWN BY: GRS | CKD BY: KSN/GAR | SOLICITATION NO.:
SUBMITTED BY: | CONTRACT NO.:
PLOT SCALE: 1:1 | PLOT DATE: No | FILE NUMBER:
SIZE: | FILE NAME: ADA\NED\B2004\..._B-200400.dgn

U.S. ARMY CORPS OF ENGINEERS
ST. PAUL DISTRICT

FEASIBILTY STUDY - ADA, MINNESOTA
WILD RICE & MARSH RIVERS
ADA, MINNESOTA

BORING LOGS: 06-11M
06-12M, 06-13M & 06-14M
NED PLAN

SHEET IDENTIFICATION
B-004

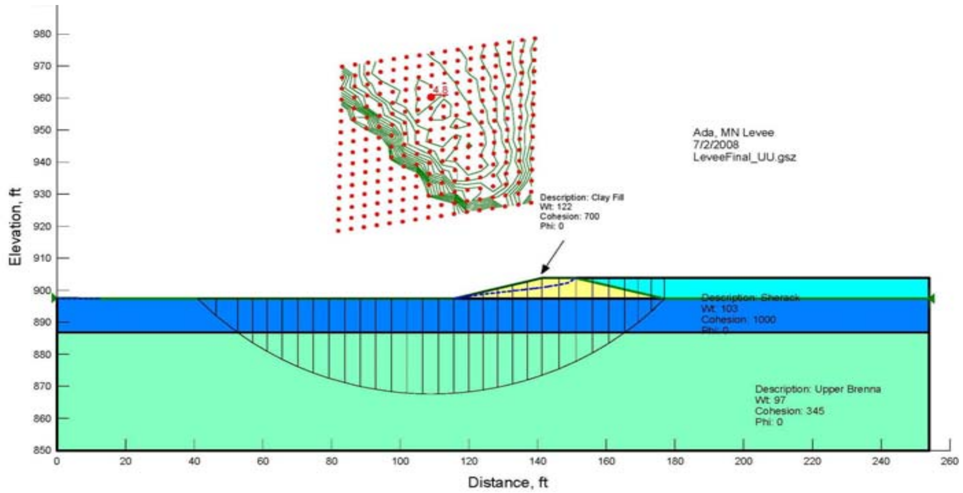
Ada Flood Control Project

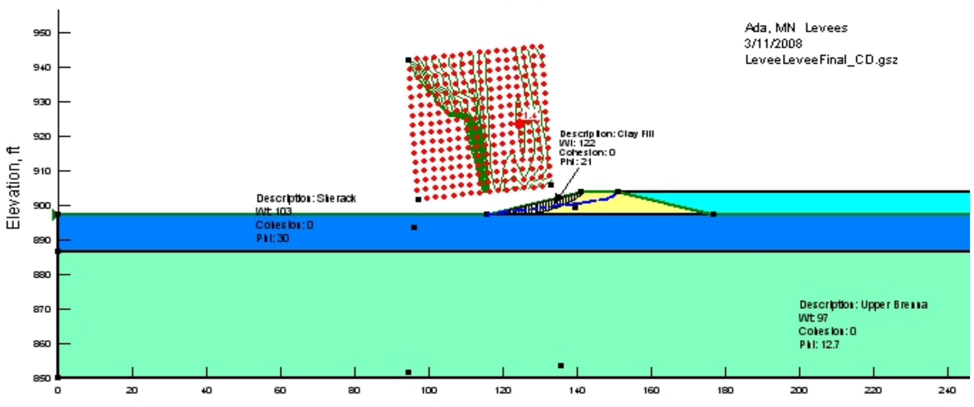
Summary of FS Results

Levee Slopes			Computed	Required	JD 51			Computed	Required
A. Case I	Q-strengths	FS=	4.8	1.3	A. Case I	Q-strengths		Not Applicable	
B. Case III	S-strengths	FS=	1.4	1.4	B. Case III	S-strengths	FS=	1.4	1.4

Summary of Soil Shear Strengths

	Unit Wieght		Q-Strengths		S-Strengths	
Soils	Saturated	Moist	Cohesion	Phi angle	Cohesion	Phi angle
Clay Fill	122	122	700	0	0	21
Sherack	103	102	1000	0	0	30
Upper Brenna	97	97	345	0	25	12.7





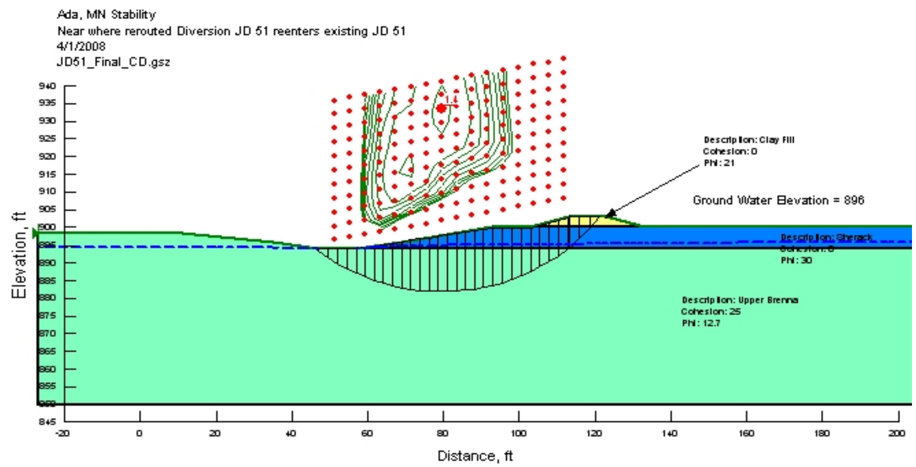


PLATE C-5

ADA MN Seepage

from ETL 1110-2-555 "Design Guidance on Levees" Nov. 1997, p. 2-1

Sherack: γ_{sat} = 122 lbs./ft^3

γ_{water} = 62.4 lbs./ft^3

$i_{cr} = (\gamma_{sat} - \gamma_{water})/\gamma_{water} =$ 0.96

$FS = i_{cr} / i_y$ $\quad i_{yrequired} = i_{cr} / FS_{required}$ = 0.96 / 3 = 0.318

$FS_{required}$ = 3

$i_{yAct.}$ = 0.68

$FS_{act} = i_{cr} / i_y =$ 0.96 / 0.318 = 1.40

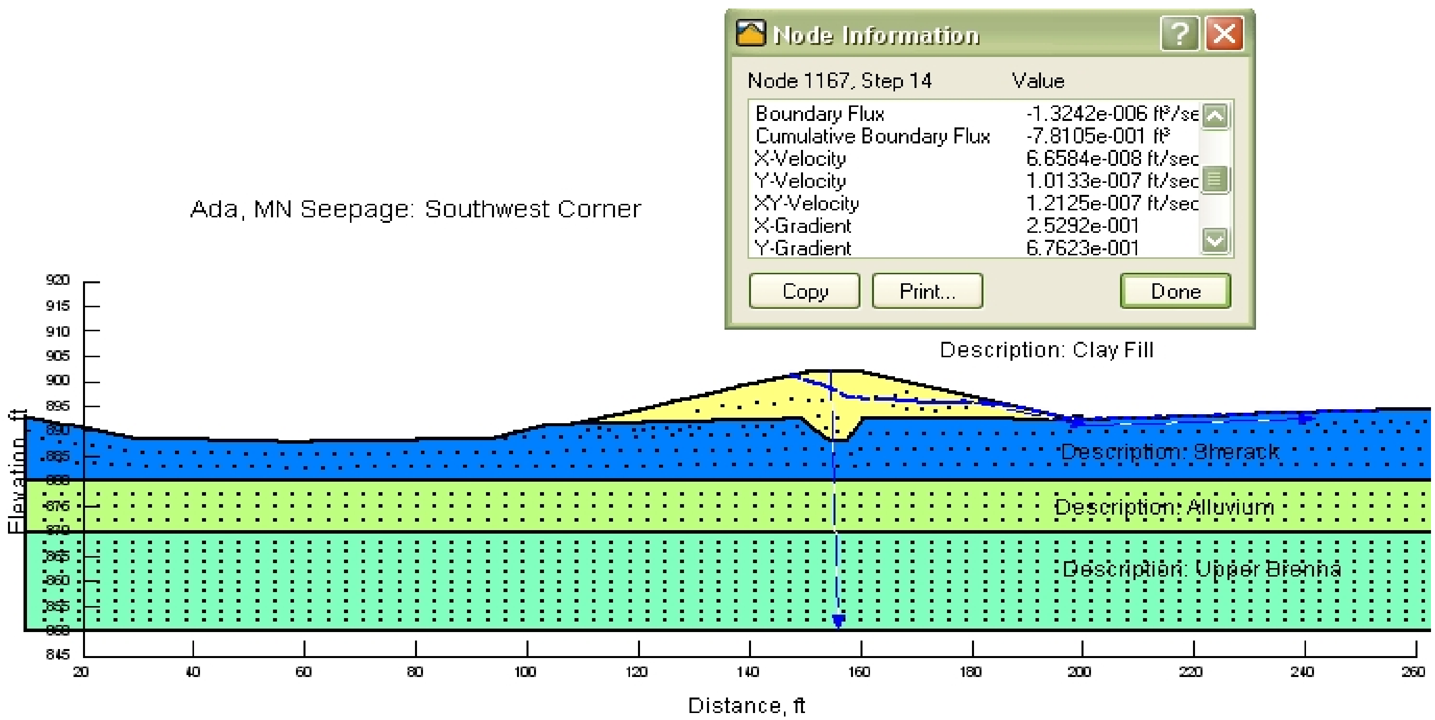
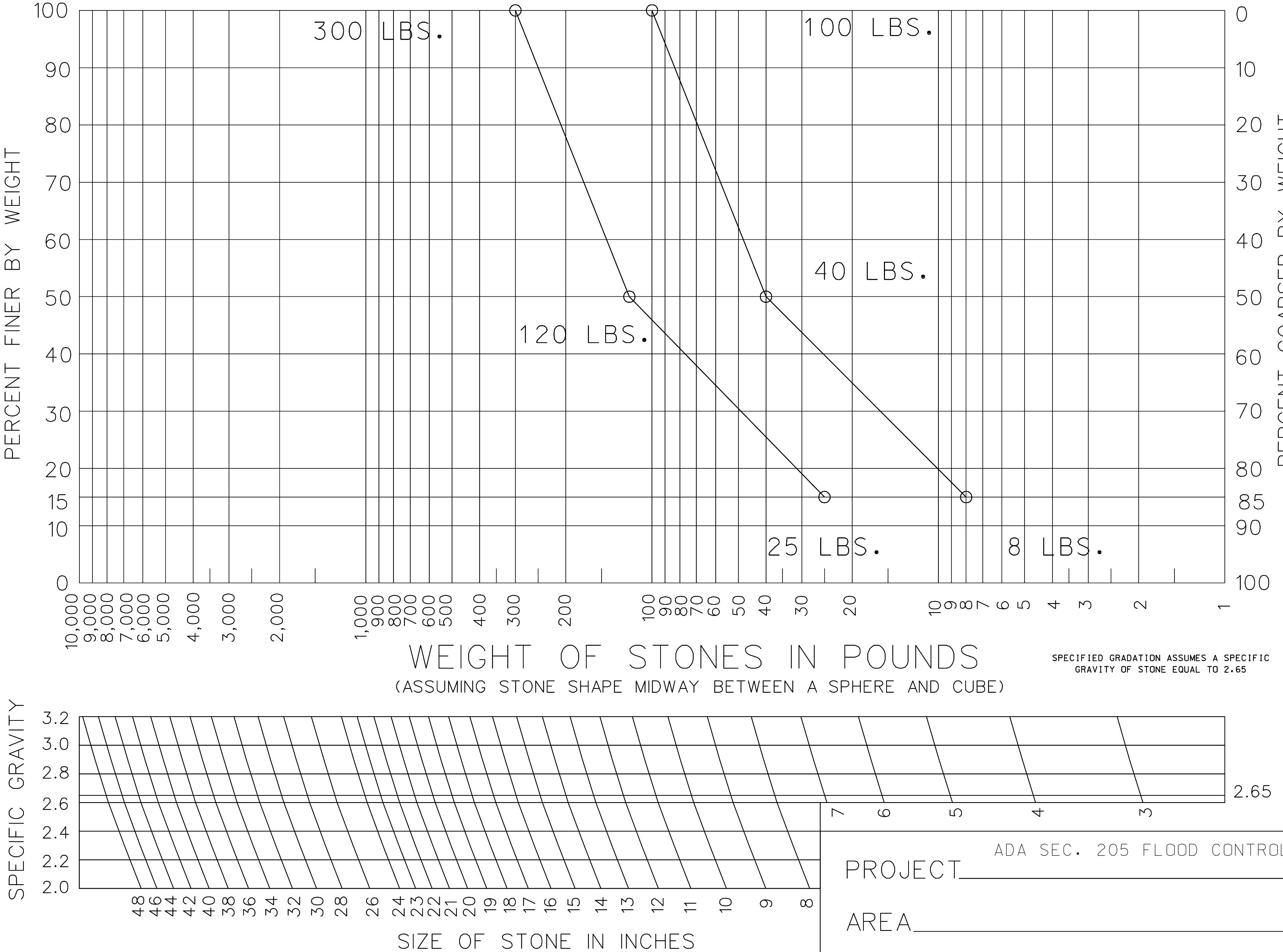


PLATE C-6

PLATE C-7



SPECIFIC GRAVITY OF STONE =

PROJECT ADA SEC. 205 FLOOD CONTROL

AREA ____________________

DATE ____________________

RIPRAP/ROCKFILL GRADATION CURVE

ENG FORM 4055 *COMPUTER GENERATED*
APRIL 2003

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX D

STRUCTURAL ANALYSIS

ADA, MN

SECTION 205 FLOOD CONTROL STUDY

FEASIBILITY

STRUCTURAL ANALYSIS AND DESIGN

PURPOSE

1. The following describes the design criteria and methods of analyses used for the design and analysis of the structural features of the Ada, MN Section 205 Flood Control Study. A summary of references, material properties, loads, design criteria, and assumptions is presented along with a description of the design of all structural features in the project. Structural features associated with this project include a box culverts and bridge structure, Gatewell west control structures and miscellaneous drainage structures. The primary objective of this effort was to determine feasibility of designs and establish reasonable quantities for the baseline cost estimate. The level of design was conducted to sufficient detail to attain these objectives.

REFERENCES

2. Loading conditions, material design strengths, design criteria and assumptions are based on applicable sections of the following references.

EM 1110-2-2104, Strength Design for Reinforced Concrete Hydraulic Structures (30 June 92)
EM 1110-2-2502, Retaining and Floodwalls (29 Sep 89)
EM 1110-2-2902, Conduits, Culverts and Pipes
EM 1110-1-2101, Working Stresses for Structural Design (01 Nov. 63)
EM 1110-2-2105, Design of Hydraulic Steel Structures (31 May 1994)
EM 1110-2-2504, Design of Sheet Pile Walls (31 March 1994)
ETL 1110-2-256, Sliding Stability for Concrete Structures (24 Jun 81)
ETL 1110-2-307, Flotation Stability Criteria for Concrete Hydraulic Structures (23 Aug 87)
ETL 1110-2-322, Retaining and Floodwalls (15 Oct 90)
American Concrete Institute (ACI) 318-02 Building Code Requirements for Reinforced Concrete.
American Institute of Steel Construction (AISC), Steel Load & Resistance Factor Design, 3rd Ed.
American Concrete Pipe Association (ACPA) Concrete Pipe Handbook
The Aluminum Association Aluminum Design Manual, 1994
Moments and Reactions for Rectangular Plates, United States Department of the Interior, Bureau of Reclamation, Engineering Monograph No. 27.

GENERAL DESIGN PROCEDURES

3. The level of design for the structural features is based on structural design, engineering judgment, past experience, and similar structures designed and constructed for other projects.

DESIGN CRITERIA AND DESIGN DATA

4. Design criteria for general design requirements are listed in the following paragraphs. Design criteria used for specific designs are described in paragraphs specific to those designs.

SOIL PARAMETERS

5. Soil properties are assumed and are shown in the following table. Only drained strengths were considered for designs in this report. Soil pressures are based upon formulae presented in EM 1110-2-2502.

LOCATION	Phi	C	γ_{moist}	γ_{sat}
All	28^o	0 psf	116 pcf	117 pcf

HYDRAULIC DATA

6. The Hydraulic Engineering Section provided flood and top of levee elevations for corresponding river sections and geometry of structures. This information was used to determine loading conditions and dimensions of the structures.

SURVEY DATA

7. The General Engineering Section showing the location of project features and the surrounding topography provided survey information. This information was used to determine existing ground elevations and locations of structures.

REINFORCED CONCRETE

8. All reinforced concrete is designed in accordance with the applicable sections of EM 1110-2-2104 and ACI 318-02. Concrete design is based upon the Ultimate Strength Design Method with the design strength of concrete at 28 days, f_c', taken as 4,000 psi. A uniform load factor of 1.7 was used for all reinforced concrete design with additional factor of 1.3 applied to all hydraulic structures.

9. Concrete reinforcing steel is ASTM A615 Grade 60 with a yield stress, f_y of 60,000 psi. All development and splice lengths are to conform to EM 1110-2-2104 and ACI 318-99.

STRUCTURAL STEEL

10. Structural steel used in bars, plates and shapes is ASTM A36 with the minimum yield stress, f_y taken as 36,000 psi. Steel design is to conform to EM 1110-2-2105, Design of Hydraulic Steel Structures and AISC LRFD, 2nd Ed.

STEEL SHEETPILE WALLS

11. Steel Sheetpiling, where applicable, to be designed according to EM 1110-2-2504, Design of Sheet Pile walls, and to conform to the requirements of ASTM A328 having a yield stress (Fy) of 38,500 psi. The maximum allowable stress conforms to the requirements of EM 1110-1-2101

ALUMINUM

12. Aluminum used in the design is assumed to be Alloy 6061, temper T6. Allowable stresses are in conformance with EM 1110-1-2101 and the Aluminum Design Manual.

UNIT WEIGHTS

13. Material unit weights (other than soil) are as follows:

Reinforced Concrete:	γ_c = 150 pcf
Water:	γ_w = 62.5 pcf
Steel:	γ_s = 490 pcf
Aluminum:	γ_{al} = 169 pcf

FROST PROTECTION

14. All foundations are placed a minimum depth of 7.00 feet below ground surface to avoid problems with frost.

DESIGN AND ANALYSIS OF STRUCTURAL FEATURES

BOX CULVERTS AND BRIDGE STRUCTURES

15. Box Culvert Structures will be placed where the diversion channel crosses Highway 9 and 210th Avenue (CSAH 63). The structures are composed of 3 box culverts and a retaining wall on each corner. Each precast concrete box culvert is 12 feet high, 12 feet wide and 56 feet long. Each retaining wall is made of reinforced concrete and is approximately 20 feet deep, 2.0 feet thick and 46 feet long. The bottom of the wall footing is placed 7.00 feet below the invert of the culvert. There is a cut off wall under each end of the box culverts. The cut off walls are 6 feet deep and 1 foot thick. This structure is modeled using similar structure designed for Marshall, MN, Stage 2, Flood Control, constructed in 1999. See structural plate no. 1.

16. Box Culverts that installed under the road will be designed according to EM 1110-2-2902, Conduits, Culvert and Pipes and ACPA Concrete Pipe Handbook guidelines. Also Minnesota Department of Transportation guidelines for box culvert highway design will apply.

17. The Retaining Walls are T-walls. Design procedure for T-walls will be according to EM 1110-2-2502 for load and load combination determinations and stability analyses, and EM 1110-2-2104 for reinforced concrete design. For T-wall, load Cases R1 and R2 will be the only load cases investigated and only long-term soil conditions (drained condition) will be analyzed. Water elevations on both sides will be taken to the top of the wall for Load Case R2. The design flood elevation will be used for Load Case R1 and is an average of about 3.0 feet below top of wall elevations on the soil side and no water in the channel on the channel side. The bottom of the base slab is embedded 7.00 feet

below the ground surface for frost protection. The water elevation on the road side of the wall is taken at the top of soil elevation.

18. T-Walls will be analyzed for rotation, bearing, and sliding stability. Sliding stability will be evaluated for the inclined and block wedge conditions. Wall thicknesses will be obtained from factored pressures from the top of the wall with no resisting loads. Slab thicknesses will be obtained from factored bearing pressures.

19. The water table is estimated to be 7 feet above the bottom of T-Wall and dewatering should be required for construction of the Box Culverts and T-Wall.

GATEWELL CONTROL STRUCTURES

20. Gatewell gravity Control Structures are used to control flow of water within the flood-protected areas. There are nine gate wells. The structures are single-bay reinforced concrete box-shaped structures. Flows are controlled by sluice gates and aluminum stop logs secondary closures. They are sized based on past experience with similar structures. See Structural Plate no. 2 for top elevation, invert elevation, pipe diameter and sluice gate size for each structure.

21. Each control structure is of reinforced concrete founded on reinforced concrete slab. The structure will be analyzed for bearing and flotation stability and primary members will be sized using preliminary design procedures. Two load conditions will be considered, water to top of walls with uniform uplift, and normal gravity flow operation. Structural members will be designed assuming flat plate behavior where applicable, otherwise beam behavior will be assumed. Gravity flow conduits will be designed using EM 2902.

22. The design of control structure will follow criteria provided in EM 1110-2-3104 (for loading conditions and stability criteria), EM 1110-2-2502 (for determining soil loads), and EM 1110-2-2104 (for reinforced concrete design).

23. Future designs will optimize member sizes and will evaluate additional gravity flow needs through consultation with Mechanical-Electrical Engineering and Hydraulic Engineering.

MISCELLANEOUS DRAINAGE FEATURES

24. Drainage pipes and outlet and inlet pipes are precast concrete and are assumed to be a Class 4 design. Future designs will follow EM 1110-2-2902 and ACPA Concrete Pipe Handbook guidelines.

SANITARY SEWER LIFT STATIONS

25. Two sanitary sewer pump stations are planned. Pump stations constructed of a vertical 8 foot diameter reinforced concrete pipe (manhole) is planned. Design will conform to EM 1110-2-2902, ACI 318-02, and the ACPA Concrete Pipe Handbook, as applicable.

COMPUTATIONS

26. No computations are included but initial calculations for sizing structural components and calculations for similar structures from other projects are available upon request.

ADA, MN

SECTION 205 FLOOD CONTROL STUDY

FEASIBILITY

STRUCTURAL ANALYSIS AND DESIGN

PURPOSE

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American Concrete Pipe Association (ACPA) Concrete Pipe Handbook
The Aluminum Association Aluminum Design Manual, 1994
Moments and Reactions for Rectangular Plates, United States Department of the Interior, Bureau of Reclamation, Engineering Monograph No. 27.

GENERAL DESIGN PROCEDURES

3. The level of design for the structural features is based on structural design, engineering judgment, past experience, and similar structures designed and constructed for other projects.

DESIGN CRITERIA AND DESIGN DATA

4. Design criteria for general design requirements are listed in the following paragraphs. Design criteria used for specific designs are described in paragraphs specific to those designs.

SOIL PARAMETERS

5. Soil properties are assumed and are shown in the following table. Only drained strengths were considered for designs in this report. Soil pressures are based upon formulae presented in EM 1110-2-2502.

LOCATION	Phi	C	γ_{moist}	γ_{sat}
All	28^o	0 psf	116 pcf	117 pcf

HYDRAULIC DATA

6. The Hydraulic Engineering Section provided flood and top of levee elevations for corresponding river sections and geometry of structures. This information was used to determine loading conditions and dimensions of the structures.

SURVEY DATA

7. The General Engineering Section showing the location of project features and the surrounding topography provided survey information. This information was used to determine existing ground elevations and locations of structures.

REINFORCED CONCRETE

8. All reinforced concrete is designed in accordance with the applicable sections of EM 1110-2-2104 and ACI 318-02. Concrete design is based upon the Ultimate Strength Design Method with the design strength of concrete at 28 days, f_c', taken as 4,000 psi. A uniform load factor of 1.7 was used for all reinforced concrete design with additional factor of 1.3 applied to all hydraulic structures.

9. Concrete reinforcing steel is ASTM A615 Grade 60 with a yield stress, f_y of 60,000 psi. All development and splice lengths are to conform to EM 1110-2-2104 and ACI 318-99.

STRUCTURAL STEEL

10. Structural steel used in bars, plates and shapes is ASTM A36 with the minimum yield stress, f_y taken as 36,000 psi. Steel design is to conform to EM 1110-2-2105, Design of Hydraulic Steel Structures and AISC LRFD, 2nd Ed.

STEEL SHEETPILE WALLS

11. Steel Sheetpiling, where applicable, to be designed according to EM 1110-2-2504, Design of Sheet Pile walls, and to conform to the requirements of ASTM A328 having a yield stress (Fy) of 38,500 psi. The maximum allowable stress conforms to the requirements of EM 1110-1-2101

ALUMINUM

12. Aluminum used in the design is assumed to be Alloy 6061, temper T6. Allowable stresses are in conformance with EM 1110-1-2101 and the Aluminum Design Manual.

UNIT WEIGHTS

13. Material unit weights (other than soil) are as follows:

Reinforced Concrete:	γ_c = 150 pcf
Water:	γ_w = 62.5 pcf
Steel:	γ_s = 490 pcf
Aluminum:	γ_{al} = 169 pcf

FROST PROTECTION

14. All foundations are placed a minimum depth of 7.00 feet below ground surface to avoid problems with frost.

DESIGN AND ANALYSIS OF STRUCTURAL FEATURES

BOX CULVERTS AND BRIDGE STRUCTURES

15. A Box Culvert Structure will be placed where the diversion channel crosses Highway 9 and 210th street. The structures are composed of 3 box culverts and a retaining wall on each corner. Each precast concrete box culvert is 12 feet high, 12 feet wide and 56 feet long. Each retaining wall is made of reinforced concrete and is approximately 20 feet deep, 2.0 feet thick and 46 feet long. The bottom of the wall footing is placed 7.00 feet below the invert of the culvert. There is a cut off wall under each end of the box culverts. The cut off walls are 6 feet deep and 1 foot thick. This structure is modeled using similar structure designed for Marshall, MN, Stage 2, Flood Control, constructed in 1999. See structural plate no. 1.

16. Box Culverts that installed under the road will be designed according to EM 1110-2-2902, Conduits, Culvert and Pipes and ACPA Concrete Pipe Handbook guidelines. Also Minnesota Department of Transportation guidelines for box culvert highway design will apply.

17. The Retaining Walls are T-walls. Design procedure for T-walls will be according to EM1110-2-2502 for load and load combination determinations and stability analyses, and EM 1110-2-2104 for reinforced concrete design. For T-wall, load Cases R1 and R2 will be the only load cases investigated and only long-term soil conditions (drained condition) will be analyzed. Water elevations on both sides will be taken to the top of the wall for Load Case R2. The design flood elevation will be used for Load Case R1 and is an average of about 3.0 feet below top of wall elevations on the soil side and no water in the channel on the channel side. The bottom of the base slab is embedded 7.00 feet

below the ground surface for frost protection. The water elevation on the road side of the wall is taken at the top of soil elevation.

18. T-Walls will be analyzed for rotation, bearing, and sliding stability. Sliding stability will be evaluated for the inclined and block wedge conditions. Wall thicknesses will be obtained from factored pressures from the top of the wall with no resisting loads. Slab thicknesses will be obtained from factored bearing pressures.

19. The water table is estimated to be 7 feet above the bottom of T-Wall and dewatering should be required for construction of the Box Culverts and T-Wall.

GATEWELL CONTROL STRUCTURES

20. Gatewell gravity Control Structures are used to control flow of water within the flood-protected areas. There are ten gate wells. The structures are single-bay reinforced concrete box-shaped structure. Flows are controlled by sluice gates and aluminum stop logs secondary closure. They are sized based on past experience with similar structures. See Structural Plate no. 2 for top elevation, invert elevation, pipe diameter and sluice gate size for each structure.

21. Each control structure is of reinforced concrete founded on reinforced concrete slab. The structure will be analyzed for bearing and flotation stability and primary members will be sized using preliminary design procedures. Two load conditions will be considered, water to top of walls with uniform uplift, and normal gravity flow operation. Structural members will be designed assuming flat plate behavior where applicable, otherwise beam behavior will be assumed. Gravity flow conduits will be designed using EM 2902.

22. The design of control structure will follow criteria provided in EM 1110-2-3104 (for loading conditions and stability criteria), EM 1110-2-2502 (for determining soil loads), and EM 1110-2-2104 (for reinforced concrete design).

23. Future designs will optimize member sizes and will evaluate additional gravity flow needs through consultation with Mechanical-Electrical Engineering and Hydraulic Engineering.

MISCELLANEOUS DRAINAGE FEATURES

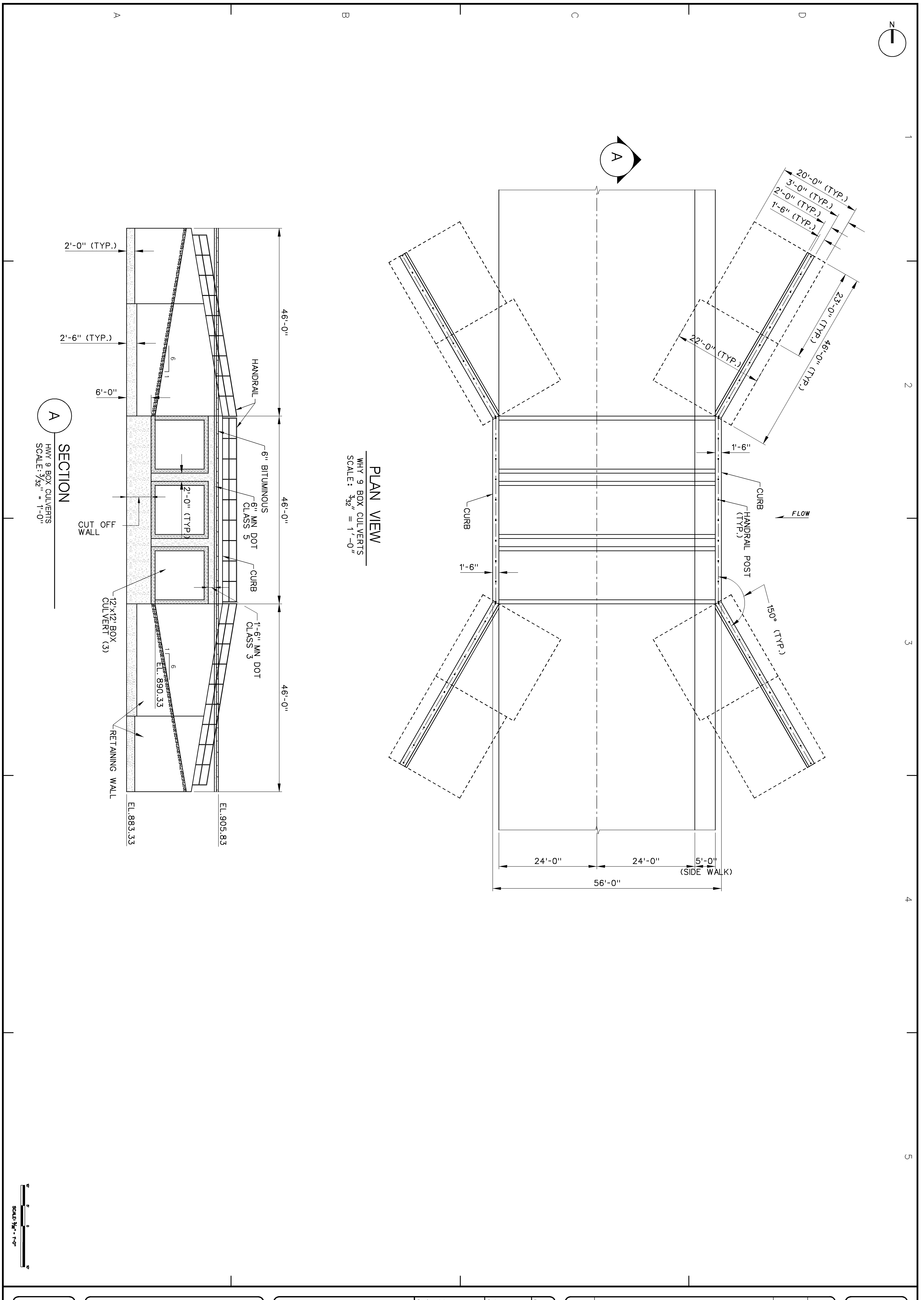
24. Drainage pipes and outlet and inlet pipes are precast concrete and are assumed to be a Class 4 design. Future designs will follow EM 1110-2-2902 and ACPA Concrete Pipe Handbook guidelines.

SANITARY SEWER LIFT STATIONS

25. Two sanitary sewer pump stations are planned. Pump stations constructed of a vertical 8 foot diameter reinforced concrete pipe is planned. (manhole) Design will conform to EM 1110-2-2902, ACI 318-02, and the ACPA Concrete Pipe Handbook, as applicable.

COMPUTATIONS

26. No computations are included but initial calculations for sizing structural components and calculations for similar structures from other projects are available upon request.



Sheet reference number:
S-001
Sheet 1 of 2

FEASIBILITY STUDY
ADA SECTION 205
WILD RICE & MARSH RIVERS - ADA, MINNESOTA
ADA, MINNESOTA

BOX CULVERTS BRIDGE
PLAN VIEW
AND SECTION

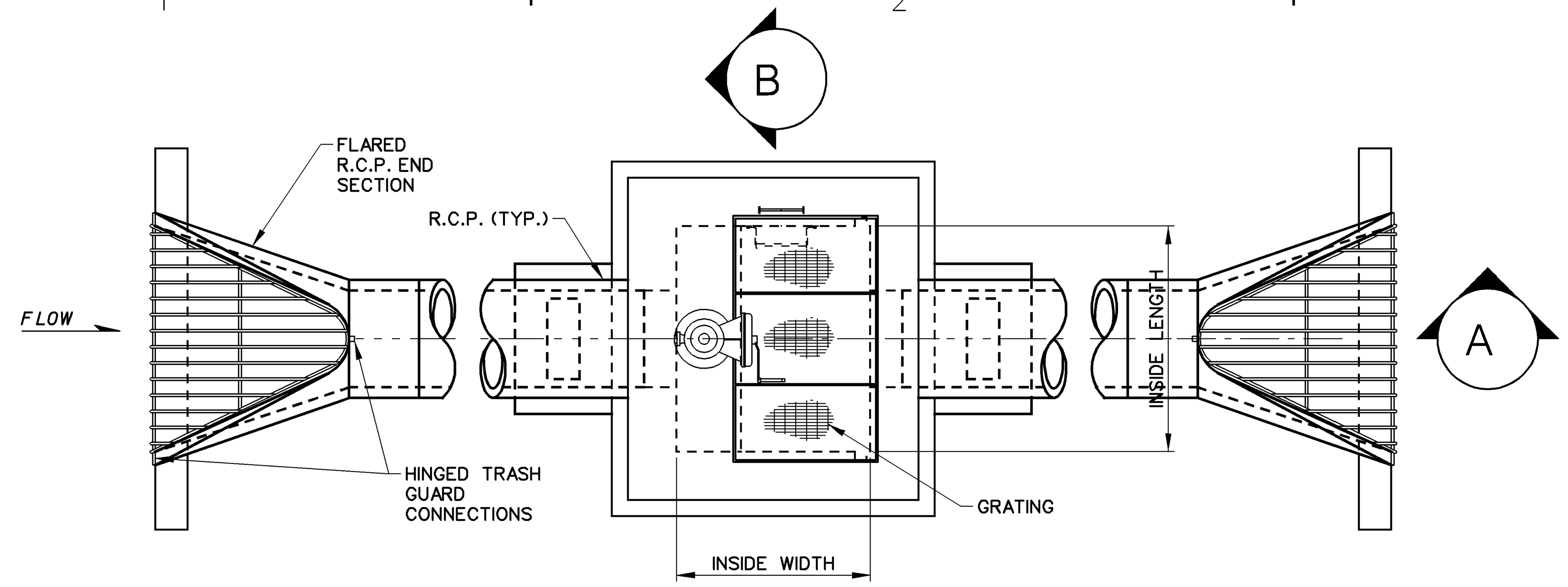
DEPARTMENT OF THE ARMY
ST. PAUL DISTRICT
CORPS OF ENGINEERS
ST. PAUL, MINNESOTA

Horizontal Coordinate System:
UTM ZONE 15
NAD 1983, US SURVEY FT
Vertical Coordinate System:
MSL NGVD 1912 (ADJ)

Designed by: TSF		Date: FEBRUARY 2008	Rev.
Dwn by: NK	Ckd by:	Solicitation No.: DACW37-YR-B-0000	
Authority: PROJECT AUTHORITY		Drawing Number: R-PR-P-CD/000	
File Name: ADA07S401___S-401---.DGN			
Plot Scale: AS SHOWN		Plot Date:	

Symbol	Description	Date	Appr.

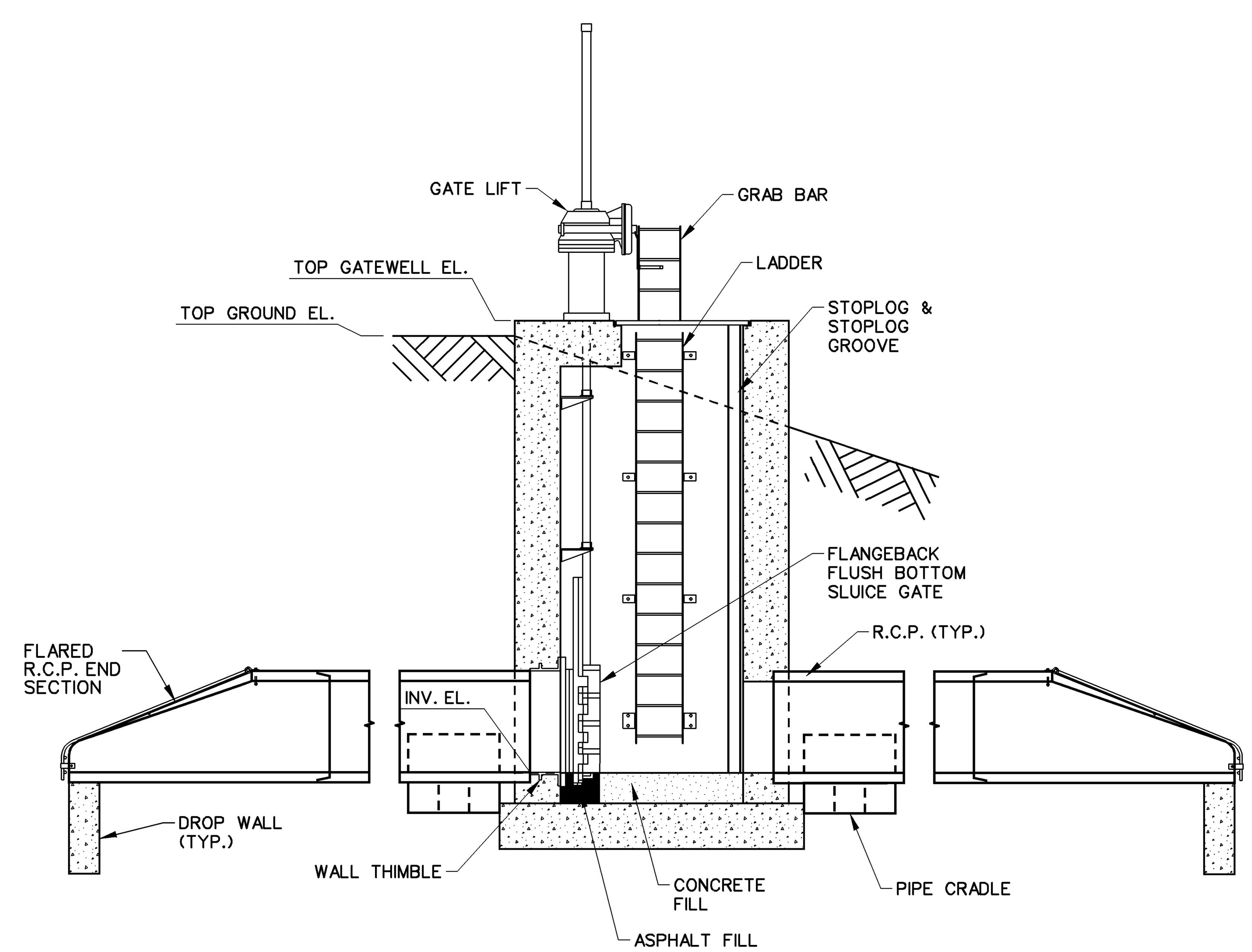
US Army Corps of Engineers
St. Paul District



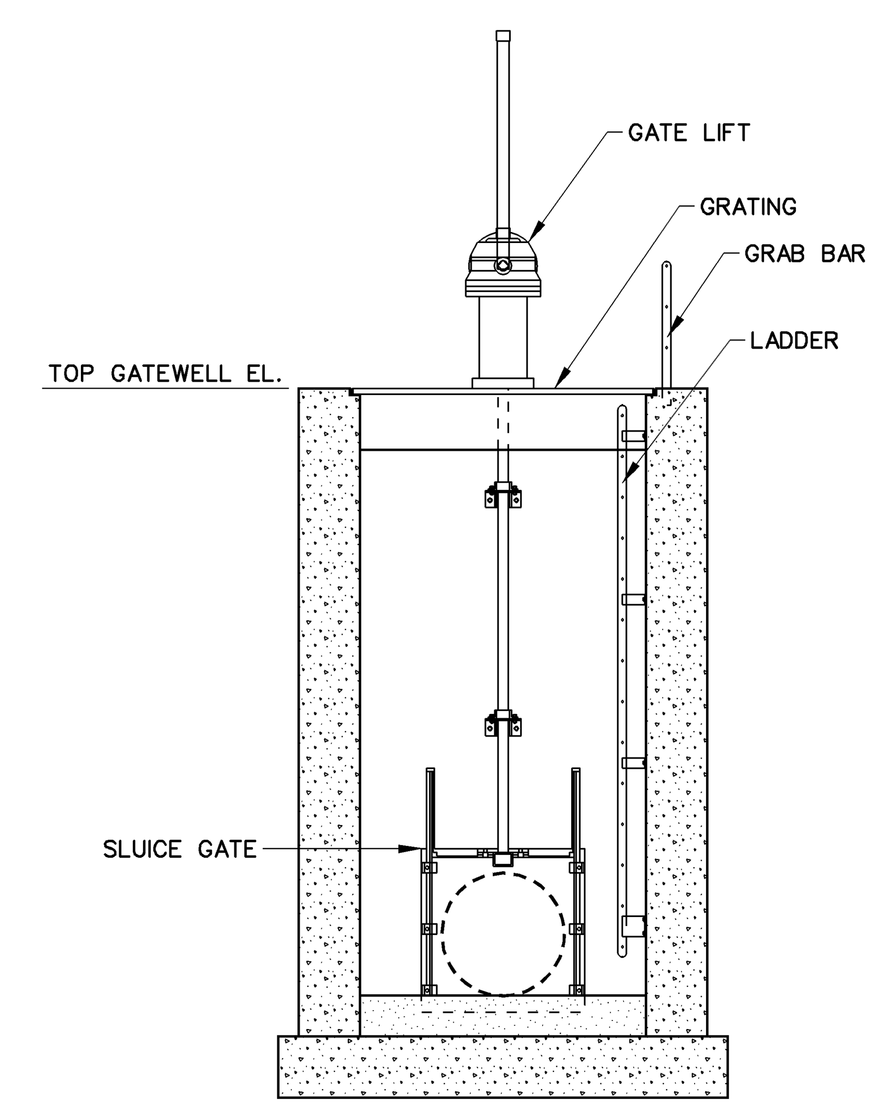
PLAN VIEW
CONTROL STRUCTURE
SCALE: NONE

CONTROL STRUCTURES

STRUCTURES	INV. EL.	TOP GROUND EL.	TOP GATE WELL EL.	HEIGHT (FT)	RCP DIA. (IN)	GATEWELL INSIDE WIDTH (FT)	GATEWELL INSIDE LENGTH (FT)	WATER TABLE ELEVATION
GATEWELL 1	889.59	905.83	906.33	17.24	48	7	5	890.80
MANHOLE	891.62	903.00	903.50	12.38	36	6	5	891.0
GATEWELL 2	894.68	901.73	902.23	8.05	36	6	5	895.60
GATEWELL 3	896.36	902.50	904.00	8.14	36	6	5	895.60
GATEWELL 4	898.43	902.74	905.74	7.81	36	6	5	895.60
GATEWELL 5	893.76	902.63	904.13	10.87	54	8	5	895.60
GATEWELL 6	895.29	897.00	902.50	7.71	36	6	5	895.60
GATEWELL 7	897.27	904.54	905.04	8.27	36	6	5	895.60
GATEWELL 8	899.08	905.71	906.21	7.63	36	6	5	895.60
GATEWELL 9	901.17	907.38	908.88	7.71	36	6	5	893.60



(A) SECTION
CONTROL STRUCTURE
SCALE: NONE



(B) SECTION
CONTROL STRUCTURE
SCALE: NONE

SCALE: 1/4" = 1'-0"

US Army Corps of Engineers
St. Paul District

Symbol	Description	Date	Appr.

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

Horizontal Coordinate System: UTM ZONE 15 NAD 1983, US SURVEY FT
Vertical Coordinate System: MSL NGVD 1912 (ADJ)

Designed by: TSF | Date: FEBRUARY 2008 | Rev.
Dwn by: NK | Ckd by: | Solicitation No.: DACW37-YR-B-0000
Authority: PROJECT AUTHORITY | Drawing Number: R-PR-P-CD/000
File Name: ADA07S402____S-402---.DGN
Plot Scale: ASH SHOWN | Plot Date:

FEASIBILITY
ADA SECTION 205
WILD RICE & MARSH RIVERS - ADA, MINNESOTA
ADA, MINNESOTA

CONTROL STRUCTURE
PLAN VIEW
AND SECTIONS

Sheet reference number:
S-002
Sheet 2 of 2

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX E

HTRW ANALYSIS

Appendix E

Update to HTRW Assessment for the Proposed Flood Control Project At Ada, Minnesota

HTRW UPDATE

The initial Phase One Environmental Site Assessment (ESA) for the Ada, Minnesota 205 Flood control Feasibility Study was conducted By Earth Tech, Inc. in August 2000 under contract DACW37-99-D-0005 task order No. 3 and was titled

Phase I Environmental Site Assessment Ada, Minnesota Section 205 Feasibility Study August 2000

This update is a review of the phase one, with the additional information gained from several field trips to the area. Since the phase one was completed the project study area has grown with additional levees to the northwest and west of town. On 7 July 2006 a field trip was made to the City of Ada to reevaluate the ESA recommendations and evaluate the new project areas. The levee 8 reach, new road between Hwy. 9 and West Main, and the JD-51 reach (see plate E-1) have the highest potential for encountering contamination.

New Road between Hwy. 9 and West Main

Along the north portion of the Implement dealer property there were unmarked drums, vehicle storage and lead acid batteries. There is a chance that contamination will be encountered in this portion of the reach.

Levee 1Reach

Levee area 1, including ponding area, and drainage ditch, is agricultural land and poses no identifiable hazards.

Levee 2 Reach

Levee 2 is to be constructed in residential / agricultural / multiuse land. The farm implement dealer (see photo E-1) located in that reach has an above ground fuel storage tank and 55-gallon drums on the premises. The drums were located approximately 300-feet from the proposed alignment. There is a slight chance that contamination will be encountered in this portion of the reach. The rest of the reach encompassing the Fair Grounds and residential area, poses little chance of encountering contamination.

Levee 3 Reach

Levee 3 is bordered by residential properties and the golf course. In this reach there is little chance of encountering contamination.

Levee 8 Reach

In this reach there are several automotive maintenance shops or former automotive maintenance shops (see photo E-2 through E-5). It was observed that there were fuel tanks, drums, stored vehicles and truck and auto parts stored in the area around these facilities. The scope of work in this reach would involve only minor striping of top soil, there is a chance that contamination could be encountered in this area.

Levee 7 / JD51 Reach

This reach runs through agricultural land but is also adjacent to the Norman County Highway Department maintenance facilities (see plate E-1). This facility is a Minnesota leaking underground storage site (LUST). Soil and groundwater contamination have been found at this site. Boring 00-2M encountered petroleum odor in the upper 5-feet soil (see plate E-1 for Boring location). The hydraulic gradient is to the west, so the contamination should be moving to the west. There is a risk of contaminants being encountered during construction of the new JD 51. Phase II borings in the proposed channel should be completed as soon as possible after rights of entry are obtained. There is a possibility the channel may have to move east in this area.

Other potential sources

Within the project area there may have been undocumented residential fuel tanks for home or out building heat, or above ground storage tanks for agricultural use. These sources should not impact the project.

Chemical wastes

Waste tires, unlabeled drums, ash pile, and open buckets of used oil filters were observed along reach 8 in the area of the automotive maintenance shops or former automotive maintenance shops. Tires and unlabeled drums were located in the northwest portion of the lot of farm implement dealer on Hwy 9 near where the new access road will be constructed. It was noted that pallets of fertilizer and unlabeled drums were left at the abandoned factory near the northeast end of levee 1.

Recommendations

Phase II borings and testing are recommended for the following areas. See map on plate E-1 for locations.

Levee 2 Reach

Behind the Implement dealer in the area of the proposed levee, two borings 4-foot in depth, testing for volatile organic compounds (VOCs), diesel range organics (DRO), and gasoline range organics (GRO).

Levee 8 Reach

Behind the automotive maintenance shops or former automotive maintenance shops in the area of the proposed levee, 6 borings 4-foot in depth, testing for volatile organic compounds (VOCs), diesel range organics (DRO), and gasoline range organics (GRO).

Levee 7 / JD51 Reach

Adjacent to the Norman County Highway Department maintenance facilities in the area of the proposed levee/ JD51 Ditch, 4 borings to elevation of the bottom of the proposed ditch, testing for volatile organic compounds (VOCs), diesel range organics (DRO), and gasoline range organics (GRO).

New Road between Hwy. 9 and West Main

Along the north portion of the Implement dealer property 2 borings 6-foot in depth, testing for volatile organic compounds (VOCs), diesel range organics (DRO), and gasoline range organics (GRO).

Photos

Levee 2 Reach

Barrels stored behind Implement dealer Photo E-1

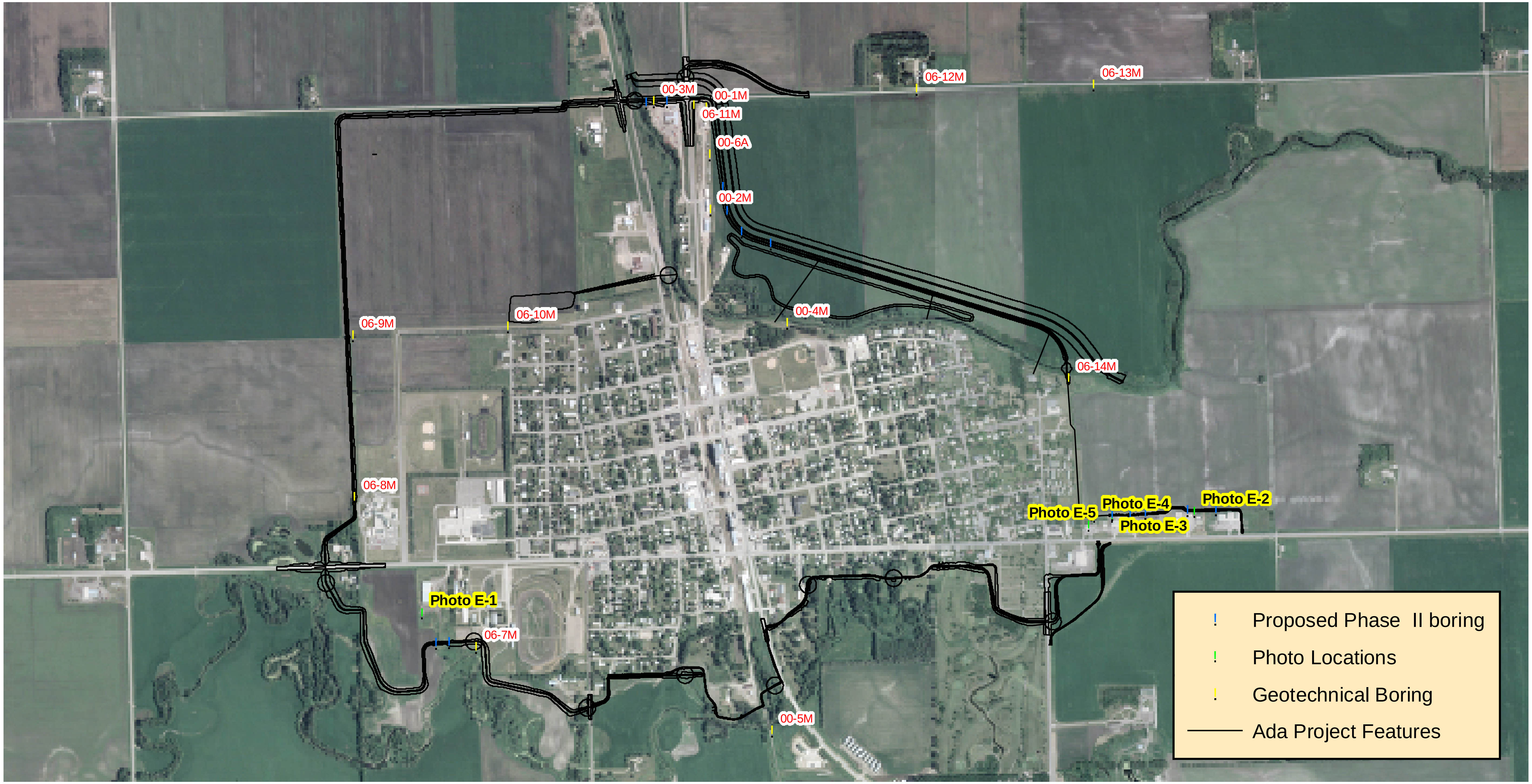
Levee 8 Reach

Barrels and vehicles along reach 8. Photo E-2

Tires tanks and barrels along reach 8. Photo E-3

Formerly used UST along reach 8. Photo E-4

Barrels, tires, and used filters along reach 8. Photo E-5



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Ada Section 205

0 600 1,200 2,400 3,600 4,800 Feet

GIS/Geology/Ada_plate_E-1/KSN3-24-08

Plate E-1

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX F

ECONOMIC ANALYSIS

Appendix F

Economic Analysis

Ada, MN

Section 205 Feasibility Study

Introduction

The purpose of this analysis is to evaluate the economic feasibility of a variety of flood protection alternatives and identify the plan that maximizes contributions to national economic development (NED plan). The analysis follows the planning regulations laid out in ER 1105-2-100. Costs and benefits are referenced to October 2007 price levels, an interest rate of 4-7/8 percent is used for discounting and annualizing costs and benefits, and the project life is set at 50 years. A range of levee alternatives providing protection to the 50-year, 100-year, 200-year, and 500-year flood levels are considered in order to identify the NED plan, the plan with the greatest net benefits.

Demographic Characteristics

Population - The population of Ada as of the latest census (2000) was 1,657. This represents a continuation of population decline in recent decades. Population was 2,076 in 1970, 1,971 in 1980, and 1,708 in 1990. In contrast, the nearest MSA, Fargo, ND-Moorhead, MN, located 40 miles to the southwest, has experienced population growth in recent years increasing from 137,574 in 1980 to 174,367 in 2000.

Income - Per capita income for Norman County in 2005 was $27,414. This was lower than that for the state of Minnesota, $37,290 and for the nation as a whole, $34,471. Income growth since 1990 was also lower than state and national figures. From 1990 to 2005, per capita income for Norman County grew 56.0 percent while Minnesota's per capita income grew 87.5 percent and that of the U.S. grew 77.0 percent.

Employment - The employment profile for Norman County is shown in Table 1. Figures for the State of Minnesota are presented also for perspective. Compared with state averages, the agricultural sector comprises a larger percentage of the local economy while manufacturing plays a much lesser role.

Table 1 - Employment by Industry (2005)				
Industry	Norman Co.	% of Total	Minnesota	% of Total
Farm employment	894	21.8%	100,539	2.9%
Forestry, fishing	*		14,094	0.4%
Mining	*		6,708	0.2%
Utilities	*		12,673	0.4%
Construction	*		200,591	5.7%
Manufacturing	10	0.2%	362,545	10.4%
Wholesale trade	119	2.9%	143,110	4.1%
Retail trade	396	9.7%	381,567	10.9%
Transportation & warehousing	*		108,389	3.1%
Information	126	3.1%	68,386	2.0%
Finance and insurance	204	5.0%	184,916	5.3%
Real Estate	94	2.3%	116,798	3.3%
Professional/technical services	119	2.9%	119,926	3.4%
Management	0	0.0%	64,510	1.8%
Administrative, waste services	*		165,371	4.7%
Educational services	> 10		71,854	2.1%
Health care, social assistance	500	12.2%	399,535	11.4%
Arts, entertainment, recreation	61	1.5%	72,726	2.1%
Accommodation, food services	*		218,673	6.3%
Other private services	260	6.3%	190,542	5.4%
Government	572	13.9%	415,134	11.9%
Total	4103	100.0%	3,498,587	100.0%
* Not shown to avoid disclosure of confidential information; estimates included in totals				
Source: BEA - Regional Economic Accounts				

Damage Analysis

Flood damages are evaluated using HEC's Flood Damage Analysis model (FDA). This model automates the process for calculating flood damages and benefits for flood damage reduction alternatives. While doing so it considers the uncertainty of data inputs and attempts to quantify the risk associated with the model results. Key inputs to the model include water surface profiles for a range of flood events, structure value and structure elevation data, depth-percent damage functions by type of structure, and levels of protection provided by alternatives. Input data includes both expected values and expressions of variability to account for uncertainty of data inputs.

Structure Inventory

The inventory of structures at Ada was updated in May 2006. Data collected for damage calculation purposes includes type of structure, location of structure, assessed market values, ground and first floor elevations, and an indication of whether or not the structure has a basement. Within the 500-year floodplain of Ada, the inventory includes 719 residential structures of which 494 have basements and 225 do not; 103 commercial properties; and 34 public units/categories including damage to streets and sewers and flood fight costs. Significant new construction since the flood of 1997 includes a new elementary/high school, hospital/nursing home complex, and a 31-unit senior citizen apartment building.

Structure Values

As directed by planning guidance, depreciated replacement value (DRV) serves as the basis for evaluating residential structure damage. These values are determined by revising upward the assessed market values (AMV) by a factor that reflects the difference between assessed market values and depreciated replacement values. These values are assigned to each structure based on a Marshall–Swift analysis of a sample of residential structures in Ada. The Marshall-Swift cost estimating procedure uses data on the physical characteristics of a residential structure to estimate its depreciated replacement value. Included among the factors affecting the value are the age and condition of the structure. A linear regression comparison between the assessed market values and the depreciated replacement values of the sample of structures yields the following equation:

$$DRV = \$34,828 + (1.056 * AMV);\ \text{correlation coefficient}\ r = 0.960$$

This equation was used to change the assessed market value of each residential structure to its corresponding depreciated replacement value. As the DRV analysis was based on May 2006 assessed market values, a minor update to October 2007 price levels using ENR Building indices was required. After this update, the current average DRV for single unit residential structures is $94,800.

Hydrologic & Hydraulic Input

Hydrologic and hydraulic data input for the model includes water surface profiles for a range of eight frequency-specific flood events. These are the 2-, 5-, 10-, 20-, 50-, 100-, 200-, and 500-year events. The profiles include discharges associated with the flood events. From this data, the FDA model develops frequency-discharge and discharge-elevation (i.e., rating curves) relationships necessary for the calculation of average annual damages and benefits.

Due to the inherent uncertainty associated with the above relationships, confidence ranges are incorporated into the analysis. FDA creates the frequency-discharge curves using data from the water surface profiles. The expected discharge values and the confidence limits are derived analytically based on a 98-year record length. For example, the 95-percent confidence limits for a 10-year flow range from 3,910 cfs to 7,156 cfs and for a 100-year flow from 7,826 cfs to 20,935 cfs (see Table 2). For the rating curve, expected values for stages at given discharges are derived from the water surface profiles also. Uncertainty, expressed as values that are two standard deviations above and below the expected stage value, are provided as part of the hydraulic input for the analysis (see Table 3).

Flood Damage Categories

Residential - The primary benefit of a project at Ada is the reduction in damage caused by flooding of the Wild Rice River. Flood damage occurs to residential, commercial, and public properties. Damage to residential properties includes physical damage to the structure and contents. Residential structure damage is based primarily on depth of flooding and value of the structure. Depth of flooding is estimated by comparing the structure elevation with the elevation of the particular flood at the structure’s location as defined by the water surface profile. Standardized depth-percent damage relationships developed by the Corps of Engineers are used to estimate the value of both structure and content damage to a residential structure for a given flood event.

Table 2 - Frequency - Discharge Relationship and Variability										
		Confidence Limit Curves (standard error)								
		Discharge (cfs)								
Frequency	Expected Discharge	-2 SD	% Difference From Expected	-1 SD	% Difference From Expected	+1 SD	% Difference From Expected	+2 SD	% Difference From Expected
0.2	3,580	2,723	-23.9%	3,122	-12.8%	4,105	14.7%	4,706	31.5%
0.1	5,290	3,910	-26.1%	4,548	-14.0%	6,153	16.3%	7,156	35.3%
0.04	7,912	5,379	-32.0%	6,524	-17.5%	9,595	21.3%	11,636	47.1%
0.02	10,200	6,564	-35.6%	8,182	-19.8%	12,715	24.7%	15,851	55.4%
0.01	12,800	7,826	-38.9%	10,009	-21.8%	16,370	27.9%	20,935	63.6%
0.004	16,567	9,542	-42.4%	12,573	-24.1%	21,829	31.8%	28,763	73.6%
0.002	19,800	10,936	-44.8%	14,715	-25.7%	26,643	34.6%	35,850	81.1%

Table 3 - Elevation-Discharge Relationships and Variability							
				75% Chance of Exceedence		25% Chance of Exceedence	
Reach 1a, 2a					Difference		Difference
	Discharge	Modal	Mean		from Mean		from Mean
Frequency	(cfs)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)	Elevation (ft)
50.0%	1,500	896.40	896.80	896.41	0.39	897.34	0.54
20.0%	3,580	898.90	899.20	898.76	0.44	899.55	0.35
10.0%	5,290	899.50	900.20	899.64	0.56	900.68	0.48
5.0%	7,240	900.10	901.30	900.48	0.82	902.05	0.75
2.0%	10,200	903.10	902.90	902.15	0.75	903.60	0.70
1.0%	12,800	903.15	903.50	903.02	0.48	903.99	0.49
0.5%	15,600	903.20	903.70	903.21	0.49	904.14	0.44
0.2%	19,800	904.60	905.40	904.82	0.58	905.95	0.55
Reach 1b, 2b							
50.0%	1,500	893.70	894.20	893.79	0.41	895.06	0.86
20.0%	3,580	897.50	897.50	897.17	0.33	897.90	0.40
10.0%	5,290	897.80	898.50	898.02	0.48	898.90	0.40
5.0%	7,240	898.20	899.60	898.68	0.92	900.38	0.78
2.0%	10,200	898.90	900.70	899.45	1.25	901.63	0.93
1.0%	12,800	900.20	901.40	900.47	0.93	902.26	0.86
0.5%	15,600	901.40	902.30	901.57	0.73	902.93	0.63
0.2%	19,800	904.00	904.30	904.00	0.30	904.51	0.21
Reach 3, 4							
50.0%	1,500	892.30	892.90	892.44	0.46	894.11	1.21
20.0%	3,580	897.30	897.10	896.79	0.31	897.37	0.27
10.0%	5,290	897.50	897.90	897.63	0.27	898.13	0.23
5.0%	7,240	897.60	898.50	897.96	0.54	898.95	0.45
2.0%	10,200	898.70	899.40	898.71	0.69	900.02	0.62
1.0%	12,800	899.80	900.20	899.72	0.48	900.65	0.45
0.5%	15,600	900.70	901.10	900.63	0.47	901.47	0.37
0.2%	19,800	901.70	902.10	901.71	0.39	902.38	0.28

Damage is assumed to begin at the structure with the lowest ground elevation at a given river mile reference point along the profile. If this structure has a basement, it is assumed that flood waters entering the basement will backup into other basements connected at that river mile location. Thus it is possible for a residential structure with a basement to be damaged before it physically comes into contact with flood waters.

Another significant source of damage to residential properties, as documented by a post-flood survey at Grand Forks/East Grand Forks after the 1997 flood, is other flood related costs. These consist of items such as cleanup costs, additional lodging, food, and travel costs incurred if evacuation from the residence is necessary, vehicle damage, medical costs, etc. These other costs start when the basement is about half flooded and they can grow to approximately 20 percent of the value of the residence as the first floor becomes significantly inundated.

Commercial - Commercial property damage consists of physical damage to commercial structures and contents and cleanup costs. It does not include business revenue losses. Damage to commercial structures is calculated by applying general depth-percent damage figures to the value of the commercial structure. The depth-damage relationships are specific for the type of business evaluated. Separate depth-percent damage relationships are used for calculating content damages as well.

Public - Public damage includes physical damage to public buildings and its contents, other public infrastructure such as streets and sewers, and flood fight costs. Like commercial damage calculation, general depth-percent damage relationships are used to calculate damages to public structures and contents when appropriate. For unique public facilities for which a general relationship does not exist, a depth-damage relationship is developed and used as input for the model. Actual damage figures from recent flood event, particularly the 1997 event, provide useful data to develop these relationships.

Flood Damages - Without-Project Condition

Emergency levees were constructed during the 1997 flood and have been modified in subsequent flood events. Geotechnical engineers have performed an analysis to determine the level of credit to assign the existing levee in terms of its capability to prevent flood damage. Their conclusion is that no credit should be assigned to the levees. This is primarily due to unstable soil conditions at selected points along the levee alignment.

As an interim step in the process of evaluating average annual damages, FDA produces elevation-damage relationships for given reaches. Table 4 below displays these relationships by damage category by reach.

Table 4 – Elevation-Damage Relationships by Category by Reach				
Reach 1a				
Stage	Residential	Commercial	Public	Total
898.0	$18,800	$1,200	-	$20,000
899.0	47,000	1,700	$2,600	51,300
900.0	114,700	2,000	45,400	162,100
901.0	228,100	2,300	145,700	376,100
902.0	650,000	2,600	207,000	859,600
903.0	1,748,400	3,000	275,000	2,026,400
905.0	5,529,400	6,600	381,400	5,917,400
907.0	9,615,800	14,500	394,600	10,024,900
Reach 1b				
Stage	Residential	Commercial	Public	Total
897.0	-	$4,400	-	$4,400
898.0	-	9,300	-	9,300
899.0	$22,500	17,800	$3,200	43,500
900.0	93,700	22,400	50,700	166,800
901.0	299,300	31,800	163,600	494,700
902.0	711,300	74,900	260,400	1,046,600
904.0	1,603,200	280,800	599,600	2,483,600
906.0	2,724,700	629,800	920,500	4,275,000

Reach 2a				
Stage	Residential	Commercial	Public	Total
898.0	-	-	-	-
899.0	-	-	$2,300	$2,300
900.0	-	-	38,400	38,400
901.0	$3,800	-	123,300	127,100
902.0	84,400	-	175,200	259,600
903.0	250,200	-	232,800	483,000
905.0	1,177,500	-	322,800	1,500,300
907.0	2,164,400	$9,700	372,700	2,546,800
Reach 2b				
Stage	Residential	Commercial	Public	Total
897.0	$5,100	$2,000	$4,600	$11,700
898.0	32,200	2,700	32,500	67,400
899.0	138,000	3,600	55,200	196,800
900.0	216,700	7,100	108,900	332,700
901.0	488,700	57,500	275,500	821,700
902.0	986,700	188,700	516,000	1,691,400
904.0	1,991,700	451,200	1,053,700	3,496,600
906.0	3,394,500	946,300	1,670,500	6,011,300
Reach 3				
Stage	Residential	Commercial	Public	Total
895.0	$8,900	$28,800	-	$37,700
896.0	50,400	43,900	-	94,300
897.0	170,800	58,800	-	229,600
898.0	461,200	77,200	$5,200	543,600
899.0	835,600	90,500	88,500	1,014,600
900.0	2,580,900	119,100	285,500	2,985,500
901.0	5,893,200	312,900	435,300	6,641,400
903.0	11,257,700	1,275,700	1,131,600	13,665,000
905.0	15,632,700	1,763,300	1,821,300	19,217,300

Reach 4				
Stage	Residential	Commercial	Public	Total
895.0	$8,900	-	-	$8,900
896.0	41,600	-	-	41,600
897.0	108,600	-	-	108,600
898.0	246,200	$2,800	$800	249,800
899.0	464,700	12,100	14,000	490,800
900.0	1,324,500	28,300	44,900	1,397,700
901.0	2,354,800	47,800	67,800	2,470,400
903.0	4,953,700	98,300	217,400	5,269,400
905.0	6,796,700	122,600	383,500	7,302,800

FDA integrates the elevation-damage, elevation-discharge, and frequency-discharge relationships to derive a frequency-damage relationship and ultimately average annual damages for the without project condition. Tables 5 and 6 display flood damages by category for selected flood events and a summary of average annual damages by damage category.

Table - 5 - Ada, MN - Flood Damage for Selected Flood Events by Category by Reach					
		Damage by Selected Flood Event			
Reach	Category	50-Year	100-Year	250-Year	500-Year
1a	Residential	2,095,000	3,399,000	5,035,200	5,467,000
	Commercial	18,000	30,000	43,900	48,000
	Public	329,000	534,000	791,200	859,000
	Total	2,442,000	3,963,000	5,870,300	6,374,000
1b	Residential	382,000	933,000	1,518,200	1,912,000
	Commercial	93,000	204,000	371,100	467,000
	Public	150,000	327,000	596,200	751,000
	Total	625,000	1,464,000	2,485,500	3,130,000
2a	Residential	326,000	558,000	799,900	856,000
	Commercial	-	-	-	-
	Public	284,000	486,000	696,600	745,000
	Total	610,000	1,044,000	1,496,500	1,601,000
2b	Residential	617,000	1,242,000	2,064,800	2,599,000
	Commercial	99,000	198,000	329,700	415,000
	Public	334,000	673,000	1,118,600	1,408,000
	Total	1,050,000	2,113,000	3,513,100	4,422,000

3	Residential	2,002,000	4,521,000	8,261,500	9,591,000
	Commercial	338,000	764,000	1,395,400	1,620,000
	Public	134,000	303,000	553,500	643,000
	Total	2,474,000	5,588,000	10,210,400	11,854,000
4	Residential	1,157,000	2,093,000	3,777,900	4,408,000
	Commercial	20,000	37,000	66,500	78,000
	Public	27,000	48,000	87,400	102,000
	Total	1,204,000	2,178,000	3,931,800	4,588,000
Grand Total	Residential	6,579,000	12,746,000	21,457,500	24,833,000
	Commercial	568,000	1,233,000	2,206,600	2,628,000
	Public	1,258,000	2,371,000	3,843,500	4,508,000
	Total	8,405,000	16,350,000	27,507,600	31,969,000

Table 6 - Average Annual Damage Without Project Condition

	Residential	Commercial	Public	Total
Average annual damage	$ 556,200	$ 53,000	$ 94,800	$ 704,000

With-Project Condition

Preliminary Screening – Four alternatives were considered for analysis early in the planning process. These were referred to as Alternatives 1 – 4. The differences among them primarily consisted of the alignment of JD 51. Selection was based solely on costs as each plan would produce similar level of benefits. The costs for each alternative were estimated as: $8,532,000 for Alternative 1; $6,377,000 for Alternative 2; $4,333,000 for Alternative 3; and $4,767,000 for Alternative 4. These costs are relative in that they do not include costs for features common to each alternative. Alternative 3, being the least costly, was selected as the alternative to carry forward for further analysis.

Flood Damages - Four levee/diversion channel alternatives were evaluated in an effort to optimize the level of protection from an economic standpoint. The alternatives vary by level of protection that they offer: 50-year, 100-year, 200-year, and 500-year protection levels. The projects are sized such that they contain the design flood with a 90-95 percent probability. Table 7 displays average annual damages with the different alternatives in place.

Table 7 - Average Annual Damage for With-Project Conditions				
Level of	Average Annual Damage (x 1,000)			
Protection	Residential	Commercial	Public	Total
50-Year	$119,100	$13,300	$24,700	$157,100
100-Year	64,800	7,800	14,800	87,500
200-Year	33,200	3,800	7,600	44,600
500-Year	700	100	100	900

Project Benefits

Flood Damage Reduction – Flood damage reduction benefits are the difference between flood damages for the without-project condition compared with the with-project condition. Table 8 displays the average annual flood damage reduction benefits and the percent damage reduction for the alternatives under consideration.

Table 8 - Average Annual Benefits by Alternative			
	Average	Average	% Damage
Condition	Annual Damage	Annual Benefit	Reduction
Without Project	$704,000		
50-Year protection	157,100	$546,900	77.70%
100-Year protection	87,500	616,500	87.60%
200-Year protection	44,600	659,400	93.70%
500-Year protection	900	703,100	99.87%

Flood Insurance Cost Savings - For those alternatives that provide 100-year level of flood protection or greater, property owners would no longer be required to purchase flood insurance. By eliminating these policies, a benefit occurs to the nation in the form of a saving of the costs to administer these policies. Currently, 29 flood insurance policies are in effect at Ada. At an annual saving of $191 per policy, this benefit amounts to $5,600. This benefit can be claimed for the 100-year, 200-year, and 500-year projects, but not the 50-year project.

Floodproofing Cost Savings – A minor benefit that can be claimed by removing an area out of the 100-year flood plain is the saving of the cost to floodproof new construction. According to city officials new construction is occurring in the floodplain at an average rate of 2 units per year. This area is located in the northwest corner of town platted as the Cougar Addition. These units are floodproofed either by raising them on fill or by building the homes with poured concrete basements. In either case the low entry point for floodwater into the home is at or above the 100-year flood level. Floodproofing adds an average of $10,000 to the cost of constructing a home in the floodplain. There are 36 lots available for future development to which this benefit can be applied. The annualized equivalent of the present value of the floodproofing cost savings benefit amounts to $12,700. This is calculated as follows.

Calculation of Floodproofing Cost Savings Benefit

Savings per year (2 units x $10,000/unit)	$ 20,000
NPV factor (Present worth of $1 per period; 4-7/8% for 18 years)	11.8046
NPV of Total Savings (Savings/year x NPV factor)	236,092
Interest & Amortization Factor (4-7/8% over 50 years)	0.053722
Average Annual Benefit (NPV Total Svgs x Int & Amort factor)	12,683

Benefit Summary - Table 9 presents a summary of benefits by alternative

Table 9 - Summary of Benefits by Alternative

Category	50-Yr Levee	100-Yr Levee	200-Yr Levee	500-Yr Levee
Flood damage reduction	$546,900	$616,500	$659,400	$703,100
Floodproofing cost savings		12,700	12,700	12,700
Flood insurance savings		5,600	5,600	5,600
Total Avg Ann Benefits	546,900	634,800	677,700	721,400

Average Annual Costs

Computation of average annual costs appears below. Interest during construction is included based on a one-year construction schedule. Costs are amortized at 4-7/8 percent over a 50-year project life.

Table - Calculation of Average Annual Costs by Alternative

	50-Yr Levee	100-Yr Levee	200-Yr Levee	500-Yr Levee

Project Costs	6,840,000	7,270,000	7,670,000	8,910,000
Interest During Const *	164,741	175,098	184,732	214,597
Total Investment	7,004,741	7,445,098	7,854,732	9,124,597
Int & Amort Factor	0.05372	0.05372	0.05372	0.05372
Avg Ann Investment	376,295	399,951	421,956	490,173
Avg Ann O&M	25,286	27,107	28,741	32,552
Total Avg Ann Costs	401,581	427,058	450,697	522,725
* Based on one year construction schedule				

Benefit – Cost Ratio

Table 11 presents a summary of average annual benefits and costs. Each of the alternatives is economically feasible. Planning regulations direct that the project with the greatest net benefits be selected as the plan to be recommended for implementation. This is the NED plan, the plan that maximizes net economic benefits. Of the plans considered in this analysis the 200-year plan has the greatest net benefits and is therefore the NED plan.

Table 11 - Summary of Benefits, Costs, BCR's, Net Benefits				
	50-Yr Levee	100-Yr Levee	200-Yr Levee	500-Yr Levee
Average Annual benefits	$546,900	$634,800	$677,700	$721,400
Average Annual Costs	401,581	427,058	450,697	522,725
Benefit-Cost Ratio	1.36	1.49	1.50	1.38
Net Benefits	145,319	207,742	227,003	198,675

Project Performance

Given the uncertainty associated with the various hydraulic, hydrologic, and economic relationships used in the flood damage analysis, there is likewise some uncertainty regarding a project's ability to provide a given level of protection. FDA measures a project's performance by calculating the probability that flood stages will exceed the project's capacity. The project is generally designed so that there is a 90-95 percent probability it contains the design flood. Table 12 shows the probability that the 200-year levee project will contain selected flood levels. For example, the levee in Reaches 1a and 2a will contain the 100-year flood (1% event) with a probability of 98.61 percent. Because of the ranges of uncertainty, the 200-year project also has the ability to contain the 500-year flood (probability of 81.68 percent). On the other hand, there is some risk that the project may not necessarily contain the 200-year flood. There is still a 2.47 percent probability (1 – 0.9753) that the 200-year flood will overtop the 200-year project in Reaches 3 and 4.

Table 12 - Probability of Levee Overtop by Event

	Top of Levee	Conditional Non-Exceedence Probability by Events				
Reach	Elevation	4.0%	2.0%	1.0%	0.5%	0.2%
1a, 2a	906.2	0.9995	0.9994	0.9861	0.9084	0.8168
1b, 2b	904.4	0.9998	0.9965	0.9618	0.7706	0.547
3, 4	903.7	0.9999	0.9999	0.9989	0.9753	0.9126

In addition to considering the probability of a particular event overtopping a levee as above, one can consider the probability of a levee being overtopped over a given period of time (say 10, 25, or 50 years). Table 13 presents project performance in this manner for the 200-year levee in each Reach. Based on the data presented in the table, the levee along Reaches 1b and 2b will have a 6.91 percent chance of being overtopped within a period of 25 years. As the period of time increases in length, the probability for an overtopping event for the levee increases.

Table 13 – Long-term Risk of 200-Year Levee Alternative

	Expected Annual	Probability of Exceedance		
	Probability of Design	Over Indicated Time Period		
Reach	Being Exceeded	10 Years	25 Years	50 Years

1a, 2a	0.000	0.0090	0.0223	0.0440
1b, 2b	0.003	0.0282	0.0691	0.1335
3, 4	0.001	0.0032	0.0081	0.0161

Another measure of project performance is to consider the probability that the BCR of the project will be above 1.0. The following two tables provide information upon which to consider this. Table 14 contains output derived from the FDA model and shows, for each levee alternative, the probability of attaining a given level of damage reduction benefits. For instance, for the 100-year plan there is a 75-percent chance that the project will generate damage reduction benefits exceeding $323,560. These can be compared with the level of benefits needed to justify costs (Column 3). Based on the data presented, the probability of attaining the amount of damage reduction benefits needed to justify the costs lies between 50 and 75 percent for each of the levee alternatives.

Table 14 - Probability of Attaining Minimum Required Benefits					
		FDR Benefits	Probabilities That FDR Benefits		
Levee	Avg Ann	Needed to	Exceed Indicated Values		
Alternative	Costs	Justify Costs*	0.75	0.50	0.25
50-Year	$ 401,600	$ 401,600	$ 305,890	$ 473,880	$ 711,190
100-Year	427,100	408,800	323,560	528,080	803,300
200-Year	450,700	432,400	331,170	544,030	870,520
500-Year	522,700	504,400	341,640	562,410	914,610
* Difference between this figure and costs is Other Benefits (flood insurance cost savings					
and floodproofing cost savings = $18,300)					

Table 15 is derived from Table 14 and shows the probability of a levee alternative achieving a BCR of the indicated level. For example, the 100-year levee has a 50-percent chance of exceeding a BCR of 1.29. The table also shows the probability of the BCR exceeding the feasibility threshold of 1.0. This is calculated as a straight interpolation between the probability values of 0.5 and 0.75 of achieving a BCR of 1.0. For example, the probability of the 200-year levee attaining a BCR >1 is 63 percent. This is the interpolation between a BCR of 0.76 (at 75-percent probability) and a BCR of 1.26 (at 50-percent probability).

Table 15 - Expected and Probabilistic Value of Benefit-Cost Ratios

			Probabilities that Benefit-Cost Ratio		
	Expected	Probability	Exceeds Indicated Values		
Alternative	Value of BCR	BCR > 1.0	0.75	0.50	0.25
50-Year	1.36	0.61	0.76	1.18	1.77
100-Year	1.49	0.64	0.79	1.29	1.96
200-Year	1.50	0.63	0.76	1.26	2.01
500-Year	1.38	0.56	0.68	1.11	1.81

Incremental Option Areas

Three separate areas adjacent to the Ada city limits are considered for inclusion within the protected area of the proposed 200-year levee. These are referred to as the East, West, and Northwest Option Areas. The East Option Area is located along Hwy 200 east of Ada and consists of several businesses. The West Option Area is along the west edge of Ada and consists of two farmsteads on either side of Hwy 200. The Northwest Option Area consists of open land currently in agricultural production northwest of Ada's city limits. For purposes of this economic analysis, future land use in this area within the period of analysis is not projected to change.

An economic analysis was performed to determine if it is feasible to add these areas as incremental components to the basic 200-year flood risk management plan. Results of this analysis are summarized in Table 16 below. (Note: Cost for the basic 200-year plan differs from the estimate that appears in Table 10 for the alternatives analysis due to further refinement of itemized costs.)

Due to construction efficiencies, adding the West and Northwest Option Areas to the basic 200-year plan actually result in lower overall project costs. Therefore, on an incremental basis, it is economically feasible to add these features to the basic 200-year plan. The East Option Area costs the same to build as the basic plan. Given the minor level of additional benefits expected for the East Option Area, it makes sense to add this feature to the basic plan as well. In conclusion, the three Option Areas are incrementally justified as additional features to the basic 200-year flood risk management alternative for Ada, Minnesota.

Table 16 - Economic Summary of Adding Option Areas to 200-year Levee Plan			
	200-Year Levee Plan plus Option Area		
	East	West	Northwest
First cost	$ 7,670,000	$ 7,660,000	$ 7,650,000
First cost - Basic 200-yr levee	7,670,000	7,670,000	7,670,000
Incremental Cost	0	(10,000)	(20,000)
Avg Ann Incremental Cost	0	(537)	(1,074)
Avg Ann O&M	28,700	28,700	28,700
Avg Ann O&M - Basic 200-yr levee	28,700	28,700	28,700
Avg Ann Incremental O&M	0	0	0
Total Avg Ann Incremental Cost	0	(537)	(1,074)
Avg Ann Incremental Benefit	10 - 100	1,350	> 0
Incremental BCR	> 1.0	> 1.0	> 1.0

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX G

ALTERNATIVES SCREENING COST ESTIMATE

			Alternate 1		Alternate 2		Alternate 3		Alternate 4	
Total Project Cost				8,532,000		6,377,000		4,333,000		4,767,000
				1.00		0.75		0.51		0.56
	Units	Unit Price	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
l 5										
Lands and Damages				3,527,702		1,940,552		68,250		198,739
Levee 4				1,626,000						
Industrial	LOT	6,000.00	25.00	150,000						
Agricultural	AC	1,500.00								
Residential	AC	17,424.00								
Improvements										
Garage	EA	10,000.00	15.00	150,000						
Residential	EA	75,000.00	13.00	975,000						
Relocations										
Owner	EA	27,000.00	13.00	351,000						
Tenant	EA	7,000.00								
Levee 5						38,850				
Industrial	LOT	6,000.00								
Agricultural	AC	1,500.00			25.90	38,850				
Residential	AC	17,424.00								
Improvements										
Garage	EA	10,000.00								
Residential	EA	75,000.00								
Relocations										
Owner	EA	27,000.00								
Tenant	EA	7,000.00								
Levee 6				1,901,702		1,901,702				
Industrial	LOT	6,000.00								
Agricultural	AC	1,500.00								
Residential	AC	17,424.00	12.15	211,702	12.15	211,702				
Improvements										
Garage	EA	10,000.00								
Residential	EA	75,000.00	16.00	1,200,000	16.00	1,200,000				
Relocations										
Owner	EA	27,000.00	14.00	378,000	14.00	378,000				
Tenant	EA	7,000.00	16.00	112,000	16.00	112,000				
Levee 7								68,250		32,055.00
Industrial	LOT	6,000.00								
Agricultural	AC	1,500.00					45.50	68,250	21.37	32,055.00
Residential	AC	17,424.00								
Improvements										
Garage	EA	10,000.00								
Residential	EA	75,000.00								
Relocations										
Owner	EA	27,000.00								
Tenant	EA	7,000.00								
Remote JD51										50,235.00

Total Project Cost				8,532,000		6,377,000		4,333,000		4,767,000
				1.00		0.75		0.51		0.56
			Alternate 1		Alternate 2		Alternate 3		Alternate 4	
	Units	Unit Price	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
Industrial	LOT	6,000.00								
Agricultural	AC	1,500.00							33.49	50,235.00
Residential	AC	17,424.00								
Improvements										
Garage	EA	10,000.00								
Residential	EA	75,000.00								
Relocations										
Owner	EA	27,000.00								
Tenant	EA	7,000.00								
Damages Anticipated	AC	375.00							310.53	116,448.75
Relocations				56,875		6,000		4,000		4,000.00
Sanitary Sewer				30,000		0		0		0.00
8" PVC forcemain relocation	LF	80.00	360.00	28,800						
Valve	EA	300.00	4.00	1,200						
Water				16,875		0		0		0.00
6" PVC Waterline w/ Service Lines	LF	45.00	375.00	16,875						
Electricity				10,000		6,000		4,000		4,000.00
Required Pole Relocations	EA	1,000.00	10.00	10,000	6.00	6,000	4.00	4,000	4.00	4,000.00
Diversion Channels				2,575,998		3,623,009		3,715,708		4,018,805.20
JD 51				1,586,685		1,736,407		1,879,106		1,696,167.47
Topsoil, 4" & Seed	CY	16.00	16,214.40	259,430	15,858.38	253,734	15,353.57	245,657	14,097.58	225,561.30
BCY needed for levees from JD51 Excavatio	BCY	6.00	110,419.86	662,519	108,805.79	652,835	115,773.21	694,639	115,773.21	694,639.23
BCY excess from JD51 Excavation	BCY	5.25	126,616.30	664,736	158,064.48	829,839	178,820.88	938,810	147,803.23	775,966.94
Water Control	LS	50,000.00	4.00	200,000	3.00	150,000	2.00	100,000	1.00	50,000.00
Erosion Protection at Existing Ditch	LS	200,000.00			1.00	200,000	1.00	200,000	1.00	200,000.00
Transition Structure at 210the street	LS	200,000.00							1.00	200,000.00
Control Structure Downstream Old Ditch				0		101,413		101,413		101,412.72
Site Preparation										
Structural Excavation	CY	6.00			426.67	2,560	426.67	2,560	426.67	2,560.00
Backfill Material from Excavation	CY	7.00			534.07	3,739	534.07	3,739	534.07	3,738.52
Base Slab Concrete										
Forms	SF	8.00			48.00	384	48.00	384	48.00	384.00
Reinforcing	LBS	0.45			757.01	341	757.01	341	757.01	340.65
Concrete	CY	150.00			5.33	800	5.33	800	5.33	800.00
Finished Surface (Float Finish)	SF	1.00			144.00	144	144.00	144	144.00	144.00
Curing Surface	SF	0.50			144.00	72	144.00	72	144.00	72.00
Construction Joint Surface Treatment	SF	2.00			28.00	56	28.00	56	28.00	56.00
Wall Concrete										
Forms	SF	12.00			980.00	11,760	980.00	11,760	980.00	11,760.00
Reinforcing	LBS	0.50			3,148.19	1,574	3,148.19	1,574	3,148.19	1,574.10
Concrete	CY	220.00			16.67	3,667	16.67	3,667	16.67	3,666.67
Curing Surface	SF	0.50			456.00	228	456.00	228	456.00	228.00
Construction Joint Surface Treatment	SF	2.00			21.00	42	21.00	42	21.00	42.00

Total Project Cost				8,532,000		6,377,000		4,333,000		4,767,000
				1.00		0.75		0.51		0.56
			Alternate 1		Alternate 2		Alternate 3		Alternate 4	
	Units	Unit Price	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
Elevated Slab Concrete										
Forms	SF	12.00			22.50	270	22.50	270	22.50	270.00
Reinforcing	LBS	0.45			129.33	58	129.33	58	129.33	58.20
Concrete	CY	250.00			0.83	208	0.83	208	0.83	208.33
Finish Top Surface, Steel Trowel	SF	1.00			22.50	23	22.50	23	22.50	22.50
Curing Surface	SF	0.50			22.50	11	22.50	11	22.50	11.25
RCP Pipes										
60" Diam RCP Pipe, class 4	LF	245.00			100.00	24,500	100.00	24,500	100.00	24,500.00
60" Diam RCP Pipe End Section, class 4	Each	1,200.00			2.00	2,400	2.00	2,400	2.00	2,400.00
Gratings										
Grating, serrated	SF	4.00			24.50	98	24.50	98	24.50	98.00
Framing Angle, Steel, Galvanized	LB	1.00			196.00	196	196.00	196	196.00	196.00
Headed Studs, Welded to Framing Angle, 3/8"	EA	4.00			20.00	80	20.00	80	20.00	80.00
Ladder, Wall Mounted or Vertical Grab Bars										
Galvanized Steel Ladder bolted to Concrete	LF	45.00			20.00	900	20.00	900	20.00	900.00
1/2" Anchor Bolts, x 5"	EA	12.00			14.00	168	14.00	168	14.00	168.00
Sluice Gate										
60"x60" Sluice Gates	Each	40,000.00			1.00	40,000	1.00	40,000	1.00	40,000.00
Stoplog Panel and grooves										
4x6x1/4-5.5ft long aluminum tube stoplogs	EA	65.00			35.00	2,275	35.00	2,275	35.00	2,275.00
Sill Chanel and frame, Galvanized steel	LB	1.00			237.50	238	237.50	238	237.50	237.50
Anchors, 16" long	EA	10.00			6.00	60	6.00	60	6.00	60.00
1/2" Anchor Bolts, x 5"	EA	12.00			26.00	312	26.00	312	26.00	312.00
Fence										
6' high fence	LF	15.00			30.00	450	30.00	450	30.00	450.00
Personnel gate, 3.5' wide	EA	200.00			1.00	200	1.00	200	1.00	200.00
Fence										
Hwy guardrail	LF	45.00			80.00	3,600	80.00	3,600	80.00	3,600.00
Precast Box Culverts Structure 210th St. for field access				0		0		0		336,036.17
Site Preparation										
Structural Excavation	CY	6.00							0.00	
Backfill Material from Excavation	CY	7.00							0.00	
Drainage Material Between Box Culverts	CY	25.00							82.96	2,074.07
Precast Box Culverts and Walls										
12'x12' box culverts 85 ft long each	FT	1,500.00							75.00	112,500.00
RC Concrete cut off walls	CY	250.00							18.74	4,685.19
RC Concrete Wing wall's slab	CY	200.00							302.22	60,444.44
RC Concrete Wing wall's wall	CY	250.00							201.48	50,370.37
Cut off wall reinforcement	LBS	0.55							1,825.29	1,003.91
Slabs reinforcement	LBS	0.55							20,260.13	11,143.07
Wing walls reinforcement	LBS	0.65							18,232.48	11,851.11
Slab's formwork	SF	**8.00**							1,608.00	12,864.00
Walls' formwork	SF	**12.00**							4,640.00	55,680.00

Total Project Cost				8,532,000		6,377,000		4,333,000		4,767,000
				1.00		0.75		0.51		0.56
			Alternate 1		Alternate 2		Alternate 3		Alternate 4	
	Units	Unit Price	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
Handrail										
Handrail galvanized 1.5" Diam. Pipes	LBS	2.00							1,760.00	3,520.00
Hwy Guardrail	LF	45.00							220.00	9,900.00
Precast Box Culverts Structure 210th St				0		695,876		695,876		695,875.90
Site Preparation										
Structural Excavation	CY	6.00			8,533.33	51,200	8,533.33	51,200	8,533.33	51,200.00
Backfill Material from Excavation	CY	7.00			5,200.00	36,400	5,200.00	36,400	5,200.00	36,400.00
Drainage Material Between Box Culverts	CY	25.00			311.11	7,778	311.11	7,778	311.11	7,777.78
Precast Box Culverts and Walls										
12'x12' box culverts 85 ft long each	FT	1,500.00			255.00	382,500	255.00	382,500	255.00	382,500.00
RC Concrete cut off walls	CY	250.00			18.74	4,685	18.74	4,685	18.74	4,685.19
RC Concrete Wing wall's slab	CY	200.00			302.22	60,444	302.22	60,444	302.22	60,444.44
RC Concrete Wing wall's wall	CY	250.00			201.48	50,370	201.48	50,370	201.48	50,370.37
Cut off wall reinforcement	LBS	**0.65**			1,825.29	1,186	1,825.29	1,186	1,825.29	1,186.44
Slabs reinforcement	LBS	0.55			20,260.13	11,143	20,260.13	11,143	20,260.13	11,143.07
Wing walls reinforcement	LBS	0.45			18,232.48	8,205	18,232.48	8,205	18,232.48	8,204.62
Slab's formwork	SF	8.00			1,608.00	12,864	1,608.00	12,864	1,608.00	12,864.00
Walls' formwork	SF	12.00			4,640.00	55,680	4,640.00	55,680	4,640.00	55,680.00
Handrail										
Handrail galvanized 1.5" Diam. Pipes	LBS	2.00			1,760.00	3,520	1,760.00	3,520	1,760.00	3,520.00
Hwy Guardrail	LF	45.00			220.00	9,900	220.00	9,900	220.00	9,900.00
Precast Box Culverts Structure located under hwy 9				789,313		739,313		739,313		739,312.94
Site Preparation										
Remove existing box culverts/bridge	Job	50,000.00	1.00	50,000						
Structural Excavation	CY	**6.00**	9,481.48	56,889	9,481.48	56,889	9,481.48	56,889	9,481.48	56,888.89
Backfill Material from Excavation	CY	7.00	10,444.44	73,111	10,444.44	73,111	10,444.44	73,111	10,444.44	73,111.11
Drainage Material Between Box Culverts	CY	**25.00**	352.59	8,815	352.59	8,815	352.59	8,815	352.59	8,814.81
Precast Box Culverts and Walls										
12'x12' box culverts 85 ft long each	FT	**1,500.00**	255.00	382,500	255.00	382,500	255.00	382,500	255.00	382,500.00
RC Concrete cut off walls	CY	**250.00**	18.74	4,685	18.74	4,685	18.74	4,685	18.74	4,685.19
RC Concrete Wing wall's slab	CY	**200.00**	302.22	60,444	302.22	60,444	302.22	60,444	302.22	60,444.44
RC Concrete Wing wall's wall	CY	**250.00**	201.48	50,370	201.48	50,370	201.48	50,370	201.48	50,370.37
Cut off wall reinforcement	LBS	**0.65**	1,825.29	1,186	1,825.29	1,186	1,825.29	1,186	1,825.29	1,186.44
Slabs reinforcement	LBS	0.55	20,260.13	11,143	20,260.13	11,143	20,260.13	11,143	20,260.13	11,143.07
Wing walls reinforcement	LBS	0.45	18,232.48	8,205	18,232.48	8,205	18,232.48	8,205	18,232.48	8,204.62
Slab's formwork	SF	8.00	1,608.00	12,864	1,608.00	12,864	1,608.00	12,864	1,608.00	12,864.00
Walls' formwork	SF	**12.00**	4,640.00	55,680	4,640.00	55,680	4,640.00	55,680	4,640.00	55,680.00
Handrail										
Handrail galvanized 1.5" Diam. Pipes	LBS	2.00	1,760.00	3,520	1,760.00	3,520	1,760.00	3,520	1,760.00	3,520.00
Hwy Guardrail	LF	45.00	220.00	9,900	220.00	9,900	220.00	9,900	220.00	9,900.00
Levees and Floodwalls				432,812		260,256		287,143		287,147.51
Levee 4 Ring				179,370		0		0		0.00
Excavation	CY	5.00	0.00							

Total Project Cost				8,532,000		6,377,000		4,333,000		4,767,000
				1.00		0.75		0.51		0.56
			Alternate 1		Alternate 2		Alternate 3		Alternate 4	
	Units	Unit Price	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
Levee Fill	CY	3.00	32,509.63	97,529						
Stripping	CY	3.00	5,875.92	17,628						
Topsoil, 4" & Seed	CY	16.00	4,013.31	64,213						
Levee 5				0		154,382		0		0.00
Excavation	CY	5.00			0.00					
Levee Fill	CY	**3.00**			31,093.78	93,281				
Stripping	CY	**3.00**			4,384.04	13,152				
Topsoil, 4" & Seed	CY	**16.00**			2,996.80	47,949				
Levee 6				18,683		18,683		0		0.00
Excavation	CY	**5.00**	0.00		0.00					
Levee Fill	CY	**3.00**	1,061.35	3,184	1,061.35	3,184				
Stripping	CY	**3.00**	1,121.60	3,365	1,121.60	3,365				
Topsoil, 4" & Seed	CY	16.00	758.36	12,134	758.36	12,134				
Levee 7				0		0		199,952		199,952.30
Excavation	CY	5.00					0.00		0.00	
Levee Fill	CY	**3.00**					38,266.90	114,801	38,266.90	114,800.70
Stripping	CY	**3.00**					6,112.71	18,338	6,112.71	18,338.14
Topsoil, 4" & Seed	CY	16.00					4,175.84	66,813	4,175.84	66,813.46
Raised West Main Road / Levee #4				205,985		0		0		0.00
Excavation	CY	5.00	0.00							
Roadway Fill	CY	3.00	5,542.46	16,627						
Stripping	CY	3.00	4,188.52	12,566						
Topsoil, 4" & Seed	CY	16.00	1,356.36	21,702						
2" Wear Course Volume	CY	40.00	738.53	29,541						
4" Base Course Volume	CY	40.00	1,477.05	59,082						
12" Underlayment Volume	CY	15.00	4,431.16	66,467						
IntersectionHwy 9 & 210th Ave.				28,774		87,191		87,191		87,195.21
Excavation	CY	5.00					0.00		0.00	
Roadway Fill	CY	3.00	3,044.14	9,132	9,224.67	27,674	9,224.67	27,674	9,224.67	27,674.01
Stripping	CY	**3.00**	653.70	1,961	1,980.91	5,943	1,980.91	5,943	1,980.91	5,942.74
Topsoil, 4" & Seed	CY	**16.00**	326.93	5,231	990.69	15,851	990.69	15,851	990.69	15,851.09
2" Wear Course Volume	CY	40.00	59.29	2,371	179.63	7,185	179.63	7,185	179.65	7,186.17
4" Base Course Volume	CY	40.00	118.57	4,743	359.27	14,371	359.27	14,371	359.31	14,372.33
12" Underlayment Volume	CY	15.00	355.72	5,336	1,077.81	16,167	1,077.81	16,167	1,077.92	16,168.87
Interior Flood Control				1,938,166		546,792		258,231		258,230.72
Ada Pump Station				894,683						
Site Preparation										
Structural Excavation	CY	6.00	502.52	3,015						
Backfill Material from Excavation	CY	7.00	837.78	5,864						
Base Slab Concrete										
Forms	SF	8	216.00	1,728						
Reinforcing	TN	800.00	0.00							
Concrete	CY	**150.00**	57.78	8,667						

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	Units	Unit Price	Alternate 1 Quantity	Alternate 1 Amount	Alternate 2 Quantity	Alternate 2 Amount	Alternate 3 Quantity	Alternate 3 Amount	Alternate 4 Quantity	Alternate 4 Amount
Total Project Cost				8,532,000		6,377,000		4,333,000		4,767,000
				1.00		0.75		0.51		0.56
Finished Surface (Float Finish)	SF	**1.00**	780.00	780						
Curing Surface	SF	**0.50**	780.00	390						
Construction Joint Surface Treatment	SF	**2.00**	205.50	411						
Concrete fill (Lean Concrete)	CY	80.00	17.78	1,422						
Wall Concrete										
Forms	SF	12.00	5,355.00	64,260						
Reinforcing	TN	900.00	0.00							
Concrete	CY	220.00	122.50	26,950						
Curing Surface	SF	0.50	5,565.00	2,783						
Construction Joint Surface Treatment	SF	2.00	216.00	432						
Elevated Slab Concrete										
Forms	SF	12.00	776.00	9,312						
Reinforcing	TN	800.00	0.00							
Concrete	CY	250.00	24.89	6,222						
Finsih Top Surface, Steel Trowel	SF	1.00	780.00	780						
Curing Surface	SF	0.50	780.00	390						
RCP Pipes										
60" Diam RCP pipe, class 4	LF	245.00	160.00	39,200						
60" Diam flared end section and trash guard	Ea	1200	4.00	4,800						
Ladder, Wall Mounted or Vertical Grab Bars										
Ladder, Steel, 18" Wide, Bolted to Concrete	VLF	45	84.00	3,780						
Galvanized Steel	LB	0.65	420.00	273						
1/2" Anchor Bolts, x 5.25"	EA	12	40.00	480						
Fabricated Roof Hatch										
Hatches(2-4'x4.5', 2-3'x2.5', 2-3'x4')	EA	2000	6.00	12,000						
Stop Logs										
Extruded Aluminum Tube, 4"x6", 6' long, 70 stc	LB	5	2,520.00	12,600						
Neoprene Pads	SF	10	138.60	1,386						
Stop Logs Grooves and Sill										
Plates	LB	0.45	750.00	338						
Neoprene Pads	SF	10	18.00	180						
Stainless Anchors, 6" long	EA	40	104.00	4,160						
Fence										
6' high barbed wires fence	LF	15.00	112.00	1,680						
8' wide Fence Gate	EA	400.00	1.00	400						
Additional Items										
60"x60" Sluice Gates	EA	60,000.00	4.00	240,000						
Pumps., 5000 GPM Each	LS	150,000.00	2.00	300,000						
Interior Electrical work.	LS	60,000.00	1.00	60,000						
Other Pump Station Features	LS	50,000.00	1.00	50,000						
Power Supply	LS	30,000.00	1.00	30,000						
Storm Sewer System				925,375		310,574		140,122		140,121.96
Manhole/Catchbasin	EA	5,000.00	6.00	30,000	3.00	15,000				

	Units	Unit Price	Alternate 1 Quantity	Alternate 1 Amount	Alternate 2 Quantity	Alternate 2 Amount	Alternate 3 Quantity	Alternate 3 Amount	Alternate 4 Quantity	Alternate 4 Amount
Total Project Cost				8,532,000		6,377,000		4,333,000		4,767,000
				1.00		0.75		0.51		0.56
12" RCP	LF	24.00	79.93	1,918	79.93	1,918				
16" RCP	LF	36.00	512.58	18,453	307.80	11,081				
18" RCP	LF	50.00	805.97	40,299	805.97	40,299				
21" RCP	LF	66.00	1,365.18	90,102	1,097.18	72,414				
24" RCP	LF	88.00	712.07	62,662						
33" RCP	LF	**120.00**	616.36	73,963						
36" RCP	LF	**165.00**	1,004.77	165,787						
36" Flared End Section	EA	**500.00**	2.00	1,000	2.00	1,000				
Filled or Removed Storm Sewer	LF	25.00	1,636.25	40,906	668.39	16,710				
Culverts Crossing Levee	LF	88.00	209.04	18,395	72.34	6,366	77.04	6,779	77.04	6,779.52
Closure Structure	EA	118,108.76	3.00	354,326	1.00	118,109	1.00	118,109	1.00	118,108.76
Interior Culverts	LF	55.00	276.98	15,234	276.98	15,234	276.98	15,234	276.98	15,233.68
Replaced Culvert Length	LF	25.00	493.17	12,329	497.79	12,445				
Gatewell At (Sta:0+00.00) Invert Elev. 887.00				118,109		118,109		118,109		118,108.76
Site Preparation										
Structural Excavation	CY	6.00	426.67	2,560	426.67	2,560	426.67	2,560	426.67	2,560.00
Backfill Material from Excavation	CY	7.00	534.07	3,739	534.07	3,739	534.07	3,739	534.07	3,738.52
Base Slab Concrete				1,872		1,872		1,872		1,872.35
Forms	SF	8.00	48.00	384	48.00	384	48.00	384	48.00	384.00
Reinforcing	LBS	0.55	757.01	416	757.01	416	757.01	416	757.01	416.35
Concrete	CY	150.00	5.33	800	5.33	800	5.33	800	5.33	800.00
Finished Surface (Float Finish)	SF	1.00	144.00	144	144.00	144	144.00	144	144.00	144.00
Curing Surface	SF	**0.50**	144.00	72	144.00	72	144.00	72	144.00	72.00
Construction Joint Surface Treatment	SF	2.00	28.00	56	28.00	56	28.00	56	28.00	56.00
Wall Concrete				17,428		17,428		17,428		17,428.17
Forms	SF	12.00	980.00	11,760	980.00	11,760	980.00	11,760	980.00	11,760.00
Reinforcing	LBS	**0.55**	3,148.19	1,732	3,148.19	1,732	3,148.19	1,732	3,148.19	1,731.51
Concrete	CY	220.00	16.67	3,667	16.67	3,667	16.67	3,667	16.67	3,666.67
Curing Surface	SF	**0.50**	456.00	228	456.00	228	456.00	228	456.00	228.00
Construction Joint Surface Treatment	SF	**2.00**	21.00	42	21.00	42	21.00	42	21.00	42.00
Elevated Slab Concrete				583		583		583		583.22
Forms	SF	**12.00**	22.50	270	22.50	270	22.50	270	22.50	270.00
Reinforcing	LBS	**0.55**	129.33	71	129.33	71	129.33	71	129.33	71.13
Concrete	CY	**250.00**	0.83	208	0.83	208	0.83	208	0.83	208.33
Finish Top Surface, Steel Trowel	SF	**1.00**	22.50	23	22.50	23	22.50	23	22.50	22.50
Curing Surface	SF	0.50	22.50	11	22.50	11	22.50	11	22.50	11.25
RCP Pipes										
60" Diam RCP Pipe, class 4	LF	**245.00**	100.00	24,500	100.00	24,500	100.00	24,500	100.00	24,500.00
60" Diam RCP Pipe End Section, class 4	Each	**1,200.00**	2.00	2,400	2.00	2,400	2.00	2,400	2.00	2,400.00
Gratings										
Grating, serrated	SF	4.00	24.50	98	24.50	98	24.50	98	24.50	98.00
Framing Angle, Steel, Galvanized	LB	1.00	196.00	196	196.00	196	196.00	196	196.00	196.00
Headed Studs, Welded to Framing Angle, 3/8" Dia	EA	**4.00**	20.00	80	20.00	80	20.00	80	20.00	80.00

Total Project Cost				8,532,000		6,377,000		4,333,000		4,767,000
				1.00		0.75		0.51		0.56
			Alternate 1		Alternate 2		Alternate 3		Alternate 4	
	Units	Unit Price	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
Ladder, Wall Mounted or Vertical Grab Bars										
Galvanized Steel Ladder bolted to Concrete	LF	**45.00**	20.00	900	20.00	900	20.00	900	20.00	900.00
1/2" Anchor Bolts, x 5"	EA	**12.00**	14.00	168	14.00	168	14.00	168	14.00	168.00
Sluice Gate										
60"x60" Sluice Gates	Each	60,000.00	1.00	60,000	1.00	60,000	1.00	60,000	1.00	60,000.00
Stoplog Panel and grooves										
4x6x1/4-5.5ft long aluminum tube stoplogs	EA	**65.00**	35.00	2,275	35.00	2,275	35.00	2,275	35.00	2,275.00
Sill Chanel and frame, Galvanized steel	LB	1.00	237.50	238	237.50	238	237.50	238	237.50	237.50
Anchors, 16" long	EA	**10.00**	6.00	60	6.00	60	6.00	60	6.00	60.00
1/2" Anchor Bolts, x 5"	EA	**12.00**	26.00	312	26.00	312	26.00	312	26.00	312.00
Fence										
6' high fence	LF	15.00	30.00	450	30.00	450	30.00	450	30.00	450.00
Personnel gate, 3.5' wide	EA	**250.00**	1.00	250	1.00	250	1.00	250	1.00	250.00
GatewellAt (Sta:34+38.00) Invert Elev. 887.76				0		118,109		0		0.00
Site Preparation										
Structural Excavation	CY	**6.00**			426.67	2,560				
Backfill Material from Excavation	CY	**7.00**			534.07	3,739				
Base Slab Concrete										
Forms	SF	8.00			48.00	384				
Reinforcing	LBS	0.55			757.01	416				
Concrete	CY	150.00			5.33	800				
Finished Surface (Float Finish)	SF	**1.00**			144.00	144				
Curing Surface	SF	**0.50**			144.00	72				
Construction Joint Surface Treatment	SF	2.00			**28.00**	56				
Wall Concrete										
Forms	SF	**12.00**			980.00	11,760				
Reinforcing	LBS	**0.55**			3,148.19	1,732				
Concrete	CY	**220.00**			16.67	3,667				
Curing Surface	SF	**0.50**			456.00	228				
Construction Joint Surface Treatment	SF	**2.00**			21.00	42				
Elevated Slab Concrete										
Forms	SF	12.00			22.50	270				
Reinforcing	LBS	0.55			129.33	71				
Concrete	CY	250.00			0.83	208				
Finish Top Surface, Steel Trowel	SF	1.00			22.50	23				
Curing Surface	SF	0.50			22.50	11				
RCP Pipes										
60" Diam RCP Pipe, class 4	LF	245.00			100.00	24,500				
60" Diam RCP Pipe End Section, class 4	Each	1,200.00			2.00	2,400				
Gratings										
Grating, serrated	SF	4.00			24.50	98				
Framing Angle, Steel, Galvanized	LB	1.00			196.00	196				
Headed Studs, Welded to Framing Angle, 3/8" Dia	EA	4.00			20.00	80				

Total Project Cost				8,532,000		6,377,000		4,333,000		4,767,000
				1.00		0.75		0.51		0.56
			Alternate 1		Alternate 2		Alternate 3		Alternate 4	
	Units	Unit Price	Quantity	Amount	Quantity	Amount	Quantity	Amount	Quantity	Amount
Ladder, Wall Mounted or Vertical Grab Bars										
Galvanized Steel Ladder bolted to Concrete	LF	**45.00**			20.00	900				
1/2" Anchor Bolts, x 5"	EA	12.00			14.00	168				
Sluice Gate										
60"x60" Sluice Gates	Each	60,000.00			1.00	60,000				
Stoplog Panel and grooves										
4x6x1/4-5.5ft long aluminum tube stoplogs	EA	65.00			35.00	2,275				
Sill Chanel and frame, Galvanized steel	LB	1.00			237.50	238				
Anchors, 16" long	EA	10.00			6.00	60				
1/2" Anchor Bolts, x 5"	EA	12.00			26.00	312				
Fence										
6' high fence	LF	15.00			30.00	450				
Personnel gate, 3.5' wide	EA	250.00			1.00	250				
Planning, Engineering and Design	LS									

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX H

REAL ESTATE PLAN

SECTION 205 FEASIBILITY REPORT
ADA, MINNESOTA
REAL ESTATE PLAN

(the Real Estate Plan will be included in the Final Feasibility Report)

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX I

NED SCREENING COST ESTIMATE

	ADA FLOOD DAMAGE REDUCTION PROJECT					50 YEAR				100 YEAR				200 YEAR				200 YEAR WITH EAST OPTION				200 YEAR WITH WEST OPTION				200 YEAR WITH NORTHWEST OPTION				500 YEAR		
	NED Analysis		Unit Price			5,530,000	1,310,000	6,840,000		5,880,000	1,400,000	7,270,000		6,190,000	1,480,000	7,670,000		6,200,000	1,930,000	7,670,000		6,180,000	1,920,000	7,660,000		6,180,000	1,920,000	7,650,000		7,200,000	1,700,000	8,910,000
	Description of Work	Unit	Most Likely	Contingency %	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total
1	Lands and Damages	$$	1	15%	711,460	711,460	106,719	818,179	715,105	715,105	107,266	822,371	718,210	718,210	107,732	825,942	723,427	723,427	108,514	831,942	729,949	729,949	109,492	839,442	718,210	718,210	107,732	825,942	1,006,961	1,006,961	151,044	1,158,005
1																																
2	Relocations							83,866				104,335				105,961				105,969				105,870				105,902				109,753
2	Waterline, 1.25" PVC	LF	32	25%	225	7,200	1,800	9,000	225	7,200	1,800	9,000	225	7,200	1,800	9,000	225	7,200	1,800	9,000	225	7,200	1,800	9,000	225	7,200	1,800	9,000	225	7,200	1,800	9,000
2	Fiber Optic Cable	LF	10000	25%	1	10,000	2,500	12,500	1	10,000	2,500	12,500	1	10,000	2,500	12,500	1	10,000	2,500	12,500	1	10,000	2,500	12,500	1	10,000	2,500	12,500	1	10,000	2,500	12,500
2	Power Poles	EA	5000	25%	6	30,000	7,500	37,500	9	45,000	11,250	56,250	9	45,000	11,250	56,250	9	45,000	11,250	56,250	9	45,000	11,250	56,250	9	45,000	11,250	56,250	9	45,000	11,250	56,250
2	Unknown Relocations	LS	0.50%	25%	3,978,592	19,893	4,973	24,866	4,253,645	21,268	5,317	26,585	4,513,765	22,569	5,642	28,211	4,515,064	22,575	5,644	28,219	4,499,280	22,496	5,624	28,120	4,504,282	22,521	5,630	28,152	5,120,457	25,602	6,401	32,003
2																																
8	Roads, Railroads, and Bridges					1,158,618	289,655	1,448,273		1,260,322	315,081	1,575,403		1,379,036	344,759	1,723,796		1,379,036	344,759	1,723,796		1,379,036	344,759	1,723,796		1,379,036	344,759	1,723,796		1,484,664	371,166	1,855,830
8	Site Preparation					198,029	49,507	247,536		209,733	52,433	262,166		238,447	59,612	298,059		238,447	59,612	298,059		238,447	59,612	298,059		238,447	59,612	298,059		245,117	61,279	306,396
8	Top of Road	Elev			1,808				1,808				1,812				1,812				1,812				1,812				1,814			
8	Existing Ground Surface Elevation	Elev			1,802				1,802				1,802				1,802				1,802				1,802				1,802			
8	Bottom of Excavation Elevation	Elev			1,760				1,760				1,760				1,760				1,760				1,760				1,760			
8	Excavation for Box Culverts and wing	CY	6	25%	16,119	96,714	24,179	120,893	17,067	102,402	25,601	128,003	18,015	108,090	27,023	135,113	18,015	108,090	27,023	135,113	18,015	108,090	27,023	135,113	18,015	108,090	27,023	135,113	18,548	111,288	27,822	139,110
8	Side Slopes 1 Vertical to X Horizonta	Slope																														
8	Backfill Material	CY	7	25%	12,770	89,390	22,348	111,738	13,333	93,331	23,333	116,664	16,326	114,282	28,571	142,853	16,326	114,282	28,571	142,853	16,326	114,282	28,571	142,853	16,326	114,282	28,571	142,853	16,822	117,754	29,439	147,193
8	Drainage Material Between Box Culve	CY	25	25%	477	11,925	2,981	14,906	560	14,000	3,500	17,500	643	16,075	4,019	20,094	643	16,075	4,019	20,094	643	16,075	4,019	20,094	643	16,075	4,019	20,094	643	16,075	4,019	20,094
8																																
8	Precast Box Culverts and Walls					933,749	233,437	1,167,187		1,023,749	255,937	1,279,687		1,113,749	278,437	1,392,187		1,113,749	278,437	1,392,187		1,113,749	278,437	1,392,187		1,113,749	278,437	1,392,187		1,212,443	303,111	1,515,554
8	Three 12'x12' box culverts	FT	1500	25%	345	517,500	129,375	646,875	405	607,500	151,875	759,375	465	697,500	174,375	871,875	465	697,500	174,375	871,875	465	697,500	174,375	871,875	465	697,500	174,375	871,875	501	751,500	187,875	939,375
8	RC Concrete cut off walls	CY	250	25%	37	9,250	2,313	11,563	37	9,250	2,313	11,563	37	9,250	2,313	11,563	37	9,250	2,313	11,563	37	9,250	2,313	11,563	37	9,250	2,313	11,563	37	9,250	2,313	11,563
8	RC Concrete Wing wall's slab	CY	200	25%	604	120,800	30,200	151,000	604	120,800	30,200	151,000	604	120,800	30,200	151,000	604	120,800	30,200	151,000	604	120,800	30,200	151,000	604	120,800	30,200	151,000	684	136,800	34,200	171,000
8	RC Concrete Wing wall's wall	CY	250	25%	403	100,750	25,188	125,938	403	100,750	25,188	125,938	403	100,750	25,188	125,938	403	100,750	25,188	125,938	403	100,750	25,188	125,938	403	100,750	25,188	125,938	456	114,000	28,500	142,500
8	Cut off wall reinforcement	LB	0.65	25%	3,651	2,373	593	2,966	3,651	2,373	593	2,966	3,651	2,373	593	2,966	3,651	2,373	593	2,966	3,651	2,373	593	2,966	3,651	2,373	593	2,966	3,651	2,373	593	2,966
8	Slabs reinforcement	LB	0.55	25%	40,520	22,286	5,572	27,858	40,520	22,286	5,572	27,858	40,520	22,286	5,572	27,858	40,520	22,286	5,572	27,858	40,520	22,286	5,572	27,858	40,520	22,286	5,572	27,858	45,230	24,877	6,219	31,096
8	Wing walls reinforcement	LB	0.65	25%	36,465	23,702	5,926	29,628	36,465	23,702	5,926	29,628	36,465	23,702	5,926	29,628	36,465	23,702	5,926	29,628	36,465	23,702	5,926	29,628	36,465	23,702	5,926	29,628	41,027	26,668	6,667	33,334
8	Slab's formwork	SF	8	25%	3,216	25,728	6,432	32,160	3,216	25,728	6,432	32,160	3,216	25,728	6,432	32,160	3,216	25,728	6,432	32,160	3,216	25,728	6,432	32,160	3,216	25,728	6,432	32,160	3,360	26,880	6,720	33,600
8	Walls' formwork	SF	12	25%	9,280	111,360	27,840	139,200	9,280	111,360	27,840	139,200	9,280	111,360	27,840	139,200	9,280	111,360	27,840	139,200	9,280	111,360	27,840	139,200	9,280	111,360	27,840	139,200	10,008	120,096	30,024	150,120
8																																
8	Handrail																															
8	Handrail galvanized 1.5" Diam. Pipes	LB	2	25%	3,520	7,040	1,760	8,800	3,520	7,040	1,760	8,800	3,520	7,040	1,760	8,800	3,520	7,040	1,760	8,800	3,520	7,040	1,760	8,800	3,520	7,040	1,760	8,800	3,652	7,304	1,826	9,130
8	Hwy Guardrail	LF	45	25%	440	19,800	4,950	24,750	440	19,800	4,950	24,750	440	19,800	4,950	24,750	440	19,800	4,950	24,750	440	19,800	4,950	24,750	440	19,800	4,950	24,750	440	19,800	4,950	24,750
8																																
9	Channels and Canals					1,290,778	322,695	1,613,473		1,109,616	277,404	1,387,020		1,086,360	271,590	1,357,950		1,076,931	719,958	1,346,163		1,001,618	701,130	1,252,023		1,052,559	713,865	1,315,698		891,674	222,918	1,114,592
9	Channels																															
9	Excavation, Load, Shape Channel	BCY	0.98	25%	259,740	254,647	63,662	318,309	259,740	254,647	63,662	318,309	259,740	254,647	63,662	318,309	259,740	254,647	514,387	318,309	259,740	254,647	514,387	318,309	259,740	254,647	514,387	318,309	259,740	254,647	63,662	318,309
	Excavation, Haul out of channel and a	BCY	0.98	25%	259,740	254,647	63,662	318,309	259,740	254,647	63,662	318,309	259,740	254,647	63,662	318,309	259,740	254,647	63,662	318,309	259,740	254,647	63,662	318,309	259,740	254,647	63,662	318,309	259,740	254,647	63,662	318,309
	Exc Below Groundwater Line, Dewate	BCY	0.25	25%	62,338	15,584	3,896	19,481	62,338	15,584	3,896	19,481	62,338	15,584	3,896	19,481	62,338	15,584	3,896	19,481	62,338	15,584	3,896	19,481	62,338	15,584	3,896	19,481	62,338	15,584	3,896	19,481
	Usable Exc Below GW Line	**BCY**			**56,104**				**56,104**				**56,104**				**56,104**				**56,104**				**56,104**				**56,104**			
	Exc Above Groundwater Line	BCY			197,402				197,402				197,402				197,402				197,402				197,402				197,402			
	Usable Exc Above GW Line	BCY			177,662				177,662				177,662				177,662				177,662				177,662				177,662			
	Required for Levees	ECY			76,621				125,224				154,151				**155,233**				**175,407**				**161,529**				243,269			
	Required for Levees	BCY			87,069				142,300				175,172				176,401				199,327				183,556				276,442			
	Above GW Exc used for Levees	BCY			87,069				142,300				175,172				176,401				177,662				177,662				177,662			
	Below GW EXC used for Levees, Dr	**BCY**	**1.00**	**25%**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**21,664**	**21,664**	**5,416**	**27,081**	**5,894**	**5,894**	**1,473**	**7,367**	**56,104**	**56,104**	**14,026**	**70,130**
	Above GW Exc to be Disposed	BCY			110,333				55,102				22,231				21,001				19,740				19,740				19,740			
	Below GW EXC to be Disposed	BCY			62,338				62,338				62,338				62,338				40,673				56,444				6,234			
	Exc to be disposed, shaped at Dispos	BCY	1.55	25%	172,671	267,640	66,910	334,549	117,440	182,032	45,508	227,540	84,568	131,081	32,770	163,851	83,339	125,008	31,252	156,260	60,413	90,620	22,655	113,275	76,184	114,276	28,569	142,845	25,974	40,260	10,065	50,325
	Exc to be disposed, haul distance	MI	0.87	2	2				2				2				2				2				2				2			
	Exc to be disposed, haul distance	BCY	1.73	25%	172,671	298,738	74,685	373,423	117,440	203,183	50,796	253,979	84,568	146,312	36,578	182,890	83,339	144,185	36,046	180,231	60,413	104,522	26,130	130,652	76,184	131,806	32,952	164,758	25,974	44,938	11,234	56,172
	Disposal Area Site Prep and Restor	ECY	1.00	25%	2	2	1	3	2	2	1	3	84,568	84,568	21,142	105,711	83,339	83,339	20,835	104,174	60,413	60,413	15,103	75,517	76,184	76,184	19,046	95,230	25,974	25,974	6,494	32,468

ADA FLOOD DAMAGE REDUCTION PROJECT				50 YEAR				100 YEAR			
NED Analysis		Unit Price			5,530,000	1,310,000	6,840,000		5,880,000	1,400,000	7,270,000
Description of Work	Unit	Most Likely	Contingency %	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total
Total levee fill from JD 51	BCY										
Levee fill required from off site	BCY										
	ecy w/co 1.08131										
9 Topsoil	CY	16	25%	12,470	199,520	49,880	249,400	12,470	199,520	49,880	249,400
9											
11 Levees and Floodwalls					1,529,195	382,299	1,911,494		1,883,707	470,927	2,354,633
11 Levees					685,153	171,288	1,284,629		1,004,232	251,058	1,691,603
11 Fill, Spread and Compact	ECY	2	25%	76,621	153,242	38,311	191,553	125,224	250,448	62,612	313,060
Levee Haul Costs							98,560				138,950
Load off site fill	ECY	0.5	25%	0				0			
Levee fill required from off site	**ECY**			**0**				**0**			
Haul Distance	MI	0.87		3				3			
Cubic Yard Mile	CYM	0.87	25%	0	0	0	0	0	0	0	0
Levee 1 Haull	**ECY**		25%	**12,359**				**22,431**			
Haul Distance	MI	0.87		1				1			
Cubic Yard Mile	CYM	0.87	25%	12,359	10,691	2,673	13,364	22,431	19,404	4,851	24,255
Road Raise at Levee 1 and 2	**ECY**		25%	**978**				**1,245**			
Haul Distance	MI	0.87		1				1			
Cubic Yard Mile	CYM	0.87	25%	978	846	211	1,057	1,245	1,077	269	1,346
Road raise Levee 1	**ECY**		25%					**2,812**			
Haul Distance	MI	0.87		1.33				1.33			
Cubic Yard Mile	CYM	0.87	25%	0	0	0	0	3,728	3,225	806	4,031
Levee 2	**ECY**		25%	**30,322**				**37,674**			
Haul Distance	MI	0.87		2.05				2.05			
Cubic Yard Mile	CYM	0.87	25%	62,022	53,652	13,413	67,065	77,060	66,660	16,665	83,326
Road Raise Over Levee 2	**ECY**		25%	**318**				**448**			
Haul Distance	MI	0.87		1.53				1.53			
Cubic Yard Mile	CYM	0.87	25%	488	422	105	527	688	595	149	744
Levee 3	**ECY**		25%	**2,260**				**3,912**			
Haul Distance	MI	0.87		2.39				2.39			
Cubic Yard Mile	CYM	0.87	25%	5,393	4,665	1,166	5,831	9,336	8,076	2,019	10,095
Road Raise 5 Levee 3	**ECY**		25%	**4,145**				**5,840**			
Haul Distance	MI	0.87		2.39				2.39			
Cubic Yard Mile	CYM	0.87	25%	9,890	8,556	2,139	10,695	13,936	12,055	3,014	15,069
Road Raise 4 Levee 3	**ECY**		25%								
Haul Distance	MI	0.87									
Cubic Yard Mile	CYM	0.87	25%	0	0	0	0	0	0	0	0
Levee 7	**ECY**		25%	**24,458**				**43,880**			
Haul Distance	MI	0.87		0				0			
Cubic Yard Mile	CYM	0.87	25%	0	0	0	0	0	0	0	0
West Option											
Haul Distance	MI	0.87									
Cubic Yard Mile	CYM	0.87	25%								
Road Raise at Intersection	**ECY**		25%	**1,706**				**6,670**			
Haul Distance	MI	0.87		0				0			
Cubic Yard Mile	CYM	0.87	25%	0	0	0	0	0	0	0	0
Levee 8	**ECY**		25%	**76**				**312**			
Haul Distance	MI	0.87	0.25	0.25				0.25			
Cubic Yard Mile	CYM	0.87	25%	19	16	4	21	78	67	17	84
11 Topsoil	CY	4	25%	11,207	44,828	11,207	56,035	14,933	59,732	14,933	74,665

ADA FLOOD DAMAGE REDUCTION PROJECT	200 YEAR				200 YEAR WITH EAST OPTION			
NED Analysis		6,190,000	1,480,000	7,670,000		6,200,000	1,930,000	7,670,000
Description of Work	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total
Total levee fill from JD 51	175,172				176,401			
Levee fill required from off site	0				0			
9 Topsoil	12,470	199,520	49,880	249,400	12,470	199,520	49,880	249,400
11 Levees and Floodwalls		2,048,369	512,092	2,560,461		2,059,097	514,774	2,573,871
11 Levees		1,146,835	286,709	1,869,856		1,157,563	289,391	1,883,266
11 Fill, Spread and Compact	154,151	308,302	77,076	385,378	**155,233**	310,466	77,617	388,083
Levee Haul Costs				175,002	155,233			175,293
Load off site fill	0				0			
Levee fill required from off site	**0**				**0**			
Haul Distance	3				3			
Cubic Yard Mile	0	0	0	0	0	0	0	0
Levee 1 Haull	**32,716**				**32,716**			
Haul Distance	1				1			
Cubic Yard Mile	32,716	28,301	7,075	35,376	32,716	28,301	7,075	35,376
Road Raise at Levee 1 and 2	**1,705**				**1,705**			
Haul Distance	1				1			
Cubic Yard Mile	1,705	1,475	369	1,843	1,705	1,475	369	1,843
Road raise Levee 1	**4,488**				**4,488**			
Haul Distance	1.33				1.33			
Cubic Yard Mile	5,950	5,147	1,287	6,434	5,950	5,147	1,287	6,434
Levee 2	**43,855**				**43,855**			
Haul Distance	2.05				2.05			
Cubic Yard Mile	89,704	77,598	19,400	96,998	89,704	77,598	19,400	96,998
Road Raise Over Levee 2	**543**				**543**			
Haul Distance	1.53				1.53			
Cubic Yard Mile	833	721	180	901	833	721	180	901
Levee 3	**5,800**				**5,800**			
Haul Distance	2.39				2.39			
Cubic Yard Mile	13,842	11,974	2,993	14,967	13,842	11,974	2,993	14,967
Road Raise 5 Levee 3	**7,128**				**7,128**			
Haul Distance	2.39				2.39			
Cubic Yard Mile	17,010	14,715	3,679	18,394	17,010	14,715	3,679	18,394
Road Raise 4 Levee 3								
Haul Distance								
Cubic Yard Mile	0	0	0	0	0	0	0	0
Levee 7	**46,779**				**46,779**			
Haul Distance	0.54				0			
Cubic Yard Mile	1	1	0	1	0	0	0	0
West Option								
Haul Distance								
Cubic Yard Mile								
Road Raise at Intersection	**10,811**				**10,811**			
Haul Distance	0				0			
Cubic Yard Mile	0	0	0	0	0	0	0	0
Levee 8	**325**				**1,407**			
Haul Distance	0.25				0.25			
Cubic Yard Mile	81	70	18	88	352	304	76	380
11 Topsoil	16,850	67,400	16,850	84,250	17,186	68,745	17,186	85,932

ADA FLOOD DAMAGE REDUCTION PROJECT	200 YEAR WITH WEST OPTION				200 YEAR WITH NORTHWEST OPTION				500 YEAR			
NED Analysis		6,180,000	1,920,000	7,660,000		6,180,000	1,920,000	7,650,000		7,200,000	1,700,000	8,910,000
Description of Work	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total
Total levee fill from JD 51	199,327				183,556				233,766			
Levee fill required from off site	0				0				42,676			
9 Topsoil	12,470	199,520	49,880	249,400	12,470	199,520	49,880	249,400	12,470	199,520	49,880	249,400
11 Levees and Floodwalls		2,118,625	529,656	2,648,282		2,072,687	518,172	2,590,859		2,744,119	686,030	3,430,148
11 Levees		1,217,091	304,273	1,957,677		1,171,153	292,788	1,900,254		1,803,353	450,838	2,690,504
11 Fill, Spread and Compact	**175,407**	350,815	87,704	438,518	**161,529**	323,059	80,765	403,823	243,269	486,538	121,635	608,173
Levee Haul Costs	175,407			197,850	161,529			182,980	277,103			476,555
Load off site fill	0				0				37,555	18,777	4,694	23,472
Levee fill required from off site	**0**				**0**				**37,555**			
Haul Distance	3				3				3			
Cubic Yard Mile	0	0	0	0	0	0	0	0	112,665	97,461	24,365	121,826
Levee 1 Haull	**31,396**				**40,095**				**45,032**			
Haul Distance	1				1				1			
Cubic Yard Mile	31,396	27,159	6,790	33,949	40,095	34,684	8,671	43,355	45,032	38,955	9,739	48,694
Road Raise at Levee 1 and 2	**1,705**				**1,705**				**3,522**			
Haul Distance	1				1				1			
Cubic Yard Mile	1,705	1,475	369	1,843	1,705	1,475	369	1,843	3,522	3,047	762	3,809
Road raise Levee 1	**11,753**				**4,488**				**7,479**			
Haul Distance	1.33				1.33				1.33			
Cubic Yard Mile	15,582	13,479	3,370	16,849	5,950	5,147	1,287	6,434	9,916	8,578	2,144	10,722
Levee 2	**41,471**				**43,855**				**56,188**			
Haul Distance	2.05				2.05				2.05			
Cubic Yard Mile	84,826	73,379	18,345	91,724	89,704	77,598	19,400	96,998	114,930	99,420	24,855	124,275
Road Raise Over Levee 2	**543**				**543**				**5,436**			
Haul Distance	1.53				1.53				1.53			
Cubic Yard Mile	833	721	180	901	833	721	180	901	8,339	7,214	1,804	9,018
Levee 3	**5,800**				**5,800**				**39,551**			
Haul Distance	2.39				2.39				2.39			
Cubic Yard Mile	13,842	11,974	2,993	14,967	13,842	11,974	2,993	14,967	94,384	81,647	20,412	102,059
Road Raise 5 Levee 3	**7,128**				**7,128**				**8,847**			
Haul Distance	2.39				2.39				2.39			
Cubic Yard Mile	17,010	14,715	3,679	18,394	17,010	14,715	3,679	18,394	21,112	18,263	4,566	22,829
Road Raise 4 Levee 3									**3,721**			
Haul Distance									2			
Cubic Yard Mile	0	0	0	0	0	0	0	0	8,893	7,693	1,923	9,617
Levee 7	**46,779**				**46,779**				**59,593**			
Haul Distance	0				0				0			
Cubic Yard Mile	0	0	0	0	0	0	0	0	0	0	0	0
West Option	**17,696**											
Haul Distance	1											
Cubic Yard Mile	17,696	15,308	3,827	19,135								
Road Raise at Intersection	**10,811**				**10,811**				**13,029**			
Haul Distance	0.00				0				0			
Cubic Yard Mile	0	0	0	0	0	0	0	0	0	0	0	0
Levee 8	325				**325**				**869**			
Haul Distance	0.25				0.25				0.25			
Cubic Yard Mile	81	70	18	88	81	70	18	88	217	188	47	235
11 Topsoil	18,075	72,299	18,075	90,374	17,309	69,236	17,309	86,545	24,334	97,336	24,334	121,670

	ADA FLOOD DAMAGE REDUCTION PROJECT				50 YEAR				100 YEAR				200 YEAR				200 YEAR WITH EAST OPTION				200 YEAR WITH WEST OPTION				200 YEAR WITH NORTHWEST OPTION				500 YEAR			
	NED Analysis		Unit Price			5,530,000	1,310,000	6,840,000		5,880,000	1,400,000	7,270,000		6,190,000	1,480,000	7,670,000		6,200,000	1,930,000	7,670,000		6,180,000	1,920,000	7,660,000		6,180,000	1,920,000	7,650,000		7,200,000	1,700,000	8,910,000
	Description of Work	Unit	Most Likely	Contingency %	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total
11	Stripping	CY	3	25%	16,467	49,401	12,350	61,751	20,917	62,751	15,688	78,439	24,708	74,124	18,531	92,655	25,213	75,640	18,910	94,550	25,402	76,207	19,052	95,258	25,361	76,083	19,021	95,103	35,263	105,789	26,447	132,236
11	Inspection Trench	LF	4	25%	22,424	89,696	22,424	112,120	22,848	91,392	22,848	114,240	24,403	97,612	24,403	122,015	25,763	103,054	25,763	128,817	25,017	100,068	25,017	125,084	24,249	96,998	24,249	121,247	29,111	116,444	29,111	145,555
11	Pavement Removal	SF	1	25%	83,513	83,513	20,878	104,391	133,069	133,069	33,267	166,336	142,580	142,580	35,645	178,225	142,580	142,580	35,645	178,224	142,580	142,580	35,645	178,224	142,580	142,580	35,645	178,225	191,187	191,187	47,797	238,984
11	2" Wear Course	CY	90	25%	516	46,440	11,610	58,050	821	73,890	18,473	92,363	880	79,200	19,800	99,000	880	79,211	19,803	99,014	880	79,211	19,803	99,014	880	79,200	19,800	99,000	1,180	106,200	26,550	132,750
11	4" Base Course	CY	90	25%	1,031	92,790	23,198	115,988	1,643	147,870	36,968	184,838	1,760	158,400	39,600	198,000	1,760	158,422	39,605	198,027	1,760	158,422	39,605	198,027	1,760	158,400	39,600	198,000	2,360	212,400	53,100	265,500
11	12" Aggegate Base	CY	15	25%	3,093	46,395	11,599	57,994	4,928	73,920	18,480	92,400	5,281	79,215	19,804	99,019	5,281	79,211	19,803	99,014	5,281	79,211	19,803	99,014	5,281	79,215	19,804	99,019	7,081	106,215	26,554	132,769
11	**12" RCP**	LF	55	25%	5550	305,250	76,313	381,563	5550	305,250	76,313	381,563	5550	305,250	76,313	381,563	5550	305,250	76,313	381,563	5,550	305,250	76,313	381,563	5550	305,250	76,313	381,563	5550	305,250	76,313	381,563
11	**Catch Basins**	EA	4000	25%	7	28,000	7,000	35,000	7	28,000	7,000	35,000	7	28,000	7,000	35,000	7	28,000	7,000	35,000	7	28,000	7,000	35,000	7	28,000	7,000	35,000	7	28,000	7,000	35,000
11	12" RCP, Driveway Culverts	LF	50	25%	186	9,300	2,325	11,625	316	15,800	3,950	19,750	316	15,800	3,950	19,750	316	15,800	3,950	19,750	316	15,800	3,950	19,750	316	15,800	3,950	19,750	316	15,800	3,950	19,750
11																																
11	Gatewells							626,865				663,031				690,605				690,605				690,605				690,605				739,644
11	Additional 3 Gatewells and outlets	LS	0.28571	25%	390,049	111,443	27,861	139,303	412,552	117,872	29,468	147,340	429,710	122,774	30,694	153,468	429,710	122,774	30,694	153,468	429,710	122,774	30,694	153,468	429,710	122,774	30,694	153,468	460,223	131,492	32,873	164,365
11	Site Preparation							34,215				42,044				42,854				42,854				42,854				42,854				51,271
11	New Ground Surface	Elev			6,312				6,319				6,326				6,326				6,326				6,326				6,335			
11	Existing Ground Surface Elevation	Elev			6,305				6,308				6,312				6,312				6,312				6,312				6,312			
11	Bottom of Excavation Elevation	Elev			6,240				6,240				6,232				6,232				6,232				6,232				6,232			
11	Excavation	CY	6	25%	1,790	10,740	2,685	13,425	2,331	13,986	3,497	17,483	2,166	12,996	3,249	16,245	2,166	12,996	3,249	16,245	2,166	12,996	3,249	16,245	2,166	12,996	3,249	16,245	2,166	12,996	3,249	16,245
11	Excavation Length at Bottom	FT			82				82				82				82				82				82				82			
11	Excavation Width at Bottom	FT			75				75				75				75				75				75				75			
11	Side Slopes 1 Vertical to X Horizonta	Slope																														
11	Backfill	CY	7	25%	2,376	16,632	4,158	20,790	2,807	19,649	4,912	24,561	3,041	21,287	5,322	26,609	3,041	21,287	5,322	26,609	3,041	21,287	5,322	26,609	3,041	21,287	5,322	26,609	4,003	28,021	7,005	35,026
11																																
11	Base Slab Concrete							11,606				11,606				12,171				12,171				12,171				12,171				12,171
11	Forms	SF	8	25%	300	2,400	600	3,000	300	2,400	600	3,000	319	2,552	638	3,190	319	2,552	638	3,190	319	2,552	638	3,190	319	2,552	638	3,190	319	2,552	638	3,190
11	Reinforcing	LB	0.55	25%	3,630	1,997	499	2,496	3,630	1,997	499	2,496	3,630	1,997	499	2,496	3,630	1,997	499	2,496	3,630	1,997	499	2,496	3,630	1,997	499	2,496	3,630	1,997	499	2,496
11	Concrete	CY	150	25%	26	3,900	975	4,875	26	3,900	975	4,875	28	4,200	1,050	5,250	28	4,200	1,050	5,250	28	4,200	1,050	5,250	28	4,200	1,050	5,250	28	4,200	1,050	5,250
11	Finished Surface (Float Finish)	SF	1	25%	604	604	151	755	604	604	151	755	604	604	151	755	604	604	151	755	604	604	151	755	604	604	151	755	604	604	151	755
11	Construction Joint Surface Treatment	SF	2	25%	192	384	96	480	192	384	96	480	192	384	96	480	192	384	96	480	192	384	96	480	192	384	96	480	192	384	96	480
11																																
11	Wall Concrete							98,248				107,659				114,872				114,872				114,872				114,872				126,468
11	Forms	SF	12	25%	4,198	50,376	12,594	62,970	4,620	55,440	13,860	69,300	4,850	58,200	14,550	72,750	4,850	58,200	14,550	72,750	4,850	58,200	14,550	72,750	4,850	58,200	14,550	72,750	5,326	63,912	15,978	79,890
11	Reinforcing	LB	0.55	25%	15,546	8,550	2,138	10,688	17,228	9,475	2,369	11,844	17,901	9,846	2,461	12,307	17,901	9,846	2,461	12,307	17,901	9,846	2,461	12,307	17,901	9,846	2,461	12,307	19,983	10,991	2,748	13,738
11	Concrete	CY	220	25%	88	19,360	4,840	24,200	95	20,900	5,225	26,125	107	23,540	5,885	29,425	107	23,540	5,885	29,425	107	23,540	5,885	29,425	107	23,540	5,885	29,425	118	25,960	6,490	32,450
11	Construction Joint Surface Treatment	SF	2	25%	156	312	78	390	156	312	78	390	156	312	78	390	156	312	78	390	156	312	78	390	156	312	78	390	156	312	78	390
11																																
11	Elevated Slab Concrete							6,475				6,475				6,475				6,475				6,475				6,475				6,475
11	Forms	SF	12	25%	185	2,220	555	2,775	185	2,220	555	2,775	185	2,220	555	2,775	185	2,220	555	2,775	185	2,220	555	2,775	185	2,220	555	2,775	185	2,220	555	2,775
11	Reinforcing	LB	0.55	25%	2,372	1,305	326	1,631	2,372	1,305	326	1,631	2,372	1,305	326	1,631	2,372	1,305	326	1,631	2,372	1,305	326	1,631	2,372	1,305	326	1,631	2,372	1,305	326	1,631
11	Concrete	CY	250	25%	6	1,500	375	1,875	6	1,500	375	1,875	6	1,500	375	1,875	6	1,500	375	1,875	6	1,500	375	1,875	6	1,500	375	1,875	6	1,500	375	1,875
11	Finish Top Surface, Steel Trowel	SF	1	25%	155	155	39	194	155	155	39	194	155	155	39	194	155	155	39	194	155	155	39	194	155	155	39	194	155	155	39	194
11																																
11	RCP Pipes							81,250				87,050				97,950				97,950				97,950				97,950				105,375
11	48" Diam RCP Pipe, class 4	LF	240	25%	88	21,120	5,280	26,400	104	24,960	6,240	31,200	112	26,880	6,720	33,600	112	26,880	6,720	33,600	112	26,880	6,720	33,600	112	26,880	6,720	33,600	118	28,320	7,080	35,400
11	48" Diam RCP Pipe End Section, clas	EA	1,440	25%	2	2,880	720	3,600	2	2,880	720	3,600	2	2,880	720	3,600	2	2,880	720	3,600	2	2,880	720	3,600	2	2,880	720	3,600	2	2,880	720	3,600
11	36" Diam RCP Pipe, Use existing	LF	200	25%	88	17,600	4,400	22,000	88	17,600	4,400	22,000	112	22,400	5,600	28,000	112	22,400	5,600	28,000	112	22,400	5,600	28,000	112	22,400	5,600	28,000	123	24,600	6,150	30,750
11	36" Diam RCP Pipe End Section, clas	EA	1,200	25%	8	9,600	2,400	12,000	8	9,600	2,400	12,000	8	9,600	2,400	12,000	8	9,600	2,400	12,000	8	9,600	2,400	12,000	8	9,600	2,400	12,000	8	9,600	2,400	12,000
11	30" Diam RCP Pipe, Class 3	LF	150	25%	56	8,400	2,100	10,500	56	8,400	2,100	10,500	64	9,600	2,400	12,000	64	9,600	2,400	12,000	64	9,600	2,400	12,000	64	9,600	2,400	12,000	76	11,400	2,850	14,250
11	30" Diam RCP Pipe End Section, clas	EA	900	25%	2	1,800	450	2,250	2	1,800	450	2,250	2	1,800	450	2,250	2	1,800	450	2,250	2	1,800	450	2,250	2	1,800	450	2,250	2	1,800	450	2,250
11	24" Diam RCP Pipe, Class 3	LF	100	25%	24	2,400	600	3,000	32	3,200	800	4,000	40	4,000	1,000	5,000	40	4,000	1,000	5,000	40	4,000	1,000	5,000	40	4,000	1,000	5,000	45	4,500	1,125	5,625
11	24" Diam RCP Pipe End Section, clas	EA	600	25%	2	1,200	300	1,500	2	1,200	300	1,500	2	1,200	300	1,500	2	1,200	300	1,500	2	1,200	300	1,500	2	1,200	300	1,500	2	1,200	300	1,500
11																																

	ADA FLOOD DAMAGE REDUCTION PROJECT				50 YEAR				100 YEAR			
	NED Analysis	Unit Price				5,530,000	1,310,000	6,840,000		5,880,000	1,400,000	7,270,000
	Description of Work	Unit	Most Likely	Contingency %	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total
11	Gratings							3,020				3,020
11	Grating, serrated	SF	4.00	25%	159	636	159	795	159	636	159	795
11	Framing Angle, Steel, Galvanized	LB	1.00	25%	1,292	1,292	323	1,615	1,292	1,292	323	1,615
11	Headed Studs, Welded to Framing An	EA	4.00	25%	122	488	122	610	122	488	122	610
11												
11	Ladder, Wall Mounted or Vertical Grab Bars							5,610				5,723
11	Galvanized Steel Ladder bolted to Co	LF	45.00	25%	80	3,600	900	4,500	82	3,690	923	4,613
11	1/2" Anchor Bolts, x 5"	EA	12.00	25%	74	888	222	1,110	74	888	222	1,110
11												
11	Sluice Gate					109,215	27,304	136,519		109,215	27,304	136,519
11	48" Diam. Sluice Gate	EA	23,940	25%	1	23,940	5,985	29,925	1	23,940	5,985	29,925
11	36" Diam. Sluice Gate	EA	15,517	25%	4	62,067	15,517	77,583	4	62,067	15,517	77,583
11	30" Diam. Sluice Gate	EA	12,569	25%	1	12,569	3,142	15,711	1	12,569	3,142	15,711
11	24" Diam. Sluice Gate	EA	10,640	25%	1	10,640	2,660	13,300	1	10,640	2,660	13,300
11												
11	Stoplog Panel and grooves							61,138				66,115
11	4x6x1/4-4.5ft long aluminum tube stop	EA	306.25	25%	146	44,713	11,178	55,891	159	48,694	12,173	60,867
11	Sill Chanel and frame, Galvanized ste	LB	2	25%	1,091	2,182	546	2,728	1,091	2,182	546	2,728
11	Anchors, 16" long	EA	12	25%	42	504	126	630	42	504	126	630
11	1/2" Anchor Bolts, x 5"	EA	12	25%	126	1,512	378	1,890	126	1,512	378	1,890
11												
11	Fence							5,900				5,900
11	6' high fence	LF	15	25%	198	2,970	743	3,713	198	2,970	743	3,713
11	Personnel gate, 3.5' wide	EA	250	25%	7	1,750	438	2,188	7	1,750	438	2,188
11												
11	Remove							43,581				43,581
11	18" CMP	LF	15	25%	73	1,095	274	1,369	73	1,095	274	1,369
11	12" CMP	LF	13	25%	290	3,770	943	4,713	290	3,770	943	4,713
11	48" Wide Control Structure	EA	5000	25%	6	30,000	7,500	37,500	6	30,000	7,500	37,500
11												
11												
30	Planning Engineering and Design	LS	12%	25%	4,045,684	485,482	121,371	606,853	4,337,113	520,454	130,113	650,567
31												
31	Construction Management	LS	7%	25%	4,045,684	283,198	70,799	353,997	4,337,113	303,598	75,899	379,497
31												
31						5,525,825	1,310,310	6,836,135		5,876,270	1,397,557	7,273,827
	Average Annual Operation and Maintenance			0.5%	4,045,684	20,228	5,057	25,286	4,337,113	21,686	5,421	27,107

		200 YEAR				200 YEAR WITH EAST OPTION			
			6,190,000	1,480,000	7,670,000		6,200,000	1,930,000	7,670,000
	Description of Work	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total
11	Gratings				3,020				3,020
11	Grating, serrated	159	636	159	795	159	636	159	795
11	Framing Angle, Steel, Galvanized	1,292	1,292	323	1,615	1,292	1,292	323	1,615
11	Headed Studs, Welded to Framing An	122	488	122	610	122	488	122	610
11									
11	Ladder, Wall Mounted or Vertical Grab Bars				5,723				5,723
11	Galvanized Steel Ladder bolted to Co	82	3,690	923	4,613	82	3,690	923	4,613
11	1/2" Anchor Bolts, x 5"	74	888	222	1,110	74	888	222	1,110
11									
11	Sluice Gate		109,215	27,304	136,519		109,215	27,304	136,519
11	48" Diam. Sluice Gate	1	23,940	5,985	29,925	1	23,940	5,985	29,925
11	36" Diam. Sluice Gate	4	62,067	15,517	77,583	4	62,067	15,517	77,583
11	30" Diam. Sluice Gate	1	12,569	3,142	15,711	1	12,569	3,142	15,711
11	24" Diam. Sluice Gate	1	10,640	2,660	13,300	1	10,640	2,660	13,300
11									
11	Stoplog Panel and grooves				68,074				68,074
11	4x6x1/4-4.5ft long aluminum tube stop	164	50,225	12,556	62,781	164	50,225	12,556	62,781
11	Sill Chanel and frame, Galvanized ste	1,109	2,218	555	2,773	1,109	2,218	555	2,773
11	Anchors, 16" long	42	504	126	630	42	504	126	630
11	1/2" Anchor Bolts, x 5"	126	1,512	378	1,890	126	1,512	378	1,890
11									
11	Fence				5,900				5,900
11	6' high fence	198	2,970	743	3,713	198	2,970	743	3,713
11	Personnel gate, 3.5' wide	7	1,750	438	2,188	7	1,750	438	2,188
11									
11	Remove				43,581				43,581
11	18" CMP	73	1,095	274	1,369	73	1,095	274	1,369
11	12" CMP	290	3,770	943	4,713	290	3,770	943	4,713
11	48" Wide Control Structure	6	30,000	7,500	37,500	6	30,000	7,500	37,500
11									
11									
30	Planning Engineering and Design	4,598,534	551,824	137,956	689,780	4,599,839	551,981	137,995	689,976
31									
31	Construction Management	4,598,534	321,897	80,474	402,372	4,599,839	321,989	80,497	402,486
31									
31			6,190,465	1,475,795	7,666,261		6,197,236	1,927,692	7,674,203
	Average Annual Operation and Maintenance	4,598,534	22,993	5,748	28,741	4,599,839	22,999	5,750	28,749

		200 YEAR WITH WEST OPTION				200 YEAR WITH NORTHWEST OPTION				500 YEAR			
			6,180,000	1,920,000	7,660,000		6,180,000	1,920,000	7,650,000		7,200,000	1,700,000	8,910,000
	Description of Work	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total	Quantity	Amount	Contingency	Total
11	Gratings				3,020				3,020				3,020
11	Grating, serrated	159	636	159	795	159	636	159	795	159	636	159	795
11	Framing Angle, Steel, Galvanized	1,292	1,292	323	1,615	1,292	1,292	323	1,615	1,292	1,292	323	1,615
11	Headed Studs, Welded to Framing An	122	488	122	610	122	488	122	610	122	488	122	610
11													
11	Ladder, Wall Mounted or Vertical Grab Bars				5,723				5,723				6,450
11	Galvanized Steel Ladder bolted to Co	82	3,690	923	4,613	82	3,690	923	4,613	92	4,140	1,035	5,175
11	1/2" Anchor Bolts, x 5"	74	888	222	1,110	74	888	222	1,110	85	1,020	255	1,275
11													
11	Sluice Gate		109,215	27,304	136,519		109,215	27,304	136,519		109,215	27,304	136,519
11	48" Diam. Sluice Gate	1	23,940	5,985	29,925	1	23,940	5,985	29,925	1	23,940	5,985	29,925
11	36" Diam. Sluice Gate	4	62,067	15,517	77,583	4	62,067	15,517	77,583	4	62,067	15,517	77,583
11	30" Diam. Sluice Gate	1	12,569	3,142	15,711	1	12,569	3,142	15,711	1	12,569	3,142	15,711
11	24" Diam. Sluice Gate	1	10,640	2,660	13,300	1	10,640	2,660	13,300	1	10,640	2,660	13,300
11													
11	Stoplog Panel and grooves				68,074				68,074				78,049
11	4x6x1/4-4.5ft long aluminum tube stop	164	50,225	12,556	62,781	164	50,225	12,556	62,781	189	57,881	14,470	72,352
11	Sill Chanel and frame, Galvanized ste	1,109	2,218	555	2,773	1,109	2,218	555	2,773	1,223	2,446	612	3,058
11	Anchors, 16" long	42	504	126	630	42	504	126	630	42	504	126	630
11	1/2" Anchor Bolts, x 5"	126	1,512	378	1,890	126	1,512	378	1,890	134	1,608	402	2,010
11													
11	Fence				5,900				5,900				5,900
11	6' high fence	198	2,970	743	3,713	198	2,970	743	3,713	198	2,970	743	3,713
11	Personnel gate, 3.5' wide	7	1,750	438	2,188	7	1,750	438	2,188	7	1,750	438	2,188
11													
11	Remove				43,581				43,581				43,581
11	18" CMP	73	1,095	274	1,369	73	1,095	274	1,369	73	1,095	274	1,369
11	12" CMP	290	3,770	943	4,713	290	3,770	943	4,713	290	3,770	943	4,713
11	48" Wide Control Structure	6	30,000	7,500	37,500	6	30,000	7,500	37,500	6	30,000	7,500	37,500
11													
11													
30	Planning Engineering and Design	4,583,976	550,077	137,519	687,596	4,589,004	550,680	137,670	688,351	5,208,259	624,991	156,248	781,239
31													
31	Construction Management	4,583,976	320,878	80,220	401,098	4,589,004	321,230	80,308	401,538	5,208,259	364,578	91,145	455,723
31													
31			6,184,881	1,923,951	7,658,106		6,179,125	1,923,685	7,652,085		7,204,789	1,700,501	8,905,290
	Average Annual Operation and Maintenance	4,583,976	22,920	5,730	28,650	4,589,004	22,945	5,736	28,681	5,208,259	26,041	6,510	32,552

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX J

IMPLEMENTATION COST ESTIMATE

SECTION 205 FEASIBILITY REPORT
ADA, MINNESOTA
IMPLEMENTATION COST ESTIMATE

(the implementation cost estimate will be included in the Final Feasibility Report)

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX K

PROJECT MANAGEMENT PLAN

PROJECT MANAGEMENT PLAN
Ada, Mn. – Section 205 Flood Risk Management Project

8 December 2008

1. NAME OF PRODUCT: Ada, Minnesota, Section 205 Flood Risk Management Project.

2. PURPOSE: To study the feasibility of, and to design and construct a flood risk management project for the city of Ada, Minnesota, under the authority of Section 205 of the 1948 Flood Control Act, in accordance with Corps' guidelines.

3. STUDY SCOPE AND PHASING: This project study plan covers the feasibility, design and implementation and project turnover phases of the Ada Section 205 flood risk management project.

4. PHYSICAL LOCATION: The City of Ada is located approximately 220 miles northwest of St. Paul, Minnesota, in northwestern Minnesota. Ada is bounded by the south by the old Marsh River, and on the north by Judicial Ditch 51. The Marsh River is a tributary of the Red River of the North. Flooding in Ada occurs from high stages on the Marsh River and on Judicial Ditch 51, sometimes caused by overflows from the Wild Rice River, located two miles to the south.

5. DESCRIPTION OF EXISTING FLOOD CONTROL FEATURES: The City of Ada has existing levees the south, east and part of the north sides of the city. The level of protection offered by the levees varies from an effective elevation of 900.0 at the southwest levee, to elevation 905.0 on the east side. The existing levees adjacent to JD 51 are threatened by degradation of the side slopes of the ditch, and have an effective elevation of 903.0. Substantial work was done on the existing levees following the 1997 flood, and the interior drainage outlets following the 2002 flood. The upgraded outlets have partitioned concrete gatewells with sluice gates that allow for shutting the outlets during flood events, and pumping interior flows over the levees. The City of Ada has submersible pumps for each of these outlets. The pumps are gas-powered, and can be used during a power outage.

6. HISTORY/PRIOR STUDIES: The City of Ada incurred approximately $40,000,000 in direct damage as a result of the April 1997 flood. The residential area of the town received extensive damage. Following the 1997 flood, the City of Ada constructed dikes on the south side of the city, and relocated the hospital and high school to higher ground on the west side of the city.

   On December 10, 1997, the Wild Rice Watershed District, acting as the sponsor for the City of Ada, passed a resolution requesting the Corps of Engineers to conduct studies to determine the feasibility of developing a small flood control project to provide long term flood protection for the community of Ada, under the authority of Section 205 of the Flood Control Act of 1948.

The Corps conducted a Federal interest study, which indicated that Ada was a good candidate for a full feasibility study. This study is documented in the report entitled "Initial Assessment for Flood Damage Reduction - Wild Rice and Marsh Rivers, and Judicial Ditch 51" dated July 1999.

The original Feasibility Cost Share Agreement was signed between the Wild Rice Watershed District, acting on behalf of the City of Ada, and the Corps on 7 April 2000.

The study team, including the local sponsor and interested agencies, conducted an alternatives workshop, where problem areas were identified, and alternatives to address the issues were identified. The Corps then conducted a detailed inventory of flood-prone structures, and formulated alternative plans. The alternatives analysis resulted in a recommendation to construct a levee around the City of Ada, and re-routing a portion of Judicial Ditch 51. Base information was gathered, hydrologic, hydraulic and economic analyses were completed. Cost estimates were prepared for the recommended plan, at three levels of protection. The resulting economic analysis, concluded that benefit-cost ratios were below 1.0 for all alternatives, and that a project was not feasible.

A draft feasibility report was submitted in February 2001 with the conclusion that there were not sufficient benefits to support the cost of the proposed plan. In April 2001, local interests agreed verbally with the Corps' conclusions. A draft Feasibility report was completed on 14 August 2001, documenting the findings, and recommending terminating the study. The final feasibility report was completed in February 2002, indicating local concurrence on terminating the study.

Prior to termination of the study, the Wild Rice River basin received two record-setting rainfall events in June of 2002. The City of Ada successfully fought the floods of June 2002. During the flood-fight activities, Corps observers noted leakage around several culverts in the dike system, which called into question the credit previously given the existing levees. Following these flood events, the hydraulic discharge-frequency curves for the Wild Rice River were recomputed, including the effects of the 2002 floods. The benefit-cost analysis was reanalyzed, using these revised discharge-frequency relationships, and giving less credit to the existing levees. The reanalysis resulted in a benefit-cost ratio of over 2.0, indicating that a small flood control project at Ada was now feasible. The Corps informed the City of Ada of this change in outlook in November 2002.

In December 2002, the City of Ada expressed interest in continuing the study. In May 2003, the Corps forwarded a letter outlining the steps required to continue the study, and an estimate of costs. On January 6, 2004, the City of Ada passed resolution 2004-01-01, authorizing reactivation of the study. This resolution was forwarded to the Corps on March 28, 2004.

A feasibility cost share agreement was signed with the City of Ada on October 3, 2005, and a new feasibility study was begun.

7. SCOPE OF WORK: The objective is to determine if it is feasible to provide additional, more complete, or more reliable flood risk management to the City of Ada. And, if a project is feasible, to continue with detailed design, construction, and project turnover to the City of Ada.

8. ACCOUNTING AND SCHEDULE INFORMATION:

Accounting Data: CEFMS CWIS NO: 150109
P2 Project Number: 110835

Milestones:

Sign new FCSA (CW 130)	3 Oct 2005
Receive local funds	9 Jan 2006
Receive Federal funds	6 Feb 2006
Restart Study (CW140)	21 Feb 2006
In-progress review	Feb 2007
Value Engineering study (CW 290)	Nov 2007
Alternatives Formulation Briefing (CW 190)	Jan 2008
Feasibility Project Guidance Memo (CW 060)	Feb2008
Draft Feasibility Report (DPR) (CW 150)	Jul 2008
CAP EA or FONSI Complete (CW 200)	Mar 2009
Submit final report to MVD (CW160)	Jun 2009
Feasibility report approved (CW170)	Aug 2009
MVD issues CAP Feas Commander's notice (CW260)	Aug 2009

The following are future milestones. The actual dates will be subject to the availability of Federal funding:

Sign Project Cooperation Agreement	Oct 2009
Initiate Plans and Specifications (CW300)	Oct 2009
Begin Real Estate Acquisition	Nov 2009
Complete Plans and Specifications (CW310)	Nov 2010
Complete Real Estate Acquisition	Nov 2010
Certify Real Estate/BCOE Certif (CW360)	Dec 2010
Advertise for construction	Jan 2011
Open Bids	Mar 2011
Award Construction Contract (CC800)	May 2011
Initiate Construction	June 2011
Interim O&M Manuals of completed features	As completed
Interim turnover of completed features	As completed
Complete physical Construction (contract) (CW450)	Sep 2012
Final O&M manuals	Sep 2012
Closeout construction contract (CC840)	Oct 2012
Fiscal Completion (CW470)	Mar 2013
Final turnover	May 2013

9. TECHNICAL CRITERIA:

Current Corps of Engineers ER's, EC's, EM's, and Policy Guidance Letters will be used to establish plan formulation, design, environmental assessment, implementation and operational criteria for this project. The plan formulation and development shall be in accordance with the National Environmental Policy Act (NEPA).

10. REFERENCES:

a. EC 1105-2-217, "Planning – The Continuing Authorities Program Interim Guidance," dated 30 November 1999.
b. 1994 Flood Insurance Maps.
c. CECW-PE Planning Guidance Letter 96-3, dated 16 August 1996.
d. ER 1105-2-100, "Guidance for Conducting Civil Works Planning Studies."
e. Survey and Engineering Data: None available.
f. Determination of Federal Interest Report – Ada, Minnesota.
g. Hydraulic model studies. HEC-RAS files.
h. Economic analysis files.
i. As-built information from Moore Engineering.
j. 16 August 2006 "Credit to Existing Levees" report.
k. Lidar data – DNR 2006.

11. STUDY TEAM: The feasibility, design and implementation phases will be performed by the St. Paul District Corps of Engineers, with participation by the City of Ada as the project local sponsor.

12. INDEPENDENT TECHNICAL REVIEW (ITR): An independent technical review shall be performed within the St. Paul District, by a team not involved with the study. The expertise and technical backgrounds of the ITR team members shall qualify them to provide a comprehensive technical review of the product. The review shall be ongoing through product development. All comments resulting from the independent technical review shall be documented using the DRChecks system, and shall be resolved prior to forwarding the document for review and approval by higher authority and local interests.

The ITR team leader is responsible for conducting the ITR reviews. ITR team members shall be coordinated with the branch and section chiefs, who will assign individuals familiar with Section 205 feasibility studies.

13. VALUE ENGINEERING: Corps guidelines require that any project over $1 million will undergo a value-engineering study. The purpose of the value engineering study is to ensure that the most economical plan has been identified. The value-engineering study will be

conducted early in the design phase.

14. RESPONSIBILITIES: The following are responsibilities of each study partner, through the planning, design, construction and turnover of the project.

Corps of Engineers: Provide project planning. Perform social, cultural, economic and financial analyses. Prepare environmental documentation (assumed to be Environmental Assessment and Clean Water Act documents). Conduct cultural resource surveys. Coordinate Fish and Wildlife Coordination Act Report by the Fish and Wildlife Service. Prepare feasibility report documents. Coordinate with and resolve Local sponsor issues. Conduct public involvement effort. Prepare cooperation agreements. Conduct hydrologic and hydraulic analyses. Design interior flood control features. Conduct surveys, prepare mapping, perform field investigations, design project features, estimate quantities, prepare cost estimates. Prepare engineering appendices to the feasibility report. Prepare right-of-way drawings for use by real estate. Prepare construction plans and specifications. Conduct HTRW investigation. Update flood insurance study (during construction phase). Constructibility review of report and plans and specifications. Administer construction contract and on-site inspections. Prepare the Preliminary and Final Attorney's Opinion of Compensability and a Project Takings Analysis. Documents to be provided to Real Estate for incorporation into the Real Estate Plan. Prepare a real estate Gross Appraisal of the lands necessary for the Project. Prepare the Real Estate Supplement/Appendix for the feasibility report based on findings in the Attorney's Opinion of Compensability, the Takings Analysis and the Gross Appraisal. Coordinate with the local sponsor and assist in the acquisition of required project real estate and rights-of-entry. Assist the local sponsor with LERRD's crediting during acquisition and/or construction phases. Solicit construction bids and administer other contracted work, including planning, engineering and construction.

Local Sponsor: Review feasibility report and design documents. Participate in meetings. Coordinate with the Corps and the local community. Cost share in the Feasibility Study and Environmental Assessment as defined in the Feasibility Cost Share Agreement. Cost share plans and specifications and construction as defined in the Project Cooperation Agreement. Provide all Lands, Easements, Rights-of-way, Relocations and Disposal (LERRD) sites as required. Operation and maintenance of the completed project.

Executive Committee: The executive committee shall oversee the project. The local sponsor executive committee member is Mayor Jim Ellefson from the City of Ada. The Government executive committee member is Nan Bischoff, Project Manager, Project Management and Development Branch, St. Paul District Corps of Engineers. The MnDNR executive committee member is Pat Lynch.

15. SCOPE OF WORK BY DISCIPLINE:

a. PROJECT MANAGEMENT: Scope of work shall include coordination with Local Sponsor, study team, Minnesota DNR, Mississippi Valley Division, and Headquarters –

U.S. Army Corps of Engineers; developing a project schedule; developing cost share agreements and project study plans; conducting public meetings; preparing news releases; maintaining project accounts; preparation of report documents; coordination of design documents; preparation of draft and final operation and maintenance manuals; any other duties needed to complete the project.

b. ENVIRONMENTAL: Scope of work shall include field trips; input into the plan selection process; preparing an Environmental Assessment, draft FONSI, and Section 404 (b) (1) evaluation; coordinating with the Fish and Wildlife Service to obtain the Fish and Wildlife Coordination Act Report; team meetings; preparing a mitigation plan, if required; coordinating the draft environmental documentation with local, State and Federal agencies; preparing a public notice of the availability of the draft EA and FONSI; monitoring and responding to comments; attending public meetings; and finalizing the EA and FONSI.

c. CULTURAL: Scope of work shall include preparation of scopes of work and contract administration for Phase I and II cultural resources surveys of the levee alignments and borrow areas; coordination with the State Historic Preservation Officer (SHPO); input to the study report; input to the Environmental Assessment; and in-house meetings.

d. ECONOMICS: Scope of work shall include: collection of base data for damage/benefit analysis; set up flood damage analysis (FDA) model; conduct a project affordability analysis based on updated credit-to-levee and discharge-frequency information to ensure that project benefits would support a project of the scope identified in prior studies, perform a benefit analysis; risk analysis, social analysis, and financial analysis; provide input to Environmental Assessment; field trips; report write-up; and in-house meetings.

e. HYDRAULICS: Scope of work shall field trips, input to the survey request, perform a coincidence analysis and design of interior flood control features, hydraulic design, input to risk and uncertainty analysis, HEC-RAS modeling for Judicial Ditch 51 and the old Marsh River, riprap design and in-house meetings.

f. HYDROLOGY: Scope of work shall include discharge-frequency analyses; update the flow-frequency-discharge information, and flow split characteristics needed for the economic analysis, writing a technical appendix; field trips, and in-house meetings.

g. COST ENGINEERING: Scope of work includes team meetings; preparation of cost estimates for alternatives; preparation of cost estimates for NED analysis; preparation of an implementation cost estimate for the feasibility report. Preparation of a construction cost estimate for the design phase.

h. GEOTECHNICAL: Scope of work includes team meetings; contract work to perform supplemental borings and testing; preparation of geotechnical design and drawings, including draft boring logs; input to alternatives analysis; determining soil parameters to be used in design; developing typical levee sections; performing a slope stability analysis, seepage/uplift analysis and a settlement analysis; locating potential borrow sites; input to cost estimates; preparing a geotech and geology appendices to the feasibility report; site visits; and preparing updates and a supplement to the Phase I Hazardous, Toxic and

Radioactive Waste (HTRW) analysis..

i. GENERAL ENGINEERING: Scope of work includes acting as lead engineer for the engineering and construction division; preparation of general drawings; team meetings; acquisition of 1-foot topographic mapping; base drawing layout of all features; site visits; design and calculation of quantities for the alternatives analysis, NED analysis and implementation cost estimates; input to the construction cost estimate; and development of horizontal and vertical control.

j. STRUCTURAL ENGINEERING: Scope of work includes preparation of structural drawings; team meetings; site visits; structural design of the outlets and other interior flood control features; calculating structural quantities to be included in any cost estimates.

k. MECHANICAL/ELECTRICAL ENGINEERING, ARCHITECTURE and LANDSCAPE ARCHITECTURE (MEA): Scope of work includes preparation of mechanical drawings, and electrical drawings, architectural drawings, and landscape drawings; team meetings; mechanical and electrical design of outlets, lift station for sewer line to wastewater treatment plant; and other interior flood control features; providing input to the alternatives analysis and cost estimates.

l. REAL ESTATE: : Scope of work includes coordination; team meetings; preparation of the Real Estate Plan which identifies and describes the lands, easements and rights-of-way required for construction, operation and maintenance of the proposed project, including work to be done by the local sponsor; preparation of the Gross Appraisal, input to the report; assist local sponsor as necessary to obtain rights-of-entry for surveys, borings, cultural resource surveys and any other required entry onto private lands; preparation of all real estate cost estimates for all alternatives; and, in cooperation with the Local Sponsor, conducting one landowner meeting.

m. OFFICE OF COUNSEL: Preparation of the attorney's opinion of compensability and Project Takings Analysis.

n. INDEPENDENT TECHNICAL REVIEW (ITR): The scope of work includes review of the draft and final feasibility reports, and draft and final plans and specifications to assure that the study team is in compliance with Corps standards; and documentation of the review process.

o. VALUE ENGINEERING TEAM: A team of 5 to 6 independent evaluators will conduct a value engineering study over a 2 to 3 day period, and will present the findings to the study team during the design phase.

p. CONTINGENCIES: Contingencies are included in the project cost estimate to account for any adjustments to the project scope.

q. LOCAL SPONSOR: The City of Ada is the Local Sponsor for the project, and will participate fully in the scoping and decision processes. The City of Ada, in addition to cost sharing 50% of the feasibility study costs, and 35% of the design and implementation costs, shall enter into a project cooperation agreement with the Corps of Engineers and shall assume all responsibilities for operating and maintaining the constructed project in perpetuity.

16. PROJECT COSTS: The anticipated cost of the feasibility, design, construction and project turnover phases is summarized below. Costs for the feasibility study are shared 50% Federal and 50% non-Federal. Costs for design, construction and project turnover are shared 65% Federal and 35% non-Federal.

a. Prior feasibility study with WRWD as Local Sponsor:	\$470,000
b. Feasibility study with City of Ada as Local Sponsor:	\$904,000
c. Design:	\$700,000
d. Lands and Damages:	\$830,000
e. Construction (including IDC and construction management):	\$6,340,000
f. Project turnover:	\$60,000

16. Change Management Plan: There has been an attempt to include enough contingency in the project cost and schedule to avert the need for changes to this Project Study Plan. However, delays in project funding, changes to the scope of work, and scheduling conflicts with other projects cannot all be foreseen. Any intermediate milestone delay of two weeks or more, or individual discipline cost overruns of \$2,000 or more, shall warrant review of this Project Study Plan by the Project Manager. Any delay or overrun that results in a four week or more delay of the project completion date, or \$10,000 or more increase in overall project costs shall warrant discussion with the project Local Sponsor(s). The Project Manager shall send progress reports via E-mail or other acceptable means, by the 15th of each month, to the City of Ada (Jim Ellefson) and the Minnesota DNR (Pat Lynch).

17. Approval: I hereby approve this project study plan.

Approved by: ______________________________

Nanette M. Bischoff
Project Manager

SECTION 205 FEASIBILITY REPORT

ADA, MINNESOTA

WILD RICE AND MARSH RIVERS, MINNESOTA

APPENDIX L

CORRESPONDENCE

RESOLUTION NO. 2008-01-03

Upon Motion by Roux and second by Ramey, the following Resolution was moved:

WHEREAS, the City of Ada incurred substantial damage during the flood of 1997 after which emergency levees were built; and

WHEREAS, after the 1997 flood the City continues to experience record-breaking flood events including two in June of 2002 in which weaknesses in the existing levees again caused damage within the City; and

WHEREAS, the City has asked the Army Corp of Engineers to conduct an economic analysis for a flood-risk management project in Ada, Minnesota; and

WHEREAS, the Army Corp of Engineers has completed the economic analysis for such a project and has presented the study along with certain recommendations to the City for comments.

BE IT HEREBY RESOLVED that the City supports the Corp recommendation to construct a levee designed to withstand a 200 year flood in conjunction with the rerouting of a portion of Judicial Ditch 51; and

BE IT FURTHER RESOLVED that the city supports construction of levee option areas as described in the Army Corp of Engineers study.

UPON BEING PUT TO A VOTE, the above Resolution was passed by the following vote.

AYES: Darin Ramey, Craig Edwards, Dennis "Woody" Roux, Don Vellenga.

NAYES: None.

ABSENT: Clarence Weippert, Candy Robertson, Jim Austinson.

Dated: January 23, 2008

James Ellefson

James Ellefson, Mayor

ATTEST:

Shelley Kappes

Shelley Kappes, City Clerk

NON-FEDERAL SPONSOR'S
SELF-CERTIFICATION OF FINANCIAL CAPABILITY
FOR DECISION DOCUMENTS

I, Shelley Kappes, do hereby certify that I am the Chief Financial Officer of the City of Ada, Minnesota (the "Non-Federal Sponsor"); that I am aware of the financial obligations of the Non-Federal Sponsor for the Ada Section 205 project, and that the Non-Federal Sponsor will have the financial capability to satisfy the Non-Federal Sponsor's obligations for that project. I understand that the Government's acceptance of this self-certification shall not be construed as obligating either the Government or the Non-Federal Sponsor to implement a project.

IN WITNESS WHEREOF, I have made and executed this certification this 31st day of March, 2008.

BY: Shelley Kappes

TITLE: City Clerk-Treasurer City of Ada

DATE: 3-31-08

ENCLOSURE 3