United States Department of Agriculture

Natural Resources Conservation Service

Helping People Help the Land

SPRING BROOK WATERSHED PLAN AND ENVIRONMENTAL ASSESSMENT

SPRING BROOK WATERSHED
KITTSON COUNTY, MINNESOTA

JUNE 2008

DRAFT

Cover photo: Aerial view of section 29 Spring Brook Township looking west.

draft

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

ABSTRACT

WATERSHED PLAN – ENVIRONMENTAL ASSESSMENT (EA)

This document describes a plan to reduce cropland flooding with the construction of setback dikes to the 10-year flood plain elevation, and with the dikes parallel to a historically dredged and partially leveed "Unnamed Ditch" in T159N, R48W, Sections 25 & 26, and in T159N, R47W Sections 29, 30, and 31 of Kittson County, Spring Brook Township, MN. A secondary purpose of the project is to create a riparian buffer, wildlife habitat corridor. This habitat will be created within the flood plain between the newly constructed setback dikes. The dike placement will also facilitate the natural restoration of some channel sinuosity within the flood plain, improving water quality by reducing channel bedload and sedimentation impacts to aquatic habitat. The plan describes water and related land resource problems, plan formulation, and expected social, economic, and environmental impacts. This document is intended to fulfill the requirements of the National Environmental Policy Act, and it is to be considered the basis for project authorization and funding as provided by Public Law 83-566. Prepared under the authority of the Watershed Protection and Flood Prevention Act, Public Law 83-566 as amended (16 USC 1001-1008) and in accordance with Section 102(2) (C) of the National Environmental Policy Act of 1969, Public Law 91-190, as amended (42 USC 4321 est seq). In addition, all NRCS activities must also comply with Executive Order 11990, "Protection of Wetlands", and with revised NRCS Wetland Technical Assistance Policy at 7 CFR Part 650, dated November 17, 1997.

Prepared by:

U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS)

For additional information contact:

William Hunt, State Conservationist
USDA – NRCS
375 Jackson Street, Suite 600
St. Paul, MN 55101

Phone: (651) 602-7900
Fax: (651) 602-7914
Email: william.hunt@mn.nrcs.usda.gov

draft

WATERSHED PLAN – ENVIRONMENTAL ASSESSMENT (EA)

TABLE OF CONTENTS

CONTENTS: **PAGE**

ABSTRACT 2
WATERSHED PLAN SUMMARY 6
INTRODUCTION 11
PROJECT SETTING 11
Region Description 12
Topography 12
Channel Reaches 14
Surface Water: 15
Wetlands 18
Watershed Urban Center 21
Transportation 21
Soils 21
Land Cover and Land Use 22
Federally Threatened and Endangered (T&E) Species 22
Cultural Resources 22
Wildlife 23
Recreational Development – Hunting and Wildlife Viewing 24
Fisheries 25
Population 25
WATERSHED PROBLEMS AND OPPORTUNITIES 26
Floodwater Damages 26
Fish and Wildlife Habitat Losses 28
Stream Bank Erosion and Sedimentation 28
SCOPE OF THE ENVIRONMENTAL ASSESSMENT 29
FORMULATION AND COMPARISION OF ALTERNATIVES 30
General 30
Formulation Process 30
Description of Alternatives 36
Effect of Alternative Plans 40
Comparison of Alternative Plans 48
Risk and Uncertainty 52
Rationale for Plan Selection 53
CONSULTATION AND PUBLIC PARTICIPATION 55
RECOMMENDED PLAN 57
Purpose and Summary 57
Setback Dikes 57
Cultural Resources 62
Permits 62
Cost 62
Benefits 63
Installation and Financing 65
Planned Sequence of Installation 65
Responsibilities 65

draft

Contracting 65
Real Property 66
Other Agencies 66
Financing 66
Cultural Resources 66
Conditions for Providing Assistance 67
Operation, Maintenance, and Replacement (O&M&R) 67
REFERENCES 68

APPENDICIES

A	PL-566 Required Tables	A - 1
B	Letters and Comments Received on the Draft Plan	B - 1
C	Investigation and Analysis Report	C - 1
D	Draft Mitigation Plan	D - 1
E	Draft O&M&R Plan and Agreement	E - 1
F	Project Map	F - 1

draft

LIST OF TABLES

CONTENTS: **PAGE**

Table A - Summary of Project Costs (Plan 5) 9
Table B - Summary of Channel Reach Grouping 14
Table C - Peak Discharge/Frequency Relationship at County Road 63 17
Table D - Reference between Two Different Wetland Classification Systems 19
Table E - Socioeconomics of the watershed 25
Table F - Floodwater Damage Summary 27
Table G - Average Annual Total Damages 28
Table H - Evaluation of Identified Concerns 29
Table I - Wetland Restoration in Place - Cropland Acres Flooded in Evaluation Reach 2 (Downstream) 33
Table J - Dike Spacing 40
Table K - Loss of Flood Plain Storage Estimate 41
Table L - Comparison of Alternative Plans 49
Table M - Buffer Seed Mixes 58
Table N - Breakdown of Wetlands in Project Area 61
Table O - Open Area between Ditch Blocks 61
Table P - Average Annual Total Damages 64
Table Q - Estimated Average Annual Flood Damage Reduction Benefits 64
Table R – List of Preparers – Spring Brook Project 70

LIST OF FIGURES

CONTENTS: **PAGE**

Figure A - Spring Brook Watershed Map 13
Figure B - Typical Project Reach, Unaltered Ditch Alignment 16
Figure C - Typical Project Reach, Limited Ditching 16
Figure D - Spring Brook NWI Wetlands 20
Figure E - Soils Classified as HEL within the Watershed 31
Figure F - Depressional Hydric Soils within Cropland/Grassland Land Uses 32
Figure G - Potential Storage Structure Locations 34
Figure H - The Project Areas Identified 36
Figure I - Plan 2, Locations of Dike Reaches 1 & 3 within the Lower Reach 38
Figure J - Upper Main Reach Dike Locations within the Upper Reach 39
Figure K - Typical Wetland Impact Categories 44
Figure L - Basic Dike Layout 58
Figure M - Reach 2, Cross-Section 59
Figure N - Reach 3, Cross-Section 60
Figure O - Breakout Area Layout 61

draft

Watershed Plan – Environmental Assessment (EA)
For
Spring Brook Watershed
Kittson County, MN

Congressional District 7

WATERSHED PLAN SUMMARY

Sponsors: Two Rivers Watershed District, City of Karlstad, Kittson County Soil and Water Conservation District, and Spring Brook Township.

Description of Recommended Plan: Build setback dikes along the lower reaches of the Unnamed Ditch, build dikes along one side of the channel at other locations, and implement environmental improvements at selected locations.

Resource Information:

Size of watershed (acres)	35,170
8-Digit Hydrologic Unit Number	09020311 - Lower Red Watershed

Land Cover:	**Acres**
Cropland	22,075
Wetlands	4,190
Deciduous Forest	4,050
Grassland	2,530
Transitional Agricultural Land	1,810
Developed	260
Grassland-shrub-tree (decid)	210
Other	25
Water	20

Land Ownership:

Private (percent)	92
State-Local (percent)	8
Federal (percent)	<1

Farm Statistics:	**County (2002)**[1]
Number of Farms	659
Average farm size (acres)	843
Number of minority farmers	183

Project Beneficiary Profile: Kittson County is home to approximately 5,300 people, with roughly 800 of them residing in the City of Karlstad. The population in the county and the city declined between the 1990 and 2000 census by 9% and 11% respectively.

[1] 2002 Census of Agriculture, Kittson County

Roughly 13% of Karlstad's residents 25 years and older have a Bachelors degree or higher, compared to 15% for Kittson County. The median household income for Karlstad is $31,450 which is thirty percent lower than the Kittson County median income of $40,580.

Wetlands: The U.S. Fish and Wildlife National Wetlands Inventory (NWI) and the International Coalition Land Use/Cover[2] identifies approximately 4,190 acres of Types 1-7 wetlands within the watershed. This includes Twistal Swamp which is a 1,900-acre type 3 wetland marsh lying within the 8,000 acre Twin Lakes Wildlife Management Area (WMA) four miles east of Karlstad. Since the MN Wetland Conservation Act, and the MN DNR discuss wetlands by Type, the discussion of wetlands in this report uses both the Type and definition of, wetlands per *Wetlands of the United States, FWS Circular 39*, a well as utilizing maps to discuss the impacts of various NWI mapped wetlands per *Classification of Wetlands and Deepwater Habitats of the United States, Cowardin et al., FWS/OBS – 79/31*.

Highly Erodible Soils: Determinations for highly erodible soil are based upon an erodibility index for wind erosion as defined in the National Food Security Act Manual. 18,030 acres of highly erodible soils on cropland were identified within the watershed boundary.

Federal Threatened and Endangered Species: No federally listed *endangered* species, or their habitat is currently known to be occurring within the watershed.

The Western Prairie Fringed Orchid (*Platanthera praeclara*), with habtat occuring in wet prairies and sedge meadows, is the only *threatened* species listed on the Federal FWS (U.S. Fish and Wildlife Service) Threatened and Endangered County List for Kittson County, MN. As a result, a consultation with the Ft. Snelling, MN, FWS is under way with a determination category of "may affect but is not likely to adversely affect" the Western Prairie Fringed Orchid.

The Dakota Skipper (*Hesperia dacotae*) butterfly is a federally listed *candidate* insect species known to occur within Kittson County, and a conference with the Ft. Snelling, MN FWS again determined that the proposed project may affect but is not likely to adversely affect this species.

Cultural Resources: An initial cultural resources review of the proposed project was conducted by the MN NRCS Cultural Resources Specialist in 2004. The review indicated no previously recorded archaeological sites or properties listed in either the National Register of Historic Places (NRHP), or the Minnesota Historical Society, in or near the proposed project area. The lack of previously recorded sites is more than likely due to the fact that no cultural resources surveys have been performed in or near the project area.

[2] International Coalition Land Use/Land Cover was developed by Land Management Information Center (LMIC). Release date 10/1/1995.

Problem Statement: Floodwater damage is a major problem for several landowners/operators in Spring Brook Township of the Two Rivers Watershed District. Severe flooding has been reoccurring in this area since 1993. Federal disaster declarations have been issued in 1993, 1996, 1997, 1999, 2000 and 2002.

Flooding can occur during both spring snowmelt and growing season convective storms. Convective storms occur while crops are actively growing and thus have a high potential for causing crop losses. Severity of growing season losses depend on floodwater levels and the duration water is at those levels. Although spring snowmelt events do not occur while the crop is actively growing, damages can occur in the form of road, bridge, and fence damages, loss of topsoil due to flood plain scour, and delayed planting losses.

Floodplains: Because of the relatively small vertical elevation difference in the watershed, the floodplain can get extremely large during some events. In some places along the channel, buffer strips have been installed. At other locations, the fields are cropped to the edge of the channel.

Alternative Plans Considered: The formulation process concluded with the development of four alternative plans. Beside the no action plan, the other plans have varying average widths between inside toe to inside toe of the setback dikes.

Plan 1 – No Action;
Plan 2 – Moderate spacing between setback dikes with channel meanders and riffles (average width = 270')
Plan 3 – Wide spacing between setback dikes with channel meanders and riffles (average width = 330')
Plan 4 – Narrow spacing between setback dikes with streambank protection and rock drops (average width = 70')
Plan 5 – Moderate spacing between setback dikes with streambank protection and rock drops (average width = 270')

Project Purpose: Flood protection

Principal Project Measures: The primary purpose of this project is to reduce cropland flooding through the construction of setback dikes to the 10-year flood[3] elevation. A secondary purpose of the project is to create a riparian buffer and wetland, wildlife habitat corridor. This habitat will be created within the flood plain between the constructed setback dikes. Plan 5 – Dike Alignment A is the most feasible way to accomplish these goals.

[3] A growing season 10-year frequency event is the maximum level of protection as set by the Red River Basin Flood Reduction Work Group per the 1998 Flood Damage Reduction Mediation Agreement. The agreement is a product of federal, state and local agencies, local landowners and environmental groups which set broad goals for flood damage reduction and natural resource enhancement in the Minnesota portion of the Red River Basin.

Project Cost:

Table A - Summary of Project Costs (Plan 5)

Item	Total
Construction	$ 708,000
Engineering	$ 142,000
Technical assistance (including Administration)	$ 183,000
Real property rights	$ 367,000
Total	**$ 1,400,000**

Period of Analysis: The period of analysis used in this EA is 102 years. The first two years will consist of the design and construction phases. The 100 years following construction represents the project life and payback period.

Project Life: The assumed project life is 100 years.

Project Benefits: Implementation of the project would reduce the flooding, up to a 10-year event, in the Spring Brook Watershed. The benefits from this protection are reduced crop, personal property, and infrastructure damages.

To estimate the project benefits, conditions with and without the project were established and compared. Future without project conditions are continued flood damages. The value of the reduced flooding under the future with project conditions are the project benefits. Under the future with project conditions, the total project benefits are $1.94 million, or an average annual value of $95,380. The recommended plan results in a project benefit cost ratio of 1.35:1.0. Details on how the flood damage values were estimated can be found in Appendix C – Economics section.

Environmental Values Changed or Lost: Wetland acreage within the project was estimated using NWI mapping and 2005 aerial photos[4]. Using this wetland database, 76.1 acres of wetlands on 28 sites will potentially be impacted by project construction activities as follows[5]:

[4] These aerial photos were taken after a major precipitation event.

[5] Total acres of impacted and/or mitigated wetlands will be determined by wetland field determinations completed by the project Sponsors.

1. Approximately 8.6 acres of wetlands on 8 sites within the flood plain between the dikes will be permanently protected and enhanced. Mitigation will not be required on these wetlands.

2. Approximately 14.6 acres on 9 wetland sites will be directly impacted by dike construction, of which 1.5 acres will be filled by the dike footprint. Mitigation is planned for impacted sites.

3. Altered hydrology (reduced floodwaters from main channel) will impact approximately 52.9 acres of wetlands occurring outside of the dikes. Mitigation is planned as part of the project.

Approximately 188 acres between the constructed dikes will be converted to permanent riparian habitat. This may enhance opportunities for such large indigent terrestrial species like the moose, which is a species of special concern in Kittson County and northwest Minnesota. The additional wetland habitat will provide additional acres of brooding and nesting habitat for declining waterfowl species such as the pintail and the scaup.

Major Conclusion: The primary purpose of this project is flood protection up to the 10-year event. This protection results in benefits to the landowners in the Spring Brook Watershed. This environmental assessment has concluded that all acres of impacted wetlands will be mitigated.

Issues to be Resolved: The field wetland determinations and terms of land acquisition.

Areas of Controversy: None

draft

INTRODUCTION

This document contains the Watershed Plan – Environmental Assessment (EA) for the Spring Brook Watershed, Kittson County, MN. It describes water and related land resource problems, plan formulation, and expected impacts. The project purposes are to reduce the flooding along the Unnamed Ditch and to create a riparian wildlife habitat corridor.

The Sponsors of this project are the Two Rivers Watershed District, Kittson County Soil and Water Conservation District, the City of Karlstad, and Spring Brook Township.

Specific authority for assisting in the development of the plan is Public Law 83-566, (PL-566) Watershed Protection and Flood Prevention Act, as amended (16 USC 1001-1008). The plan was prepared in accordance with Section 102(2) (C) of the National Environmental Policy Act of 1969, Public Law 91-190, as amended (42 USC 4321 est seq). Responsibility for compliance with National Environmental Policy Act (NEPA) rests with the NRCS. In addition, all NRCS activities must also comply with Executive Order 11990, "Protection of Wetlands", and with revised NRCS Wetland Technical Assistance Policy at 7 CFR Part 650, dated November 17, 1997.

PROJECT SETTING

Spring Brook Township, Kittson County, Minnesota, expressed interest in a project following several flood events. The Two Rivers Watershed District contacted the United States Department of Agriculture, Natural Resources Conservation Service (NRCS) to determine if assistance under PL-566, the Watershed Protection and Flood Prevention Act, would be applicable. Under Public Law 83-566, NRCS provides technical and financial assistance to local organizations or Sponsors representing the people living in small watersheds (<250,000 acres). Sponsors apply for the assistance. The program requires that a physically, environmentally, socially, and economically sound plan of improvements for soil conservation and other purposes be developed and that it be scheduled for implementation over a period of years. Local Sponsors are required to share in the cost of the installation, assume operation and maintenance responsibilities, and meet other requirements as conditions for PL-566 assistance.

An unnamed tributary which lies between County Ditch 10 and Judicial Ditch 10 in Kittson County floods cropland in Spring Brook Township and some land in surrounding townships. The Two Rivers Watershed District requested assistance from the United States Department of Agriculture, Natural Resources Conservation Service, (USDA-NRCS) to study options for installing levees along the unnamed tributary to reduce flood damages on adjoining cropland.

The Spring Brook Watershed, a 35,170 acre sub-watershed of the Lower Red Watershed (United States Geologic Survey (USGS) catalog unit #09020311), is located in northwestern Minnesota (See Figure A). Spring Brook watershed is contained almost entirely by Kittson County. The nearest town is Karlstad, which is located near the watershed's eastern boundary and within U.S. Congressional District Seven and MN

Legislative District One. The City of Karlstad is home to approximately 700 people[6]. The channel reaches where the proposed levee work would be completed are part of an "Unnamed Ditch" located in T159N, R48W, Sections 25 & 26, and in T159N, R47W Sections 29, 30, and 31 of Kittson County, Spring Brook Township, MN.

Region Description

The project area is located in the Red River Valley Ecoregion. This ecoregion is characterized by the flat plain left behind by The Glacial Lake Agassiz that extends from the southern tip of the basin to the Canadian border and beyond. The original vegetation of the Red River Valley was tall bluestem prairie, with cottonwood, willow and elm trees along streams. Presently, the vast majority of the land in the ecoregion is used for agriculture and little natural vegetation remains. The main crops grown are spring wheat, sugar beets, barley, sunflowers, potatoes, corn and soybeans.

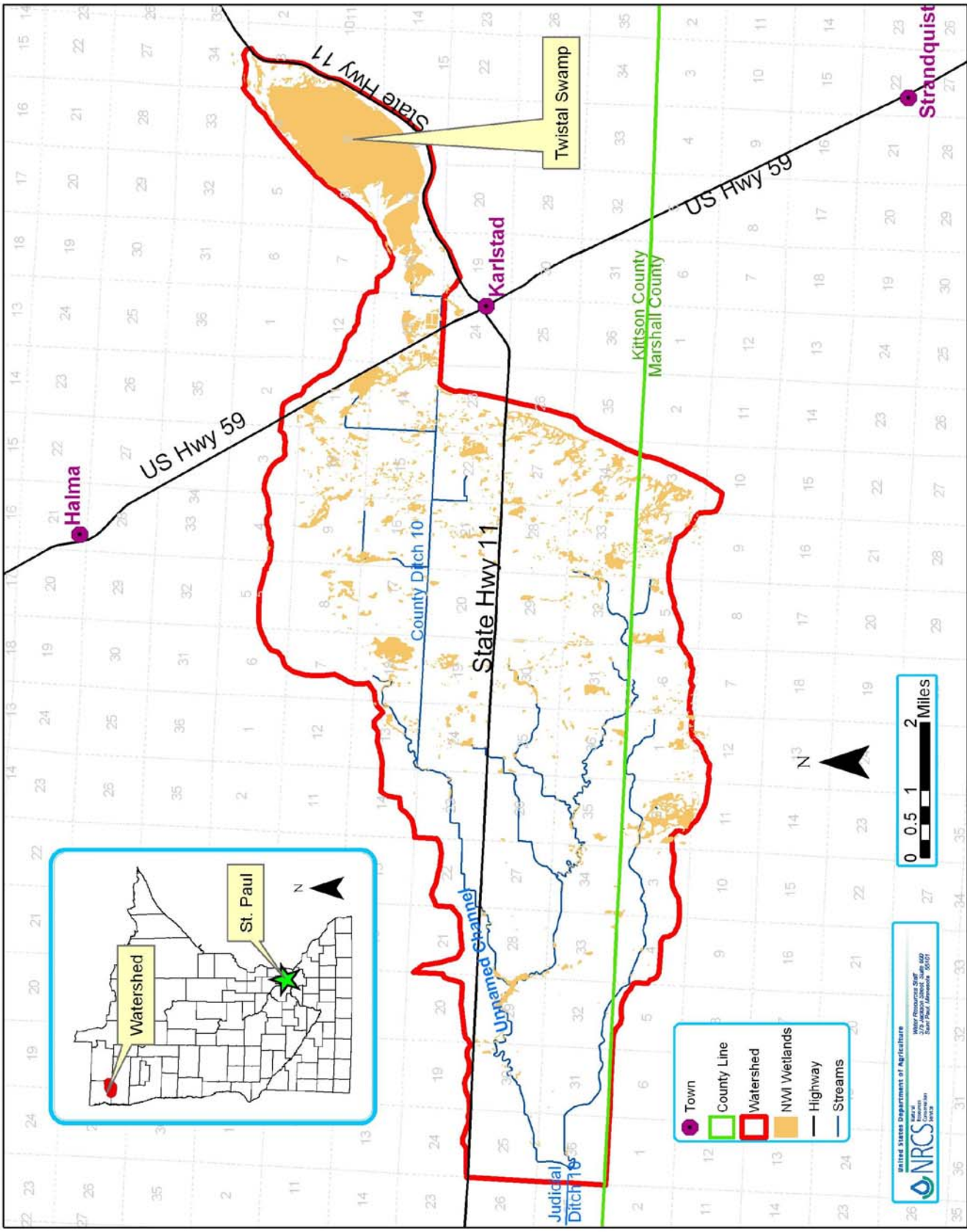
Topography

The watershed is part of an extensive glacial lake plain (The Glacial Lake Agassiz). It consists of two regions, a lacustrine plain to the west and a water-worked till plain on the east. Portions of the lacustrine lake plain are level, but small dunes and a series of low beach ridges and swales exist also. The beach ridges are commonly gravelly and the swales often contain abundant cobbles and boulders (Cummins and Grigal, 1981). The water-worked till plain has low relief due to wave action of The Glacial Lake Agassiz. The topography is level to gently rolling.

draft

[6] 2002 US Census estimate.

Figure A - Spring Brook Watershed Map



Climate

The climate of the watershed is continental. During the winter season, cold, dry continental polar air dominates while growing seasons experience both hot/dry tropical air masses from the southwest and warm/moist maritime tropical air from the Gulf of Mexico. High intensity thunderstorms are common throughout the summer. Spring and fall seasons are transition periods where air masses from a variety of sources can occur.

Using data from the NOAA Karlstad Climate Station, the average annual temperature for the watershed is 38 degrees F. Annual maximum and minimum temperature extremes occur in July (79.4 degrees F) and January (-9.8 degrees F) respectively. On the average, temperatures are above 32 degrees F for 107 days (May 22 through September 5).

Average annual precipitation is 18.56 inches and approximately 14.5 inches occurs as rainfall. Average total snow fall is about 37 inches.

Channel Reaches

Depending on the different assessments done, the channel reaches may have been grouped to describe the features of the assessment. The reference chart, Table B shows the different grouping methods used and how each grouping method relates to each other.

Table B - Summary of Channel Reach Grouping

Wetland Grouping	Economic Grouping	Stream Assessment ID	Computer Modeling Grouping
Lower Reach	Reach 1	1A	Main Branch
	Reach 2 us	2A	
		2B	
		2C	
	Reach 2 ds	2D	
Upper Reach	Reach 3 us	3A	
		3A2	
		3B	
		3C	
		3D	
N/A	Reach 3 ds	3E	
		3F	
Lower Reach	Reach 4	4A	Tributary 1
		4B	
		4C	
N/A	Reach 5	5A	Tributary 2
		5B	
	Reach 6	6A	
	Reach 7	7A	

Surface Water:
The project's watershed has a surface water drainage area of approximately 48.25 square miles (30,880 acres), which does not include landlocked areas. The outlet of the project's main channel is the upper end of Judicial Ditch 10 at County Road 63. The upper reaches of the project's main channel is County Ditch 10 which extends 7 miles west from the City of Karlstad down to the southwest corner of section 13 Deerwood Township. The reach where flooding is a concern is the 8.7 mile unnamed open ditch between Judicial Ditch 10 and County Ditch 10. See Figure 1F – Spring Brook Watershed Project Map in Appendix F. The three reaches analyzed within this watershed were:

1. The unnamed main channel from the downstream end of County Ditch 10 (section line 13/24 in Spring Brook Township) to its confluence with Judicial Ditch (JD) 10 at County Road 63. The current channel length in this reach is 8.7 miles long. This reach between County Ditch 10 and Judicial Ditch 10 is not classified as an "official" ditch within the Two Rivers Watershed District. Portions of this reach have been straightened and deepened during the 1950's - 1960's for agricultural drainage purposes. This reach is classified as a protected watercourse by the Minnesota DNR.

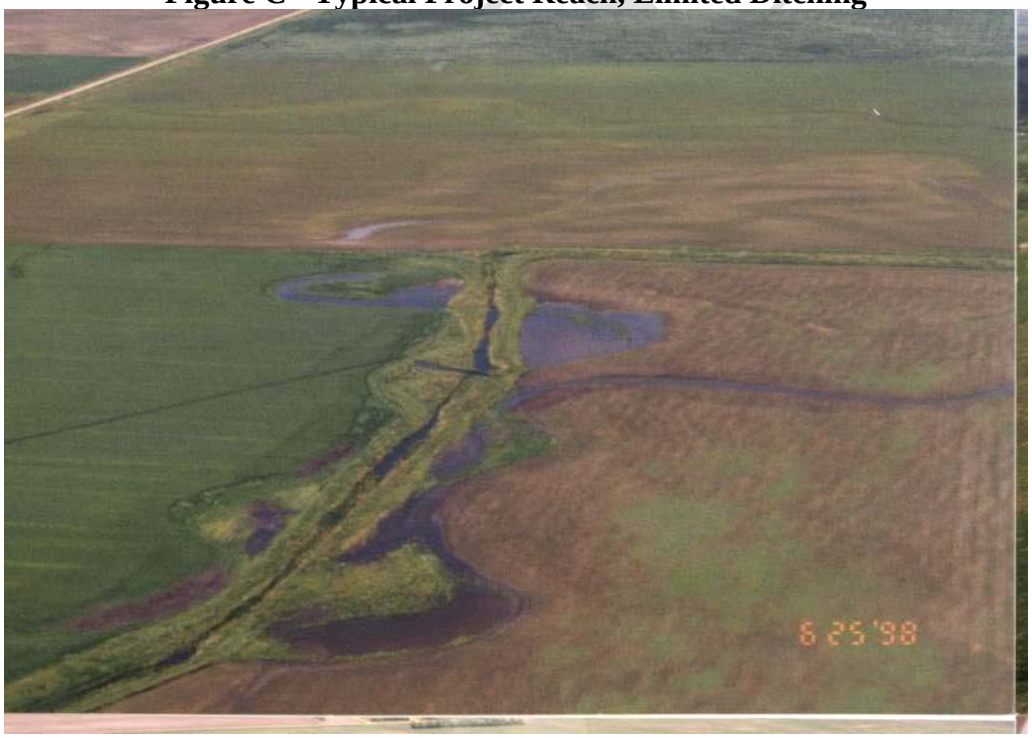
2. Tributary #1 - This is an unnamed tributary that enters the unnamed main channel just upstream of its confluence with JD-10 (Section 36 of Davis Township). It has a drainage area of approximately 7.9 square miles. The total channel reach in this section is approximately 3.5 miles long.

3. Tributary #2 – This is an unnamed tributary that enters the unnamed main channel in Section 29 of Spring Brook Township. It has a drainage area of approximately 17.5 square miles. The total channel reach in this section is approximately 3.4 miles long.

Existing agricultural drainage within this watershed consists primarily of surface ditches. Due to the lack of channel capacity within this part of the watershed, frequency of out-of-bank flooding is high. Subsequently, large portions of the existing flood plain has been allowed to revert to wetlands or been enrolled in conservation set aside programs. Figure B shows a typical view of these frequently flooded areas where original alignment has not been altered. The lower approximately 2.4 miles has been channelized, however because of limited cross sectional area, non-continuity of spoil levee, and low lying adjacent flood plain, capacity is limited and cropland flooding occurs on runoff events with less than a 2-year return period (50% chance in any given year). Figure C shows a typical reach section where some ditching has occurred, however flooding is still an issue.

Figure B - Typical Project Reach, Unaltered Ditch Alignment

Figure C - Typical Project Reach, Limited Ditching



Runoff in this region of Minnesota averages between 2 and 3 watershed inches (11% - 16% of annual precipitation). Runoff includes surface runoff, interflow, and groundwater flow that eventually makes its way to the stream/channel system. Based on regional gage analysis, the annual maximum peak discharge occurs during snowmelt conditions (March

– April) approximately 50 – 60% of the time. Approximately 45% of the water year's total runoff occurs during March and April.

Twistal Swamp, a 1,900 acre wetland, is located in the far northeast end of the watershed. It has an indirect connection with County Ditch 10 and essentially contributes very little flow to the main channel. Locals describe this contribution mostly as "seep" or "spring" type levels.

A hydrologic model (NRCS - WinTR20) was developed to estimate the peak discharge-frequency information for both Annual and Growing Season peak discharge-frequency series. These are defined as:

- Annual Peak Discharge/Frequency Series describes the probability of flows that can occur any time of the year. Snowmelt events plus growing season thunderstorm events are included.

- Growing Season Peak Discharge/Frequency Series describes the probability of flows that can occur only during the growing season.

In general, the ratio between growing season peaks are about 65% of the annual peaks.

Table C summarizes the peak discharge/frequency for the watershed at its outlet (County Road 63). See Appendix C - Hydrology for details.

Table C - Peak Discharge/Frequency Relationship at County Road 63

Probability (% chance)	Return Period (years)	Growing Season (June 1 - Oct 1) Daily Average Peak (cfs)	Annual Daily Average Peak (cfs)
50%	2	135	275
20%	5	180	685
10%	10	690	1,050
4%	25	1,040	1,590
2%	50	1,330	2,050
1%	100	1,630	2,530

Peak discharge/frequency values from Table C above were used as input to a hydraulic model (HEC-RAS) to estimate how deep that discharge will be in the channel. HEC-RAS estimates flow depths based on channel roughness, shape, slope, etc. Output from HEC-RAS in turn is used in conjunction with topographic surveys to estimates acres flooded by discharge.

Wetlands

The U.S. Fish and Wildlife, National Wetlands Inventory (NWI)(Figure 4), and the International Coalition Land Use/Cover[7] identifies approximately 4,170 acres of Types 1-8 wetlands within the watershed, *Wetland Codes and Definitions*[8], This includes Twistal Swamp which is a 1,900-acre Type 3 (Circular 39), PEMC (Cowardin) wetland marsh lying within the 8,000 acre Twin Lakes Wildlife Management Area (WMA) just four miles east of Karlstad. However, the predominant wetlands occurring within the watershed project boundaries are as follows:

Type 1 – Seasonally flooded basins or flats. The soil is usually well drained during much of the growing season and can be covered with water or is waterlogged during variable seasonal periods. Vegetation varies greatly according to season and duration of flooding from bottomland hardwoods to herbaceous plants. Common sites are upland depressions, bottomland hardwoods (flood plain forests). NWI Symbols mapped in the watershed are PEMA, PEMAd and PFOA.

Type 2 – Inland fresh meadows. Soil is saturated or nearly saturated during most of the growing season, usually without standing water during most of the growing season but waterlogged within at least a few inches of the surface with hydrophytic vegetation consisting of grasses, sedges, rushes, and various broad-leaved plants. Common sites may fill shallow basins, sloughs, or farmland sags; may border shallow marshes on the landward side and include low prairies, sedge meadows, and calcareous fens. NWI Symbols mapped in the watershed are PEMB, PEMBd, PEMBg, PEM/FO1B, PEM/SS1B, PEM/SS1Bd, PEM/SS1Bg and PEM/SS1Bgd.

Type 3 – Shallow Marsh. Soil is usually waterlogged early during the growing season, and is often covered with 6 inches or more of water. Hydrophytic vegetation is comprised grasses such as reed canarygrass; bulrush; spikerush; and various other marsh plants such as cattail, arrowhead, pickerelweed, and smartweed. NWI Symbols mapped in the watershed are PEMC, PEMCd, PEMCx, PEMF, PEM/SS1C and PEM/UBF.

Type 4 – Deep Marsh. The soil is inundated, usually covered with 6 inches to 3 feet or more of water during the growing season. Vegetation is cattail, reed, bulrush, and wild rice; open areas may have pondweed, naiad, coontail, watermilfoil, waterweed, duckweed, water lily, and spatterdock. Common sites may completely fill shallow lake basins, potholes, limestone sinks, and sloughs; may border open water in such depressions. NWI Symbols mapped in the watershed are PEM2G, PEM/UBG, PUB/EMF, PUBF and PUBFx.

Type 5 – Shallow Open Water. Soil is inundated usually covered with less than 10-foot-deep water; includes shallow ponds and reservoirs. Vegetation is fringe of emergent vegetation similar to open areas of Type 4. Common sites are

[7] International Coalition Land Use/Land Cover was developed by Land Management Information Center (LMIC). Release date 10/1/1995.
[8] http://www.fws.gov/nwi/mapcodes.htm

shallow lake basins and may border large open water basins. NWI Symbols mapped in the watershed are PUBG, PUBGx, and PUBKx.

Type 6 – Palustrine Shrub Swamps. Soil is water logged during the growing season and is often covered with as much as 6 inches of water; water table is at or near the surface. Vegetation includes alder, willow, buttonbrush, dogwood, and swamp privet. Common sites are along sluggish streams, drainage depressions, and occasionally on floodplains. NWI Symbols mapped in the watershed are PSS/FO1B, PSS/FO1Bg, PSS/FO1C, PSS/FO1Cd, PSS1EMB, PSS1EMBg, PSS1Ad, PSS1B, PSS1Bd, PSS1Bg, PSS1Bgd, and PSS1C.

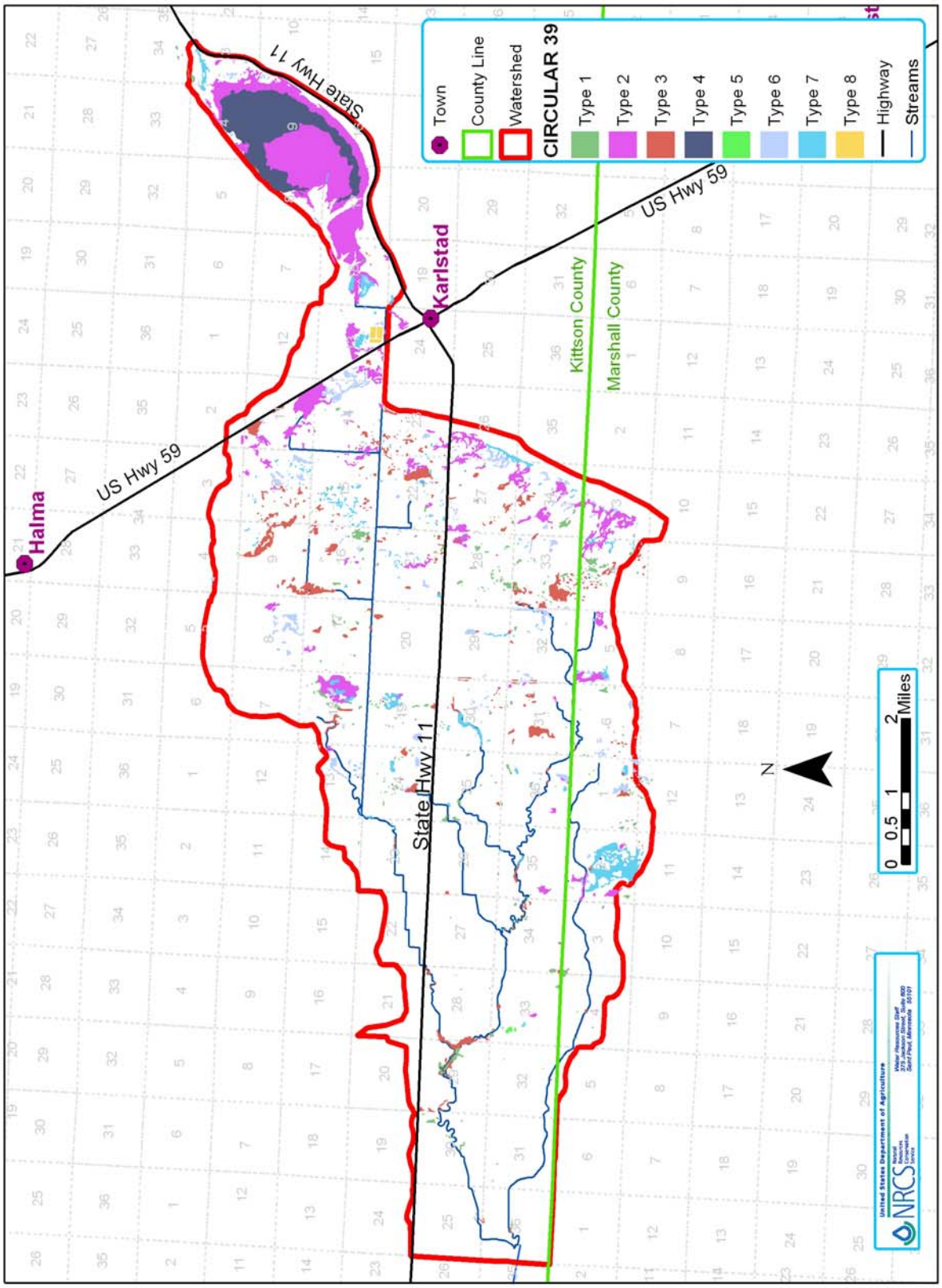
Type 7 – Wooded Swamp. Soil is waterlogged within a few inches of the surface during the growing season and is often covered with as much as 1 foot of water; water table is at or near the surface. Vegetation is hardwood and coniferous swamps with tamarack, northern white cedar, black spruce, balsam fir, balsam poplar, red maple, and black ash; deciduous sites frequently support beds of duckweed and smartweed. NWI Symbols mapped in the watershed are PEM/FO1C, PFO1/EMB, PFO1/EMC, PFO1B, PFO1Bg, PFO1C, PFO1/Cd, PFO1/Cx, PFO1/SS1B, PFO1/SS1Bg, PFO1/SS1C.

Type 8 – Bogs. Soil usually waterlogged and the water table is at or near the surface. Vegetation is woody, herbaceous, or both supporting a spongy covering of mosses, sedges, leatherleaf, Labrador tea, cranberry, and cottongrass; may include stunted black spruce and tamarack. Common sites are mostly on shallow glacial lake basins and depressions, flat terrains, and along sluggish streams. The NWI Symbol mapped in the watershed is PUBKGx.

Table D - Reference between Two Different Wetland Classification Systems

Circular 39 Identification	Cowardin Classification
Type 1	PEMA, PEMAd, PFO1A
Type 2	PEMB, PEMBd, PEMBg, PEM/F01B, PEM/SSI1B, PEM/SS1Bd, PEM/PSS1Bgd
Type 3	PEMC, PEMCd, PEMCx, PEMF, PEM/SS1C, PEM/UBF
Type 4	PEM2G, PEM/UBG, PUB/EMF, PUBF, PUBFx
Type 5	PUBG, PUBGx, PUBKx
Type 6	PSS/FO1B, PSS/FO1Bg, PSS/FO1Cd, PSS1/EMB, PSS1/EMBg, PSS1Ad, PSS1B, PSS1Bd, PSS1Bgd, PSS1C
Type 7	PEM/FO1C, PFO1/EMB, PFO1/EMC, PFO1B, PFO1Bg, PFO1C, PFO1Cd, PFO1Cx, PFO/SS1B, PFO/SS1Bg, PFO/SS1C
Type 8	PUBKGx

Figure D - Spring Brook NWI Wetlands



Watershed Urban Center

No major urban center is located in the watershed. The nearest town is Karlstad, which is located near the southeastern boundary of the watershed. Detailed information regarding the socioeconomics of the City of Karlstad and Kittson County can be found in the population section below.

Transportation

The City of Karlstad, Minnesota, is located in the southeast corner of Kittson County at the junction of U.S. Highway 59 and Minnesota State Highway 11. However, being located in a rural area, the Spring Brook Watershed is serviced and accessed almost entirely by county roads.

Soils

The primary soils along the channel are *alluvial land* (1002), *Arveson* (61), and *Borup loam* (46) (USDA-SCS, 1979).

Alluvial land is frequently flooded and consists of alluvium that was deposited in old stream channels, oxbows, or land along the edges of rivers and smaller streams. The soils are typically nearly level and gently sloping and are dissected by narrow, winding channels of intermittent streams. This map unit includes as much as 15% of areas such as marshes and intermittent open water areas. Wetness limits the cultivation and agricultural uses of these soils. This map unit also includes areas that are flooded for a short enough time that cultivation and cropping are possible.

Arveson has a mantle of loamy sediment over fine sand. It is nearly level and poorly drained. Native vegetation is a wet-site community of reeds, sedges and tall prairie grasses. The seasonal high water table commonly fluctuates from a depth of 0 to 3 feet. Wetness limits the use of these soils. Soil blowing and erosion are hazards where cultivated areas have no protective cover. Some areas of Arveson soil are cultivated, with small grain, sunflowers, and potatoes as common crops. When not cultivated these soils commonly support grasses. In scattered areas, quaking aspen and lowland brush grow in these soils.

Borup is a nearly level, poorly drained soil formed under a growth of sedges and tall grasses in calcareous loamy lacustrine sediment underlain by very fine sandy and coarse silt. Most areas of Borup are cultivated with small grain and sugar beets as common crops. Borup has about 22” of loam over very fine sand.

18,030 acres of highly erodible soils (HEL) are in the watershed. Wind is a serious erosion problem. The Kittson County District Conservationist reports that 100% of the cooperators in Spring Brook Watershed use conservation tillage, with residue management in the 25% to 35% range on these HEL soils subject to wind erosion. On the more erosive HEL soils the 35% residue management level provides protection from both wind and water erosion. The only time water erosion becomes a problem within the watershed is when overland flooding occurs. During normal rainfall events, there is very little soil erosion.

Land Cover and Land Use

A land use dataset was developed using the U.S. Fish and Wildlife National Wetlands Inventory (NWI) and the International Coalition Land Use/Cover for the watershed. The dominant land use within the Spring Brook Watershed is cropland (62.8%), with the remaining 37.2% as follows: water and wetlands (12%); woodland - primarily deciduous (11.5%); grassland (7.2%); Transitional Agricultural Land (5.1%); farmsteads (0.7%); Grassland-shrub-tree (deciduous) (.6%); and other (0.1%). These acres were calculated with ArcMap (LMIC, 1989). The major crops produced are sugar beets, wheat, corn, alfalfa, canola or rape seed, soybeans, barley, sunflower, and potatoes. The crop which produces the largest return for the producer is sugar beets.

Federally Threatened and Endangered (T&E) Species

No federally listed *endangered* species, or their habitat is currently known to be occurring within the watershed.

The Western Prairie Fringed Orchid (*Platanthera praeclara*), is the only federally listed *threatened* species known to occur within Kittson County, MN. Under a Section 7 consultation with the FWS at Ft. Snelling, MN, it was determined that the proposed project may affect, but is not likely to adversely affect this federally threatened plant species.

The Dakota Skipper (*Hesperia dacotae*) butterfly is a federally listed *candidate* insect species known to occur within Kittson County, and a conference with the Ft. Snelling FWS again determined that the proposed project may affect but is not likely to adversely affect this species.

State of MN Listed T & E and Species of Special Concern

The MN DNR List of T & E, and Special Concern, Plant and Animal Species for Kittson County, MN was consulted. No known state of MN T&E, or Species of Special Concern sites have been identified within the proposed project area.

Cultural Resources

A wealth of resources was available to prehistoric and early historic inhabitants of the Red River Valley area. The major faunal resource during the Late Holocene period were bison, which were present in very large herds along the Red River Valley. Large elk herds were also reported in the contact period. Waterfowl would have been seasonally abundant on the shallow marshes while vegetal foods would have included various prairie species (e.g. prairie turnip), marsh plants (e.g. cattails), and berries and nuts from the riparian forests (Anfinson 1990).

Bands of beach ridges are the only features of topographic relief within the flat, level flood plain of The Glacial Lake Aggasiz. Typically these ridges would be where sites would be expected. While no bedrock outcrops occur in the Red River Valley Region, lithic resources are available in beach ridge cobble deposits throughout the eastern part of the region. These are most accessible where rivers have cut through the beaches.

No early prehistoric materials (e.g. fluted points) have been found in this general area. However, Late Paleoindian projectile points (i.e. Plano) have been recovered from beach

ridges in the eastern portion of the area and may also be present in the Lake Agassiz Plain.

Middle Prehistoric period Archaic sites are the first evidence of widespread occupation of the Red River Valley (Anfinson 1990). It's possible that these Archaic components, much like later Early Prehistoric components, are buried by over a meter of alluvium in the Red River Valley (Anfinson 1990). The primary subsistence activity during the Archaic period was bison hunting.

Scattered evidence of Woodland habitation sites has been found at higher elevations along the Red River and include Laurel, St. Croix, and Blackduck ceramics. Some variations exist in which certain Early Woodland ceramic types concentrate, but seasonal bison hunting camps, habitation sites on beach ridges, and some sites exhibiting horticultural activity are expected to be found in the area. Later Woodland sites tend to be located on meander loops in the Red River Valley.

At contact, the western Dakota Teton and Yanktonai controlled the entire region except the far north, which was occupied by the Assiniboine (Anfinson 1990). By 1800 the Yanktonai controlled the southern area and the Ojibwa the northern.

British and American fur posts were located along the Red River as far south as Lake Traverse, however, some posts were located inland along major tributaries. The Woods Trail, the easternmost Red River Trail and one of the most traveled of the ox cart trails, passes just west of the project area. Unlike the other trails in the network, the Woods Trail was pioneered by men going north to the Red River Settlement (now Manitoba) from St. Paul (Gilman et al. 1979). In the Red River Valley region, these trails often followed the beach ridges in order to avoid marshy areas. The name "Woods Trail" was an exaggeration since only a small section from Detroit Lakes to Crow Wing was wooded (Gilman et al.1979). The rest of the trail threaded its way through a varied landscape from low savannah country to high treeless prairie.

Wildlife

Most of the prodigious wildlife of Northwest MN disappeared a century or more ago as a result of agricultural draining. The Red River Basin of the past was a wildlife wilderness of legendary proportions. Herds of bison and antelope; grizzlies; huge flocks of cranes and waterfowl; mink, otter, and beaver, moose and hundreds of other species inhabited the open grasslands and forests. This prodigious wildlife disappeared a century or more ago. Most of the fish and wildlife habitat in the Spring Brook Watershed has been altered due to land use changes, drainage, and channel modifications. Migratory waterfowl species such as the mallard, pintail, and scaup continue to decline in numbers (Fish and Wildlife Service 2007).

The long-term survival of each of the basin's primary wildlife communities - grassland, wetland, woodland, and riparian - is threatened by habitat loss, fragmentation, and degradation. Expanding, buffering, and connecting the wooded river corridors that remain intact in the basin is critical to wildlife conservation. For example, moose in Kittson County are on the verge of disappearing and are very seldom seen in the proposed project area where they once were common. According to a recent MN DNR

Wildlife Resources Survey, only an estimated 84 moose now live in far Northwest Minnesota, of which Kittson County is a major part, down from 253 four years ago, and a sliver of the 4,000 animal herd tallied in the mid-1980s (MN DNR, 2007).

Game animals and game birds and waterfowl found and hunted within the watershed district include whitetail deer, black bear, moose, elk, fox, sharp-tailed and ruffed grouse, and woodcock. A wide variety of migratory waterfowl such as mallards, green and blue-winged teal, northern shovlers, redheads, canvasbacks, scaup and pintails, as well as Canada, snow, blue, and Ross' geese compete for wetland habitat. Many fur-bearing animals such as mink, muskrat, beaver, otter, fox, raccoon, coyote, fisher, and bobcat may be trapped or hunted.

In addition to the game species listed above, many non game species of animals also exist within the District. These include, but are not limited to, sandhill crane, great blue heron, magpie, bald eagle, timber wolf, American bittern, marbled godwit, loon, and many other migratory and resident bird species such as eared grebes, northern harriers, marbled godwits, American bitterns, Franklin's gulls, and great gray owls (*MN DNR, A Travelers Guide to Wildlife in MN, 1997).*

Recreational Development – Hunting and Wildlife Viewing

The major recreational hunting activities would be for deer, waterfowl, and sharp-tailed and ruffed-grouse. In the latest available deer harvest by license and type and zone in 2004, 651 deer which includes does, bucks, and fawns were harvested from permit area 403 of Zone 2, which most nearly coincides with the proposed project area. Zone 2 extends through a broad band of north central to northwestern MN, and had the highest percentage rate of success for harvested deer among the 6 major zones in the state. Permit area 403 covers the northwest corner of Zone 2. (*Status of Wildlife Populations, MN DNR, Fall, 2006*).

Waterfowl hunting is concentrated in the Twin Lakes Wildlife Management Area (WMA) located about 4 miles NE of Karlstad. However, The WMA contains a 1,200 acre waterfowl sanctuary. No trespassing or hunting is allowed in the sanctuary during September and October. The major waterfowl hunted during open season would be mallards, canvasbacks, redheads, ringnecks, and Canada and snow geese.

The Twin Lakes WMA is an excellent area for all species of wildlife found in northwestern Minnesota. The forest and brush land habitats offer excellent food and cover for deer, moose, bear, ruffed grouse, woodcock, and other woodland species. The lakes and wetlands offer good habitat for ducks, geese, sandhill cranes, grebes, herons, rails, and black terns. Twistal Swamp has been a major fall staging area for sandhill cranes. More than 1,000 birds have roosted in the marsh in September and early October. A wheelchair accessible viewing platform located off State Highway 11 near Twistal Swamp that overlooks the marsh. Wildlife viewing options include wetland prairie, and forest.

Fisheries

Most of the fish habitat in the watershed has been altered due to land use changes, drainage, and channel modifications. The fish habitat is particularly limited by channelization of most watercourses and a flow regime characterized by short periods of high flow and lengthy periods of extremely low profiles that support little aquatic life. No major sport fishery is associated with the Spring Brook watershed area. Any fishery that exists would be localized to pools of water, and perennially drained public ditch areas. This fishery would consist of an occasional game fish being caught such as a northern pike, smallmouth bass, walleye, sunfish species, or channel catfish. Any restored aquatic habitat associated with the proposed setback/flood plain renovation would favor certain indigenous prairie stream species such as mudminnows (*Umbra*, spp.), and sticklebacks (*Gasterosteus, spp.*). Some of the ditch channels dry up seasonally and provide no aquatic habitat.

Population

Kittson County is home to approximately 5,300 people, with roughly 800 of them residing in the City of Karlstad. This population in the county and the city declined between the 1990 and 2000 census by 9% and 11% respectively. Roughly 13% of Karlstad's residents 25 years and older has a Bachelors degree or higher, compared to 15% for Kittson County. The median household income for Karlstad is $31,450, which is 29 percent lower than Kittson County at $40,580.

Table E - Socioeconomics of the watershed

	City of Karlstad	Kittson County
Population	794	5,285
Median Household Income[1]	31,450	40,580
Individuals below poverty line	99	521
Median Age (years)	45	42
25 and over	551	3,661
Education (Age 25 and over)		
High School	401	2,916
BS or higher	73	540
Unemployment	44%	41%
Average Family Size	2.8	3.0
Median Value of Home[1]	57,110	47,570

1. 2007 Dollars

draft

WATERSHED PROBLEMS AND OPPORTUNITIES

Floodwater Damages

Floodwater damage is a major problem for landowners/operators in Spring Brook Township of the Two Rivers Watershed District. Severe flooding has been a recurring problem in this area since 1993. Federal disaster declarations have been issued in 1993, 1996, 1997, 1999, 2000 and 2002.

The watershed is prone to flooding during spring rains and snowmelt and from summer convective storms. Heavy late spring and summer storms often occur while crops are actively growing, creating the potential for large crop losses. The severity of growing season flood losses depends on water levels, duration of inundation, and timing. Producers have also reported severe pesticide and herbicide losses from the flooding and associated erosion. The flooding and erosion in the project area causes a reduction in the effectiveness of herbicides and pesticides. This results in reduced yields and increased production costs, reducing net farm income. Although the spring snowmelt events do not occur while the crops are actively growing, damages can occur in the form of road, bridge, and fence damages, loss of topsoil due to flood plain scour, and delayed planting losses.

Since the project reach (unnamed intermittent watercourse between County Ditch 10 (CD #10) and Judicial Ditch 10 (JD #10) was never constructed as a single drainage project, the existing dikes and channel are not continuous and allow breakouts and uncontrolled flow across the adjacent flood plain. The following narrative was developed by the Two Rivers Watershed District as part of a 2001 Flood Hazard Mitigation grant request to the Minnesota DNR:

> "The intermittent water way that this project will be located along experiences severe flooding from an upstream drainage area of about 50 square miles. Immediately upstream is Kittson County Ditch #10, a straight line ditch with a length of 8 miles. This ditch travels through several ridges and brings in water from the City of Karlstad and an area known as Twistal Swamp. Because of the slope, nature of the sandy soils, and the relatively large drainage area, the water that comes to this waterway comes with high velocity, is very erosive in nature, and brings with it large amounts of sediment. When the water gets into the intermittent waterway, the presence of vegetation and the winding channel cause the water to slow down enough that the high sediment load drops out and fills the channel. This reduces the capacity of the channel to carry water and as a result the water breaks out of the channel and flows overland.
>
> The overland flooding and the sediment the water picks up as a result is generally deposited back into road ditches, or finds its way back into the original intermittent waterway, where the sediment is deposited. This

> creates the problem of sediment blocking ditches and waterways and creates a maintenance cost. Repeated flooding of this nature brings a cost to repair public roads and other structures in the hundreds of thousands of dollars. The damage to agricultural land and crop damages brings an additional cost in the hundreds of thousands of dollars. This project will attempt to reduce the overland flooding, thereby reducing the sediment loads, and reducing the damages."

Project Sponsors note that upstream sedimentation has been addressed since the grant request was written in 2001. Eight grade stabilization structures have been installed reducing sediment movement and channel head cutting.

Floods along the Unnamed Ditch adversely affect agriculture by physically damaging crops, fences, buildings, and land. Rural roads and bridges are damaged by the loss of the surface materials, washouts at bridges and culverts, and bridge structural damage attributable to ice and scour. Having limited detailed records on the current level of monetary damages experienced for various flood levels, estimates were generated using NRCS Project Economic Evaluation procedures (see Appendix C - Economics Section for details). The acres flooded within the project area were estimated using hydrology/hydraulics models in combination with GIS (Table F, Appendix C – Hydrology Section for details). Modeled results were verified by local NRCS and Two Rivers Watershed District personnel review. These results were combined with producer interviews conducted in the watershed. The interviews contained detailed information on cropping practices, estimates of historic flood damages, and first hand information on the characteristics of the flooding. Total monetary damages to cropland and other areas were estimated. Average annual damages for the project are summarized in Table F and

Table G.

Table F - Floodwater Damage Summary

Reach*	Crop Damage	Average Annual Acres of Cropland Flooded	Cropland Acres Flooded by Event						
			1.5 yr	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
1	$ 3,561	23	0	0	11	76	167	223	274
2(us)	$ 6,497	36	12	19	56	71	115	173	267
2(ds)	$ 42,417	246	16	60	483	729	962	1080	1158
3(us)	$ 8,258	47	3	5	99	138	170	218	308
3(ds)	$ 3,695	22	1	2	43	60	85	113	153
4	$ 13,564	76	14	20	119	198	317	436	568
5	$ 3,108	18	5	7	23	34	73	129	218
6	$ 60	0	0	0	0	1	2	3	4
7	$ 242	1	0	0	1	3	8	13	19
Total	$81,402.00	469	51	113	835	1310	1899	2388	2969

*Stream reach locations used for the calculation of floodwater damages can be found on Figure 1C in Appendix C.

Table G - Average Annual Total Damages

Category	Average Annual Damages	
Crop	$	81,400
Farmstead	$	18,870
Roads and Bridges	$	81,400
Total	**$**	**120,230**

Fish and Wildlife Habitat Losses

The long-term survival of each of the basin's primary wildlife communities—grassland, wetland, woodland, and riverine - is threatened by habitat loss, fragmentation, and degradation (See Appendix C - Stream Visual Assessment).

Expanding, buffering, and connecting the wooded river corridors that remain intact in the basin is critical to wildlife conservation. Wildlife habitat is especially limited by a lack of grasslands and wetland habitat and by limited connectivity of riparian corridors for food, cover and traveling lanes. Only a few remnant grassland habitat blocks are present in the watershed, most wetlands have been drained, and CRP land is almost exclusively limited to a patchwork of riparian buffer strip areas adjacent to some of the channel bank system throughout the cropland fields.

Stream Bank Erosion and Sedimentation

In some portions of the watershed, drainage ditches have been constructed through non-cohesive sandy soils resulting in bank instability and head cutting. Over the past several years, grade control structures have been installed to address this in the CD-10 portion of the watershed.

Damages from sedimentation have been identified by project Sponsors as a major concern. Sediment can deposit in existing channels which in turn reduces flow conveyance, and forces floodwaters out into the flood plain more frequently. If this happens early in the growing season before vegetal cover has been established, deep scour channels can form in the cropland. One landowner interviewed during project planning indicated that during 1993, 2 to 4 feet deep scour channels had formed approximately 100 to 200 feet from the main channel. Because the channel reaches within the PL-566 project area are not part of the organized Two Rivers Watershed District Ditch System, cleanouts must be carried out by private landowners. In this situation, obtaining permits can be a problematic hurdle. In some areas, notably sections 22 and 23, the lack of cleanout and flood plain sediment deposition has caused some cropland to be abandoned.

SCOPE OF THE ENVIRONMENTAL ASSESSMENT

Project scoping was used to identify problems and needs, and to rate their significance. This list of concerns was refined through public meetings, technical meetings, and discussion with other federal, state and local governmental agencies. Table H lists and rates the significance of the concerns which have been addressed. Later in the report, each concern item that is rated "high" for degree of significance to decision making is discussed as to how the alternative affects that concern.

Table H - Evaluation of Identified Concerns

Economic, Social, Environmental, and Cultural Concerns	Degree of Concern	Degree of Significance to Decision Making[9]	Remarks
Floodwater Damage	High	High	An estimated 469 average annual acres of cropland are flooded along the proposed project reaches. Total average annual damages due to flooding are $148,080.
Downstream Floodwater Damage	High	High	Confining flood flows between dikes has the potential to increase peak discharges downstream.
Local Surface Drainage	High	High	Evaluation of any project alternatives must consider impacts on existing local surface drainage systems.
Wetlands	High	High	Approximately 4,170 acres for Types 1-8 wetlands exist within the watershed. 112 acres of wetlands exist within a 1,000' corridor along the main channel (between CD10 and JD10) and tributaries 1 and 2.
Wildlife Habitat	High	High	The long-term survival of the watershed's primary wildlife communities-grassland, wetland, woodland and riverine is threatened by habitat loss, fragmentation, and degradation. Opportunities exist for expanding, buffering, and connecting the wooded river corridors within the project area.
Rare, Threatened, and Endangered Species	High	Medium	No federally listed *endangered* species, one federal *threatened* species (Western Prairie Fringed Orchid), and one federal candidate (Dakota Skipper Butterfly) occurs in Kittson County. MnDNR lists one *endangered*, and five *threatened* animal species, three *endangered* and three *threatened* plant species occur in Kittson County
Fish Habitat	High	Medium	Previous ditching efforts have eliminated the majority of the fish habitat with the project area.
Soil Erosion & Sedimentation	High	Medium	Wind erosion potential is high within this area; however 100% of cooperators within the watershed have implemented conservation practices to address this. Sedimentation and scour damages from excessive floodplain flows are currently an issue.
Cultural Resources	High	Medium	Initial cultural resources review revealed that there are no previously recorded archaeological sites or properties listed in the NRHP in or near the project area. However there is moderate to high probability for archaeological sites given its proximity to Red River tributaries and Glacial Lake Agassiz beach ridges.
Recreation Development	Medium	Medium	Natural habitat and migration corridors for many animal and bird species within the region has declined dramatically since agricultural expansion during the early 20th century to present. Any increase or enhancement of the wildlife habitat create potential for increased recreation through activities such as wildlife watching and hunting.
Human Health & Safety	Medium	Low	None identified by Sponsors.
Forest Land	Medium	Low	Amount and quality of forested lands is reasonable for this Eco-Region
Prime Farmland	High	Low	The acreage of prime farmland protected from project activities would far outweigh the small amount taken out of production.
Property Values	High	Low	Project actions/reduced flooding may increase property values

[9] **High** - may be affected significantly by alternative solutions
Medium - may be affected by some alternative solutions
Low - considered, but not major

FORMULATION AND COMPARISION OF ALTERNATIVES

General

Plan formulation for works of improvement administered by NRCS was according to the U.S. Water Resources Council's "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G)." P&G specifies that the federal objective of water and land resources planning is to contribute to national economic development (NED) consistent with protecting the nation's environment and being responsive to state and local concerns.

Formulation Process

All reasonable methods of solving the identified water related land resource problems of the watershed were considered. Alternative plans were developed that included nonstructural measures, structural measures, and the possibility of no action. They were formulated in consideration of four criteria: (1) Completeness, (2) Effectiveness, (3) Efficiency, and (4) Acceptability.

Coordination was maintained with federal, state, citizens from within the watershed and local agencies having related programs or interests in the Spring Brook Watershed area.

Alternatives measures considered for flood prevention include:

1. No Action

2. Nonstructural Measures
    a. Accelerated conservation land treatment
    b. Wetland restoration
    c. Obtaining flowage easements
    d. Purchasing land

3. Structural Measures
    a. Upstream reservoir storage
    b. Channel modification
    c. Dike system

1. No Action

The no action plan or maintaining the status quo would not provide PL-566 federal assistance to address existing problems. Flood damages would continue to occur. Environmental quality of the area would potentially decline.

Land use changes would likely occur as CRP contracts expire or programs change over time. Any future conversion of the existing CRP acreage to cropland within the watershed would likely increase frequency and duration of flooding due to increased runoff amounts and reduced travel time from fields to surface water channels. Sediment loading to the channel would further increase flooding potential. Environmental quality of the area under this scenario would decline.

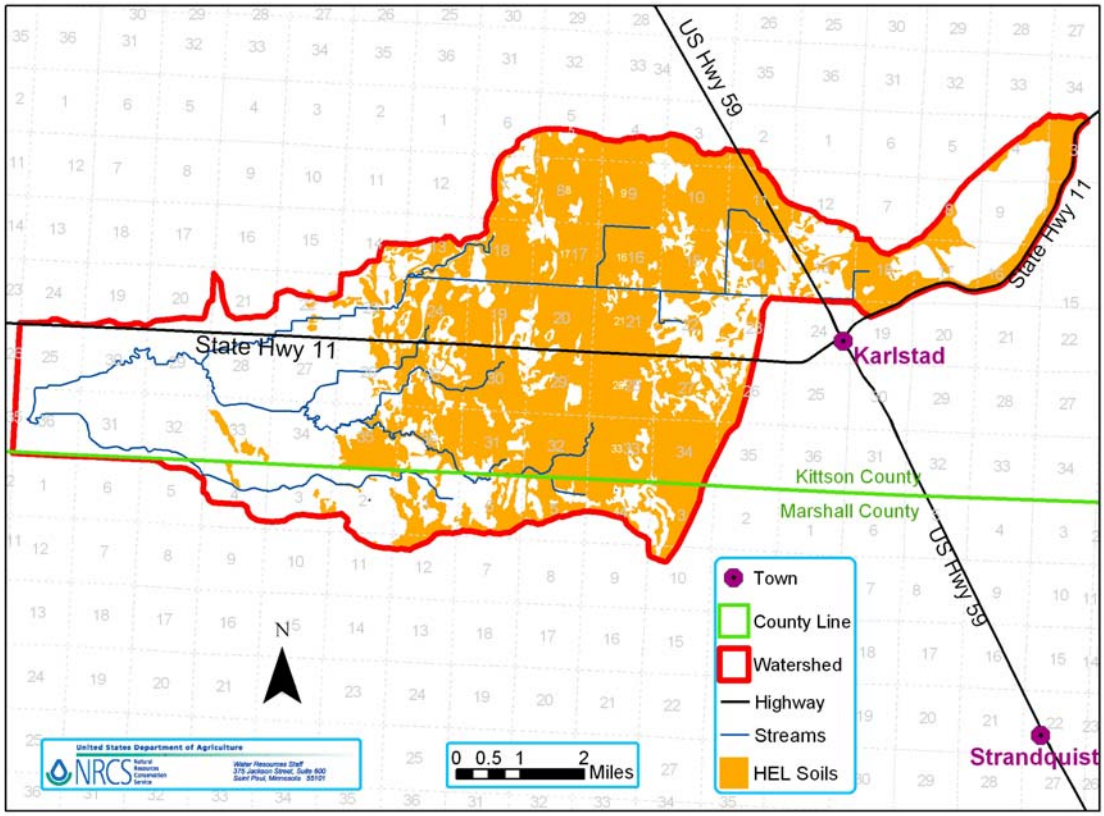
draft

2. Nonstructural Measures

2a. Accelerated Conservation Land Treatment. In general, conservation practices can reduce surface runoff. Runoff reducing practices include crop residue management, cropping rotations, terraces, water and sediment control basins, and small ponds. If applied uniformly over large percentages of a watershed, runoff volumes and peak discharges can be reduced.

Within the Spring Brook Watershed, approximately 18,030 acres of Highly Erodible Land (HEL) have been identified (approximately 53% of the total watershed area). HEL is defined as the potential of a soil to water and/or wind erosion. A vast majority of this HEL acreage in the watershed falls in the potential wind erosion category. See Figure E for a general mapping of HEL classified land within the watershed.

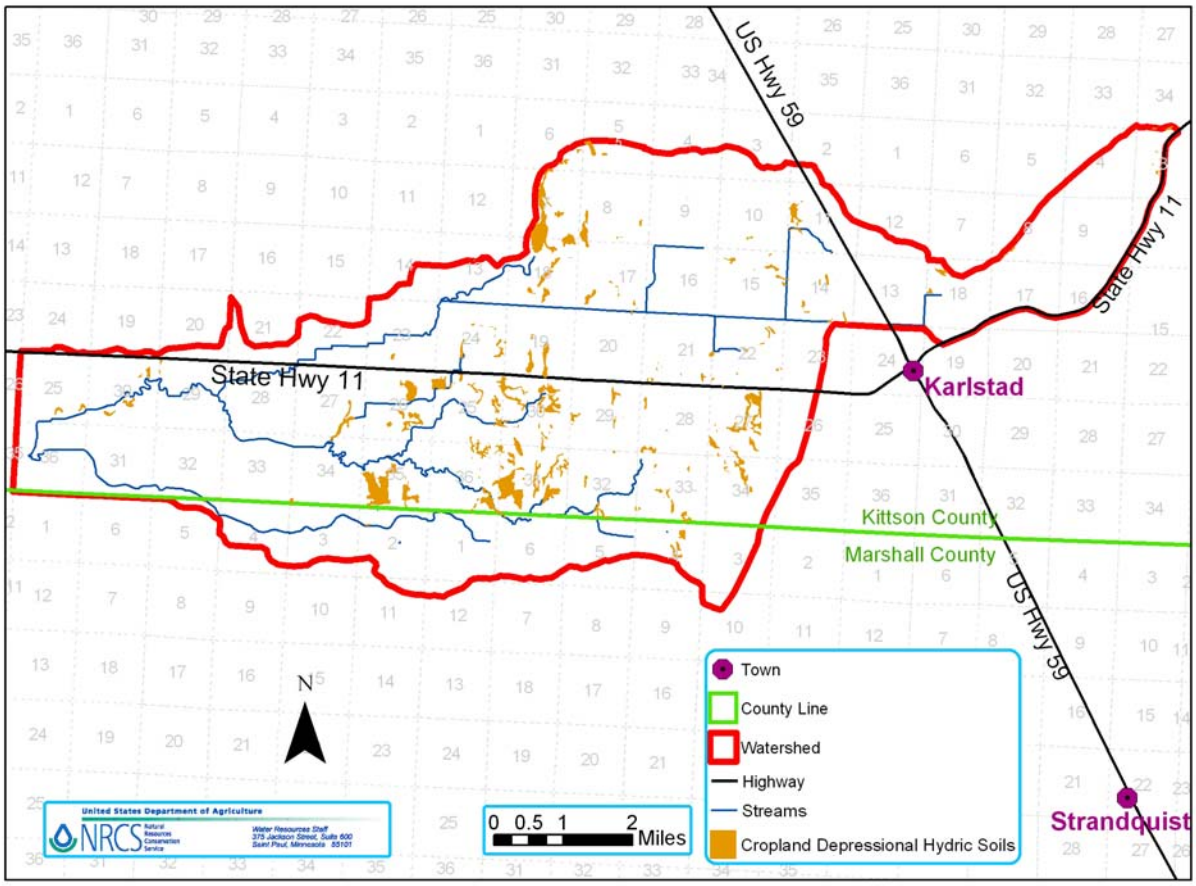
Figure E - Soils Classified as HEL within the Watershed



NRCS field staff estimate that approximately 100% of this acreage is currently protected. Treatment usually involves crop residue management between 25% and 35% cover at time of planting. Future without project conditions assumes cropping rotations and treatment will remain the same. Therefore no potential for reducing flooding through accelerated conservation land treatment exists.

2b. Wetland Restoration. Loss of wetlands can reduce the potential runoff storage within a watershed. The project's contributing watershed contains approximately 2,600 acres of drained wetlands. Of these, approximately 1,020 acres are within cropland. These acres are based on an ARCMAP analysis intersecting depressional hydric soils with cropland land uses.
Figure F displays a general mapping showing this intersection.

Figure F - Depressional Hydric Soils within Cropland/Grassland Land Uses



In this region of Minnesota, the majority of wetlands are drained using land leveling and or surface channels. Restoration would involve blocking these surface channels. Assuming 50% of these cropland drained wetlands are restored and a 4:1 upland drainage area/wetland surface area ratio is used[10], average annual cropland flooding within Reach 2 - DS (reach with > 50% of total project damages - see Appendix C for location), would be reduced by 25 acres[11]. If a 10:1 upland drainage area/wetland surface area ratio is assumed, the average annual cropland flooding within Reach 2 -DS would be reduced by

[10] Ratio of land area draining to wetland to the wetland pool area. This estimate is based on similar wetland restoration projects in the Glacial Ridge Wetland Restoration area.
[11] Assumes wetland stores 100% of contributing runoff from events less than or equal to 5-year growing season events and 75% and 50% for the 10-year and 25-year events respectively. No reduction is assumed for the 50- and 100-year events.

51 acres. Table I summarizes the impact by event for both upland ratio restoration scenarios.

Table I - Wetland Restoration in Place - Cropland Acres Flooded in Evaluation Reach 2 (Downstream)

Growing Season Event	Cropland Acres Flooded - Present Condition	Cropland Acres Flooded - 50% Restored Wetlands 4:1 Wetland/Upland Ratio	Cropland Acres Flooded - 50% Restored Wetlands 10:1 Wetland/Upland Ratio
1.5 yr	19	17	14
2-yr	85	59	32
5-yr	486	424	361
10-yr	783	723	649
25-yr	1012	986	956
50-yr	1154	1154	1154
100-yr	1198	1198	1198
Average Annual	257	232	206
# ac benefited:		25	51

An approximate benefit:cost ratio analysis shows costs far exceeding benefits with these scenarios. In addition, over 600 acres would continue to be flooded by a 10-year event in this reach with wetland restoration in place making this unacceptable to the Sponsors' goal of flood protection.

2c. Obtaining flowage easements. Flowage easements for the land affected by the 10-year event would secure. A total of 1,720 acres is the estimated size. It is estimated that the easements would cost $500 per acre, for a total cost of $860,000 plus administration fees.

There are no tangible benefits to doing this alternative. Channel stability would not improve and the economical loss to the local farmers would continue when an event occurs.

The project Sponsors have decided not to consider this alternative due to cost, land acquisition complications, and lost to local farming economy.

2e. Purchasing land. All the land affected by the 10-year event would be bought. A total of 1,720 acres is the estimated size. It is estimated that it would cost $1,000 per acre, for a total cost of $1,430,000 plus administration fees.

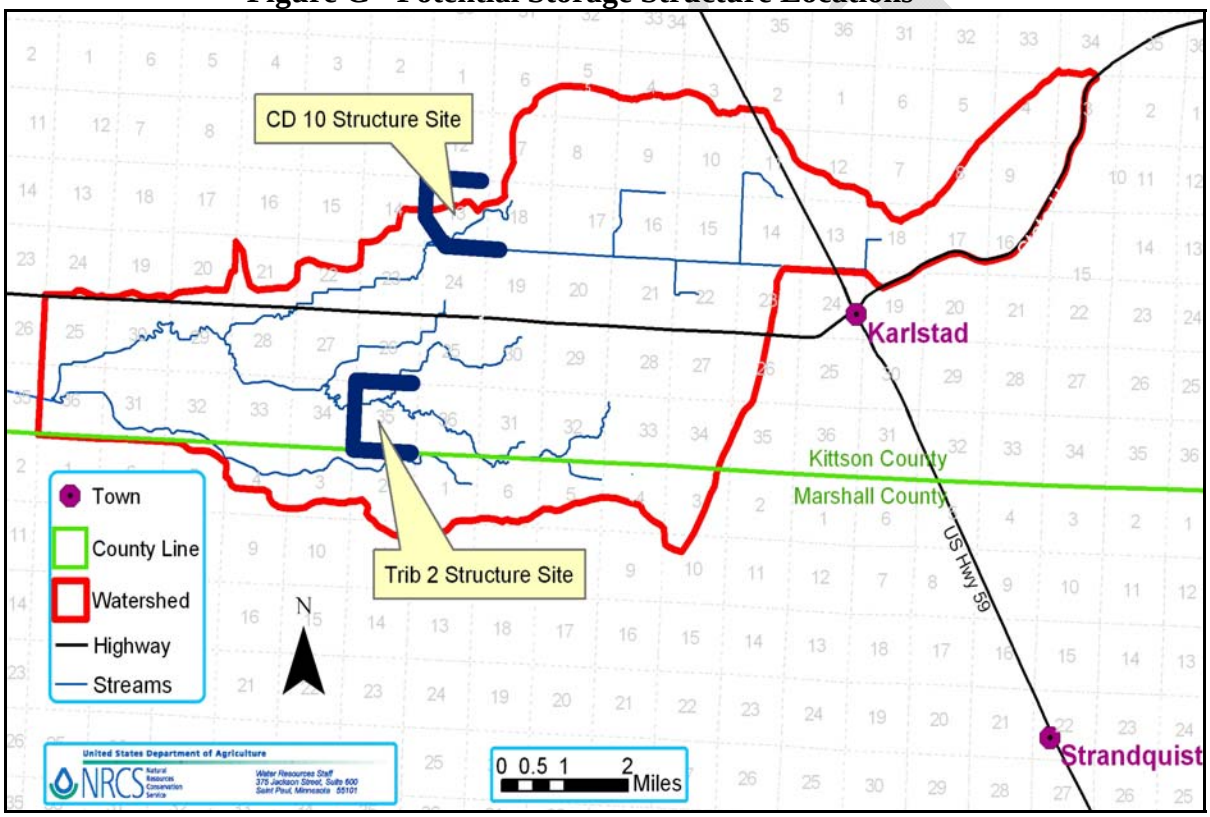
There are no tangible benefits to doing this alternative. Channel stability would not improve and the economical loss to the local farmers would continue when an event occurs.

The project Sponsors have decided not to consider this alternative due to cost, land acquisition complications, and lost to local farming economy.

3. Structural Measures

3a. Upstream Reservoir Storage. Upstream storage can reduce peak discharges by storing water and releasing it at rates that downstream channels can contain. Prior to NRCS's planning efforts, the Sponsors had identified two potential upland storage structure sites. These are located in sections 13 and 35, T159N/R47W (Spring Brook Township), see Figure G. These are referred to as the CD-10 Structure and the Trib 2 Structure respectively.

Figure G - Potential Storage Structure Locations



The CD 10 Structure Site was evaluated as both a "flow through" (all CD-10 water would flow through the structure) and as an off channel storage type structure. An off channel storage structure would divert only a portion of the higher flows into the reservoir. This results in a smaller storage structure.

Preliminary hydrologic analysis of these reservoirs show that with the CD-10 Structure in place, average annual acres of flooded cropland along the main

channel would be reduced by approximately 50% and 27% for a flow through structure and off channel storage type structure respectively. With only Trib #2 Structure in place, average annual cropland flooding would be reduced by approximately 20%. See Appendix C for hydrologic routing details for Upstream Reservoir Storage.

The project Sponsors have decided not to consider any of the reservoir alternatives due to cost, future O&M obligations, land acquisition complications, and seepage concerns due to the sites' sandy soils. In addition, the CD-10 flow through structure would likely be classified as "high hazard" due to its proximity to a downstream residence. High hazard structures require that a Probable Maximum Flood (PMF) pass through without overtopping which can substantially increase embankment/fill costs.

3b. Channel Modification. This option involves excavating a channel that would contain the 10-year growing season event such that water levels would be below the average flood plain elevation and velocities at or below 3.0 feet per second. The channel would only be installed in the reaches that currently flood cropland during the 10-year growing season event (same reaches as described later in the report where the dike system is proposed).

Preliminary designs for the upper and lower reach channels are:

- Lower Reach - Approximately 16,450 feet long. This section would have a 25 foot bottom width, 3:1 side slopes. Channel bottom slopes range from 0.001 ft/ft to 0.0015 ft/ft, depths from 4.1 to 4.4 feet, and velocities from 2.5 to 3.0 feet per second. A small 2 foot drop structure would be needed approximately 2,500 feet upstream from County Road 63.
- Upper Reach - Approximately 5,690 feet long. This section would have a 10 foot bottom, 3:1 side slopes. Channel bottom slopes range from 0.0025 ft/ft to 0.0028 ft/ft, depth about 3.2 feet, and velocities about 3.0 feet per second. Two small 1.5 foot drop structures would be required - one at the head of channel work and one approximately 1,500 feet downstream from the first 1.5 foot drop.

Sponsors have decided not to pursue this option due to environmental concerns and low probability of obtaining permits for such an alternative.

3c. Dike Systems. Dikes would be constructed of earthen fill along areas that currently flood during the 10-year growing season event[12]. The dikes would be setback away from the channel to allowing flood flows to access a flood plain while preventing water from reaching cropland outside the dikes.

[12] A growing season 10-year frequency event is the maximum level of protection as set by the Red River Basin Commission's 1998 Flood Damage Reduction Mediation Agreement. The agreement is a product of federal, state and local agencies, local landowners and environmental groups which set broad goals for flood damage reduction and natural resource enhancement in the Minnesota portion of the Red River basin. Protection of agricultural property above this level would not be issued permits.

Description of Alternatives

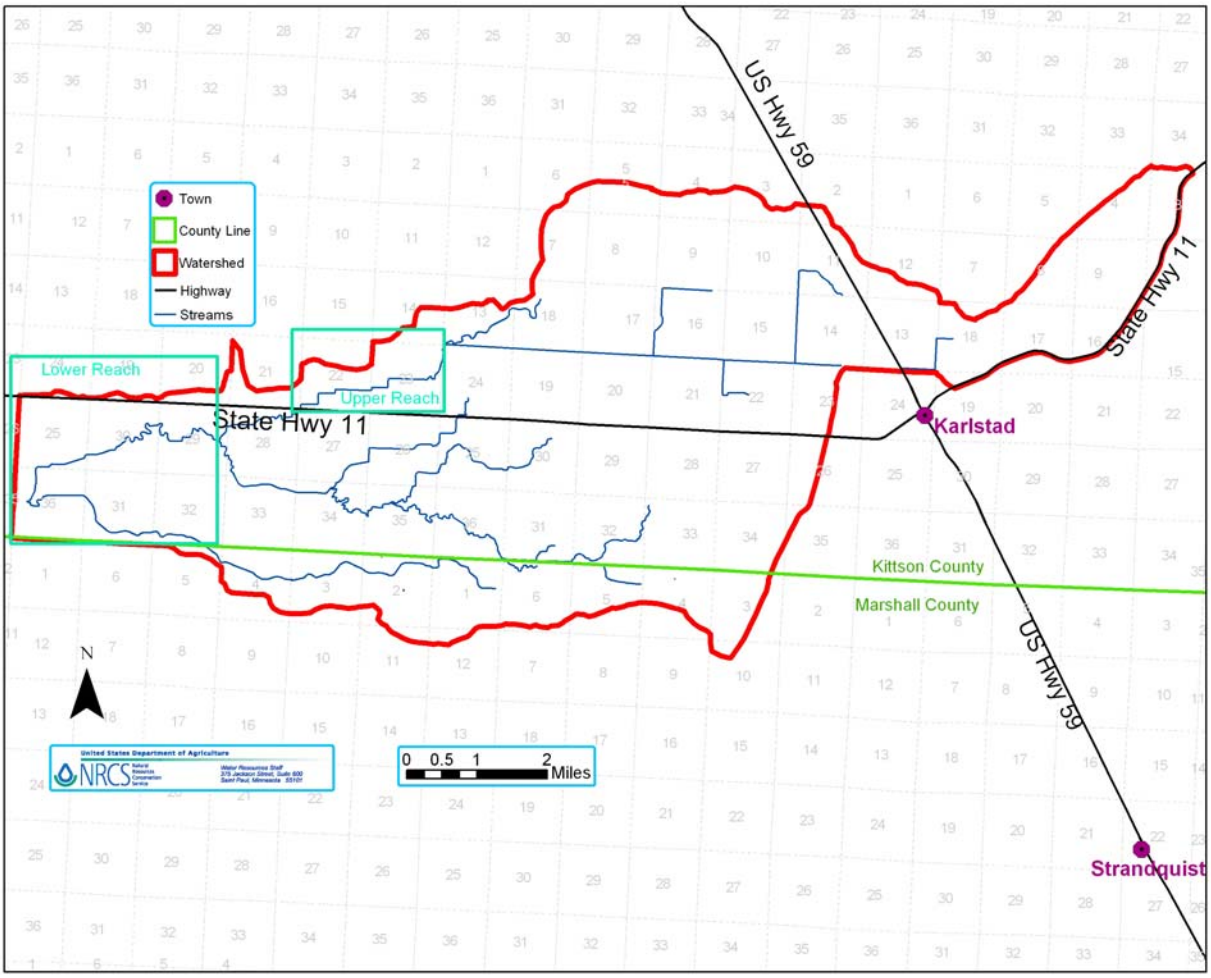
The formulation process next considered combining feasible measures into alternative plans.

Plan 1. The No Action Plan – consists of foregoing the project and relying on existing local, state, and federal resource conservation programs for corrective action.

Plan 2. Moderate spacing between setback dikes with channel meanders and riffles - This plan proposes dikes at locations along the main channel and tributary #1 where major cropland damages occur from a 10-year growing season runoff event. Reaches along the main channel and tributary #1 that either have the 10-year event flowing within existing channel banks, or do not flood cropland, do not have dikes proposed[13].

Figure H identifies the project areas within the watershed.

Figure H - The Project Areas Identified



[13] Determined by HEC-RAS water surface profile model in conjunction with field personnel estimates.

For this plan, three reaches of dikes are proposed:

1. Lower Main - This project reach includes 15,550 feet of dikes on both sides of the channel from County Road 63 up to CSAH 2. The average inside toe to inside toe distance varies from 330 feet to 645 feet with an average width of 440 feet.

   In addition to the dikes, the upper 6,060 feet of main channel will be re-aligned to flow in a meandered pattern similar to the channel's historic alignment[14]. The channel within the re-aligned segment will be sized to "channel forming" flow levels[15]. Within the channel, rock riffles will be installed to provide channel and bank stability.

2. Upper Main - This project reach includes 12,500 foot of the main channel from State Highway 11, through T159N, R47W Section 22 and part of Section 23. Three sections of dike are proposed for this reach:

   A. 2,530 feet of dikes on both sides of the channel (two-sided) from State Highway 11 upstream. Average inside toe to inside toe distance between the dikes is 235 feet.

   B. 2,000 feet downstream of and 3,900 feet upstream of the north-south Section 22/23 road. The average inside toe to inside toe distance between the dikes is 285 feet.

   C. 1,400 feet of dike on the north side of the main channel - ties in to the downstream two-sided dike section. The average inside toe to inside toe distance between the dikes is 388 feet.

   In addition to the dikes within B and C, the upper 3,500 feet of the main channel will be re-aligned to flow in a meandered pattern similar to the channel's historic alignment. The channel within the re-aligned segment will be sized to the 1.5-year flow event. Within the channel, rock riffles will be installed to provide channel and bank stability. The total channel length where riffles would be installed is approximately13,200 feet. A riffle spacing of 9 channel widths[16] and an average channel width of 27 feet was used to calculate the number of riffles required. The estimated number of riffles is 55. This number will probably change as the construction design details are developed.

3. Tributary #1 - This project reach includes 5,930 feet of dikes on both sides of the channel within T159N, R47W Section 31. Average inside toe to inside toe distance between the dikes is 325 feet.

[14] The meander restoration reach is based on recommendations made in the Spring Brook Stream Assessment Report (January 2006).
[15] In this region of Minnesota, channel forming flows have a return period of approximately 1.3 years.
[16] Federal Interagency Stream Restoration Working Group. (Oct 1998). Stream Corridor Restoration – Principles, Processes, and Practices. [Manual].

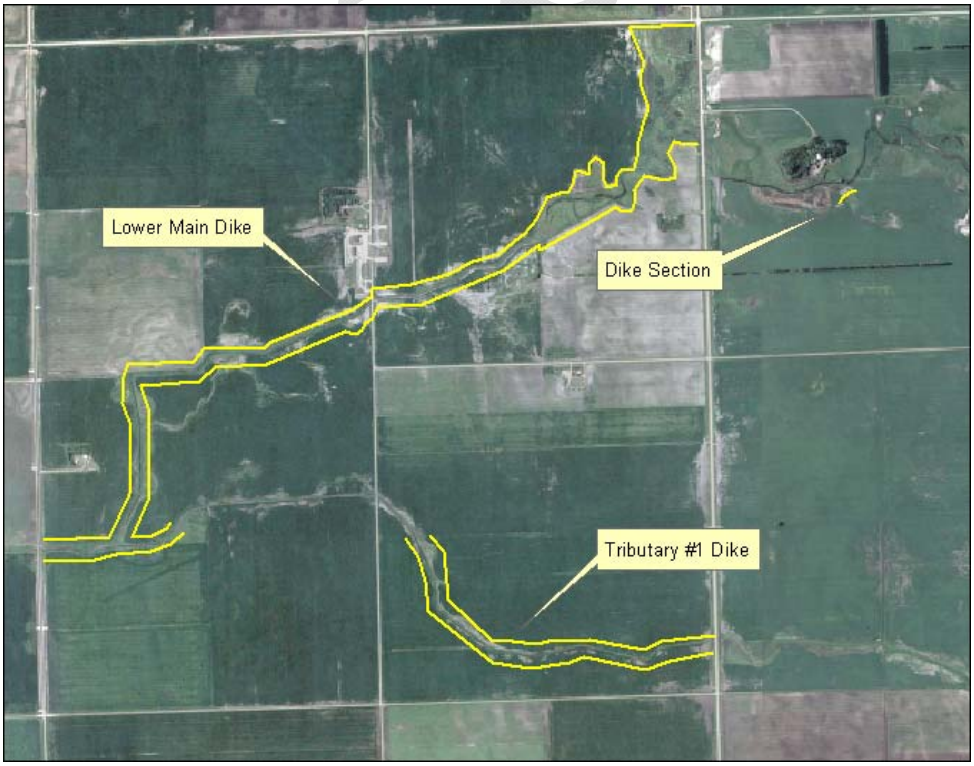
4. Reaches 1A and 4C, identified in the Stream Assessment Report, will have rock riffles installed to provide channel and bank stability.

In addition to the three reaches described above, a dike less than 300 foot long is proposed along the south side of the main channel within T159N, R47W Section 29 as part of this plan.

Twenty surface water inlets (SWI's) would be installed for connecting local drainage areas into the main dike/channel system. Flap gates would be installed on all SWI's to prevent backup of main channel flows into fields. Although the flap gates will prevent back water from the main channel they also would prevent local inflows from entering the main channel as the main flood wave passes[17]. Flood easements will be obtained from land owners affected by the backup of local runoff onto cropland. For planning purposes, these easements are based on the assumption that 50 percent of the average annual runoff (up to the 10-year event) will back up on the cropland side of the dike/channel system (see Appendix C for details). Using this assumption, 40 acres of flood easements would be required. The area within these flood easements could still be cropped assuming no current restrictions exist (wetlands, CRP contract obligations, etc.).

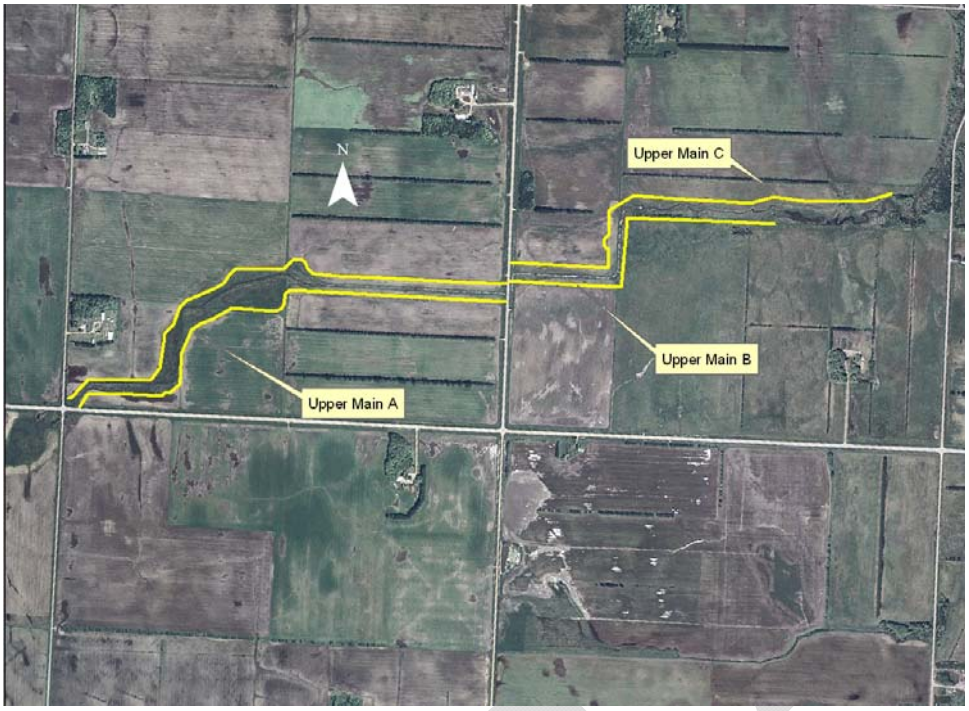
To reduce the number of SWI's and flood easements, 21,540 feet of small interceptor ditches would be constructed along the outside edge of the dikes to combine and bring local runoff to "collection areas". Most of these collection areas are located at the downstream junction of the dike and a road.

Figure I - Plan 2, Locations of Dike Reaches 1 & 3 within the Lower Reach



[17] See Appendix C for details

Figure J - Upper Main Reach Dike Locations within the Upper Reach



Plan 3. Wide spacing between setback dikes with channel meanders and riffles - This plan consists of the same dike lengths as Plan 2 except that in some reaches, the inside toe to inside toe dimensions on the two-sided segments are wider. Basically, the dike alignment follows the boundaries of current flood plain CRP buffer acreages (existing CRP areas would be within the project flood plain flows). As with Plan 2, the dikes would provide flood protection to adjacent cropland for up to a 10-year growing season runoff event. See Table J for a summary of inside toe to inside toe widths for this alignment. The channel restoration reaches, SWI locations, and interceptor ditches would be the same as Plan 2.

Plan 4. Narrow spacing between setback dikes with streambank protection and rock drops - This plan has a dike alignment with minimum spacing between dikes. The minimum spacing was determined by narrowing the distance between dikes such that the 10-year water surface between the dikes did not increase more than 1 foot compared with those from Plan 2. See Table J for a summary of inside toe to inside toe widths for this alignment. The SWI locations and interceptor ditches would be the same as for as Alignment A. Because of the narrow spacing, restoring the historic meander pattern would not be practical. The existing channel alignment would be used and unstable sections would be treated (riprap, grade control, etc.).

Plan 5. Moderate spacing between setback dikes with streambank protection and rock drops - This plan consists of the same dike length, SWI locations, and interceptor ditches as Plan 2. The existing channel alignment would be used and any unstable channel bank sections would be treated (riprap, grade control, etc).

Table J - Dike Spacing

Reach	Dike Alignment A	Dike Alignment B	Dike Alignment C
	Inside Toe to Toe Width (ft)	Inside Toe to Toe Width (ft)	Inside Toe to Toe Width (ft)
Lower Main	341	443	120
Upper Main A	233	233	55
Upper Main B	201	287	55
Upper Main C	262	388	55
Tributary #1	325	325	Not Evaluated

Effect of Alternative Plans

The effects of the alternative plans on the identified concerns are described below.

1. Floodwater Damage

Future with plan 1 (no action). With the no action alternative, floodwaters will affect the watershed and damages will result. Local producers will experience crop, pesticide, and herbicide losses from the flooding. Additionally flooding will cause damages to roads and bridges, loss of topsoil, and delayed planting losses. The total average annual damages would be $148,310.

Future with plan 2. With this plan the floodwater damages will be reduced by building a series of setback dikes. These dikes will control floodwaters up to a 10-year event. Any events larger than the 10-year event will result in flooding equivalent to the no action alternative or current conditions. The setback dikes will be built along selected reaches of the Unnamed Ditch. These areas are identified as Lower and Upper Main, Tributary #1, and a small section on the south side of the main channel in Section 29. Detailed information on the sizing and location of the dikes can be found in the plan descriptions above.

Also mentioned above in the plan descriptions is the need for surface water inlets on the outside of the dike. Near these inlets, surface water flow outside of the dikes will pool and be slowly released into the channel. The ponding of waters in these areas will result in crop loss in the case of agricultural lands. Therefore, flood easements will be purchased for the ponding area. It is estimated that 40 acres of land outside of the dikes will likely be impacted on an average annual basis due to the channel/dike system

The land located between the dikes will continue to flood. In plan 2 the total acreage between the dikes is 188 acres. Lands will either need to be purchased by the project Sponsors, be placed under some type of easement, or enrolled in a land retirement program. Method for attaining property rights for these acres will affect the overall project cost.

Future with plan 3. Plan 3 will provide the same flood damage reductions as plan 2. The difference between this plan and plan 2 is the amount of land between the dikes**.** In plan 3 the total acreage between the dikes is 233 acres.

Future with plan 4. Plan 4 flood damage reductions are the same as plan 2. The difference between this plan and plan 2 is the amount of land between the dikes**.** In this plan the total acreage between the dikes is 25 acres.

Future with plan 5. Same as with plan 2.

2. Downstream Floodwater Damage

Future with plan 1 (no action). - With the No Action plan, floodwaters would continue to have access to the flood plain. Downstream discharges would be unchanged.

Future with plan 2. A hydrologic analysis was performed to estimate the downstream effects of losing flood plain storage (see Appendix C for details). For this plan, approximately 22,200 feet of channel have two-sided dike construction proposed. Table K below summarizes estimates of flood plain storage lost with dikes in place.

Table K - Loss of Flood Plain Storage Estimate

Return Period	Loss of Flood plain Storage Due to Levees (Acre-Feet)	% of 10-year Growing Season Runoff Volume
low flow	0	0.0%
1.5 year	-1.1	-0.2%
2-year	-19.4	-2.6%
5-year	-212	-10.9%
10-year	-410	-13.3%

Because of the Red River Basin Commission's Flood Damage Reduction Mediation Agreement, the maximum protection that this project can provide is up to the 10-year growing season event. With the project in place, flood flows and acres impacted for events larger than a 10-year event would be essentially the same as the pre-project condition[18].

Based on lost flood plain storage only, downstream discharges were estimated to increase from 5% to 7.5% range for the 5- to 10-year events. Using limited NRCS cross section survey of JD-10 downstream of the project, stages within the channel downstream of County Road 63 could increase in the 0.5" to 2.0" range. Because of the flat nature of the flood plain left and right of JD-10, this level of stage increase would have an insignificant impact on the total number of acres flooded downstream of the project.

Some aspects of the project were not modeled and would likely have a <u>decreasing</u> impact on peak discharge. These include:

[18] A minimal benefit (fewer acres flooded) is realized for the 25-year event in the project reaches with dikes on both sides of the channel. Also, for events having a return period greater than a 10-year, flows would pass over the dikes back onto the flood plain at controlled sections. Culverts at certain surface water inlet locations would be oversized to ensure that for areas outside the dikes, project flood durations are not longer than pre-project flood durations for these larger events.

- Proposed channel meandering/channel size restoration for portions of the upper and lower reaches. These reaches would likely have more frequent use of flood plain and increased total reach roughness.
- Leveling of existing spoil piles resulting in an increase of flood plain flow area.
- Temporary storage of local inflows behind the dikes during the passage of the main channel flood flows.

Also, as other tributaries contribute to JD-10 downstream of county road 63, relative impacts of the Spring Brook Project will diminish.

In conclusion, the impacts of the project on downstream flooding would be slight/insignificant for the 10-year and smaller events. For larger events, there would be no changes between pre- and post-project.

Future with plan 3. This plan, with its wider dike spacing, would result in even less of an impact than described in plan 2. The same conclusion applies to this plan.

Future with plan 4. This plan has a dike system with narrower spacing than plan 2 thus would result in more loss of flood plain storage and likely higher stages in downstream JD-10 for events up to the 10-year. As with plan 2, overtopping for events larger than the 10-year would result in discharges/stages equal to pre-project conditions. If plan 4 were to be considered, more extensive surveys should be conducted downstream of County Road 63 to estimate project impacts. If the downstream stage and acres flooded increase, flood easements may be required.

Future with plan 5. Same as with plan 2.

3. Local Surface Drainage

Future with plan 1 (no action). The land adjacent to the channel will drain as it always has. The existing drainage system and patterns would not be altered.

Future with plan 2. Setback dikes will be built along selected reaches of the channel. Along some of the reaches, setback dikes will be built either along both sides of the channel; on one side of the channel; or not built at all on either side of the channel. In the locations where dikes are built, side water inlets (SWI) and breakout areas will be near low lying areas to allow local drainage to reach the channel.

A SWI will contain one CMP culvert. It is estimated that twenty – 18” CMP culverts will be needed for the entire project. Each culvert will have a steel flap gate installed on the downstream end of each of them. Once the water flows within the channel raise, the flap gates will be shut and the local drainage will be stored along the outside edge of the dike. When the flows within the channel recede, the flap gates will open and the local drainage water that was stored in fields outside of the dikes will be able to flow back through the culvert and back into the channel.

Near each SWI, a breakout area will also be constructed. The purpose of the breakout areas is to allow the channel to spill over the setback dike at predetermined locations

once a 10-year event is exceeded. Once the water levels within the channel recede, the breakout areas and SWI would be also used to allow water back into the channel. After 10-year or greater events, the breakout areas should be inspected and repaired as needed.

It is estimated that 40 acres of land outside of the dikes will likely be impacted due to the channel/dike system. This is land where the local drainage cannot enter the main channel because SWI flap gates may be closed during the passage of the main flood discharges. For purposes of this plan, it is assumed that 50 percent of the average annual runoff volume will back up onto the outside side of the dike/channel system (see Appendix C – Hydrology Section for details).

Future with plan 3. Same as with plan 2.

Future with plan 4. Same as with plan 2.

Future with plan 5. Same as with plan 2.

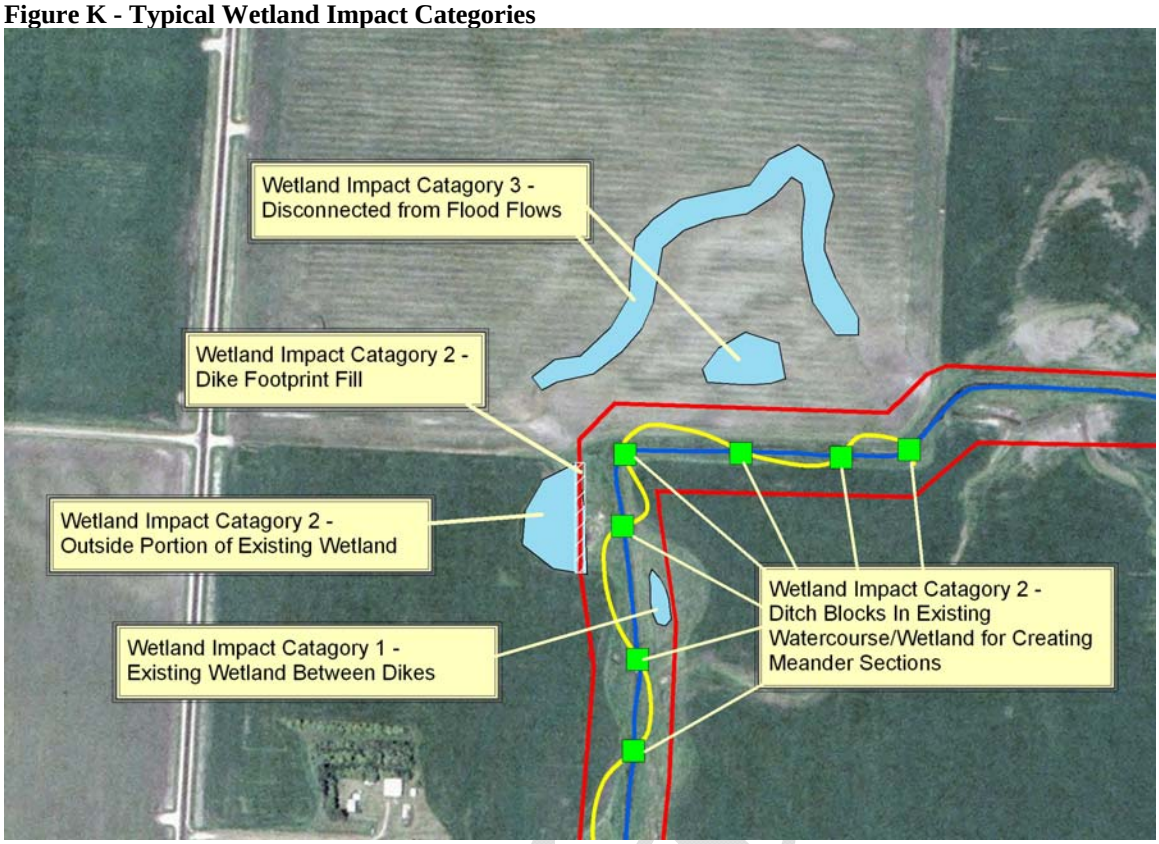
4. Wetlands

Future with plan 1 (no action). No existing wetlands would be impacted by dike construction activities. The seasonal Type 1 and 2 PEMA and PEMB1 wetlands occurring in depressional hydric soil sites in cropland fields would continue to be recharged whenever runoff events exceed the existing channel capacity.

Future with plan 2. Approximately 77.3 acres of wetlands will be impacted on 31 wetland sites. There are 3 impact categories; 1) Wetlands within the proposed setback dikes, 2) Wetlands impacted by dike construction, and 3) Wetlands impacted by reduced floodwater from the main channel. Figure K below illustrates these typical wetland impact categories.

draft

Figure K - Typical Wetland Impact Categories



For plan 2, approximately 8.5 acres in 10 wetland sites are mapped within the proposed diked flood plain (wetland impact category 1). These wetland acres will not require mitigation because the new dike construction will avoid them. Approximately 17.5 acres of wetlands will be impacted by the dike construction, of which 1.5 acres are filled (wetland impact category 2). 51.3 acres of cropped wetlands were identified in the fields outside of the dikes (wetland impact category 3) impacted because of reduced floodwaters from the main channel. When the 1:1 and 2:1 wetland acre replacement ratios, are calculated, per the Minnesota Wetland Conservation Act, a total of 75.3 acres will need to be mitigated.

Future with plan 3. Approximately 77.3 acres of wetlands will be impacted on 31 wetland sites. This includes approximately 8.5 acres on 10 wetland sites mapped within the proposed diked flood plain (wetland impact category 1). These wetland acres will not require mitigation because the new dike construction will avoid them. Approximately 36.5 acres of wetlands will be impacted by the dike construction, of which 1.2 acres are filled (wetland impact category 2). There is 32.2.acres of cropped wetlands occurring in the fields outside of the dikes (wetland impact category 3) impacted because of reduced floodwaters from the main channel. When the 1:1 and 2:1 wetland acre replacement ratios, are calculated, per the Minnesota Wetland Conservation Act, a total a total of 75.3 acres will need to be mitigated.

Future with plan 4. Approximately 72.3 acres of wetlands will be impacted on 25 wetland sites. Approximately 10.1 acres of wetlands will be impacted by the dike construction, of which 0.9 acres are filled (wetland impact category 2). There are 62.3

acres of wetlands occurring in the cropped fields outside of the dikes impacted because of reduced floodwaters from main channel (wetland impact category 3). When the 1:1 and 2:1 wetland acre replacement ratios, are calculated, per the Minnesota Wetland Conservation Act, a total of 82.2 acres will need to be mitigated.

Future with plan 5. Same as with plan 2 but without the ditch blocks, channel meanders and riffles.

5. Wildlife Habitat

Future with plan 1 (no action). The trend for enhancement of upland wildlife habitat through the continuous and riparian buffer CRP, the Wildlife Habitat Incentive Program (WHIP), and the Re-Invest in Minnesota (RIM) programs is expected to continue. However, the total acres of grassland, riparian buffer establishment, and shrub and tree cover established or maintained in the watershed will fluctuate. CRP, WHIP, and RIM contracts will continue to be signed, while existing contracts are not re-enrolled or expire. The vegetative habitat cover may be converted back to crop production.

Future with plan 2. It is estimated that 188 acres of restored flood plain riparian habitat, not including the watercourse, would be established in permanent vegetative cover for enhanced riparian wildlife and waterfowl habitat. A seeding mixture approved by the Sponsors and the cooperating agencies will be used.

Future with plan 3. Same as plan 2, except it is estimated that 233 acres of restored flood plain riparian habitat, not including the watercourse exist.

Future with plan 4. Same as plan 2 except it is estimated that only 25 acres of restored flood plain riparian habitat, not including the watercourse exist

Future with plan 5. Same as with plan 2 but without the channel meandors and riffles.

6. Threatened and Endangered Species

Future with plan 1 (no action). No project construction activities would occur, therefore state and federal threatened and endangered species would not be impacted. On a routine basis T&E plant and animal species are inventoried and evaluated in all counties of the state.

Future with plan 2. Potential habitat may exist in the project area for all the T&E species listed. Consultation with the U.S. Fish and Wildlife Service is under way with a determination category of “may affect but are not likely to adversely affect” the federally listed species. Project activities that may impact any state and/or federally listed plant and animal species and their habitat would be avoided and/or mitigated. An annual field review would be recommended to determine if any dormant, threatened and endangered plant species such as the Western Prairie Fringed Orchid may become re-established. The Minnesota Nature Conservancy has been restoring farmland and pasture to tallgrass prairie and wetlands at the Glacial Ridge Project in Polk County, MN which is about 60 miles south of the Kittson County project area. A new population of the federally

threatened western prairie fringed orchids was found in a wetland area on one of the recently restored sites in the Glacial Ridge site, and the same potential for this threatened plant species is expected in the area. The same potential may exist for new habitat for MN animal species in greatest need such as American bittern and moose.

Future with plan 3, 4, or 5. Same as with plan 2.

7. Fish Habitat

Future with plan 1 (no action). No change from present conditions.

Future with plan 2. Fish habitat for indigenous stream invertebrate species and stream fish species such as mudminnows, brook sticklebacks, common shiners, fathead minnows, darters and madtoms would be enhanced. The establishment of an average 270 feet flood plain between the dikes would improve water quality by creating a continuous stream vegetative buffer to filter out sediment and attached nutrients, herbicides, and pesticides. In particular, the construction of channel meanders in upper reach 3B and lower reach 2D would help retard the velocity of runoff events, and prevent further down cutting and head cutting and channel bank sloughing off. This would help reduce channel sedimentation. The meanders also give stream aquatic life rest and protection during runoff events. Approximately fifty rock riffles will be constructed within Stream Assessment identified reaches 1A, 3B, 2D, and 4C to improve in stream habitat. The rock riffle areas will provide attachment areas for stream invertebrates which will increase the biomass of stream invertebrates available for enhanced larval and adult fish production. Over time these stream minnow species will produce more biomass for larger sport fish species to feed on in the lower tributaries and main stem of the Red River.

Future with plan 3. Same as plan 2, with the exception that the average width (335') of flood plain between the dikes being wider with Plan 3. The increased width should enhance the reach to a somewhat greater degree than Plan 2.

Future with plan 4. Same as plan 2, with the exception that the average width (60') of flood plain between the dikes would be the narrowest. This plan would have the least enhancement value for a given reach of the 5 plans.

Future with plan 5. Fish habitat for indigenous stream invertebrate species and stream fish species such as mudminnows, brook sticklebacks, common shiners, fathead minnows, darters and madtoms would be enhanced. The establishment of an average 270 feet flood plain between the dikes would improve water quality by creating a continuous stream vegetative buffer to filter out sediment and attached nutrients, herbicides, and pesticides. The rock drop areas will provide some attachment areas for stream invertebrates which will increase the biomass of stream invertebrates available for enhanced larval and adult fish production. Over time these stream minnow species will produce more biomass for larger sport fish species to feed on in the lower tributaries and main stem of the Red River.

draft

8. Soil Erosion & Sedimentation

Future with plan 1 (no action). Sedimentation damages would continue to deposit in existing channels reducing flow conveyance and forcing floodwaters out into the flood plain more frequently. These frequent and excessive flood plain flows would still result in large scour channels within flood plain cropland. Cleanout issues (permits, organizing local landowners to pay for and carry out) would still occur.

Future with plan 2. Sedimentation would be reduced. As part of the project, stream bank and channel grade will be stabilized while the flood plain (area between the dikes) will be kept in permanent cover reducing any potential scour. Sediments from stream bank erosion will be reduced in some reaches through the re-establishment of the original channel meanders (increased flow distance/reduced energy). Other reaches will have pool and riffle structures to reduce overall channel grade. During final design, a geomorphologic assessment will be made to ensure the channel/dike system can convey anticipated sediment flows (suspended and bed load) without excessive deposition.

Future with plan 3. Same as with plan 2.

Future with plan 4. With Plan 4, sedimentation would be reduced. As part of the project, stream bank and channel grade will be stabilized while the flood plain (area between the dikes) will be kept in permanent cover reducing any potential scour. Grade control structures would reduce down cutting and lateral stream bank erosion. Overall, sedimentation would be reduced but not as much as that from plans 2 and 3 (plan 4 flood plain deposition area would be smaller since it is narrower).

Future with plan 5. Same as with plan 2.

9. Cultural Resources

Future with plan 1 (no action). No project construction activities would occur. Therefore, no potential effects to historic properties or cultural resources that might be present would occur.

Future with plan 2. This alternative involves earth moving within areas considered to be highly probable for containing archaeological sites. Since none of the project area has undergone a formal archaeological survey, any areas slated for earth moving will have a formal field investigation once the planning has developed, and well in advance of project construction.

Future with plan 3, 4, or 5. Same as with plan 2

10. Recreation Development

Future with plan 1 (no action). No opportunities for the development of recreational opportunities exist under the no action alternative.

Future with plan 2. Plan 2 will create or enhance wildlife habitat between the dikes. The dike alignment sizing of plan 2 would enhance or create 188 acres. This would increase the wildlife watching opportunities in the watershed. The close proximity of the project area to the Agassiz National Wildlife Refuge, where visitors are currently going for wildlife watching, may result in visitors taking a half day driving tour of the project area. Additionally, the channel enhancement proposed in this plan may result in improved fish populations in the channel. The increased food and habitat source, created by the new vegetative cover established between the dikes, may add to the attraction of local and migrating wildlife, thus increasing wildlife watching opportunities.

Future with plan 3. Same as plan 2 except the number of acres, 231, restored between the dikes is greater, and thus more wildlife habitat restored/created. Additionally, the channel enhancement proposed in this plan may result in improved populations of indigenous stream fish species.

Future with plan 4. Plan 4 creates or enhances only 26 acres of fish and wildlife habitat between the dikes. The limited acres created as the result of this plan's dike alignment are unlikely to create any new recreational activity in the project area. Also, the channel stabilization features proposed in this alternative will have limited impacts on indigenous stream fish species populations.

Future with plan 5. Same effects as with plan 2 with slightly reduced benefits for the fish population. These reduced benefits are the result of excluding the rock riffles and channel meanders in favor of the rock drops and stream bank protection.

Comparison of Alternative Plans

For plans 1 through 5 the major items used in the decision making process are summarized in Table L. Within this table, the *National Economic Development Account* includes tangible monetary effects of the projects while the *Environmental Quality Account* relates to environmental impacts of the project that were not quantified.

draft

Table L - Comparison of Alternative Plans

Effects	Plan #1 (No Action)	Plan #2 Moderate Spacing	Plan #3 Wide Spacing	Plan #4 Narrow Spacing (NED Plan)	Plan #5 Moderate Spacing (Recommended Plan)
Measures	None	Setback Dikes with channel meanders and riffles	Setback Dikes with channel meanders and riffles	Setback Dikes with streambank protection and rock drops	Setback Dikes with streambank protection and rock drops
Project Investment	$0	$ 1,462,000	$ 1,578,000	$ 1,614,000	$1,400,000
NATIONAL ECONOMIC DEVELOPMENT ACCOUNT					
Adverse Annual Effects	$ 120,230	$ 66,210	$ 71,690	$ 72,730	$ 63,490
Average Annual O&M	$ 0	$ 7,600	$ 8,200	$ 8,390	$ 7,270
Average Annual Beneficial	$ 0	$ 95,380	$ 77,860	$ 107,520	$ 95,380
Average Annual Net Beneficial	$ (120,230)	$ 21,570	$ (2,030)	$ 26,400	$ 24,620
ENVIRONMENTAL QUALITY ACCOUNT					
Floodwater Damage	Floodwaters will affect the watershed and damages will result. Local producers will experience crop, pesticide, and herbicide losses from the flooding. Additionally flooding will cause damages to roads and bridges, loss of topsoil, and delayed planting losses.	With this plan the floodwater damages will be reduced by building a series of setback dikes. These dikes will control floodwaters up to a 10-year event. Any events larger than the 10-year event will result in flooding equivalent to the no action alternative or current conditions. The setback dikes will be built along selected reaches of the Unnamed Ditch. These areas are identified as Lower and Upper Main, Tributary #1, and a small section on the south side of the main channel in Section 29.	Will provide the same flood damage reductions as plan 2. The difference between this plan and plan 2 is the amount of land between the dikes. In plan 3 the total acreage between the dikes is 233 acres.	Flood damage reductions are the same as plan 2 except the total acreage between the dikes is only 25 acres.	Same as with Plan #2.
Downstream Floodwater Damage	Floodwaters would continue to have access to the flood plain. Downstream discharges would be unchanged.	Approximately 22,200 feet of channel will have a two-sided dike. Flood flows and acres impacted for events larger than a 10-year event would be essentially the same as the pre-project condition construction proposed. The impacts of the project on downstream flooding would be slight/insignificant for the 10-year and smaller events. For larger events, there would be no changes between pre- and post-project.	With its wider dike spacing, would result in even less of a flooding impact than described in plan 2. The same conclusion applies to this plan.	Has a dike system with narrower spacing than plan 2 thus would result in more loss of flood plain storage and likely higher stages in downstream JD-10 for events up to the 10-year. As with plan 2, overtopping for events larger than the 10-year would result in discharges/stages equal to pre-project conditions.	Same as with Plan #2.
Local Surface Drainage	The land adjacent to the channel will drain as it always has. The existing drainage system and patterns would not be altered.	Setback dikes will be built along selected reaches of the channel. Along some of the reaches, setback dikes will be built either along both sides of the channel; on one side of the channel; or not built at all on either side of the channel. In the locations where dikes are built, side water inlets (SWI) and breakout areas will be near low lying areas to allow local drainage to reach the channel. Twenty – 18” CMP culverts will be needed for the entire project.	Same as with Plan #2.	Same as with Plan #2.	Same as with Plan #2.

Draft

Effects	Plan #1 (No Action)	Plan #2 Moderate Spacing	Plan #3 Wide Spacing	Plan #4 Narrow Spacing (NED Plan)	Plan #5 Moderate Spacing (Recommended Plan)
Wetlands[4]	No Impact	Cat 1 – 8.5 acres protected. Cat 2 – 17.5 acres impacted. Cat 3 – 51.3 acres of formerly cropped wetlands enhanced at a 1:1 ratio.	Cat 1 – 8.5 acres protected. Cat 2 – 36.5 acres impacted. Cat 3 – 32.3 acres of formerly cropped wetlands enhanced at a 1:1 ratio.	Cat 1 – 0.0acres protected Cat 2 – 10.1 acres impacted Cat 3 – 62.3 acres impacted.	Cat 1 – 8.5 acres protected. Cat 2 – 17.5 acres impacted. Cat 3 – 51.3 acres of formerly cropped wetlands enhanced at a 1:1 ratio.
		8.5 acres within the diked flood plain avoided and protected. Moderated wetland impacts with 17.5 acres dissected by the dikes. Potentially 51.23 acres of cropped wetlands outside of the dike will be restored at 1:1 ratio within the newly created 188 acre flood plain.	8.5 acres within the diked flood plain avoided and protected. The most wetland impacts with 36.5 dissected by the dikes. Potentially 32.3 acres outside of the will be restored at a 1:1 ratio within the newly created 233 acre flood plain.	No wetlands gained within the narrow diked flood plain.	8.5 acres within the diked flood plain avoided and protected. Moderated wetland impacts with 17.5 acres dissected by the dikes. Potentially 51.23 acres of cropped wetlands outside of the dike will be restored at 1:1 ratio within the newly created 188 acre flood plain.
Wildlife Habitat	Will remain status quo or may continue to decline	Major improvement with 188 acres of permanent riparian vegetative habitat establishment. Stream length increased with meanders. Wildlife and waterfowl habitat acres will be created when cropland and other land uses are converted to permanent riparian wildlife and waterfowl habitat in the newly created flood plain.	Most improvement with 233 acres of permanent riparian vegetative habitat establishment. Stream length increased with meanders. Most wildlife habitat acres created with cropland and other land uses converted to permanent riparian wildlife and waterfowl habitat in the newly created flood plain.	Minor improvement with only an additional 25 acres of permanent riparian vegetative habitat establishment for enhanced riparian wildlife and waterfowl habitat.	Major improvement with 188 acres of permanent riparian vegetative habitat establishment. Stream length increased with meanders. Wildlife and waterfowl habitat acres will be created when cropland and other land uses are converted to permanent riparian wildlife and waterfowl habitat in the newly created flood plain.
Rare, Threatened and Endangered Species	No project construction activities would occur, therefore state and federal threatened and endangered species would not be impacted.	Potential habitat may exist in the project area for all the T&E species listed. Consultation with the U.S. Fish and Wildlife Service is under way with a determination category of “may affect but are not likely to adversely affect” the federally listed species.	Potential habitat may exist in the project area for all the T&E species listed. Consultation with the U.S. Fish and Wildlife Service is under way with a determination category of “may affect but are not likely to adversely affect” the federally listed species.	Potential habitat may exist in the project area for all the T&E species listed. Consultation with the U.S. Fish and Wildlife Service is under way with a determination category of “may affect but are not likely to adversely affect” the federally listed species.	Potential habitat may exist in the project area for all the T&E species listed. Consultation with the U.S. Fish and Wildlife Service is under way with a determination category of “may affect but are not likely to adversely affect” the federally listed species.
Fish Habitat	Will continue to decline	Some improvement for indigenous stream species of sculpins, minnows and sticklebacks with new channel meanders and rock riffle habitat areas created.	Most improvement for indigenous stream species of sculpins, minnows and sticklebacks with new channel meanders and rock riffle habitat areas created.	Least improvement for indigenous stream species of sculpins, minnows and sticklebacks.	Some minor stream habitat and aquatic invertebrate production improvement for indigenous stream species of sculpins, minnows and sticklebacks with rock drops.

Draft

Effects	Plan #1 (No Action)	Plan #2 Moderate Spacing	Plan #3 Wide Spacing	Plan #4 Narrow Spacing (NED Plan)	Plan #5 Moderate Spacing (Recommended Plan)
Soil Erosion & Sedimentation	Currently, 100% of wind related HEL cropland is under control through the use of residue management. It is likely that this type of management will continue however, with changing market conditions/agricultural program, it cannot be guaranteed. Flood plain scour/sediment deposition and stream bank erosion would continue to occur.	Excessive upland erosion that may threaten the dike/channel function will be controlled as per PL-566 upland treatment requirements. Flood plain scour/sediment deposition outside of the dike system would be moderately reduced. Stream bank erosion would be controlled through the use of channel drop structures/riffles, improved flood water access to flood plain, and increased channel length (decreased energy slope) in channel re-meander sections.	Same as with Plan #2 except that Plan #3 would have *slightly more* reduction of flood plain scour/sediment deposition outside of the dike system due to the increased spacing between the dikes.	Same as with Plan #2 except that Plan #4 would have *less* reduction of flood plain scour/sediment deposition outside of the dike system due to the narrower dike spacing. Also, stream bank erosion would be reduced the use of channel drop structures only (no channel re-meander sections in Plan #4)	Same as with Plan #2 except that stream bank erosion controlled with drops and stream bank protection practices instead of channel re-meandering and pool/riffle structures.
Cultural Resources	No project construction activities would occur. Therefore, no potential effects to historic properties or cultural resources that might be present would occur.	This alternative involves earth moving within areas considered to be highly probable for containing archaeological sites. Since none of the project area has undergone a formal archaeological survey, any areas slated for earth moving will have a formal field investigation once the planning has developed, and well in advance of project construction.	Same as with Plan #2	Same as with Plan #2.	Same as with Plan #2.
Recreation Development	No opportunities for the development of recreational opportunities exist under the No Action alternative.	The dike alignment sizing would enhance or create 188 acres between the dikes This would increase the wildlife watching opportunities in the watershed. Additionally, the channel enhancement proposed in this plan may result in improved fish populations in the channel. The increased food and habitat source, created by the new vegetative cover established between the dikes, may add to the attraction of local and migrating wildlife, thus increasing wildlife watching opportunities.	Same as plan 2 except the number of acres, 233, restored between the dikes is greater, and thus more wildlife habitat restored/created.	Creates or enhances only 26 acres of fish and wildlife habitat between the dikes. The limited acres created as the result of this plan's dike alignment are unlikely to create any new recreational activity in the project area.	The dike alignment sizing would enhance or create 188 acres between the dikes This would increase the wildlife watching opportunities in the watershed. This increased food and habitat source, created by the new vegetative cover established between the dikes, may add to the attraction of local and migrating wildlife, thus increasing wildlife watching opportunities.

NOTE:

1. Interest Rate – Plans evaluated at 4.875%
2. Period of Analysis – Plans evaluated for 100 years
3. Price Levels – 2007 price levels
4. Final acres to be determined by field investigations and by field wetland determinations

Risk and Uncertainty

Certain aspects of plan formulation relied on assumptions and/or limited data. This creates some level of risk and uncertainty to the success of the project if it is implemented as proposed. To aid the Sponsors in the decision making process, this section describes those aspects encountered during the development of the plan.

- Surface Water Inlets (SWI) - Detailed hydrologic modeling to estimate the effects of the dike system on all local drainages was impractical. Analysis involves unsteady flow routings which considers local/main channel hydrograph flow timings, flap gate operation, and specific storm event durations. Detailed routing of hypothetical storm hydrographs was performed for a few specific cases and those results transferred to other sites. Also, the combination of local drainages with interceptor channels was made with limited survey data. Local inlet inundation areas, SWI locations and interceptor channels described in the plan are general in nature and are only presented to come up with a general cost. Prior to final design, it is suggested that detailed surveys be made to determine the best location/combination of SWI's.

- Topographic Information - Dike heights, spacing, and acres flooded assessments are based on survey data which combine on-the-ground surveys with general USGS topographic information. Contour information is based on limited post processing (i.e. - incorporation of break lines at roads, channel banks, etc.). Without detailed topographic data, estimating dike containment and flow splits is difficult. This plan assumes that the current spoil piles do not uniformly prevent water from inundating the flood plain. If the spoil piles in their current condition prevent water from accessing the flood plain, then this plan overestimates the benefits of the recommended measures.

- Hydrologic/Hydraulic Model Calibration - Due to the limited amount of historic data (high water marks), calibration of hydraulic models was not performed for any out of bank flows. Verification of models was limited to qualitative correlations between landowners' descriptions of floods and aerial photographs. During the period between planning and implementation, Sponsors should continue to monitor channel flows and precipitation in the hope that a valid calibration of the hydrologic and hydraulic models can be performed.

- Sedimentation/Grade Control Issues - A geomorphologic analysis was not performed for this plan. The plan assumes sediment within runoff is in equilibrium with channel bed and banks. Documents prepared by the Sponsors describe sedimentation problems upstream (CD-10) have been addressed with the installation of eight grade stabilization structures. The recommended plan incorporates limited grade control in the reaches that have habitat enhancement (establishment of pool and riffles). It is recommended that a sedimentation analysis be undertaken prior to development of construction drawings to assess channel stability and potential need for grade control

- Road Culvert Blockages - The hydraulic analysis assumes clear openings in the road crossings. Ice or debris blockage in the culvert openings may result in backups causing water to break out back over the dikes. It is recommended that in final design, freeboard be added to the dikes upstream to accommodate a reasonable amount of culvert blockage.

- CRP Land Use - This plan assumes that land that is currently in CRP would, in the future, be cropland. If current CRP lands remain in the program or permanently remain non-crop for other reasons, then the project economics change (most likely a reduction in benefits).

- Wetland Mitigation – This plan assumes 75.3 acres will need to be mitigated as a result of project activities. However the actual acreage needed for mitigation will not be known until a field determination has been completed. If the acreage calculated and reported in this plan is off by 100%, the recommended plan will still result in positive net benefits, and a B:C ratio of 1.5:1.0.

Rationale for Plan Selection

Plan 5 is the recommended plan. This plan addresses the Sponsors concerns and goals for the Spring Brook Watershed. By creating setback dikes, the farmland will be protected from flooding of a 10-year event. The area between the setback dikes will benefit wildlife by providing cover and a travel corridor. Installation costs for this alternative were estimated to be $1.40 million, with an annual operation cost of $8,390. The average annual costs are $63,490 for construction and installation and $7,270 operation and maintenance. Annual benefits amount to $95,380 resulting in a B:C ratio of 1.35:1.0, the best of all plans considered. Additionally, after meeting with the project sponsors and detailing the effect of each plan, Plan 5 was selected unanimously as the preferred plan.

Plan 2 would provide flood prevention to a 10-year event. This plan addresses the Sponsors concerns and goals for the Spring Brook Watershed. By creating setback dikes, the farmland will be protected from flooding of a 10-year event. The area between the setback dikes and the channel restoration will benefit wildlife by providing cover and a travel corridor. Streambank erosion will be reduced as the vegetation between the dikes becomes established. Installation costs for this alternative were estimated to be $1.46 million, with an annual operation cost of $8,770. The average annual costs are $66,210 for construction and installation and $7,600 operation and maintenance. Annual benefits amount to $95,380 resulting in a B:C ratio of 1.29:1.0.

Plan 1 is the no action plan. It is not an acceptable solution for the Sponsors to address the watershed problems.

Plan 3 would provide flood prevention to a 10-year event and channel restoration, but the cost is more than Plan 2. The setback dike heights are approximately the same, as when compared to Plan2, but the cost of the additional land between the setback dikes makes this plan more expensive. Installation costs for this alternative were estimated to be $1.58 million, with an annual operation cost of $9,470. The average annual costs are

$71,690 for construction and installation and $8,200 annual operation and maintenance costs. Annual benefits amount to $77,860 resulting in a B:C ratio of 0.97:1.0.

Plan 4 maximizes net benefits and is the National Economic Development (NED) Plan. This plan would provide flood prevention up to a 10-year event, but would not allow for channel restoration and the creation of a wildlife riparian corridor/habitat. Although this plan maximizes net benefits, it does not fully meet the Sponsors project objectives. Preliminary discussion with MN DNR indicated that obtaining permits for this alternative would be unlikely. Because the distance between the setback dikes is narrow; therefore reducing the floodplain area, the dike heights would need to be increased to provide the same level of protection as in Plan 2. Additionally, all mitigation would occur outside of the corridor, which when compared to Plan 2, increases the price because of the additional land needed. Installation costs for this alternative were estimated to be $1.61 million, with an annual operation cost of $9,680. The average annual costs are $72,730 for construction and installation and $8,390 annual operation and maintenance costs. Annual benefits amount to $107,520 resulting in a B:C ratio of 1.33:1.0.

draft

CONSULTATION AND PUBLIC PARTICIPATION

On May 28 -29, 2002, the NRCS Water Resources Staff (WRS) met with the Two Rivers Watershed District in Karlstad to learn from local leaders about the floodwater damage problems in the watershed primarily along the Unnamed Ditch. A field tour was also included. The meeting also allowed NRCS to discuss the PL-566 pre-application process.

WRS reviewed all the gathered information and reports. During April 2003, the WRS finalized the PL-566 pre-application report and concluded that this proposed project meets the requirements for a PL-566 project. Therefore, the WRS encouraged the Two Rivers Watershed District to submit a formal application request.

The formal request was submitted to the State Appointing Authority on April 25, 2003. The State Appointing Authority accepted the application and assigned it a high priority ranking on May 28, 2003. NRCS received a valid application for PL-566 assistance on June 2, 2003. Detailed planning was authorized on November 6, 2003.

Several alternatives were studied over the next several years. Informational public meetings were held on September 26, 2002 and January 8, 2004. Several meetings were held with the project technical partners throughout the development of the watershed plan.

A stream Visual Assessment Protocol (SVAP) was completed in May 2005 by an interdisciplinary interagency team. This report guided selection of alternatives. It is a separate document available upon request. The reaches used for the SVAP are shown in Figure 26C. These same reaches were used for the detailed survey of the project water courses.

Informal consultation with the Minnesota State Historic Preservation Office (MN SHPO) has been conducted regarding the project. Until a plan is selected, formal consultation with the SHPO and the commencement of field investigations, in accord with the State Level Agreement between NRCS and the MN SHPO and in accord with NRCS responsibilities under Section 106 of the National Historic Preservation Act, will be in abeyance.

Consultation will be initiated with all eleven federally recognized Minnesota Indian tribes and any tribes outside of Minnesota, that have been identified and that may attach religious or cultural significance to the project area.

MN NRCS will follow 36 CFR 800.13 for all post-review discoveries. This includes when cultural resources are discovered or unanticipated effects on cultural resources are found before or after MN NRCS has completed the section 106 process.

All undertakings involving human remains on private property are subject to the Private Cemeteries Act (Minnesota Stat. Ann. 307.08) and possibly the Native American Graves Protection and Repatriation Act (NAGPRA). If human remains are discovered during an NRCS undertaking, all work shall cease and any human remains should be protected in

place. The MN NRCS Cultural Resources Specialist (CRS) and the appropriate MN NRCS Assistant State Conservationist for Field Operations will be notified immediately. The Minnesota CRS will notify the Minnesota State Archaeologist in accordance with MN Statute 307.08.

draft

RECOMMENDED PLAN

Purpose and Summary

Plan 5 is the recommended plan for the Spring Brook Watershed. The purpose of the project is to reduce the flooding along the Unnamed Ditch to up a 10-year event, as well as to enhance riparian wildlife habitat. The plan consists of the setback dikes, channel and streambank stabilization in areas where needed. Below is a breakdown of where and what is planned. Project map is located in Appendix F.

Setback dikes will be built along both sides of the Unnamed Ditch and along one side of the Unnamed Ditch at predetermined locations. See the project map in Appendix F. The setback dikes will be made from earthen fill. The earthen fill will come from the area surrounding the dike. The height of the dike depends on location from the channel and location within the watershed.

Twenty side water inlets (SWI) would be constructed along the dike at places where low points currently exist. Each SWI would have a flap gate installed on the downstream end. The flap gate would be controlled by the water level within the channel.

Setback Dikes

Three different scenarios are used:

1) setback dike built on both sides of the channel
2) setback dike built one side of the channel
3) no setback dikes built at all

The dikes will be built to provide protection for a 10-year growing season event. See Appendix F for a project map.

Figure L illustrates the basic layout of the setback dikes. The setback dikes design is based upon NRCS practice standard 356 for Class III dikes. Approximately 93,500 feet of setback dikes will be built with a top width (TW) of 8 feet and side slopes of 3:1. The height (H) of the dikes will vary based upon the dike's location from the channel and location within the watershed.

The setback dikes will be built with earthen fill that will be scraped from the area surrounding the dike. Because the height of the setback dikes ranges from 1.3' to 2.8', it was assumed that no foundation cutoff will be needed. Native grass and forbs vegetation as defined in the NRCS Field Office Technical Guide (Table M) will be established on all dikes and areas between the dikes.

The dikes will be built to an elevation of a 10-year growing season event plus 1 foot freeboard. Earthen fill quantities were increased by 10 percent to account for settlement. No testing was done to verify this assumption, so actual settlement quantities may change.

draft

Figure L - Basic Dike Layout

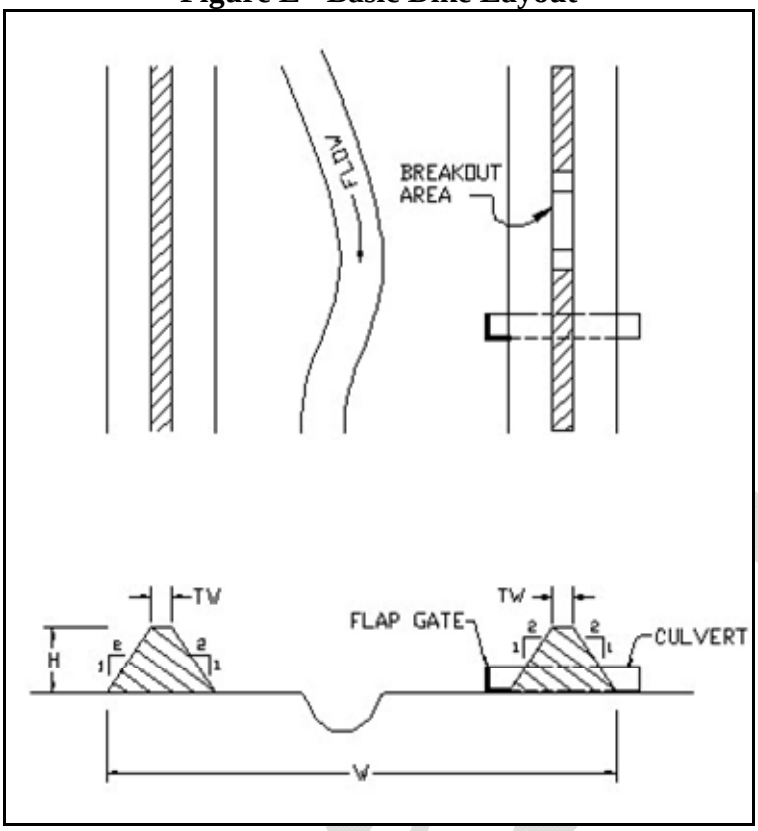
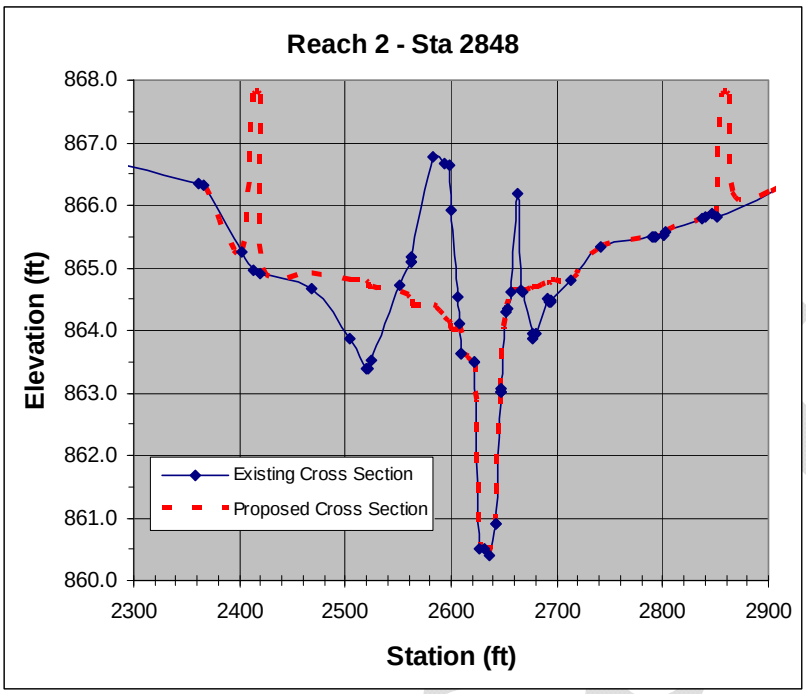


Table M - Buffer Seed Mixes

For Dry to Normal Sites	
1. Western Wheatgrass * (Rodan, Rosana, Flintlock)	4 lbs. PLS per acre
Big Bluestem * (Bison)	5 lbs. PLS per acre
Switch Grass * (Dacotah)	2 lbs. PLS per acre
2. Switch Grass * (Dacotah)	4 lbs. PLS per Acre
Western Wheatgrass * (Rodan, Rosana, Flintlock)	2 lbs. PLS per Acre
Slender Wheatgrass	2 lbs. PLS per Acre
3. Western Wheatgrass * (Rodan, Rosana, Flintlock)	8 lbs. PLS per Acre
Slender Wheatgrass	3 lbs. PLS per Acre
Switch Grass * (Dacotah)	2 lbs. PLS per Acre
For Wet Sites	
4. Western Wheatgrass * (Rodan, Rosana, Flintlock)	8 lbs. PLS per acre
Garrison Creeping Foxtail	3 lbs. PLS per acre

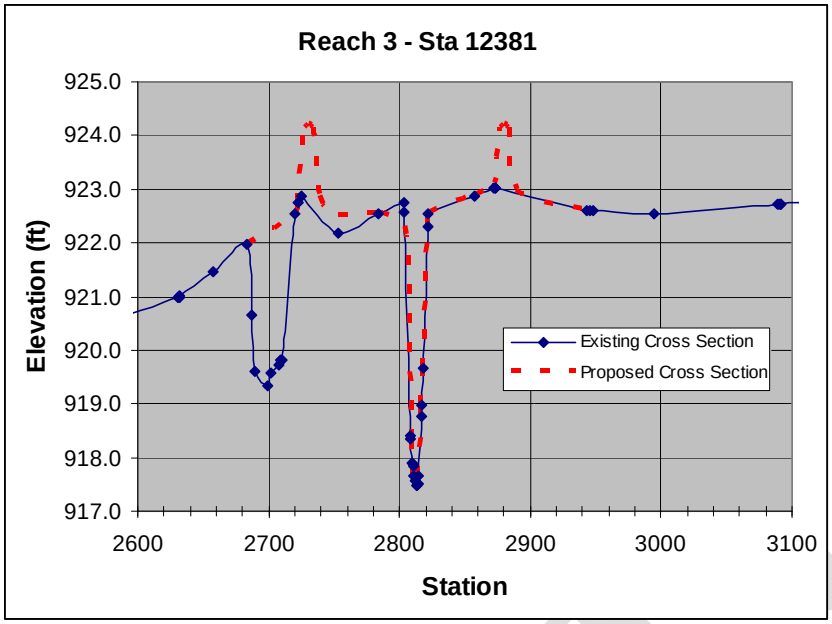
Two cross-sections were taken from the HEC-RAS model to illustrate current conditions and future conditions, Figure M from Reach 2 and Figure N from Reach 3, each display a blue and a red line. The blue line represents the existing cross-section and the red dashed line represents the cross-section once the project is completed. In both figures, the existing cross-section will have the spoil piles from either side of the channel removed.

Figure M - Reach 2, Cross-Section



The material from the existing spoil piles may be used as earthen fill for the setback dikes or graded to existing flood plain. Removing the existing spoil piles will allow the channel to access its flood plain.

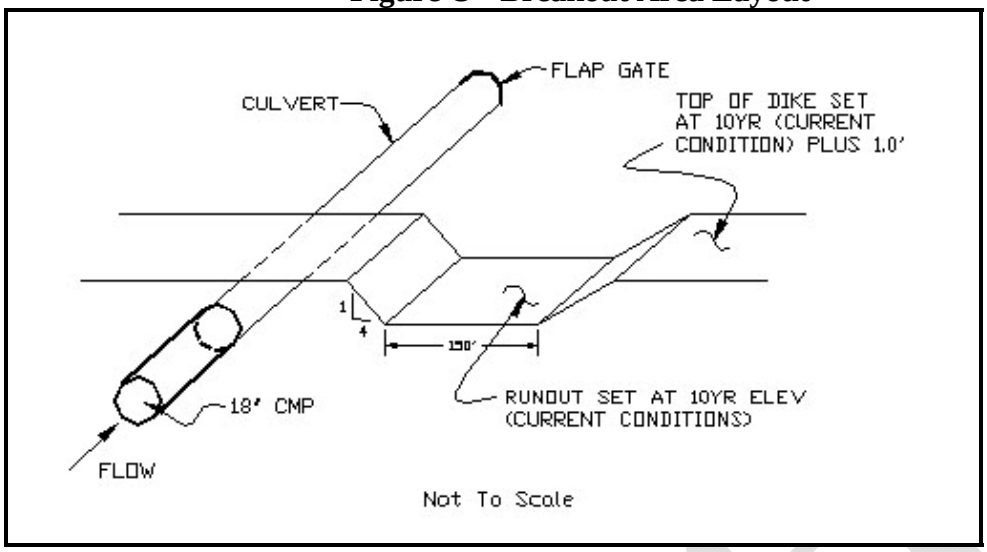
Figure N - Reach 3, Cross-Section



Twenty side water inlets (SWI) will be placed at low points along the setback dike to allow local drainage to pass through the dike and reach the channel. On the downstream end of each SWI, a flap gate will be installed. Once the flow within the channel shuts the flap gate, the local drainage water would be stored outside of the dikes until the flow within the channel is reduced and the flap gate is opened. It is estimated that easements on 40 acres will be needed for land that is flooded because the flap gates are closed during a 10-year event.

Near each SWI a breakout area will be installed (Figure O). These breakout areas will be constructed at predetermined locations to allow water to move back and forth from the channel during larger events. The breakout areas will be built to an elevation of 10-year growing season event without freeboard, be approximately 150 feet wide and have an inlet/outlet side slope of 8:1 or flatter. These areas reduce maintenance/repair needed after 10-year or greater event flows spill out over the dike system.

Figure O - Breakout Area Layout



Mitigation:

It is estimated that Plan 5, the recommended plan for the Spring Brook Watershed, will impact 77.25 acres of wetlands. Table N displays the number of wetland acres per the three categories for the project area. Wetland location maps, Figures 1D and 2D and 3D, impacted by these categories are located in Appendix D.

Table N - Breakdown of Wetlands in Project Area

Category	Wetlands (ac)
1	8.5
2	17.5
3	51.3

Table O - Open Area between Ditch Blocks

Location	Existing channel left open as is (ac) (no ditch blocks)
Upper Reach	0.7
Lower Reach	2.3
Total	**3.0**

If Plan 2 was selected to create a new meandered channel at selected locations within the project area, ditch blocks would have to be installed to force the water to use the new meandered channel and abandon the existing channel. The remaining existing channel would be left open as is (Table O). This is another location where wetland mitigation could occur.

Cultural Resources
None of the proposed project area has undergone a formal archaeological survey. Furthermore, locations within the project area seem relatively undisturbed and are considered to have moderate to high probability for containing archeological sites. These areas should undergo a formal investigation once the formal planning process has begun.

Permits
The following permits would be required:

404. Any work in water or wetlands would require authorization from the U.S. Corps of Engineers under Section 404 of the Clean Water Act.

401. Certification required from Minnesota Pollution Control Agency (MPCA) if a 404 permit is required.

Public Waters. Any measures involving excavation or filling of earth located in public waters or protected wetlands require a permit from Minnesota Department of Natural Resources (MN DNR) Waters.

MN Wetland Conservation Act. Any work impacting wetlands needs to be in compliance with the act. It is administered by the Minnesota Board of Water and Soil Resources (MN BWSR) through local governmental units.

Construction Stormwater Permit. Required for any job that disturbs more than one acre of ground. A Stormwater Pollution Prevention Plan (SWPPP) must be prepared for the work. The permit is issued by MPCA.

Local Permits. Local, city, or county zoning permits may also be required for certain measures.

Cost
The total project installation cost is estimated to be $ 1,400,000.

Contributing to the estimated cost of installing the project measures are construction, engineering services, geological investigation, real property rights, and project administration costs. All costs are allocated to the flood prevention purpose.

The estimated construction cost is $708,000. This is the cost of furnishing materials, labor, and performing all work needed to prepare and install the components of the plan. Work elements include side water inlet culverts, placement of earthfill, leveling and blending of old spoil banks, establishment of vegetation, channel stability practices, excavation of new channel, wetland mitigation, water management, and erosion control during construction. Construction cost estimates are based upon current cost for similar work in Minnesota. A 30 percent general contingency allowance is included.

Engineering service costs are estimated to be $142,000. These include the costs of field surveys, additional engineering and geologic investigations, and the design and preparation of construction plans and specifications for the plan components and construction inspection. Similar services related to obtaining real property rights and for project administration are not included in this cost.

Estimated project administration costs are $183,000. These are administrative costs associated with installation of the components of the plan. This includes $21,700 to do field wetland determinations. Does include administrative costs associated with obtaining real property rights on half of the mitigation land. Total mitigation land needed is 75.3 acres.

Real property rights for the project will be obtained through either fee simple title or term easements. The cost estimate of $367,000 includes obtaining real property rights and administration fees associated with obtaining property rights. The acres breakdown as follows:

- 124 acres of land between the setback dikes
- 38 acres of land need for mitigation
- 40 acres of land for the side water inlet easements
- 42 acres of land for the existing watercourse

Benefits

Under current conditions flooding along the Unnamed Ditch adversely affects agriculture by physically damaging crops, fences, buildings, and land. Floodwaters also result in damage to local roads and bridges through the loss of the surface materials. The flooding results in washouts and can cause structural damages to the roads and bridges through ice and floodwater scour. Having limited detailed records on the current level of monetary damages experienced for various flood levels, estimates were generated using NRCS Project Economic Evaluation procedures (see Appendix C – Economics section for details). The project acres flooded were estimated using hydrology/hydraulics models in combination with GIS (Table F, also see Appendix C – Economics section for details). Modeled results were verified by local NRCS and Two Rivers Watershed District personnel. These results were combined with producer interviews conducted in the watershed. The interviews gathered detailed information on cropping practices, estimates of historic flood damages, and first hand information on the characteristics of the flooding. Total monetary damages to cropland and other areas were estimated. Under current conditions, the Spring Brook Watershed experiences $120,230 in average annual damages (

Table P). This value is composed of crop, pesticide, fertilizer, farmstead, road and bridge damages. The crop values were estimated using a composite watershed crop value of $343/acre and percent yield loss based on flood depth and duration.

Table P - Average Annual Total Damages

Category	Average Annual Damages
Crop	$ 81,400
Farmstead	$ 19,960
Roads and Bridges	$ 18,870
Total	**$ 120,230**

For each of the alternatives, the flood conditions were modeled and damages were calculated using the same method as in the baseline or current conditions. The total average annual damages with plan 5 were $24,850 or a damage reduction value of $95,380. .

The acres located between the dikes (137 acres of cropland or CRP) would need to be taken out of production under alternative 5. Also the acres within the surface water inlet pooling areas (40 acres of cropland or CRP) would realize flood damages. Real property rights will need to be obtained for these areas and are accounted for in the project installation cost.

With an estimated average annual project cost of $70,760 and benefits of $95,380, the B:C ratio for the project is 1.35:1.0.

Table Q - Estimated Average Annual Flood Damage Reduction Benefits

Item	Average Annual Damages[1]		Damage reduction Benefit
	Without Project	With Project	
Crop	$ 81,400	$ 8,970	$ 72,430
Farmstead	$ 19,960	$ 7,760	$ 12,200
Roads and Bridges	$ 18,870	$ 8,120	$ 10,750
Total	$ 120,230	$ 24,770	$ 95,380

1. Price Base 2007. Current Normalized Prices for crop, 2007 for all others.

Installation and Financing

Planned Sequence of Installation

Fiscal Year	Funds	Completion Schedule
First	$526,000	• Obtain real property rights[19] • Design and prepare engineering construction plan and specifications for setback dikes, channel restoration and channel stabilization • Finalize O&M&R agreement • Finalize mitigation agreement • Obtain other than PL-566 monies • Project administration costs
Second	$797,000	• Prepare contract documents • Let contract for project • Start construction • Obtain other than PL-566 monies • Project administration costs
Third	$77,000	• Complete mitigation plan • Project administration costs
Total	**$1,400,000**	

Responsibilities

The Sponsors are responsible for implementing the plan. They are responsible for securing all real property rights, permits, licenses, and other entitlements, contracting, engineering, project administration, relocation advisory services, financing, and installation. They are responsible for obtaining all the necessary federal, state, and local permits required by law, ordinance, or regulation. The construction of all measures in the plan would comply with federal, state, and local regulations concerning air and water pollution.

The Sponsors must have power of eminent domain and taxation by law.

Contracting

The Sponsors would administer the contracts for the installation of works of improvement unless they formally request the NRCS to do all or part of the contracting. The group of Sponsors shall decide which Sponsor will be

[19] All real property rights must be secured before construction can start.

responsible for dealing with the NRCS during the installation period. They would also enter into a project agreement with NRCS before either party initiates work involving funds of the other party. The project agreement would set forth in detail the financial and working arrangements and other conditions that apply to the works of improvement. Construction contracts can be awarded for a measure only after the needed land rights have been secured.

Real Property

The Sponsors are responsible for obtaining the property rights needed for this project. Minimum real property rights consisting of fee simple title or term easements of approximately 275 acres for the footprint and area between the setback dikes. A rate of $1,000 per acre is estimated for purchasing the land, but easements may be obtained for less money.

It is estimated that the total land needed for mitigation is 75.3 acres. This number may change based upon the results of the field wetland determination.

The Sponsors will comply with all of the policies and procedures as outlined in Property Management Regulations in conformance with the Uniform Relocation Assistance and Real Property Acquisition Act of 1970 (Public Law 91-646).

Other Agencies

The ongoing programs of the Kittson and Marshall County SWCD's and Two Rivers Watershed District would be utilized to promote best management practices within the watershed.

Financing

The Sponsors will pay for all field wetland determinations, all real property rights, including land easements and/or purchases, utility relocations, and any project administration costs they may incur. The Sponsors have the necessary authority and power to arrange financing for their share of the project costs. They will also pay for the operation, maintenance, and replacement costs associated with the project.

Federal assistance for carrying out the works of improvement, as described in the watershed plan, will be provided under the authority of the Watershed Protection and Flood Prevention Act, (Public Law 83-566), as amended. All federal assistance obtained for PL-566 is contingent on congressional appropriation of the necessary funds.

Cultural Resources

A cultural resources survey would be required if Plan 2, 3, 4, or 5 was selected. The NRCS Cultural Resources Specialist would provide Technical Assistance and be the liaison for all Section 106 compliance activities with the Minnesota SHPO. As planning proceeds and an alternative is selected, a scope of work and research design can be prepared.

If human remains are discovered during construction, all activities deemed likely to

damage the remains will cease and the State Archaeologists Office will be notified in accordance with Minnesota State Statue 307.08 and the Native American Graves and Repatriation Act.

Conditions for Providing Assistance

Prior to entering into agreements that obligate funds of the NRCS, the Sponsors will develop a code of conduct. It will govern the performance of its officers, employees, or agents in contract with or expending PL-566 funds. The code calls for development of a financial management system for control, accountability, and disclosure of PL-566 funds received. It also calls for control and accountability of property and other assets purchased with PL-566 funds.

The Sponsors are responsible for applying for, paying for, and securing all federal, state, and local permits required to implement the plan. The Sponsors are also required to secure all real property rights either via fee simple or easements.

Operation, Maintenance, and Replacement (O&M&R)

An operation, maintenance, and replacement agreement will be executed between the Sponsors and NRCS prior to signing a project agreement. This agreement will be based upon the National Operation and Maintenance Manual. See Appendix E for a draft copy of an O&M&R agreement.

The Sponsors are responsible for financing and implementing the maintenance work. The maintenance will be performed in a timely, adequate, and appropriate manner to assure efficient operation and functioning of the works of improvement, including the mitigation measures.

Sponsors will also provide for replacement of any component part as needed so that the project will continue to function as planned throughout its design life.

Maintenance between the setback dikes will include control of noxious weeds and other unacceptable vegetation.

The side water inlet culverts will be checked bi-annually to ensure that neither the flap gate, nor the inlet is plugged with any matter of debris, or mechanical malfunction. This is routine maintenance.

Maintenance of the setback dikes may require the repair of earth fill, removal of debris, replacement of corrugated metal pipes (side water inlets). Operation and maintenance will also include the normal repair of bridges and channel culverts to maintain a stable channel.

A mitigation plan for the created wetlands, created channel, and other possible environment aspects of the plan will be finalized prior to construction. See Appendix D for a draft copy of the mitigation plan.

The Sponsor is responsible for the annual cost for O&M&R for the watershed plan. This cost is not payable with PL-566 funds. This includes inspection trips, debris removal,

weed control, repair of setback dikes, repair/replacement of side water inlet culverts and flap gate, and etc.

REFERENCES

Anfinson, Scott (1988). Annual Report Minnesota Municipal County Highway Archaeological Study. Appendix 3. Minnesota Historical Society. St. Paul.

Cowardin, L.M., V. Carter, F.C. Golet, E.T. LaRoe. 1979. Classsification of Wetlands and Deepwater Habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service. FWS/OBS-79/31.

Farm Financial Database (FINBIN). Data retrieved August, 2007 from The University of Minnesota Web site http://www.finbin.umn.edu/

Federal Interagency Stream Restoration Working Group. (Oct 1998). Stream Corridor Restoration – Principles, Processes, and Practices. [Manual].

Gilman, Rhoda R., C. Gilman, and D.M. Stultz (1979). The Red River Trails (1820-1870): Oxcart Routes Between St. Paul and the Selkirk Settlement. Minnesota Historical Society Press. St. Paul.

J F Cummins, J.F. and Grigal, D.F. Legend to map : soils and land surfaces of Minnesota, 1980. Saint Paul, Minn.: Dept. of Soil Science, University of Minnesota, Agricultural Experiment Station, 198.

Maassel Jacobsen, Sonia. A Systematic Evaluation of a Stream in Northwestern Minnesota. 2006 ASABE Annual International Meeting Presentations, paper #062212. Portland, OR.

Minnesota Department of Natural Resources. Traveler's Guide to Wildlife In Minnesota. Division of Fish and Wildlife, Nongame Wildife ProgramUniversity of Minnesota Bookstore, 324.

Minnesota Department of Natural Resources, Division of Fish and Wildlife. Status of Wildlife Populations in Minnesota, Fall 2006. [CD ROM].

Shaw, S.P., C.G. Fredine. 1956. Wetlands of the United States, Their Extent and the Value to Waterfowl and Other Wildlife. U.S. Department of the Interior, Fish and Wildlife Service, Circular 39/67.

United States Department of Agriculture – Soil Conservation Service. (1977, Rev. 1992). Minnesota Hydrology Guide. [Manual].

United States Department of Agriculture – Natural Resources Conservation Service. (Dec. 1992, 2nd Edition). National Watershed Manual. [Manual].

United States Department of Agriculture – Natural Resources Conservation Service. (Various dates). Field Office Technical Guide. [Manual].

United States Department of Agriculture - Forest Service. (2005). Updated Outdoor Recreation Use Values on National Forests and Other Public Lands. [General Technical Report PNW-GTR-658]. Loomis, John: Author

United States Department of Agriculture- Natural Resources Conservation Service (NRCS), National Water and Climate Center Technical Note 99-1, Stream Visual Assessment Protocol, December 1988, available at website http://www.nrcs.usda.gov/technical/ECS/aquatic/svapfnl.pdf at the time of this report.

United States Department of Agriculture – Natural Resources Conservation Service, WRS, St. Paul, MN. January 2006. Stream Assessment Report, Proposed PL 566 Flood Control Project, Kittson County, Minnesota, Spring Brook Township.

United States Department of Agriculture, Soil Conservation Service (SCS), (now the Natural Resources Conservation Service – NRCS), Soil Survey of Kittson County, Minnesota, April 1979, primary map pages 87 and 88.

United States Department of Interior, Fish and Wildlife Service, U.S. Fish and Wildlife Service and Canadian Wildlife Service's Waterfowl Breeding Population and Habitat Survey, July, 2007, http://www.fws.gov/migratorybirds/.

United States Weather Bureau. Rainfall Frequency Atlas of the United States. Technical Paper No. 40, May 1961.

draft

Table R – List of Preparers – Spring Brook Project

NAME	PRESENT TITLE (Time in job (years))	DEGREES	PREVIOUS EXPERIENCE (Titles & Time in job (years))	OTHER (License, etc.)
NRCS Water Resources Staff				
John Beckwith	Staff Leader-3	BS-Soil Science	Civil Eng Tech-3, Soil Cons-2, Dist Cons-8, Area Cons-4, Assistant State Cons-4, Regional Operation Cord-9	Member-SWCS
Pete Cooper	Hydraulic Engineer-22	BS-Ag Eng MS-Envir Eng	Civil Eng-3, RC&D Eng-2	PE Registration, PH Registration (AIH)
William E. Lorenzen	General Biologist-16	BS-Zoology Master's Certificate-Wildlife Recreation & Nature Tourism	Dist Cons-9, Soil Cons-2, Fisheries Research Bio.-5, Wildlife Bio.-1	Member-SWCS
Brett Coleman	Civil Engineer-6	BS-Ag Eng	Hydrologist-7	PE Registration, Member-MnAFPM
Allan Sommer	Agricultural Economist-2	BS-Resource Management MS-Resource Economics	Research Analyst-4	
Other NRCS Staff				
Patrick McLoughlin	Cultural Resources Specialist-5	BS-Anthropology MS-Archeology	Archeologist-15	Member-SAA
James Schwab	District Conservationist-7	AD-Natural Resources Mgt. U of M Crookston	Civil Engineering Tech – 7 SCT – 3 Soil Conservationist 3	Certified Conservation and Nutrient Management Planner

Two Rivers Watershed District				
Dan Money	District Administrator Two River Watershed District-9	BS-Aquatic Biology Bemidji State University	Kittson County Water Plan Coordinator - 7	Certified Erosion Control Specialist, Wetland Delineator, NOAA Skywarn Weather Observer

draft

APPENDIX A

Table 1 – Estimated Installation Cost
Spring Brook Watershed, Minnesota[1]

Installation Cost Item	Unit	Number on Non-Federal Land	Estimated Cost (Dollars)
			Total
Setback Dikes & Channel Work	No.	1	$1,400,000
Total Project			$1,400,000

[1] Price Base July 2007

Table 2 - Estimated Cost Distribution for Structural Measures
Spring Brook Watershed, Minnesota[2]

	Installation Cost (PL-566 Funds)					Installation Cost (Other Funds)				
Item	Constr[3] ($)	Eng[4] ($)	Project Admin[5] ($)	Real Property Rights ($)[6]	Total ($)	Constr ($)	Real Property Rights ($)[7]	Project Admin[8] ($)	Total ($)	Total Installation Cost ($)
Setback Dikes Channel & Streambank Stabilization	708,000	142,000	135,000	49,000	1,034,000	-	318,000	48,000	366,000	1,400,000

[2] Does not include average annual operation, maintenance, and replacement costs (O&M&R). O&M&R rates are based on 0.6% of total installation costs. Price base is July 2007.
[3] Construction – Includes the cost of furnishing materials, labor, and performing all work needed to prepare and install the components of the plan. Work elements include side water inlet culverts, placement of earthfill, leveling and blending of old spoil banks, establishment of vegetation, stream stability practices, excavation of new channel, wetland mitigation, water management and erosion control during construction. Construction cost estimates are based upon current costs for similar work in Minnesota. A 30 percent general contingency allowance is included.
[4] Engineering – This includes costs of field surveys, additional engineering and geologic investigations, and the design and preparation of construction plans and specifications for the plan components and construction inspection. Similar services related to obtaining land rights and for project administration are not included in this cost. It is estimated that this service would cost approximately 20% of construction costs.
[5] Project Administration - These are administrative costs associated with installation of the components of the plan. It is estimated that this service would cost approximately 15% of construction costs. $21,700 for doing field wetland determinations also included.
[6] PL-566 Real Property Rights – Estimated cost of obtaining rights on 50 percent of the land needed for mitigation plus a 30% contingency.
[7] Other Funds Real Property Rights - Obtain property rights for approximately 233 acres at $1,000/ac plus a 30% contingency.
[8] Administration associated with obtaining real property rights, assumed to be 15% of real property rights costs.

Table 3a - Structural Data – Dikes[9]
Spring Brook Watershed, Minnesota

Dike Number	Stationing	Top Width (ft)	Side Slope	Average Height of Dike (ft)	Dike Protection	Volume of Fill (yd^3)
1	0+00 to 53+32	8	3:1	1.7	Veg	3,700
2	55+00 to 94+16	8	3:1	2.9	Veg	6,400
3	95+00 to 115+10	8	3:1	2.6	Veg	4,000
4	120+00 to 139+95	8	3:1	2.3	Veg	3,400
5	140+00 to 166+45	8	3:1	1.4	Veg	2,100
6	170+00 to 194+10	8	3:1	2.0	Veg	2,800
7	225+00 to 233+85	8	3:1	1.9	Veg	1,200
8	255+00 to 335+00	8	3:1	1.4	Veg	3,800
9	340+00 to 406+18	8	3:1	2.2	Veg	8,500
10	410+00 to 489+77	8	3:1	2.9	Veg	18,600
11	490+00 to 561+66	8	3:1	2.7	Veg	19,700
12	570+00 to 587+85	8	3:1	2.0	Veg	4,000
13	590+00 to 645+70	8	3:1	2.1	Veg	7,900
14	650+00 to 705+62	8	3:1	2.0	Veg	7,200

[9] Dike are Class III (reference NRCS Engineering Standard No. 356) 2007/July

Table 5 - Estimated Average Annual Flood Damage Reduction Benefits
Spring Brook Watershed, Minnesota

Item	Average Annual Damages[1]		Damage reduction Benefit
	Without Project	With Project	
Crop	$ 66,210	$ 21,410	$ 44,800
Fertilizer & Pesticide	$ 43,120	$ 14,790	$ 28,330
Farmstead	$ 19,880	$ 7,680	$ 12,200
Roads and Bridges	$ 18,870	$ 8,120	$ 10,750
Total	$ 148,080	$ 52,000	$ 96,080

1. Price Base 2007. Current Normalized Prices for crop, 2007 for all others.

Table 6 - Comparison of NED Benefits and Costs
Spring Brook Watershed, Minnesota

Evaluation Unit	Damage Reduction[1]	Wildlife Watching Benefits	Total	Average Annual Cost	Benefit:Cost Ratio
Setback Dikes & Channel Work	$91,580	$1,240	$92,820	$60,100	1.54:1.0
Total Project	$91,580	$1,240	$92,820	$60,100	1.54:1.0

1. Price Base 2007. Amortized over 102 years at a discount rate of 4.875%

APPENDIX B

Letters and Comments Received on the Draft Plan

INTENTIONALLY LEFT BLANK

APPENDIX C
INVESTIGATION AND ANALYSIS REPORT
Spring Brook Watershed Project

Table of Contents

CONTENTS: PAGE

Economics 3
Engineering 6
Estimating Setback Dike Heights and Earthen Fill Volumes 6
Stream Monitoring Sites 6
Survey Grade GPS 9
Hydrology 11
Watershed Subdivision and Base Hydrologic Parameters 11
WinTR20 Calibration and Project Flow/Frequency 12
Duration of Flows 14
Evaluation of Reservoir Sites – Flow Through Type 17
Downstream Impacts of Proposed Alternatives 18
Evaluation of Off Channel Reservoir Site 24
HEC-RAS Estimation of Acres Flooded 32
Surface Water Inlets 39
Stream Visual Assessment 43
Wetlands 46

FIGURES AND TABLES: PAGE

Figure 1C - Economic Reaches 5
Figure 2C - Stream Monitoring Sites 7
Figure 3C - Stream Site - Davis #2 7
Figure 4C - Stream Site - Spring Brook #3 8
Figure 5C - Stream Site - Spring Brook #5 8
Figure 6C - Map of GPS Survey Shots Taken 10
Figure 7C - WinTR20 Hydrologic Model Sub-Watersheds 12
Figure 8C - Relationship between Annual and Growing Season Series for Middle River at Argyle Gage 13
Figure 9C - Duration Flows for Growing Season Events 14
Figure 10C - Main Channel Profile 15
Figure 11C - Slope Reaches Plan View 16
Figure 12C - Potential Upland Storage Structures 17
Figure 13C - Locations of Upper and Lower Reach Sections 19
Figure 14C - Cross Section Approximately 3,000 Feet Upstream Co Rd 63 - 10-yr Before Project. 20
Figure 15C - Cross Section Approximately 3,000 Feet Upstream Co Rd 63 - 10-yr With Project... 20
Figure 16C - Stage Increase Estimates 23
Figure 17C - OCS Plan View 26
Figure 18C - OCS Components Near Inlet 27
Figure 19C - Cross Section View of CD-10 Inline Structure and Lateral Weir 28
Figure 20C - Profile View of OCS Outlet Structure and Dimensions/Elevation Table 29

Figure 21C - 10-year Growing Flow Split for OCS - 30 ft Lateral Weir 30
Figure 22C - Estimated 5 year Present Condition 33
Figure 23C - Estimated 10 year Present Condition 34
Figure 24C - Estimated 5 year Future Conditions 35
Figure 25C - Estimated 10 year Future Conditions 36
Figure 26C - Example of Local Drainage to SWI 40
Figure 27C - Main Ditch/Local Drainage Hydrographs for a 10-year Event 40
Figure 28C - Plan View of SWI Connection to Main Ditch.....41
Figure 29C - SWI - Cross Section View.....41
Figure 30C - HECRAS Unsteady Flow Hydrographs 42
Figure 31C - Stream Assessment Map 45

Table 1C - Average Annual Total Damages.....3
Table 2C - Estimated Average Annual Flood Damage Reduction Benefits.....4
Table 3C - Calculated Stream Flows per Event Frequency 8
Table 4C - WinTR20 Hydrologic Sub-Area Size and Tc's.....11
Table 5C - Middle River Argyle Gage Growing Season/Annual Peak Discharge Ratio 13
Table 6C - WinTR20 Runoff and Rainfall Volumes Required To Match Target 14
Table 7C – Spring Brook Main Trib Slopes 15
Table 8C - Impacts of Storage Structures - Peak Discharge.....18
Table 9C - Effects of Storage Structures - Acres Flooded 18
Table 10C - Loss of Floodplain Storage Estimate 21
Table 11C - Peak Discharge Increase - Reach Routing Approach 22
Table 12C - Peak Discharge Increase - Storage Routing Approach.....23
Table 13C - Main Stem Cropland Flooded Acres by Alternative 30
Table 14C - Routing Results - 10 foot Lateral Weir.....31
Table 15C - Routing Results - 20 foot Lateral Weir.....31
Table 16C – Routing Results - 30 foot Lateral Weir 32
Table 17C - Routing Results - 40 foot Lateral Weir.....32
Table 18C - % Runoff Reduction for Watersheds above Wetland Restorations.....38
Table 19C - Percent Discharge Reduction for Varirous Wetland Restoration Scenarios/Assumptions 38
Table 20C - Percent Reduction in Acres Flooded for Various Wetland Restoration Scenarios/Assumptions 39

Economics

In general, the benefits presented in this watershed plan were developed using policy and procedures as outlined in NRCS Principles and Guidelines and Project Economics and Evaluation procedures, utilizing methods of cost avoidance as appropriate. Assessments, considerations, and calculations in these analyses were based on a 102-year evaluation period and a discount rate of 4.875 percent (2007 Federal discount rate for water resources projects). Flood damages were based on an array of flood frequencies (Low, 1.5- year, 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year). The channels within the project area were defined as shown in Figure 1C for the purposes of the economic evaluation. Agricultural damages were estimated based on land use and cropping patterns in the watershed. A composite crop value was estimated based on information obtained from local surveys conducted by NRCS in July of 2004. Crop damage probabilities were used for each storm event. Farmstead damages were also obtained from the surveys.

Using the percentage of crop type in the project area, a weighted average or composite gross revenue dollar per acre value was calculated. Under baseline conditions this value was estimated to be $650/Acre. Using the per acre production costs for these crops as reported by The Farm Financial Database (FINBIN 2007), a net return per acre was calculated to be $343.

Under current conditions, the Spring Brook Watershed experiences $120,230 in average annual damages (Table 1C - Average Annual Total Damages). This value is composed of crop, pesticide, fertilizer, farmstead, road and bridge damages. The crop values were estimated using a composite watershed crop value of $343/acre and percent yield loss based on flood depth and duration.

Table 1C - Average Annual Total Damages

Category	Average Annual Damages	
Crop	$	81,400
Farmstead	$	19,960
Roads and Bridges	$	18,870
Total	**$**	**120,230**

For each of the alternatives, the flood conditions were modeled and damages were calculated using the same method as in the baseline or current conditions. The total average annual damages with plan 5 were $24,850 or a damage reduction value of $95,380. .

The acres located between the dikes (137 acres of cropland or CRP) would need to be taken out of production under alternative 5. Also the acres within the surface water inlet pooling areas (40 acres of cropland or CRP) would realize flood damages. Real property rights will need to be obtained for these areas and are accounted for in the project installation cost.

With an estimated average annual project cost of $70,760 and benefits of $95,380 (

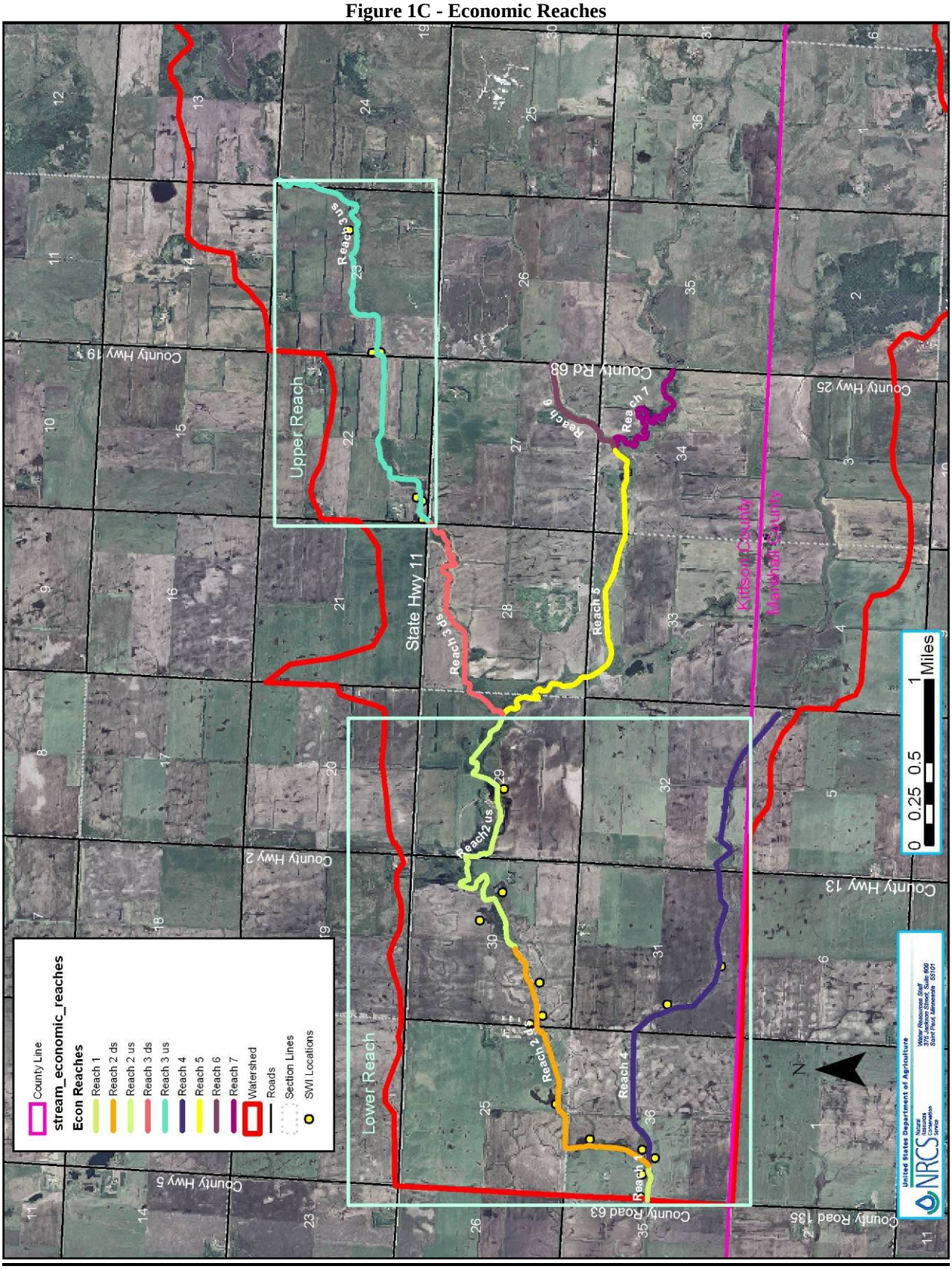
Table 2C - Estimated Average Annual Flood Damage Reduction Benefits), the B:C ratio for the project is 1.35:1.0.

Table 2C - Estimated Average Annual Flood Damage Reduction Benefits

Item	Average Annual Damages[1]		Damage reduction Benefit
	Without Project	With Project	
Crop	$ 81,400	$ 8,970	$ 72,430
Farmstead	$ 19,960	$ 7,760	$ 12,200
Roads and Bridges	$ 18,870	$ 8,120	$ 10,750
Total	$ 120,230	$ 24,770	$ 95,380

1. Price Base 2007. Current Normalized Prices for crop, 2007 for all others.

Figure 1C - Economic Reaches



Engineering

Estimating Setback Dike Heights and Earthen Fill Volumes

From the HEC-RAS computer model, the following data was used to determine the earthen fill volumes for the setback dikes:

- Location of the setback dikes within the watershed
- The current ground elevation where the proposed setback dikes would be built
- Distances between the surveyed cross-sections

Within an Excel spreadsheet, all the above mentioned data was inputted and volume calculations were made assuming the setback dikes would have a top width of 8 feet, side slopes of 3:1 and heights that varied depending on the current ground elevations and elevation of the 10-year event (plus 1 foot freeboard). Ten percent (10%) was added to the quantities of fill to account for additional fill to account for settlement. No testing was done to verify this assumption, so actual settlement quantities may change as the design progresses.

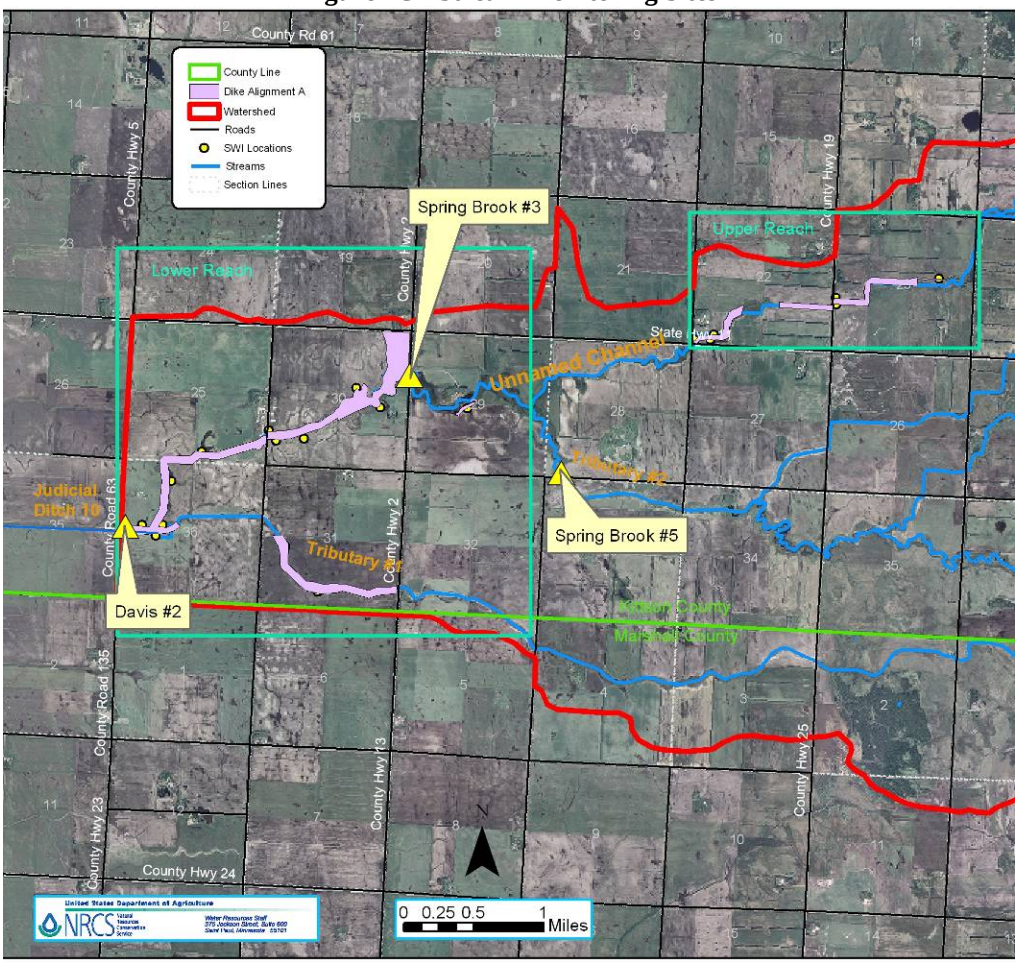
Twenty side water inlet culverts will be installed. Near each side water inlet culvert, a breakout area would be built. These areas of the setback dike are no taller than the 10-year event (no freeboard). The purpose of the breakout areas is to allow the water to cross-over the setback dike in a greater than 10-year event and to have the water breakout in pre-determined areas, usually in locations where the water would move naturally; therefore, hopefully reducing the amount of repairs that need to be done once the event is over.

Stream Monitoring Sites

Stream flow monitoring was conducted by Two Rivers Watershed District from March 2004 to July 2005.

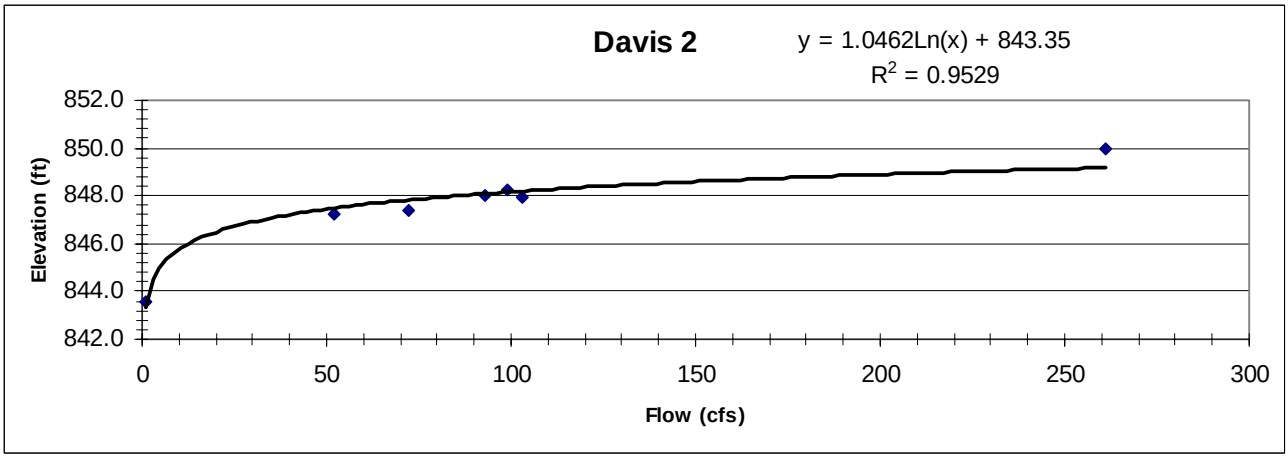
Of the six monitoring sites, only three sites are applicable to the Spring Brook Watershed Project area: Davis #2, Spring Brook #3, and Spring Brook #5. See Figure 2C. Rating curves were developed for these three sites based upon the data collected by the district.

Figure 2C - Stream Monitoring Sites



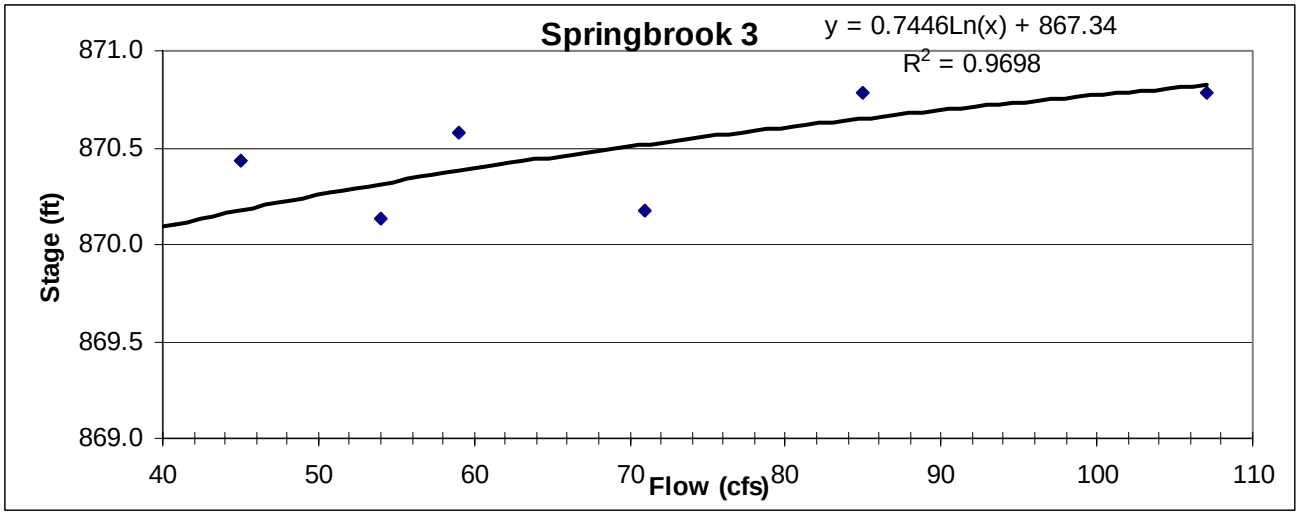
Davis #2 has an estimated drainage area of 35,170 acres. The recorded stream flow range is from 52 to 103 cfs. Figure 3C displays the rating curve below.

Figure 3C - Stream Site - Davis #2



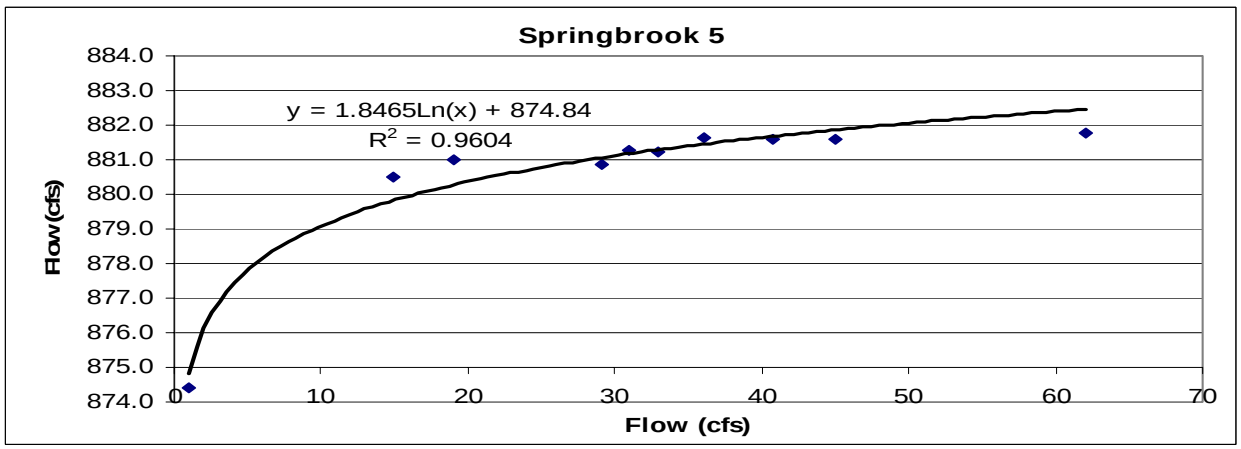
Spring Brook #3 has an estimated drainage area of 28,825 acres. The recorded stream flow range is from 45 to 107 cfs. Figure 4C displays the rating curve below.

Figure 4C - Stream Site - Spring Brook #3



Spring Brook #5 has an estimated drainage area of 11,360 acres. The recorded stream flow range is from 19 to 62 cfs. Figure 5C displays the rating curve is below.

Figure 5C - Stream Site - Spring Brook #5



The project purpose is flood prevention of cropland to a 10-year non-snowmelt event level. Based upon the hydrology of the watershed the following stream flows are estimated. See Table 3C for the stream gage monitoring sites based upon the frequency of the event.

Table 3C - Calculated Stream Flows per Event Frequency

	Stream Flow (cfs) per Event Frequency							
Monitoring Site	**Low**	**1.5 Yr**	**2 Yr**	**5 Yr**	**10 Yr**	**25 Yr**	**50 Yr**	**100 Yr**
Davis #2	39	155	213	542	810	1214	1547	1897
Spring Brook #3	31	125	170	427	642	971	1243	1531
Spring Brook #5	15	58	79	199	299	451	577	711

The stream flow information collected by the watershed district was to be used to help calibrate the HEC-RAS computer model for the Spring Brook Watershed, but based upon the calculated stream flows for the watershed, the largest event recorded was only approximately a 1.5-year event. Therefore, the stream flow data collected by the watershed district only had limited benefits in calibrating the HEC-RAS model. When the HEC-RAS model runs were completed, the results were shared with the Two Rivers Watershed District and the NRCS Hallock Field Office to visually verify the results. Once verification was received, the model was adjusted to accurately display the results of the 'real' world. The results from the HEC-RAS model were used to determine the areas flooded heights of the setback dikes, and the locations of the setback dikes.

Survey Grade GPS

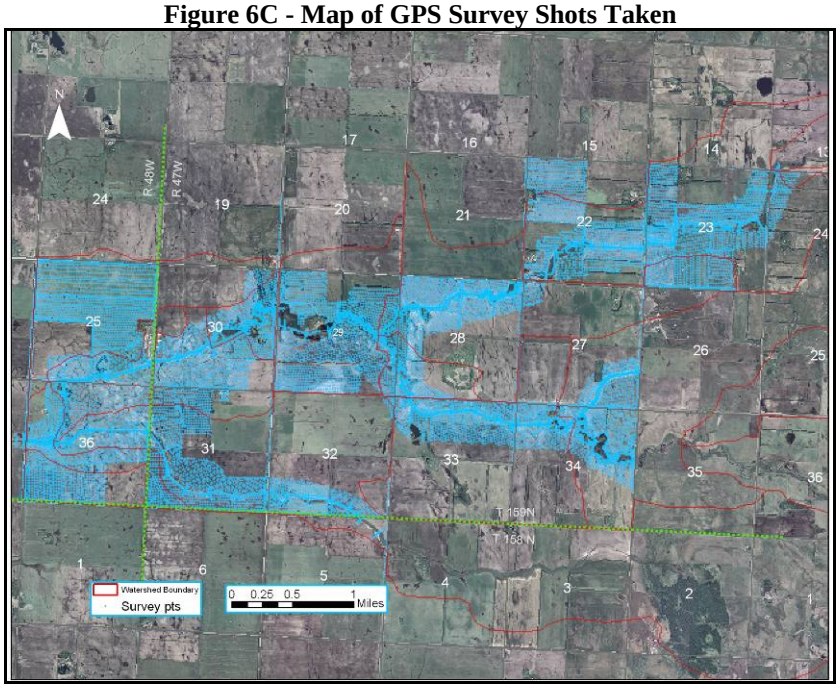
A HEC-GeoRAS computer model was created for the Spring Brook Watershed. HEC-GeoRAS is software that was developed and still maintained by the U.S. Army Corps of Engineers[1]. HEC-GeoRas is an ArcMap extension that is used to clip data, format it, and store it in a way that HEC-RAS is able to use.

The key component to HEC-GeoRAS is a hydrologically corrected digital elevation model (DEM). When the project started, the best elevation data available was a USGS quadrangle, which had contour intervals of 10', which, if used to create a DEM, would introduce unacceptable elevation errors.

The Natural Resources Conservation Service Area Office in Thief River Falls, Minnesota, conducted a survey of the area using survey grade GPS equipment. Channel cross-sections were taken at 500 feet to 1000 feet intervals for the entire project area and landscape elevations were also taken. Over 25,000 GPS elevation shots were gathered, Figure 6C.

[1] http://www.hec.usace.army.mil/default.html

Figure 6C - Map of GPS Survey Shots Taken



The survey information was used to create a DEM and contour map for the area. These maps were used in the HEC-GeoRAS Model.

Hydrology

Watershed Subdivision and Base Hydrologic Parameters

A WinTR20 Hydrologic Model was used for establishing the flow/frequency relationship for County/Judicial Ditch #10. Utilizing USGS 7.5 minute quadrangle maps, detailed topographic ground surveys, county and local NRCS/Watershed District knowledge, the watershed was divided into 11 sub-areas. See Figure 7C and Table 4C for the sub-watershed layout/delineation and watershed characteristics respectively.

Base times of concentration (Tc) were determined using the velocity method described in the Minnesota Hydrology Guide (USDA - 1977). Growing Season Runoff Curve Numbers (RCN's) were initially estimated to be approximately 76 (Dave Jones, NRCS Area Engineer, Thief River Falls, MN). A dimensionless unit hydrograph with a peak rate factor of 259 was used[2]. 3-day and 10-day rainfall/runoff distributions were used to simulate growing season (June - Sept) and annual runoff events respectively.

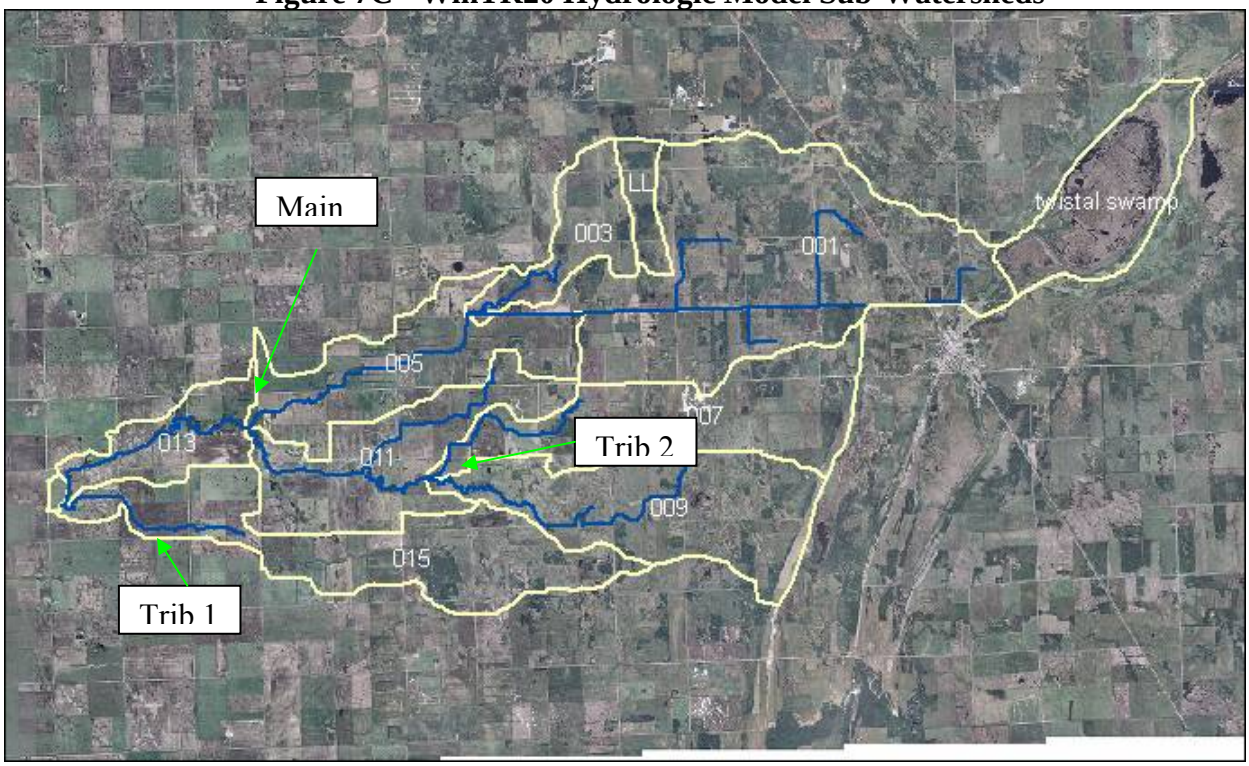
Table 4C - WinTR20 Hydrologic Sub-Area Size and Tc's

WinTR20 ID #	Drainage Area (sq mi)	Drainage Area (acres)	Calibrated Tc (hrs)
001	13.50	8640	13.8
003	2.30	1470	8.58
005	5.19	3323	6.78
007	6.22	3982	6.56
009	6.61	4228	14.64
011	5.13	3283	7.88
013	2.43	1553	8.52
015	6.87	4394	13.72
Twistal Swamp	4.14	2651	-
LL (Landlocked)	0.89	567	-

Twistal Swamp is a large Wildlife Management Area located in the headwaters of the watershed. It does outflow into the upper end of County Ditch 10 just north of Karlstad, however because of its small contributing drainage area/storage area ratio, flows are small. During runoff events, its contribution to peak discharges at the upper end of the PL-566 project (corner of sections 13, 14, 23, 24 in T159N/R46W) is minimal. For this reason, its drainage area is not included in the WinTR20 Hydrologic Model. Total drainage area of the project area, excluding Twistal Swamp and the land-locked area in sections 5, 8, and 17 in T159N/R46W, is 48.25 square miles (30,880 acres).

[2] This was the same dimensionless unit hydrograph used for the Snake River PL-566 project which lies in a similar topographic setting as the Spring Brook Township watershed.

Figure 7C - WinTR20 Hydrologic Model Sub-Watersheds



<u>WinTR20 Calibration and Project Flow/Frequency</u>
Project benefits are based on flood reductions during the growing season. The growing season flow/frequency relationship was developed using the following steps:

1. Develop the annual (all season) flow frequency curve
2. Convert the annual flow frequency curve to growing season flow frequency

The annual flow frequency curve was developed by transferring a statistically determined flow/frequency relationship for the Middle River near Argyle (53 years of gaging records used). The gage transfer accounts for differences in drainage area and storage within the watershed. The relationship between annual and growing season flow frequency series was determined by comparing the $Q_{annual}/Q_{growing}$ season ratio for the Middle River near Argyle gage data. The growing season Q_{peak} was determined to be approximately 65% of the annual Q_{peak} (Figure 8C and Table 5C).

To achieve a reasonable calibration (realistic model rainfall/runoff/frequency values necessary to match gage analysis) Tc's were doubled and RCN's reduced from 76 to 70. Table 6C below summarizes runoff/rainfall amounts required in the WinTR20 to match the "target" flow/frequency values.

Figure 8C - Relationship between Annual and Growing Season Series for Middle River at Argyle Gage

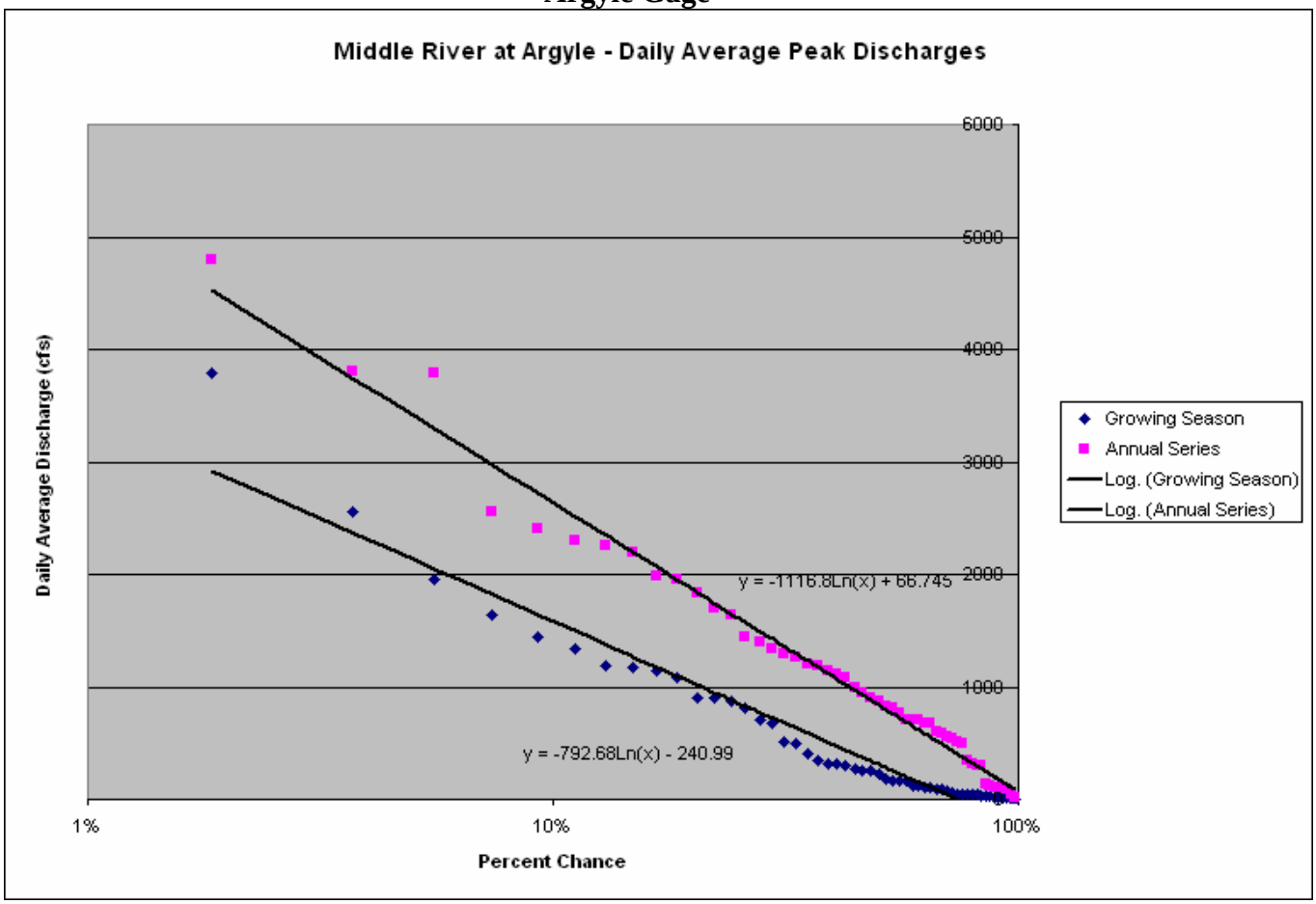


Table 5C - Middle River Argyle Gage Growing Season/Annual Peak Discharge Ratio

Flow/Freq based on best fit line through Weibull Position Plot				
Probability (% chance)	Return Period (years)	Growing Season (June 1 - Oct 1) Daily Average Peak (cfs)	Annual Daily Average Peak (cfs)	Ratio Growing Season/Annual Peak
50%	2	308	841	37%
20%	5	1,035	1,864	56%
10%	10	1,584	2,638	60%
4%	25	2,311	3,662	63%
2%	50	2,860	4,436	64%
1%	100	3,409	5,210	65%

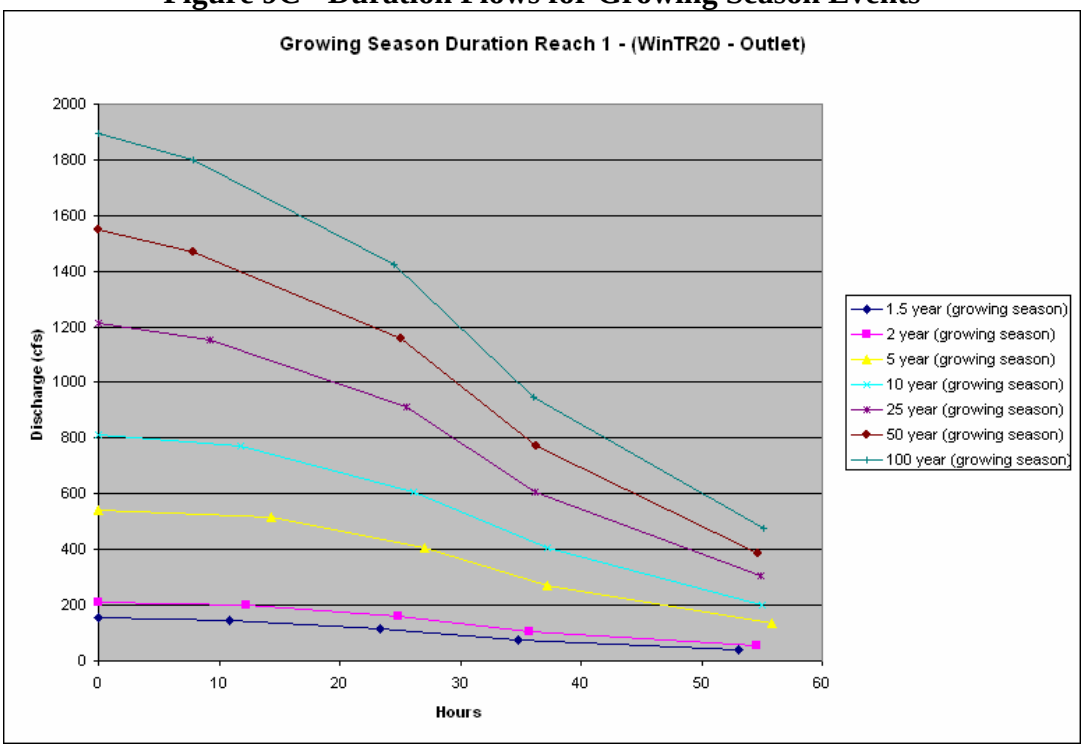
Table 6C - WinTR20 Runoff and Rainfall Volumes Required To Match Target

Return Period	Annual Series - 10-day Event			Growing Season - 3-day Event		
	Q_{peak} (cfs)	WinTR20 Runoff (")	TR60 10-day runoff vol (")	Q_{peak} (cfs)	WinTR20 Precip (")	TP49 3-day rainfall (")
1.5-year	210	0.47	-	133	1.9	2.35
2-year	277	0.62	-	181	2.1	2.65
5-year	686	1.55	-	460	3.1	3.60
10-year	1,046	2.38	-	690	3.7	4.25
25-year	1,590	3.64	4.2	1,040	4.5	5.05
50-year	2,052	4.71	4.7	1,328	5.1	5.70
100-year	2,533	5.82	5.2	1,632	5.7	6.40

Duration of Flows

Agricultural flooding damages are a function of depth and duration of water inundating the crop. The WinTR20 duration option was used to estimate the amount of time a given hydrograph flows at 95%, 75%, 50%, and 25% of the instantaneous peak flow. Figure 9C below shows a plot of flow durations for the 2- through 100-year growing season events.

Figure 9C - Duration Flows for Growing Season Events



Channel Slopes - Generally, the main channel has four distinct slope reaches. See Table 7C, Figure 10C and Figure 11C.

Table 7C – Spring Brook Main Trib Slopes

Slope Reach	Description	Length (ft)	Slope (ft/ft)	Slope (ft/mile)
1	From County Road 63 to confluence with Tributary #1	1200	0.0006	3.2
2	From main confluence with Trib #1 to center 25 | 36 section line	2900	0.004	19.9
3	From center 25 | 36 section line to section 28 crossing (M-C4)	23600	0.001	5.4
4	From section 28 crossing to start of County Ditch 10 (corner secs 13,14,23, 24)	15000	0.028	14.9

Figure 10C - Main Channel Profile

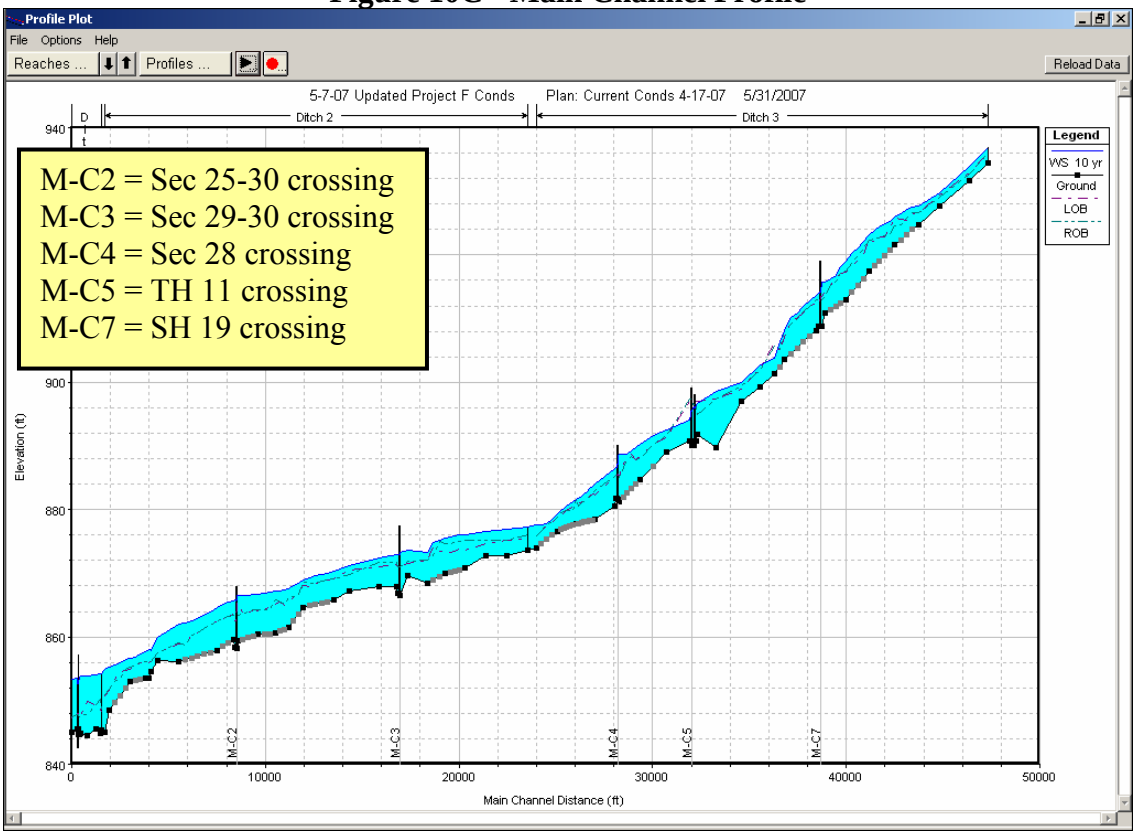
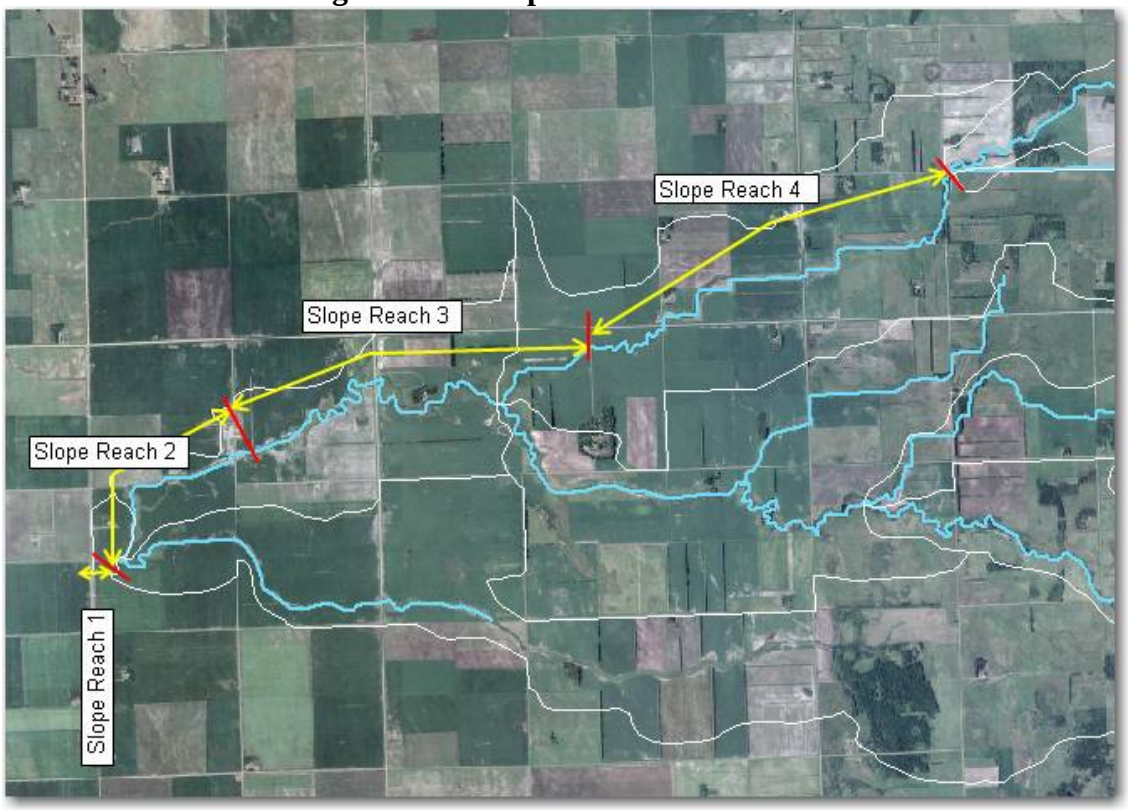


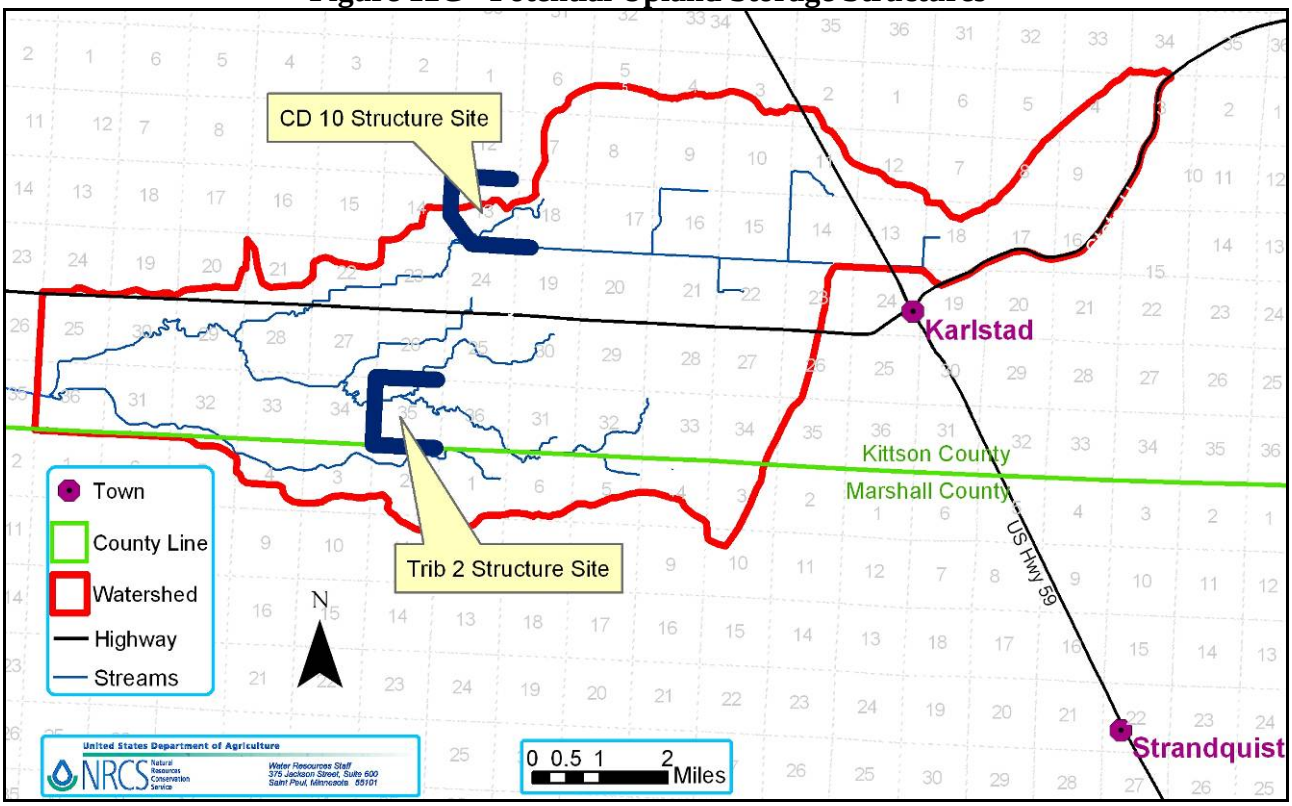
Figure 11C - Slope Reaches Plan View



Evaluation of Reservoir Sites – Flow Through Type

The effects of upstream storage were evaluated using the WinTR20 Hydrology Model. Prior to NRCS's planning efforts, the sponsors had identified two potential upland storage structure sites. These are located in sections 13 and 35, T159N/R47W (Spring Brook Township). See Figure 12C. These are referred to as CD-10 Structure and Trib 2 Structure respectively.

Figure 12C - Potential Upland Storage Structures



Stage-storage relationships were determined from delineated USGS contours. Modeling assumed 65 AF and 49 AF sediment storage pools[3]. Outlets were sized as two-staged riser/pipe configurations. Both outlets were modeled as 36" RCP principal spillway pipes with second stage weir lengths of 20 feet. Second stage weirs were set at anticipated sediment accumulation levels. Stage/discharge/storage rating curves for each were entered into the pre-project WinTR20 hydrologic model. Table 8 below summarizes the WinTR20 results for peak discharge reductions for growing season events. Table 9 provides the estimated acres flooded by reach with and without the structures in place.

[3] Sediment based on Red River Valley sediment load of 57 tons/sq mi, 94% trapping efficiency, 64#/cuft density, and a 100-year project life.

Table 8C - Impacts of Storage Structures - Peak Discharge

Project Reach/WinTR20 Reach	Drainage Area (sq mi)	Alternate	Return Period							% peak reduction from structures						
			1.5yr gs (cfs)	2yr gs (cfs)	5yr gs (cfs)	10yr gs (cfs)	25yr gs (cfs)	50yr gs (cfs)	100yr gs (cfs)	1.5 yr	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
3US / r5us	17.05	Present Condition	54	73	184	273	415	531	659							
		CD-10 str in place	9	12	64	112	122	128	133	-84%	-83%	-65%	-59%	-71%	-76%	-80%
		Trib #2 str in place	54	73	184	273	415	531	659							
3DS / r5ds	20.53	Present Condition	68	92	230	346	525	674	833							
		CD-10 str in place	18	25	72	149	202	231	268	-73%	-73%	-69%	-57%	-62%	-66%	-68%
		Trib #2 str in place	68	92	230	346	525	674	833							
2US / r13us	38.07	Present Condition	126	171	430	647	979	1256	1548							
		CD-10 str in place	77	104	257	408	612	773	955	-39%	-39%	-40%	-37%	-37%	-38%	-38%
		Trib #2 str in place	101	140	372	532	770	966	1171	-20%	-18%	-13%	-18%	-21%	-23%	-24%
2DS / r13ds	40.75	Present Condition	134	183	463	696	1051	1346	1656							
		CD-10 str in place	85	116	290	442	674	854	1058	-37%	-37%	-37%	-37%	-36%	-37%	-36%
		Trib #2 str in place	109	150	399	576	841	1056	1282	-19%	-18%	-14%	-17%	-20%	-22%	-23%
7 / r11us	12.95	Present Condition	41	56	140	209	317	406	502							
		CD-10 str in place	41	56	140	209	317	406	502							
		Trib #2 str in place	22	35	107	124	150	153	156	-48%	-39%	-24%	-41%	-53%	-62%	-69%
5 / r11ds	17.54	Present Condition	58	79	200	301	455	584	719							
		CD-10 str in place	58	79	200	301	455	584	719							
		Trib #2 str in place	34	51	153	195	249	293	340	-42%	-36%	-23%	-35%	-45%	-50%	-53%
1 / OUTLET	48.63	Present Condition	157	214	546	818	1230	1570	1928							
		CD-10 str in place	108	147	373	557	835	1067	1323	-31%	-31%	-32%	-32%	-32%	-32%	-31%
		Trib #2 str in place	130	179	474	694	1018	1280	1555	-17%	-16%	-13%	-15%	-17%	-18%	-19%
	CD-10 Str Max Pool Elevation		945.2	945.3	946.0	946.7	948.4	949.5	950.5							
	Trib #2 Str Max Pool Elevation		910.5	910.7	911.5	912.3	913.9	914.6	915.4							

Table 9C - Effects of Storage Structures - Acres Flooded

Reaches	Present Condition		CD-10 str in place		Trib #2 str in place	
	cropland acres	total acres	cropland acres	total acres	cropland acres	total acres
All Evaluation Reaches	443	535	235	305	363	443
% Reduction			-47%	-43%	-18%	-17%
On Main Stem Only	421	492	213	262	353	417
% Reduction			-49%	-47%	-14%	-10%
On Trib #2 Only	22	43	22	43	9.6	26.5
% Reduction					-56%	-39%

Downstream Impacts of Proposed Alternatives

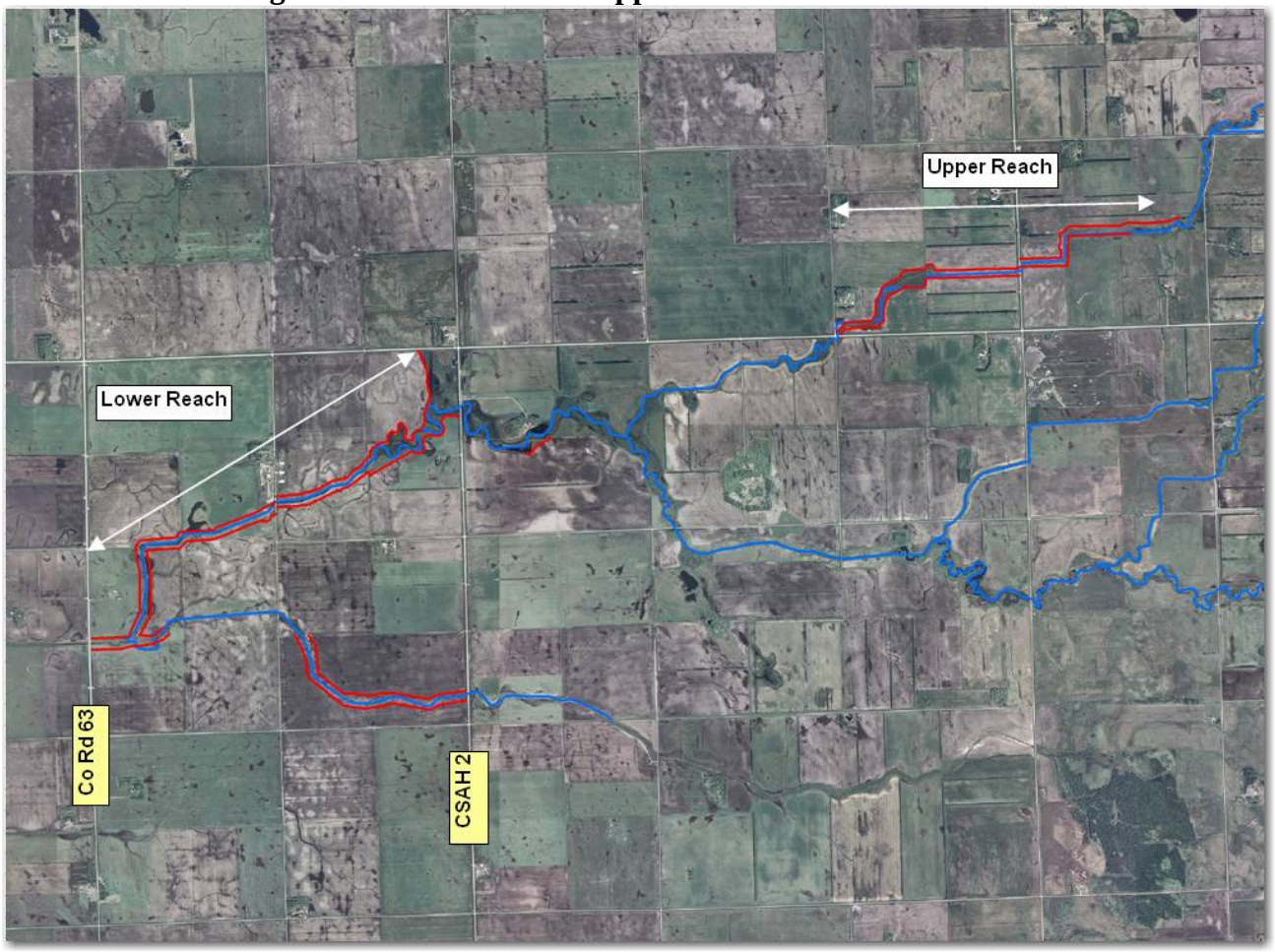
When levees or dikes are used to contain flood flows, floodwater storage within the floodplains is usually reduced resulting in increased downstream discharges for the same runoff event. In addition, the actual flow cross sectional area is reduced resulting in accelerated velocities and increased stage within the diked off channel. The concern with this project is the possibility of increased discharges to JD-10 downstream of County Road 63.

This project is designed to provide protection to cropland up to the 10-year growing season event. With the project in place, flood flows and acres impacted for events larger than a 10-year event would be essentially the same as the pre-project condition[4].

Two reaches that have continuous dikes proposed for both sides of the channel were evaluated (see Figure 13C):

1. Lower Reach: The main channel reach between County Road 63 and CSAH 2.
2. Upper Reach: The reach between the middle of section 22 Spring Brook Township up to the end of the proposed dike.

Figure 13C - Locations of Upper and Lower Reach Sections



The amount of floodplain storage lost for each reach was determined using the Corps of Engineers HEC-RAS water surface profile model. Figure 14C (before project) and Figure 15C (with project) illustrate the example of the floodplain storage lost and the resultant increase in stage due to dike construction utilizing a typical cross section view.

[4] A minimal benefit (less acres flooded) for the 25-year event occurs in the project reaches with dikes on both sides of the channel. For events having a return period greater than a 10-year, flows would pass over the dikes back onto the floodplain at controlled sections. Culverts at certain surface water inlet locations would be oversized to ensure that for areas outside the dikes, project flood durations are not longer than pre-project flood durations for these larger events.

Figure 14C - Cross Section Approximately 3,000 Feet Upstream Co Rd 63 - 10-yr Before Project

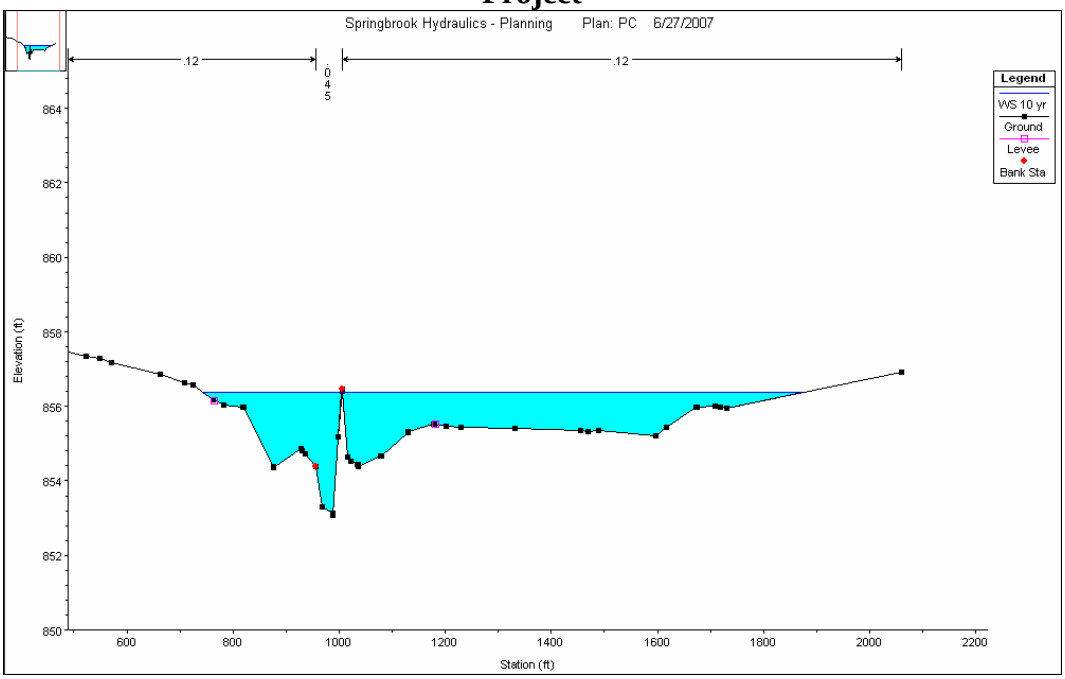
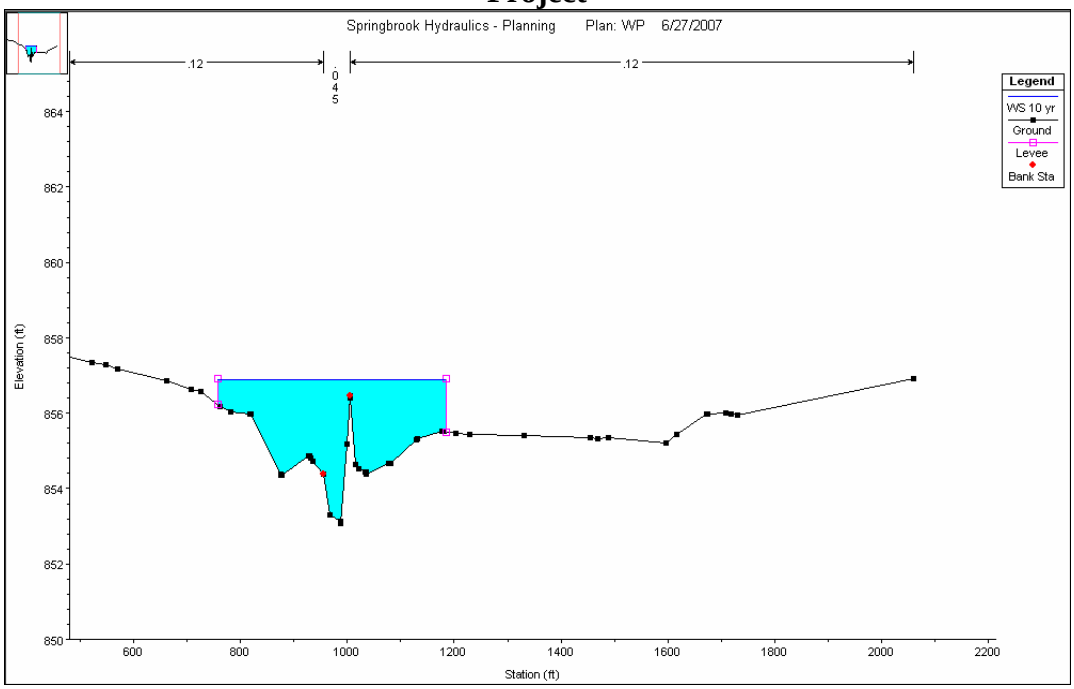


Figure 15C - Cross Section Approximately 3,000 Feet Upstream Co Rd 63 - 10-yr With Project



The difference in floodplain area occupied by water times the distance between cross sections is the estimated loss of storage. Table 10C below summarizes the results.

Table 10C - Loss of Floodplain Storage Estimate

Return Period	Loss of Floodplain Storage Due to Levees (Acre-Feet)		% of Summer Runoff Volume	
	lower reach	upper reach	lower reach	upper reach
low flow	0	0	0.0%	0.0%
1.5 year	-1.1	0.0	-0.2%	0.0%
2-year	-19.2	-0.2	-2.6%	0.0%
5-year	-201.0	-11.5	-10.9%	-0.6%
10-year	-388.8	-22.8	-13.3%	-0.8%

For example, during a 5-year growing season event, approximately 201 acre feet of floodplain storage would not be utilized by flood flows due to the dikes. This represents about 10.9% of total runoff volume for that event. As can be seen from this data, the lower reach has much more floodplain storage loss potential than the upper reach.

The downstream effects on discharge were estimated for the project using two different methods. Each method is outlined below:

1. Reach Routing Estimation

Hydrologic modeling typically estimates the effects of floodplain storage by reach routing. Reach routing uses a reach's length and hydraulic characteristics such as flow area, top width, and hydraulic grade line to estimate attenuation of flood flows as they move through the reach. Reach routing not only reduces the magnitude of peak discharges but can "shift" the timing of the peak. This has implications on total stream discharges when tributaries contribute flow also.

The same WinTR20 hydrology model that was used for estimating the watershed's flow frequency relationships was used to estimate these reach routing differences. With- and without-project WinTR20 reach routing tables for the upper and lower dike reaches were developed using output from detailed HEC-RAS water surface profile models.

The drawback to this type of analysis is that it tends to underestimate reach routing effects for reaches containing large amounts of "ineffective" flow areas (backwater areas and other places where water ponds).

2. Storage Routing Estimation

This method treats the reach as a flat pool reservoir. As with the reach routing estimate, WinTR20 was used. For the with-project condition, storage ratings for both the upper and lower reaches would be entered. These storage ratings describe the stage, discharge, and storage relationship for that part of the hydrologic system. At each stage, the discharge would be the peak flow for the particular return period while the storage would be acre feet from Table 10C associated with return period. For the without-project model, a storage routing rating is not entered - the present condition reach routing tables is used.

In general, this type of analysis overestimates storage impacts since it assumes all the storage occurs at a single location at the downstream end of a reach and it occurs as a level pool. In reality, the floodplain storage is distributed along the entire reach and the water surface has a hydraulic grade slope.

Table 11C and Table 12C below summarize the results showing increased discharges at the end of the project reach just upstream of JD-10. For example, using the reach routing procedure, peak discharges for the 5-year event would be 1.3% higher with the project in place. The Storage Routing procedure estimates peak flows being 11.0% higher with the project in place. Considering the limitations of the modeling approaches, the increase in peak discharge at County Road 63 would likely be 5% to 7.5% for the 5- to 10-year events. Based on limited NRCS cross section survey of JD-10, stages within the channel downstream of County Road 63 could increase in the 0.5" to 2.0" range. Changes in peak discharge and stage for events less than 5-year and greater than 10-year are expected to be insignificant.[5]

Some aspects of the project were not modeled that would likely have a decreasing impact on peak discharge. These include:

- Proposed channel meandering/channel size restoration for portions of the upper and lower reaches. These reaches likely have more frequent use of floodplain and increased total reach roughness.
- Removal of existing dikes resulting in an increase of floodplain flow area.
- Temporary storage of local inflows behind the dikes during the passage of the main channel flood flows.

Table 11C - Peak Discharge Increase - Reach Routing Approach

Effects Modeled as Change to Reach Routing Xsecs			
Return Period	Present Condition Qpeak at Co Rd 63	With Project Qpeak at Co Rd 63	% increase
1.5-yr	154	157	1.9%
2-yr	211	215	1.9%
5-yr	538	545	1.3%
10-yr	801	815	1.7%

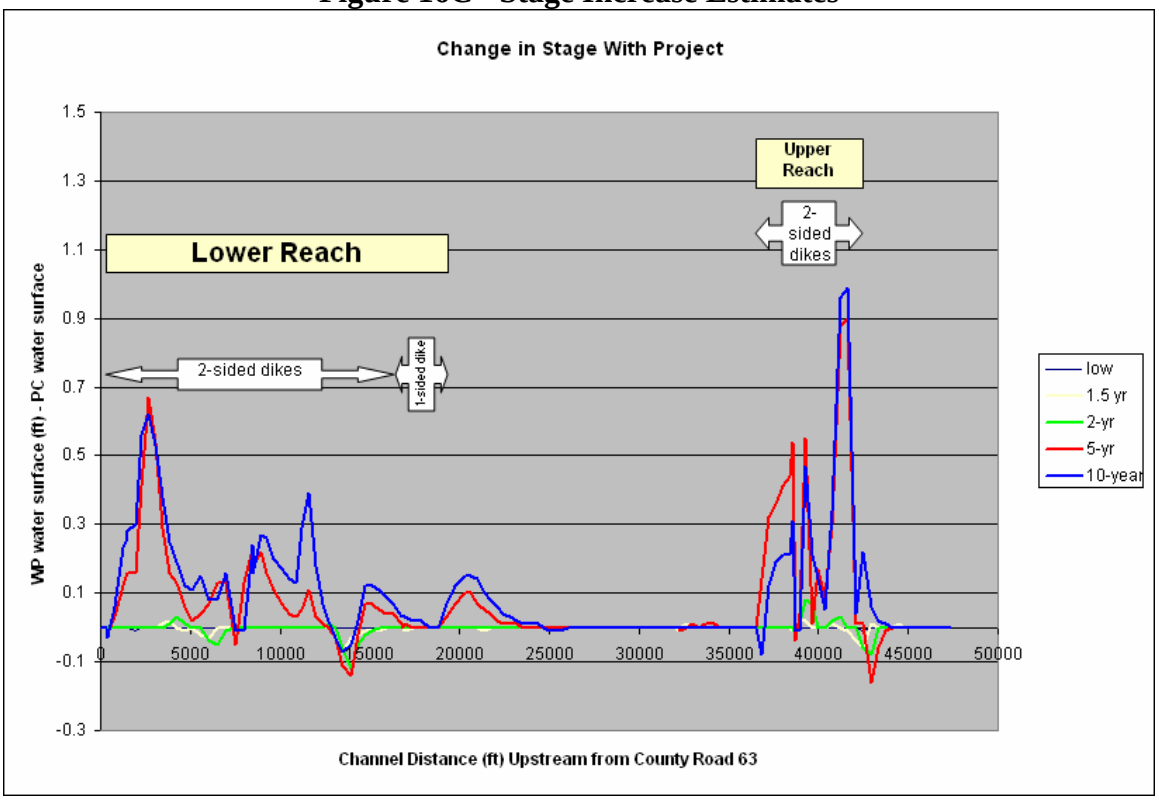
[5] Smaller events do not utilize floodplain storage while the larger events will overtop the dikes.

Table 12C - Peak Discharge Increase - Storage Routing Approach

Effects Modeled as Storage Routing			
Return Period	Present Condition Qpeak at Co Rd 63	With Project Qpeak at Co Rd 63	% increase
1.5-yr	154	154	0.0%
2-yr	211	220	4.3%
5-yr	538	597	11.0%
10-yr	801	919	14.8%

HEC-RAS was also used to estimate stage differences within the project reaches. Figure 16C summarizes those results. In general, where 2-sided dikes are proposed, the expected water surface change would be 0.1 to 0.6 feet and 0.1 to 0.9 feet for the lower and upper reaches respectively. The dikes would be designed to accommodate this increase in stage. Increases in stage for events greater than the 10-year, would not be expected since the dike would be designed to overtop during these higher events.

Figure 16C - Stage Increase Estimates



Evaluation of Off Channel Reservoir Site

An Off Channel Storage (OCS) structure was evaluated for impacts on downstream cropland flooding as part of the PL-566 Spring Brook Project. The OCS site is located in Section 18, T159N, R46W (Spring Brook Township just north of County Ditch 10 (CD-10). See Figure 17 for an overall plan view. In general, a lateral weir parallel to CD-10 would divert a portion of flood flows into a gated storage area. An interior channel is included to convey flows east to the deepest end of the storage area. The OCS embankment would include an emergency spillway opening for flows greater than 100-year annual event to flow out of the OCS.

Just downstream from the lateral inlet weir in CD10, an inline drop structure would be built to control how much water "bypasses" and continues downstream. This inline drop structure would essentially be a wall with an overflow weir and a lower orifice. This inline structure is sized such that flows would not begin entering the OCS until the 2-year all season discharge is exceeded (100 cfs). Figure 18 shows a detail plan view of the OCS components around the lateral inlet section. Figure 19 shows a cross section view of the CD-10 inline structure, lateral weir, and interior channel.

Four different sizes of OCS options were evaluated. All are based on the length of the lateral weir which takes flows out of CD-10. The size of the lateral weir affects the amount of flow into the OCS and thus the 1) height and length of the embankment, 2) second stage crest elevation of the OCS outlet, 3) the elevation crest of the emergency spillway, and 4) the interior channel size. The 4 lateral inlet weirs evaluated are 10', 20', 30' and 40'

The proposed OCS outlet structure includes a 2 foot diameter RCP barrel through the fill with a 3' x 2' box riser on the upstream end. The box riser would have a 2'x2' gated orifice allowing storage of all flows entering the OCS up to the 25-year annual event. For events larger than this, flows would enter the top (2nd stage) of the riser. The crest of the gated orifice would be set at the sediment pool level[6] (elevation 947.5). Total estimated sediment volume depositing in the OCS pool is 65 acre-feet. See Figure 20 for a sketch of the OCS outlet.

Table 14 through Table 17 detail the routing results for the 4 lateral weir inlet options. Flow label "No Flow – Gated Storage" for flow back into CD-10 indicates that all runoff is stored. This stored volume would be released after the main flood has subsided. The orifice is sized such that release rates would not cause downstream flooding with the gate wide open. Figure 21 displays the WinTR20 Hydrologic Model flow split hydrographs for a 10-year growing season event for the 30 foot lateral weir option. In this figure "ocs – Upstream" represents the flow diverted out of CD-10 into the storage site while "div – Downstream" represents the flow continuing down CD-10.

[6] Sediment volume based on a 17.05 mi^2 upland watershed, 100 year accumulation, 114 tons/mi^2 (double Snake River loading estimate), 95% trapping efficiency, 50% total sediment load enters OCS, and submerged sediment density of 65#/ft^3.

The 4 different OCS sizes were assessed based on reduction of cropland acres flooded on the main stem unnamed ditch between CD-10 and JD-10. Two assessments were made:

- OCS Alone – This assumes no other flood control measures (i.e. dikes, channel work, etc.) are installed downstream

- OCS + Dikes – This assumes the OCS in place with Alternative Plan 5 (Moderate dike spacing with streambank protection and rock drops). The dike heights would be modified to reflect the reduced discharge due to the OCS in place.

Benefits due to the OCS would include reduced acres flooded. With the OCS in place, there would be flood reduction benefits above the 10-year event whereas the original dikes only plan did not. Table 13C summarizes the cropland acres flooded along the main stem evaluation reaches for Present Conditions, Alternative Plan 5 only, OCS only, and OCS + Alternative Plan 5.

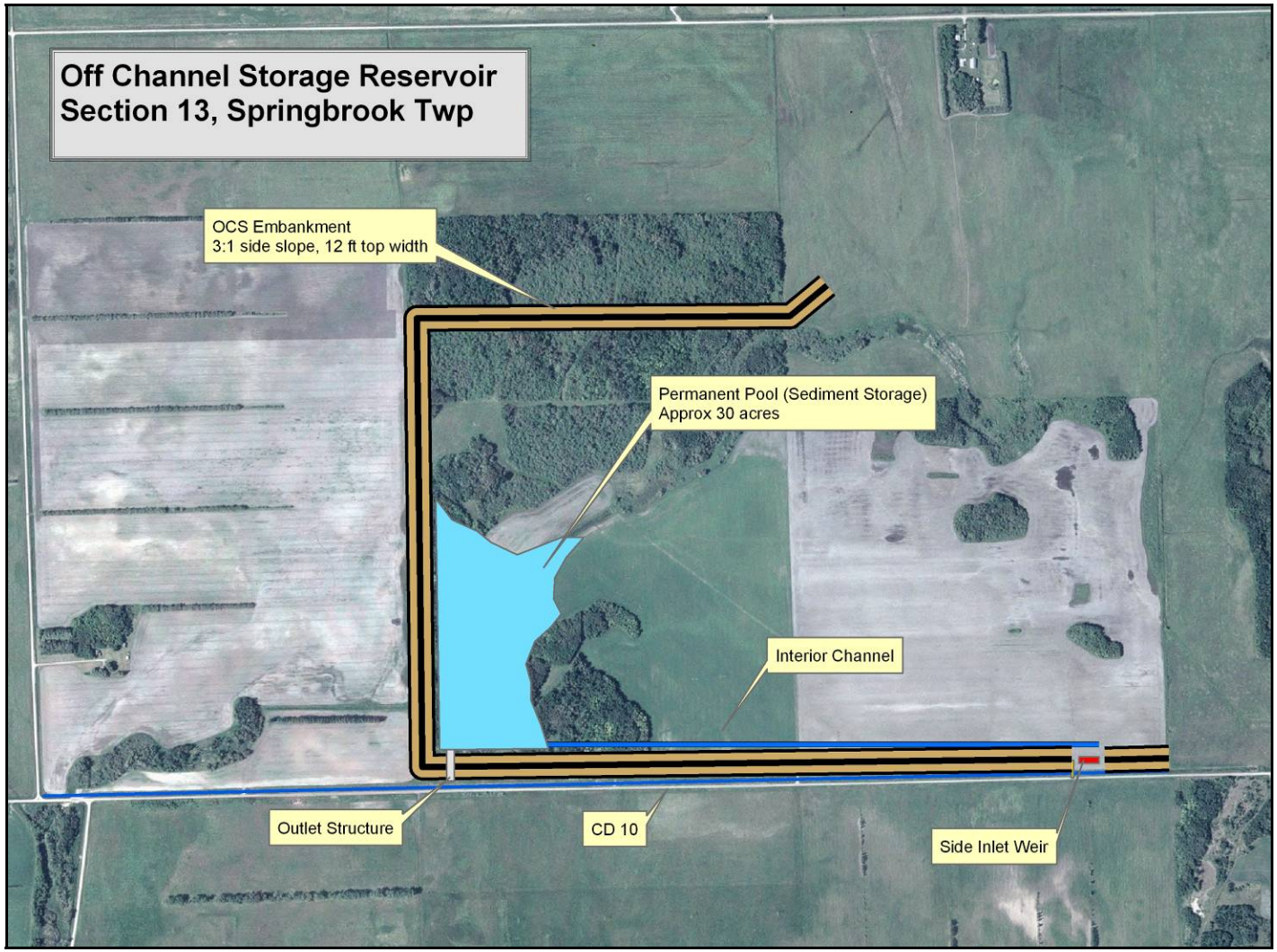


Figure 17C - OCS Plan View

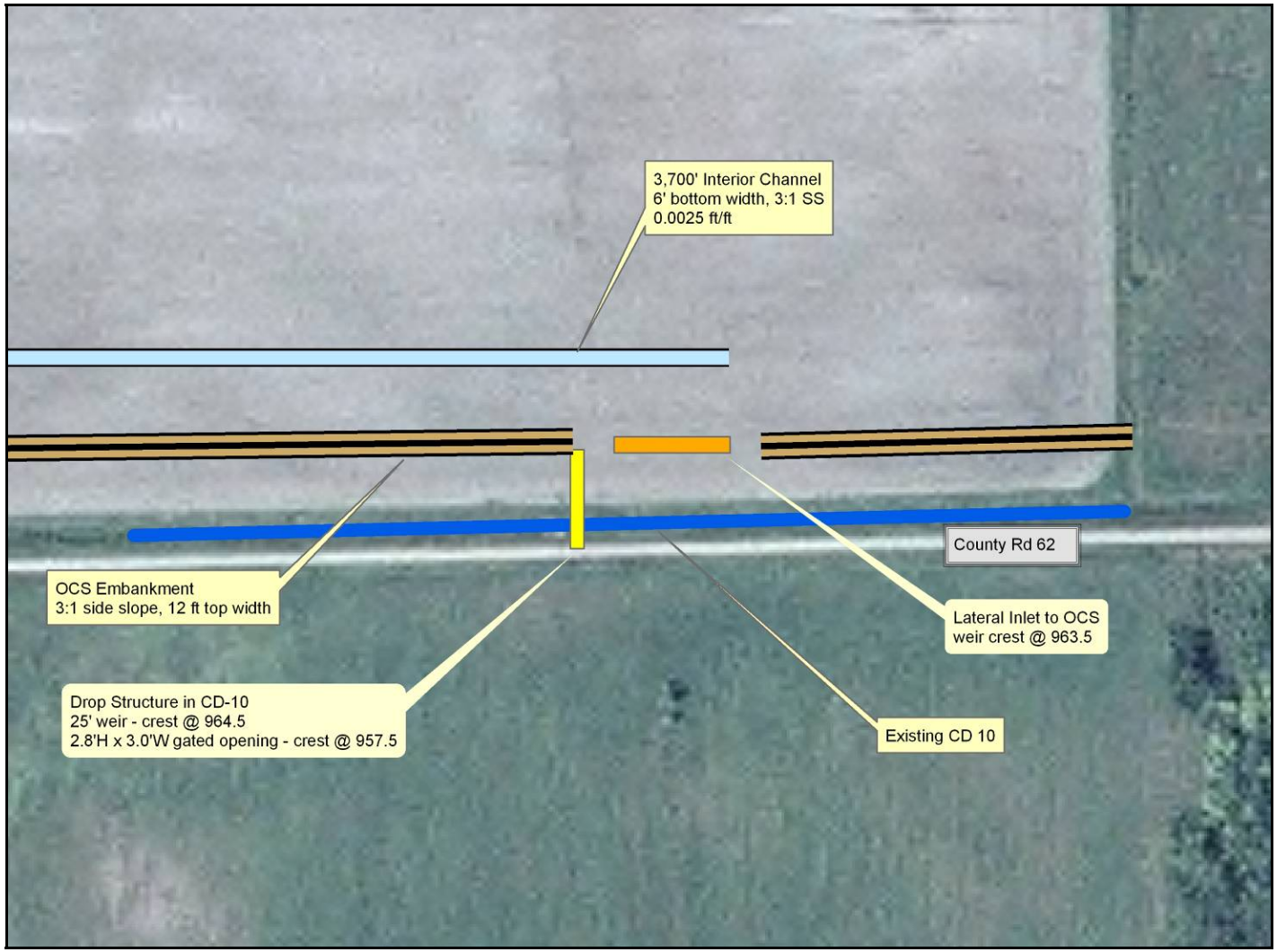


Figure 18C - OCS Components Near Inlet

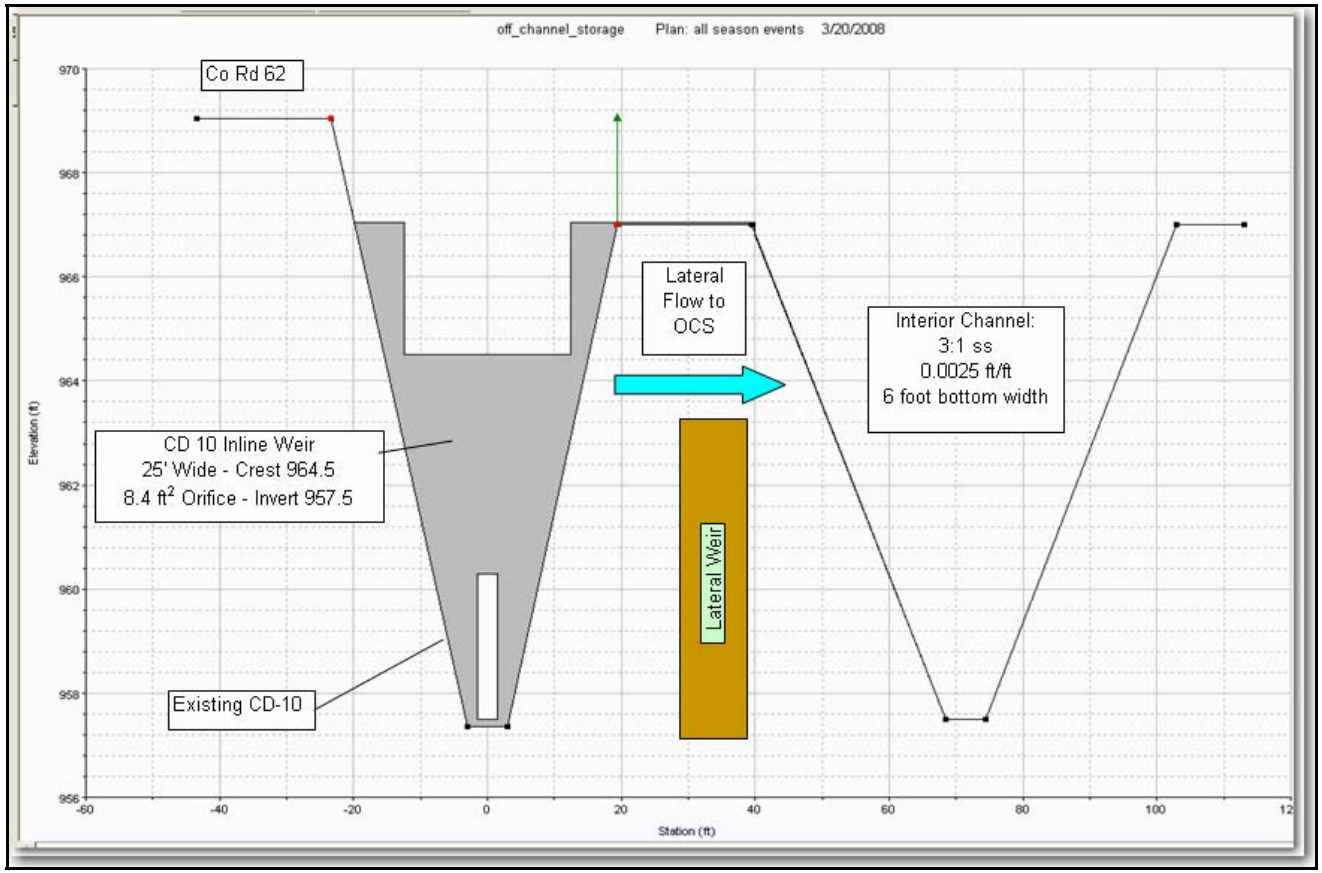


Figure 19C - Cross Section View of CD-10 Inline Structure and Lateral Weir

Outlet Structure Dimensions						
CD-10 Inlet Lateral Weir Length (feet)	Riser 2nd Stage Crest	Top of Embankment	Ht of Fill At Outlet Structure (ft)	Length of Embankment (ft)	ES Crest	Depth of Interior Channel From Inlet to Sediment Pool (ft)
10	956.1	958.3	17.3	10,300	961.3	3.7
20	958.3	961.5	20.5	11,150	964.5	4.7
30	959.4	963.0	22.0	11,500	966.0	5.1
40	960.1	964.0	23.0	12,000	967.0	5.5

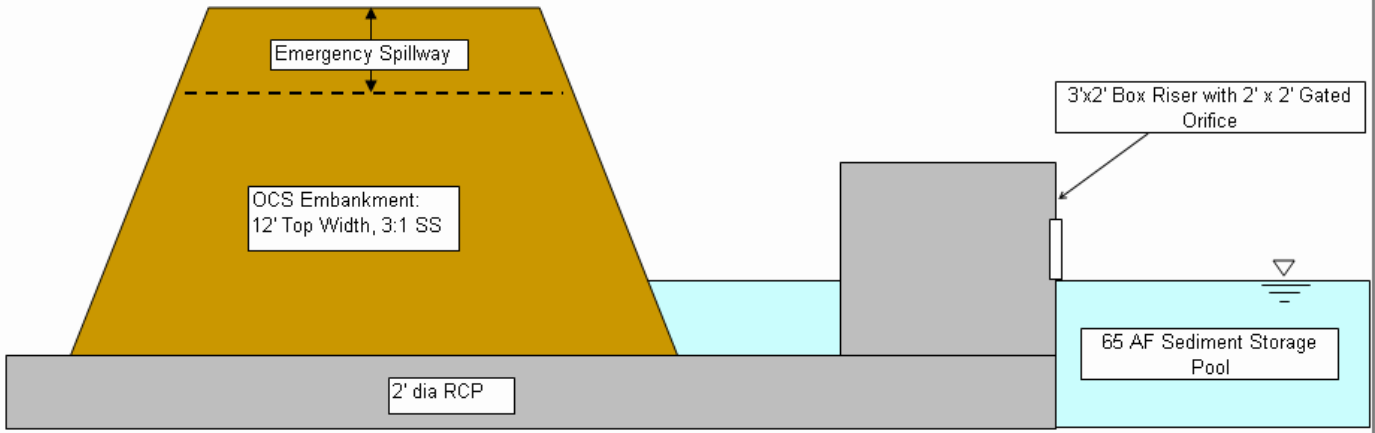


Figure 20C - Profile View of OCS Outlet Structure and Dimensions/Elevation Table

Table 13C - Main Stem Cropland Flooded Acres by Alternative

			10' OCS Lateral Inlet Weir		20' OCS Lateral Inlet Weir		30' OCS Lateral Inlet Weir		40' OCS Lateral Inlet Weir	
Return Period	Present Condition	Dike Only	OCS Only	OCS w/ 10 year dike	OCS Only	OCS w/ 10 year dike	OCS Only	OCS w/ 10 year dike	OCS Only	OCS w/ 10 year dike
1.5-yr	32	0	32	0	32	0	32	0	32	0
2-yr	86	0	86	0	86	0	86	0	86	0
5-yr	692	0	560	0	502	0	481	0	478	0
10-yr	1074	0	922	0	836	0	779	0	748	0
25-yr	1499	1499	1333	1333	1235	1235	1172	1172	1126	1126
50-yr	1807	1807	1601	1601	1503	1503	1438	1438	1386	1386
100-yr	2160	2160	1862	1862	1732	1732	1662	1662	1607	1607
Average Annual	369	119	314	105	288	98	277	93	268	90

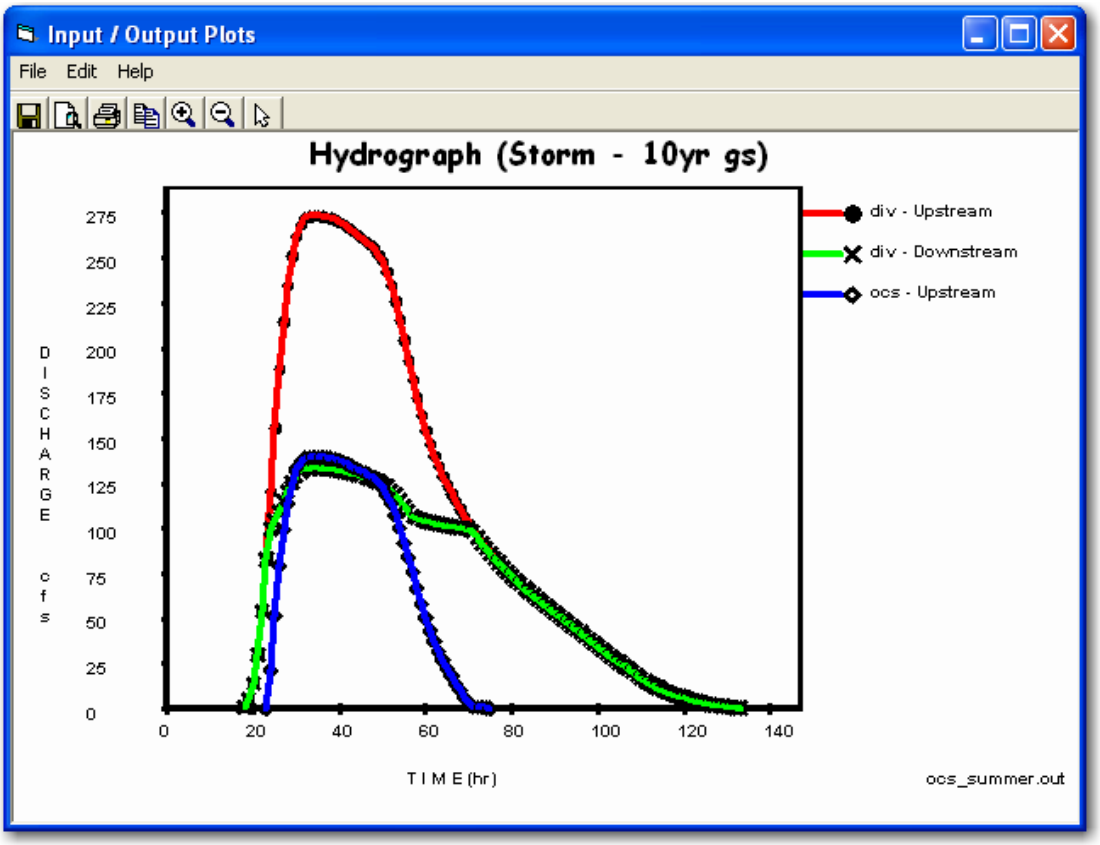


Figure 21C - 10-year Growing Flow Split for OCS - 30 ft Lateral Weir

Table 14C - Routing Results - 10 foot Lateral Weir

Return Period	OCS Max Elev	Peak Discharge (cfs)				Total Flood Storage (AF)	Gated Storage (AF)
		CD10 Upstream of Divert Point	Divert Into OCS	Continuing past Diversion	Through OCS Outlet back into CD10		
1.5-yr Growing Season	no flow in	54	no flow	54	no flow	none	none
2-yr Growing Season	no flow in	73	no flow	73	no flow	none	none
5-yr Growing Season	950.4	184	48	136	no flow-gated storage	168	168
10-yr Growing Season	951.5	273	78	195	no flow-gated storage	256	256
25-yr Growing Season	953.1	415	121	294	no flow-gated storage	384	384
50-yr Growing Season	954.4	531	154	377	no flow-gated storage	488	488
100-yr Growing Season	955.8	659	190	469	no flow-gated storage	655	655
1.5-yr Annual	no flow in	77	no flow	77	no flow	none	none
2-yr Annual	no flow in	101	no flow	101	no flow	none	none
5-yr Annual	950.7	253	72	181	no flow-gated storage	192	192
10-yr Annual	952.6	388	113	275	no flow-gated storage	344	344
25-yr Annual	956.1	593	172	422	no flow-gated storage	700	700
50-yr Annual	957.3	768	216	552	37	879	700
100-yr Annual	958.3	949	256	692	51	1028	700

Table 15C - Routing Results - 20 foot Lateral Weir

Return Period	OCS Max Elev	Peak Discharge (cfs)				Total Flood Storage (AF)	Gated Storage (AF)
		CD10 Upstream of Divert Point	Divert Into OCS	Continuing past Diversion	Through OCS Outlet back into CD10		
1.5-yr Growing Season	no flow in	54	no flow	54	no flow	none	none
2-yr Growing Season	no flow in	73	no flow	73	no flow	none	none
5-yr Growing Season	950.8	184	69	115	no flow-gated storage	200	200
10-yr Growing Season	952.2	273	117	156	no flow-gated storage	312	312
25-yr Growing Season	954.4	415	185	229	no flow-gated storage	488	488
50-yr Growing Season	956.2	531	239	292	no flow-gated storage	715	715
100-yr Growing Season	958.0	659	296	363	no flow-gated storage	983	983
1.5-yr Annual	no flow in	77	no flow	77	no flow	none	none
2-yr Annual	no flow in	101	no flow	101	no flow	none	none
5-yr Annual	951.1	253	107	146	no flow-gated storage	224	224
10-yr Annual	953.7	388	173	215	no flow-gated storage	432	432
25-yr Annual	958.3	593	267	326	no flow-gated storage	1028	1028
50-yr Annual	960	768	344	424	53	1281	1028
100-yr Annual	961.5	949	416	532	54	1624	1028

Table 16C – Routing Results - 30 foot Lateral Weir

Return Period	OCS Max Elev	Peak Discharge (cfs)				Total Flood Storage (AF)	Gated Storage (AF)
		CD10 Upstream of Divert Point	Divert Into OCS	Continuing past Diversion	Through OCS Outlet back into CD10		
1.5-yr Growing Season	no flow in	54	no flow	54	no flow	none	none
2-yr Growing Season	no flow in	73	no flow	73	no flow	none	none
5-yr Growing Season	950.9	184	77	107	no flow-gated storage	208	208
10-yr Growing Season	952.6	273	139	135	no flow-gated storage	344	344
25-yr Growing Season	955.1	415	224	190	no flow-gated storage	551	551
50-yr Growing Season	957.2	531	291	240	no flow-gated storage	864	864
100-yr Growing Season	959.4	659	362	297	no flow-gated storage	1191	1191
1.5-yr Annual	no flow in	77	no flow	77	no flow	none	none
2-yr Annual	no flow in	101	no flow	101	no flow	none	none
5-yr Annual	951.3	253	126	126	no flow-gated storage	240	240
10-yr Annual	954.2	388	209	179	no flow-gated storage	472	472
25-yr Annual	959.4	593	326	268	no flow-gated storage	1191	1191
50-yr Annual	961.1	768	422	346	54	1533	1191
100-yr Annual	963.0	949	519	430	56	1968	1191

Table 17C - Routing Results - 40 foot Lateral Weir

Return Period	OCS Max Elev	Peak Discharge (cfs)				Total Flood Storage (AF)	Gated Storage (AF)
		CD10 Upstream of Divert Point	Divert Into OCS	Continuing past Diversion	Through OCS Outlet back into CD10		
1.5-yr Growing Season	no flow in	54	no flow	54	no flow	none	none
2-yr Growing Season	no flow in	73	no flow	73	no flow	none	none
5-yr Growing Season	950.9	184	78	106	no flow-gated storage	208	208
10-yr Growing Season	952.8	273	152	121	no flow-gated storage	357	357
25-yr Growing Season	955.5	415	249	165	no flow-gated storage	610	610
50-yr Growing Season	957.8	531	326	205	no flow-gated storage	953	953
100-yr Growing Season	960.1	659	406	253	no flow-gated storage	1304	1304
1.5-yr Annual	no flow in	77	no flow	77	no flow	none	none
2-yr Annual	no flow in	101	no flow	101	no flow	none	none
5-yr Annual	951.4	253	138	115	no flow-gated storage	248	248
10-yr Annual	954.4	388	232	156	no flow-gated storage	488	488
25-yr Annual	960	593	365	228	no flow-gated storage	1281	1281
50-yr Annual	961.8	768	474	294	55	1693	1304
100-yr Annual	964.0	949	584	365	57	2196	1304

<u>HEC-RAS Estimation of Acres Flooded</u>

A HEC-RAS model was used to estimate the present conditions and the future conditions with project installed. The estimated flooding during present condition for a 5 year event, Figure 22C, and 10 year event, Figure 23C, are displayed below. The estimated flooding for the future conditions with the project installed for a 5 and 10 year event are displayed in Figure 24C and Figure 25C, respectively. It should be noted that for events larger than a 10 year event, whether present or future conditions are installed, the area flooded is almost the same.

Figure 22C - Estimated 5 year Present Condition

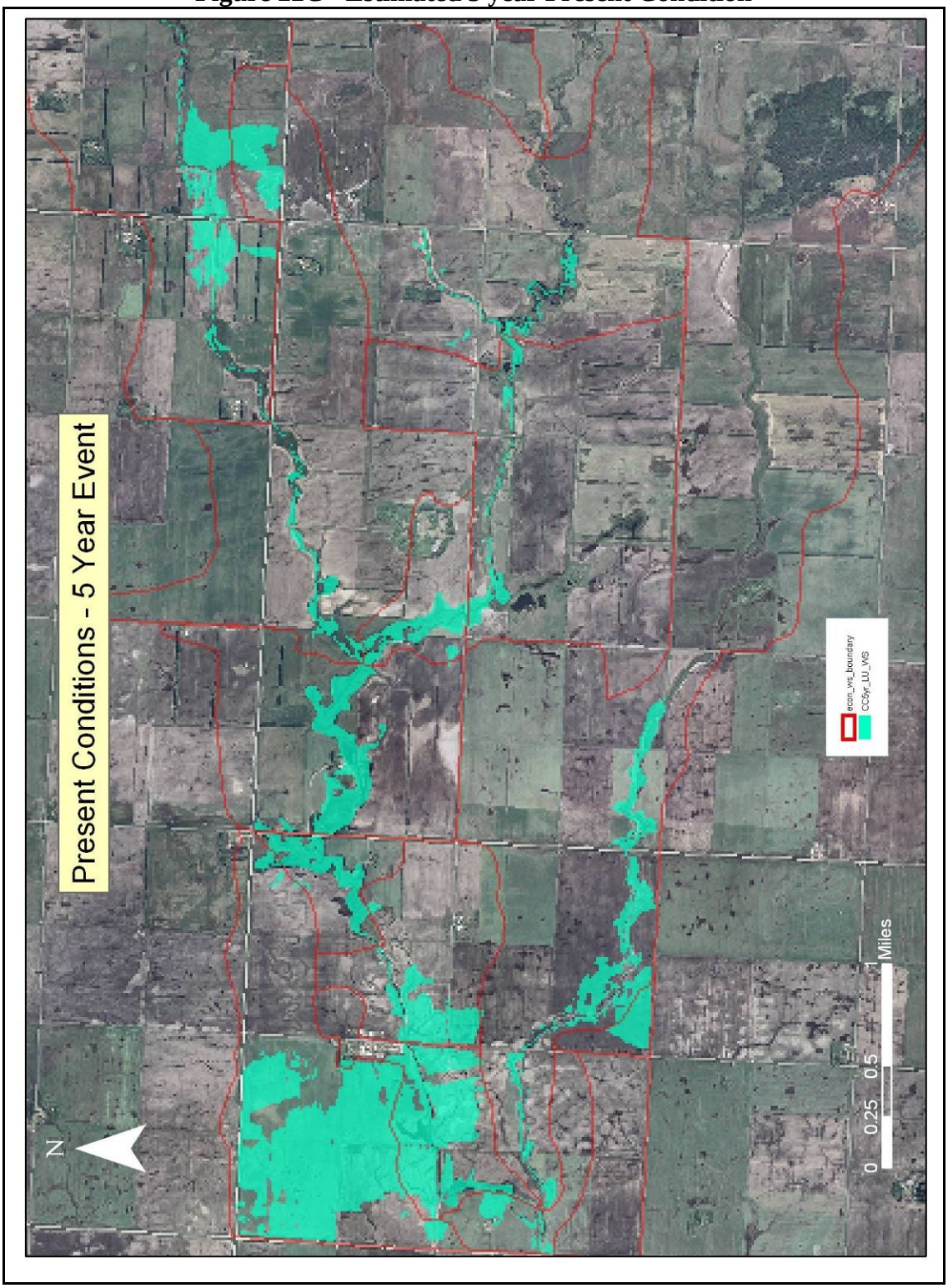


Figure 23C - Estimated 10 year Present Condition

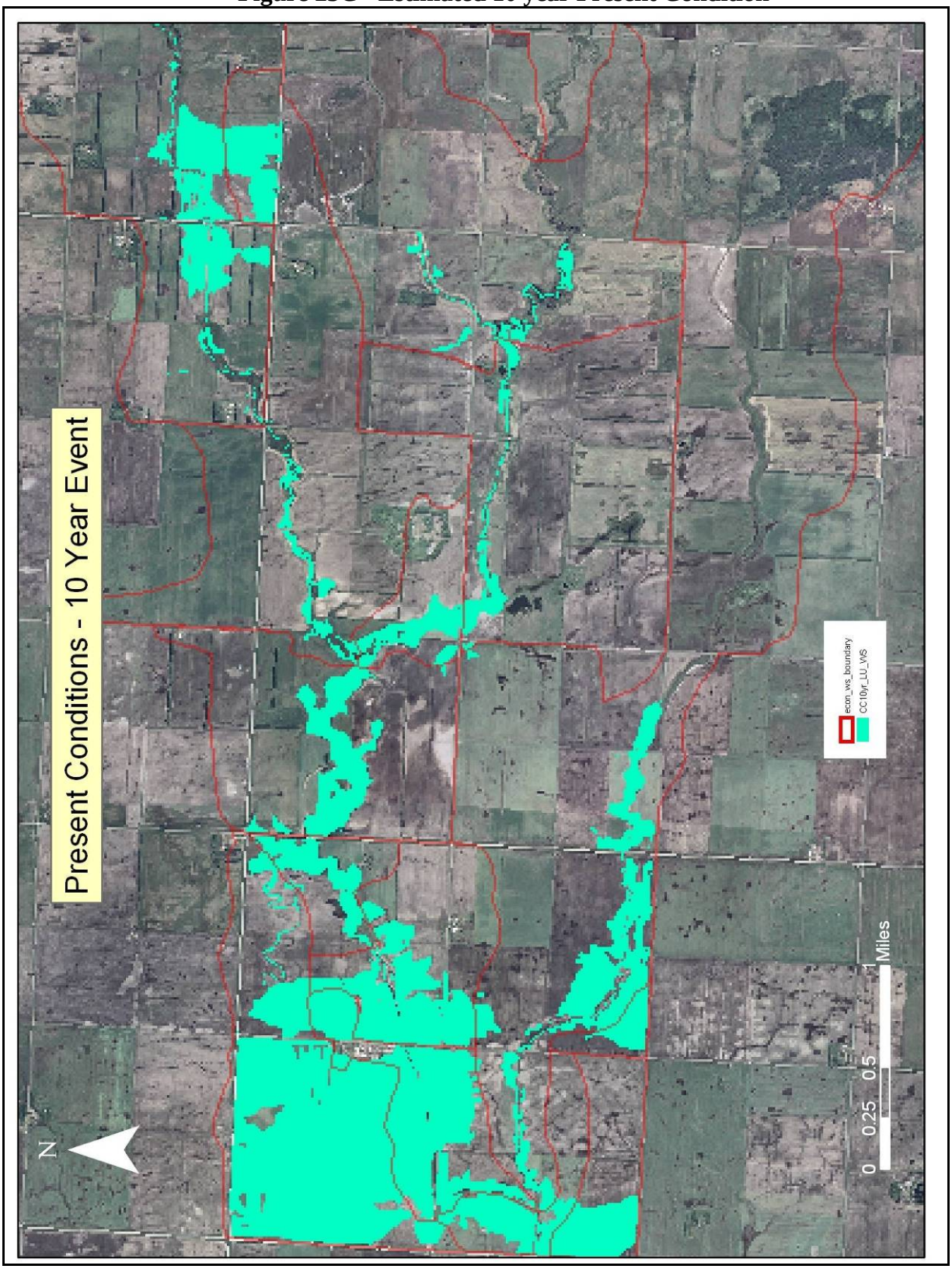


Figure 24C - Estimated 5 year Future Conditions

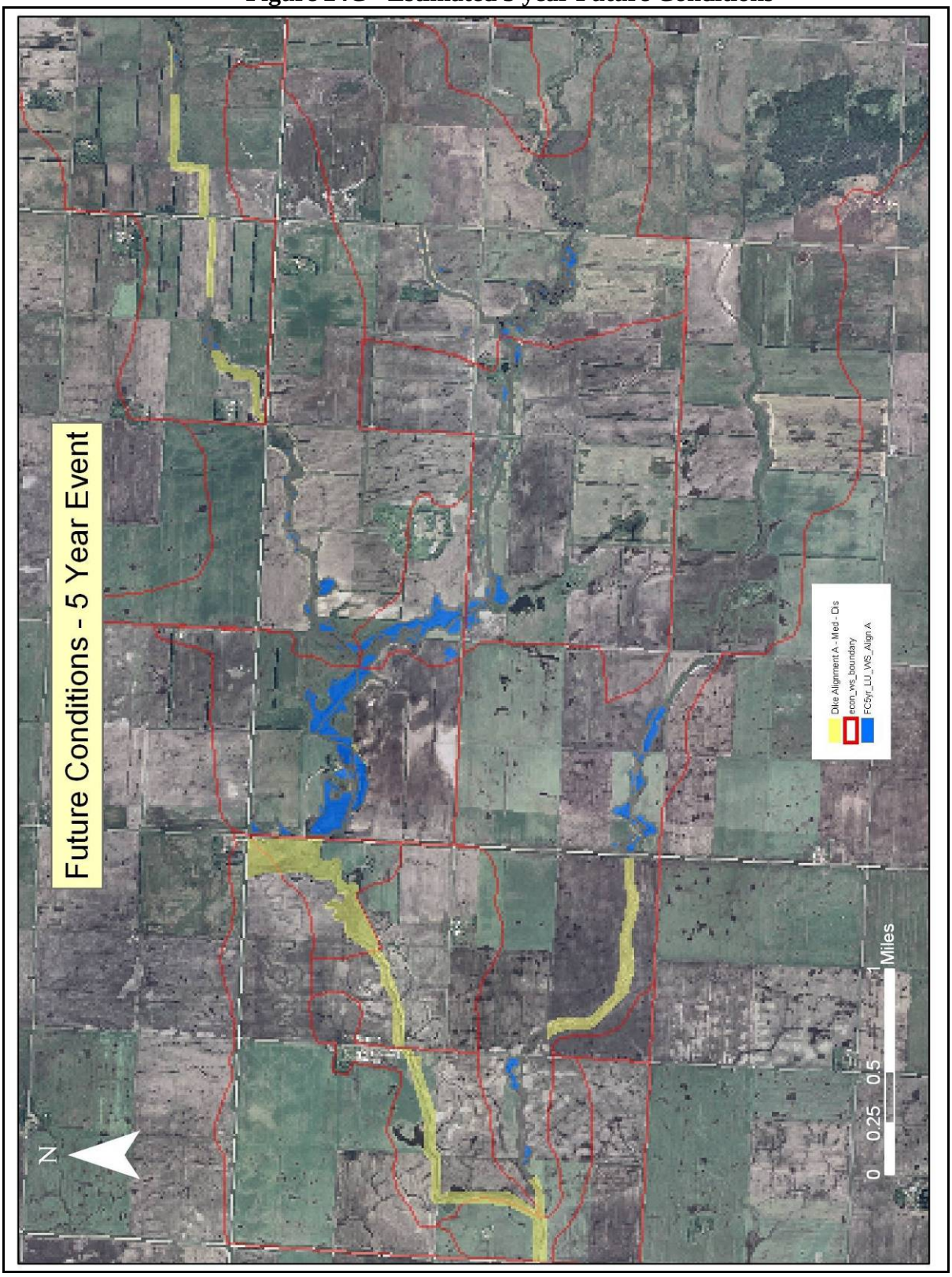
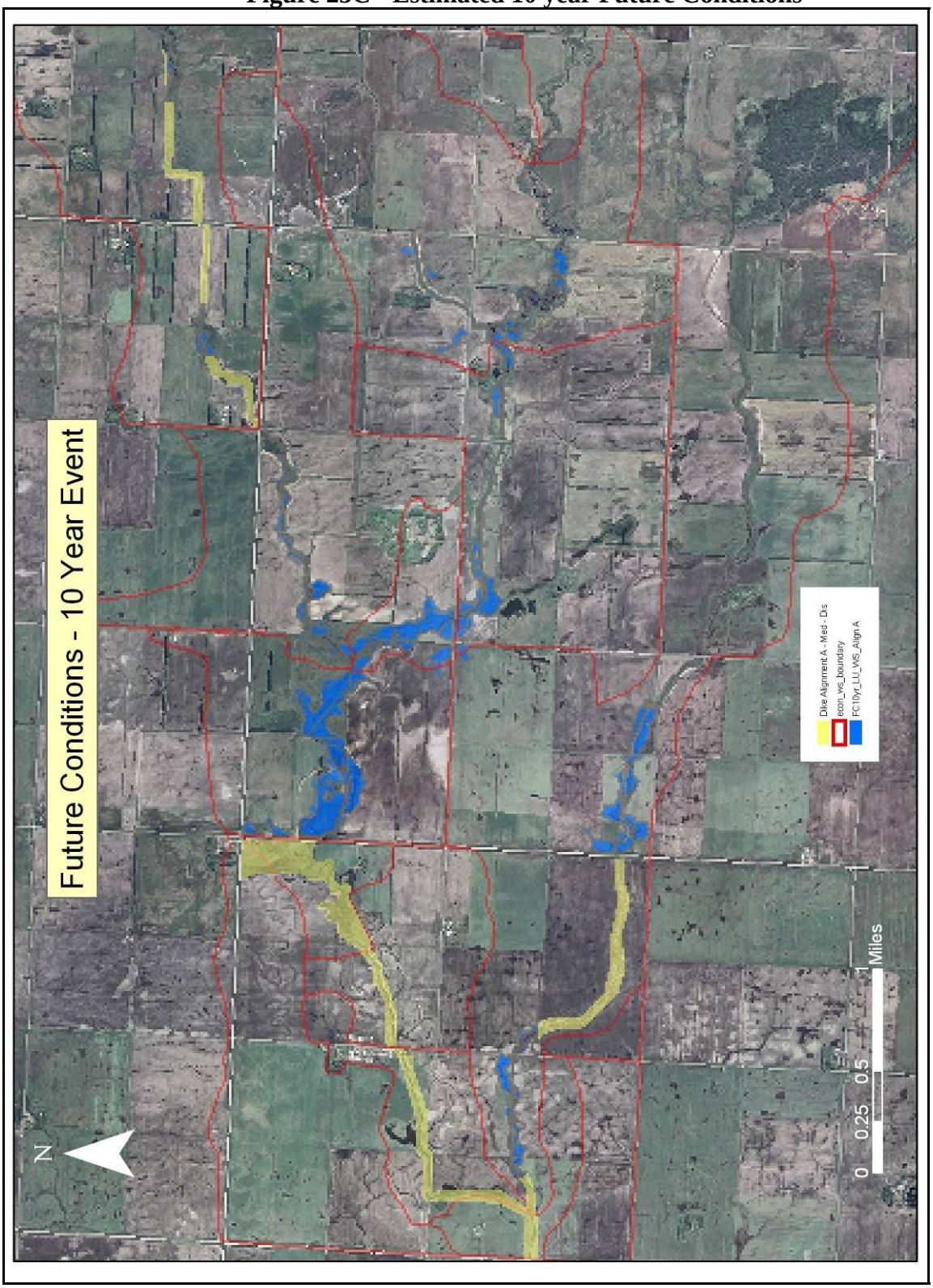


Figure 25C - Estimated 10 year Future Conditions



Impacts of Wetland Restoration

The hydrologic impacts of wetland restoration were studied as a non-structural alternative to flood damage reductions. The following steps were used to estimate the hydrologic effects of wetland restoration.

1. Kittson and Marshall Counties SSURGO GIS data bases were analyzed in ARCMAP. A layer was created intersecting depressional hydric soils and cropland land use. These acres were assumed to be restorable wetlands. Within the contributing drainage of the entire Spring Brook Township watershed, there are a total 2,635 acres of depressional hydric soils. Of these, 1,020 acres are within cropland and were considered restorable.

2. Two different percentages of restoration scenarios were evaluated and presented in the main report: 50% and 75%. In other words, 510 acres and 765 were assumed restored.

3. An upland drainage area to the restored wetlands needed to be assumed. Since each site is topographically different, two different values were used to provide the reader with a perspective on the possible range of impacts:

   - 4:1 upland drainage area to wetland pool area. For every acre of wetland, 4 acres of water would drain to it[7]. Although this can vary significantly, this is a "best guess" for small wetland restorations in this part of the state.
   - 10:1 upland drainage area to wetland pool area. For every acre of wetland, 10 acres of watershed would drain to it. A general water budget approach was used to come up with this ratio. Base data includes:

     A. 18.5" growing season evaporation (24" May-October free surface evaporation[8] x 0.77 pan coefficient[9])
     B. 14.0" growing season rainfall[10]
     C. 0.8" growing season surface water runoff[11]

     Assuming 75% of the rainfall that falls on the wetland pool itself goes towards the growing season evaporation (14" x 0.75 = 10.5"), the upland area required to balance out the remaining part of the evaporation (18.5 - 10.5 = 8.0") would be 8.0"/0.8" = 10.

   Assuming the 4:1 upland drainage area to wetland pool area, on the average, each subwatershed had approximately 12 percent of its contributing area draining through restorable wetlands. For the 10:1 upland drainage area to wetland pool area assumption, approximately 27% of the contributing area would drain through restorable wetlands.

4. The modeling approach taken was to reduce the rainfall amounts within the WinTR20 Hydrology Model of Spring Brook Watershed to simulate the reduced amount of runoff due to the wetland restorations. This would vary by return period - restorations could store water

[7] Wes Drake, NRCS Engineer, Glacial Ridge Project in NW Minnesota.
[8] NOAA Technical Report NWS 33 "Evaporation Atlas for the Contiguous 48 United States" June 1982
[9] NRCS Minnesota Hydrology Guide
[10] State Climatology Office Website: Wetland Delineation Monthly Precipitation Data Retrieval
[11] University of Minnesota Extension Phosphorus Index Risk Assessment

for small events but for larger events, wetlands would be full, causing flows to pass. See Table 18C for the percent reduction by return period assumed.

Table 18C - % Runoff Reduction for Watersheds above Wetland Restorations

Return Period	% Reduction of Runoff from Restored Wetland Upland Drainage Areas
1.5-yr	100%
2-yr	100%
5-yr	100%
10-yr	75%
25-yr	50%
50-yr	0%
100-yr	0%

Table 19C summarizes the percent reduction in WinTR20 peak discharges for the 50 and 75 percent restoration scenarios for both the 4:1 and 10:1 upland/wetland drainage area ratios. Using the watershed's discharge/cropland flooded relationship, the amount of reduced cropland flooding is determined. Table 20C summarizes the percent reduction in flooded cropland acres. This table also includes a summarized average annual acres reduction.

Table 19C - Percent Discharge Reduction for Varirous Wetland Restoration Scenarios/Assumptions

Percent Reduction in Discharge				
Growing Season Event	50% Restored Wetlands 4:1 Wetland/Upland Ratio	50% Restored Wetlands 10:1 Wetland/Upland Ratio	75% Restored Wetlands 4:1 Wetland/Upland Ratio	75% Restored Wetlands 10:1 Wetland/Upland Ratio
1.5 yr	7.6%	16.5%	10.6%	25.0%
2-yr	8.8%	17.2%	12.4%	26.5%
5-yr	8.8%	18.5%	13.0%	27.1%
10-yr	7.1%	15.3%	10.6%	22.0%
25-yr	4.9%	10.2%	7.2%	15.0%
50-yr to 100-yr	0%	0%	0%	0%

Table 20C - Percent Reduction in Acres Flooded for Various Wetland Restoration Scenarios/Assumptions

Percent Reduction in Cropland Acres Flooded				
Growing Season Event	50% Restored Wetlands 4:1 Wetland/Upland Ratio	50% Restored Wetlands 10:1 Wetland/Upland Ratio	75% Restored Wetlands 4:1 Wetland/Upland Ratio	75% Restored Wetlands 10:1 Wetland/Upland Ratio
1.5 yr	10.6%	26.5%	15.9%	37.1%
2-yr	31.0%	61.9%	51.6%	78.2%
5-yr	12.9%	25.7%	17.7%	37.0%
10-yr	7.7%	17.2%	12.0%	24.1%
25-yr	2.6%	5.5%	4.1%	8.4%
50-yr to 100-yr	0%	0%	0%	0%
Average Annual	10%	20%	14%	27%

Surface Water Inlets

An estimated 20 surface water inlets (SWI's) will be required to convey surface water from fields into the dike/channel system. Since the watershed drainage area generating flows to the main channel is much larger than the local drainage area flowing to the SWI, flap gates will be required to prevent backflow onto the fields. Figure 26C is an aerial view of a typical situation that would be encountered. This shows the main channel in Section 30, Spring Brook Township along with a 160 acre local drainage area coming from the south. A SWI will connect the local drainage to the main channel. Figure 27C compares the hydrograph volumes and peak timing between main channel flows and the local drainage flows at this location. While the water level within the main channel/dike system is high and the flap gate closed, the potential exists that local runoff cannot drain and backs up into the field until the water level in the main channel/dike system recedes to below the field backup level. Figure 28C displays the plan view and Figure 29C displays the cross section view of that situation.

Figure 26C - Example of Local Drainage to SWI

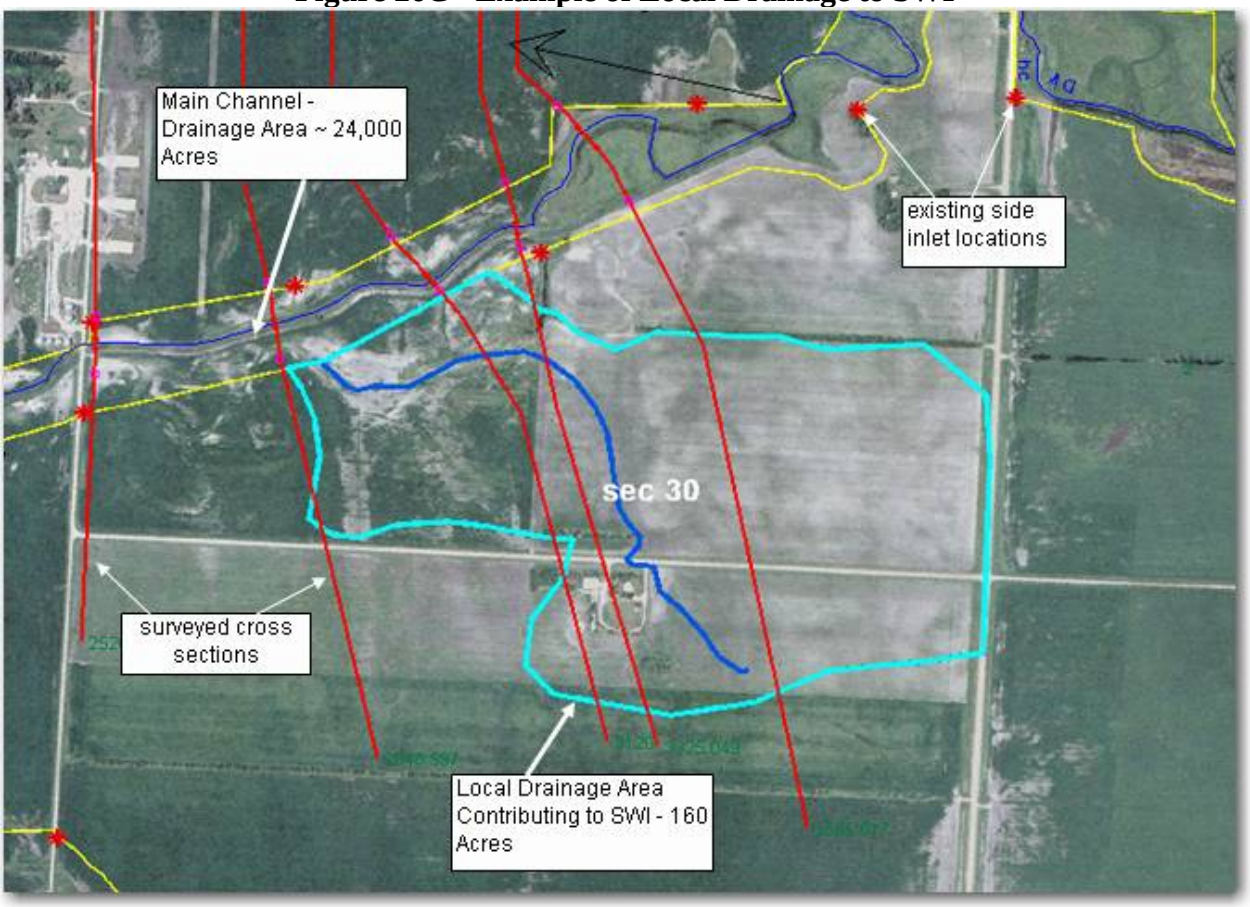


Figure 27C - Main Ditch/Local Drainage Hydrographs for a 10-year Event

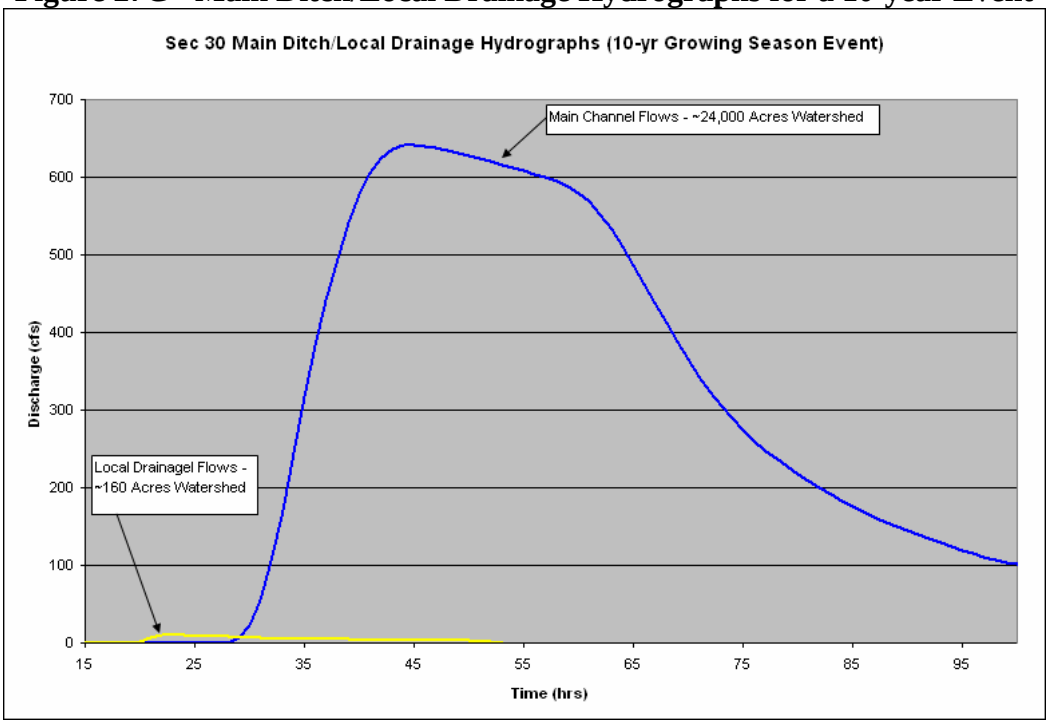


Figure 28C - Plan View of SWI Connection to Main Ditch

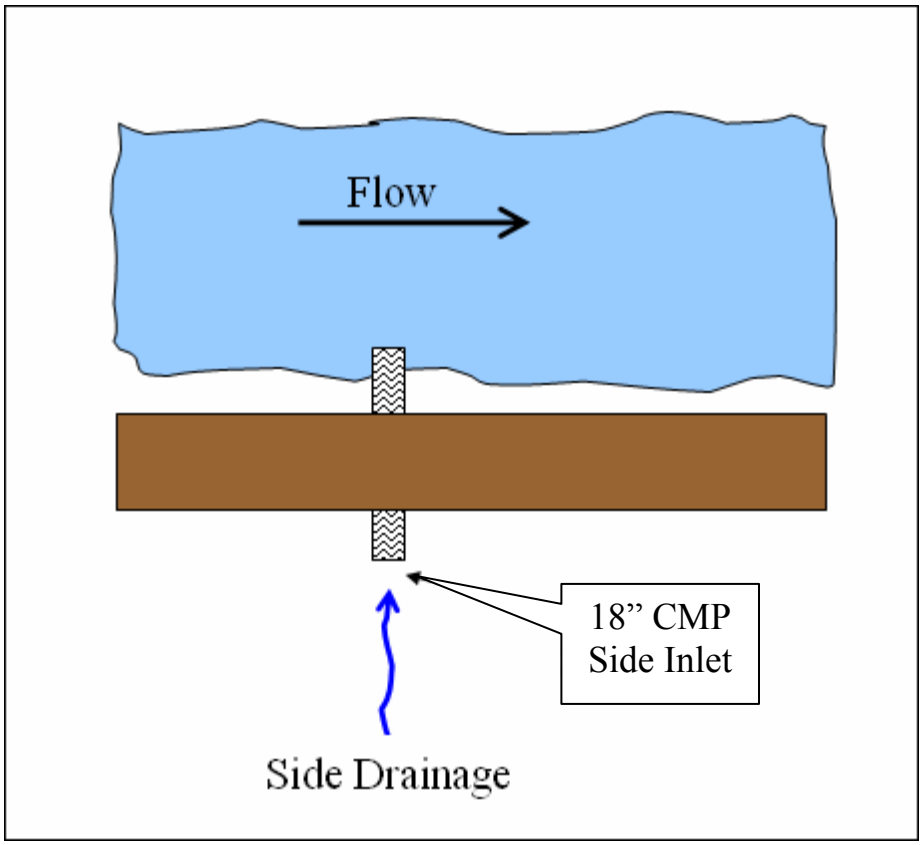
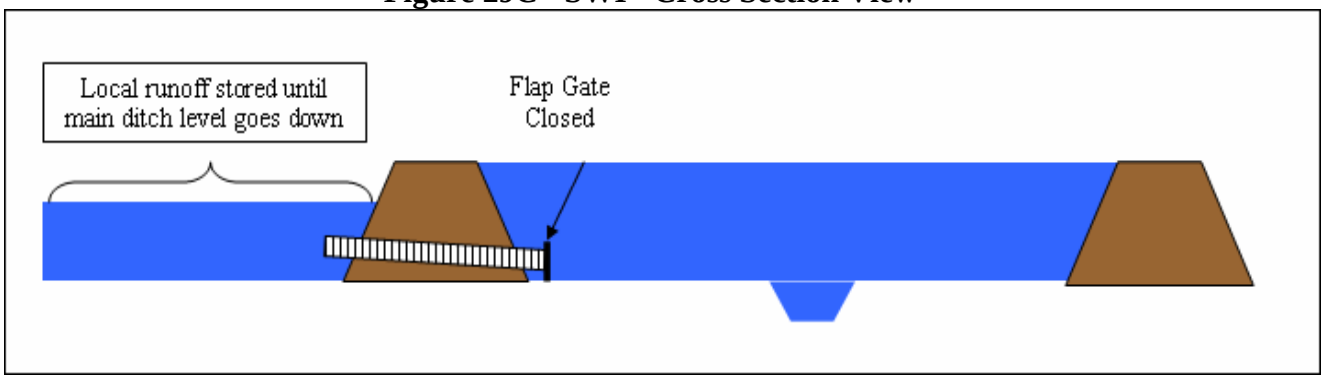
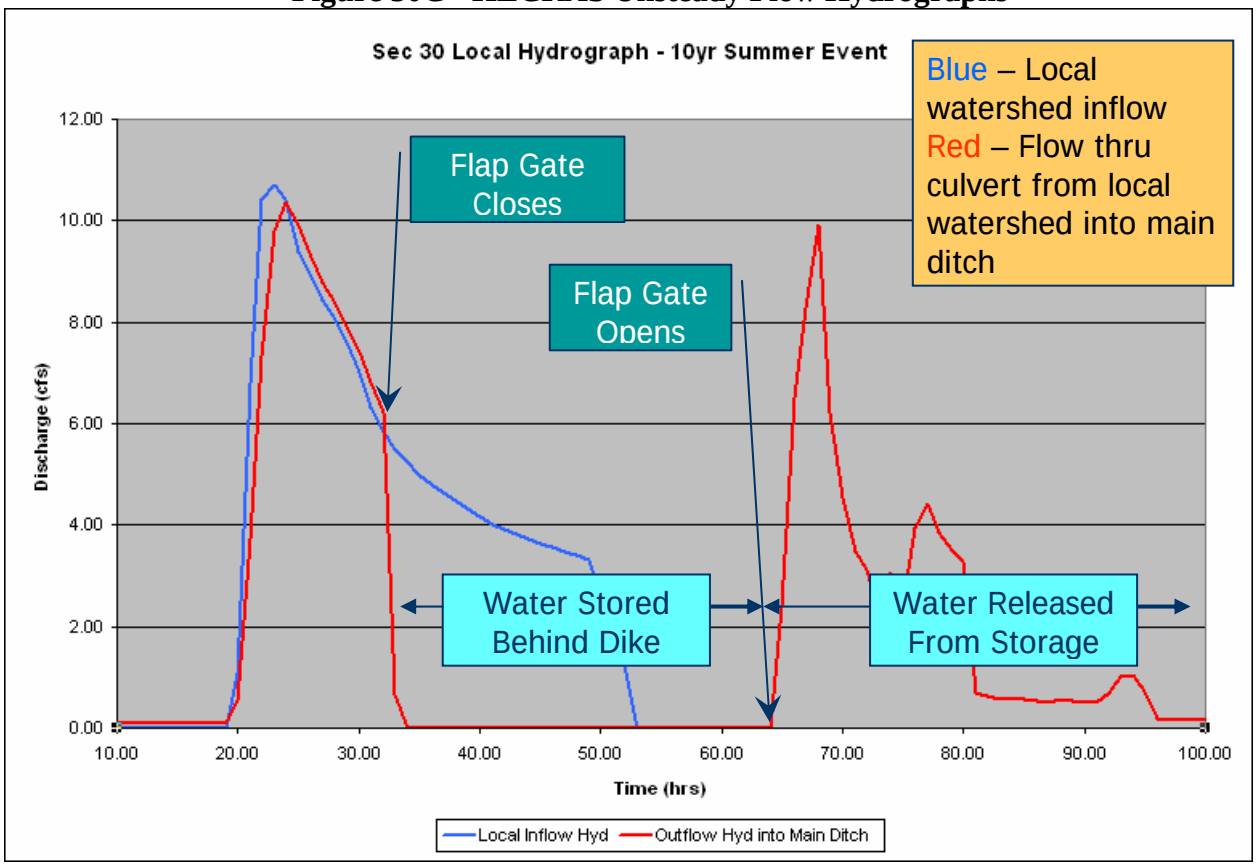


Figure 29C - SWI - Cross Section View



A HEC-RAS unsteady flow simulation was used to estimate the amount of runoff stored on the cropland side of the dike system. Figure 30C summarizes 10-year summer event model results for the Section 30 SWI described above. Hydrographs, gate open/close, and pool backup are shown. From this analysis, coupled with topographic information, pool areas can be estimated.

Figure 30C - HECRAS Unsteady Flow Hydrographs



The number of SWI's and limited topographic information makes detailed analysis of each SWI pool backup impractical. An approximate method was devised for planning purposes. The steps for the method are outlined below:

1. Detailed HEC-RAS unsteady flow modeling was performed for 3 different SWI sites for the 10-year growing season event.

2. From this analysis, the results showed an average of 50% of the local drainage runoff volume would back up on the outside of the dike.

3. For all 20 SWI's, 50 percent of the growing season runoff in acre feet was determined using drainage area and assuming a runoff curve number of 70.

4. Using contours developed from field surveys combined with volume (acre-feet) of back up storage required from the above step, elevations and surface area for each SWI site could be estimated.

5. An ARCMAP shape file defining this elevation was then used for estimating flood easement areas required to compensate for the local drainage backup.

Stream Visual Assessment

All wildlife and fisheries data was determined in consultation with the MN DNR Area Fisheries Office in Baudette, MN; with the MN DNR Twin Lakes WMA Wildlife Manager in Karlstad, MN; with the MN DNR State Office in St. Paul, MN; and with the U.S. Fish and Wildlife Service, Ecological Services Office at Fort Snelling, MN.

In early 2005 a decision was made to conduct a field assessment on the unnamed tributaries, utilizing an interdisciplinary, multi-agency team (Stream Assessment Report, Proposed PL 566 Flood Control Project, NRCS, 2006, WRS, St. Paul, MN). The objectives of the team were to assess the existing stream health in order to: 1) determine viable alternatives for the project, and 2) compare the results of a future project with existing conditions to be able to insure 10-year flood protection to cropland while also creating the opportunity to enhance riparian terrestrial, and aquatic habitat within the floodplain between the levees. From May 24–26, 2005, an interdisciplinary team completed a field stream visual assessment of the unnamed tributaries in Spring Brook Township in Kittson County, MN.

Prior to beginning the field work, the three stream reaches were divided into segments for assessment. Initially 16 segments were identified but during the field work, the team chose to both break out and consolidate segments so that the final assessment comprises 18 segments. Each segment was given the same number as the survey reach in which it lies, and then a letter in sequential order beginning with A at the upstream end of the survey reach. Reference sites were selected using aerial photos and topographic maps. Reference sites are those considered to have the highest existing condition of stream health, and which may possibly represent the highest level of health that may be achievable in this watershed. These sites provide a standard of comparison throughout the watershed drainage area. Segments 3A2, 3E, 5B and 7A were selected by the team as reference sites. The team chose to largely use the descriptions from the USDA Natural Resources Conservation Service (NRCS), National Water and Climate Center Technical Note 99-1, **SVAP**, 1998, (See References and Appendix 1 in Tech Note 99-1) for the following ten factors which were considered in the numeric ratings for each segment:

Channel Condition	Barriers to Fish Movement
Hydrologic Alternation	Instream Fish Cover
Riparian Zone	Pools
Bank Stability	Invertebrate habitat
Water Appearance	Canopy Cover

However, a few adjustments were made and agreed upon by the team. A field data sheet was completed at 18 field sites. Pictures were added to each of the 18 segment's assessment information. Based upon group discussions and interpretations of the assessment results by the SVAP Team members a stream assessment map was created based upon the stream's rating, Figure 31C. Eight recommendations for environmental enhancement to the 16 miles of the 3 unnamed tributary drainages were agreed to by the Team as follows:

1. Use natural stream channel design criteria to restore segments deemed suitable for restoration.

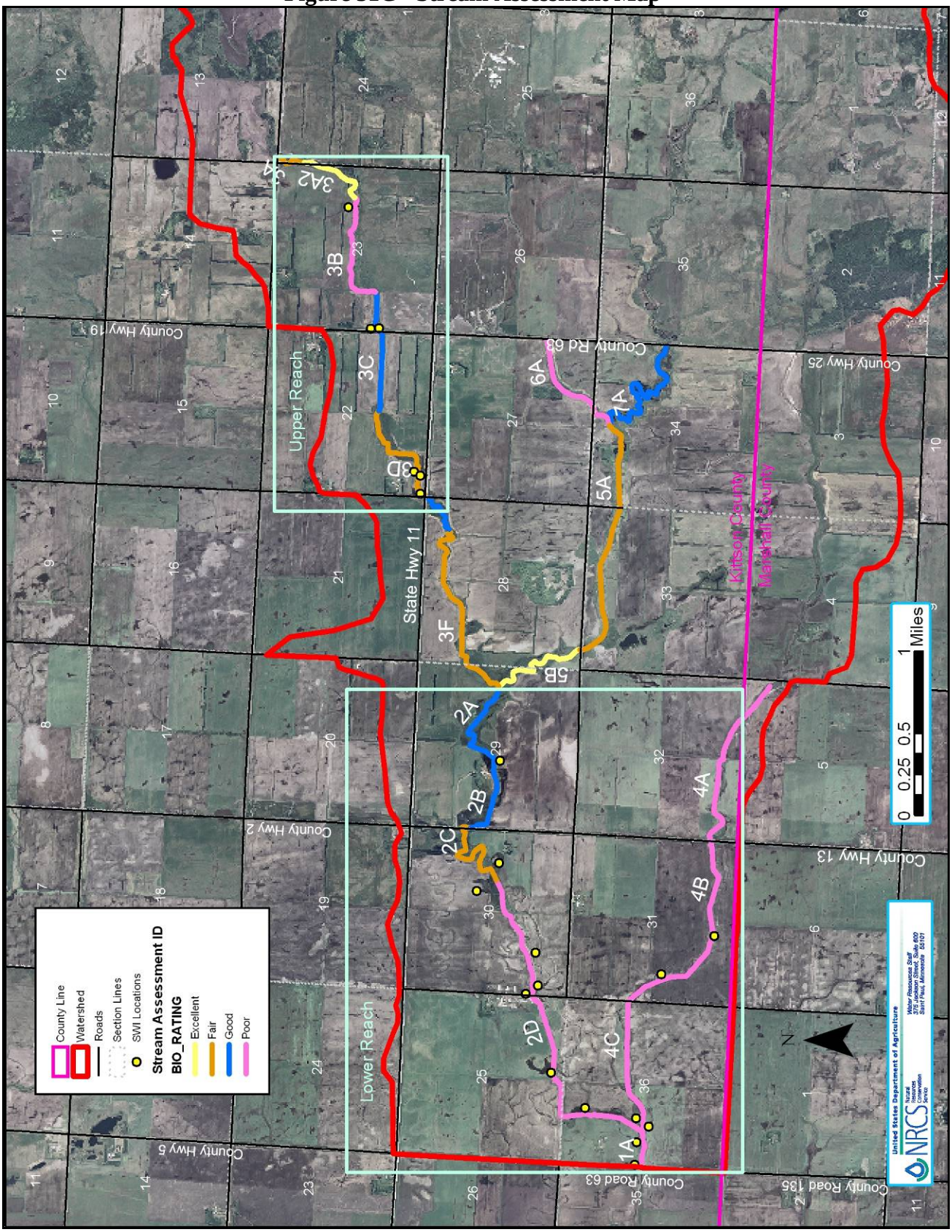
2. Reaches 3A2 and 5B were rated excellent by the SVAP process. The features of these should be used to design channel restorations. Reaches 2AB, 3C, 3E, and 7A could provide additional guidance for feasible restoration of tributary segments since these rated as good in the modified SVAP segment scoring.

3. Field measurements of existing road culverts were not made by the SVAP team but crossings were surveyed by NRCS. The passage for fish and other aquatic organisms should be an environmental concern to be improved where possible.

4. Minimize any proposed alterations to segments assessed as either excellent or good in the modified SVAP scoring. That is, do not disturb or alter segments 2AB, 3A2, 3C, 3E, 5B, and 7A since the procedure was not designed for prairie streams, and the lack of woody vegetation strongly influenced the scoring for the factors for fish cover, invertebrate habitat, and canopy cover. Segments 3A2 and 5B scored the highest composite score (8.2), with segment 3A2 perhaps being slightly more ideal because of the presence of woody vegetation. In pursuing the planning for a PL566 project, it may be prudent to examine some of the ten factors individually rather than as a composite score. For example, if the sponsors' objectives are to provide a well-vegetated riparian corridor, the assessment factor for "riparian zone" may be considered alone for each segment.

The Stream Assessment was used to determine the channel segments selected for the meandered channel development in reaches 3B and 2D

Figure 31C - Stream Assessment Map



Wetlands

Wetland locations, types, and acres were determined by using the National Wetland Inventory, Karlstad, and Karlstad SW, MINN Quad Maps along with Kittson County NRCS/FSA aerial photos of 2005. At the time of the 2005 aerial photos, ponded water in cropland depressional sites could be seen. See Appendix D – Wetland Mitigation Plan for a complete analysis and discussion of the wetlands impacted by the project within the watershed.

APPENDIX D

DRAFT MITIGATION PLAN
Spring Brook Watershed, Minnesota

To help insure the success of the required wetland mitigation measures, this draft mitigation plan is included as an appendix to the Watershed Plan-Environmental Assessment. The mitigation plan will be finalized only after the development of the final engineering plans and prior to any constructions activities, and after all field wetland determinations have been completed within the proposed project area of potential effect. The project setting, soils descriptions, and hydrology are all the same for this mitigation plan as has already been detailed in the Spring Brook Project Plan.

The definition of mitigation, consistent with the CEQ regulations includes the avoidance of impacts; the minimization of impacts; and the compensation for unavoidable impacts considered in that order of preference. Mitigation for a single project may incorporate one or more of these aspects of mitigation which this project does. The terms avoidance, minimization and compensatory mitigation as applied to this project are described below.

(a) **Avoidance -** A comprehensive evaluation of practicable alternatives to the proposed activity must be conducted. Included in this evaluation should be alternatives that would avoid wetland impacts altogether. This evaluation must demonstrate that the least environmentally damaging practicable alternative that satisfies the project purpose has been selected.

(b)**Minimization -** Wetland impacts may be at least partially mitigated through minimization efforts, such as modification of the activity to limit the wetland acreage affected by the proposed activity. As with avoidance, all steps to minimize the wetland impacts must be fully considered, and take only those steps determined to be appropriate and practicable.

(c) **Compensatory mitigation -** Compensatory mitigation is a physical measure taken to offset unavoidable wetland impacts and includes: restoration, creation and enhancement of wetlands. Compensatory mitigation is required for those unavoidable impacts which will result from the proposed activity after avoidance and minimization steps have been fully applied.

Wetland locations, types, and acres were determined by using the National Wetland Inventory, Karlstad, and Karlstad SW, MINN Quad Maps along with Kittson County aerial photos of 2005. At the time of the 2005 aerial photos, ponded water in cropland depressional sites could be seen.

The location of the wetlands in relation to an overview of the profile of the dike system is illustrated in Figure 1D. An enlarged illustration of the wetlands with an overlay image of the dike configuration in the upper and lower reaches of the watershed is shown in Figures 2D and 3D respectively.

Figure 1D - The location of wetlands in relation to an overview of the dike system.

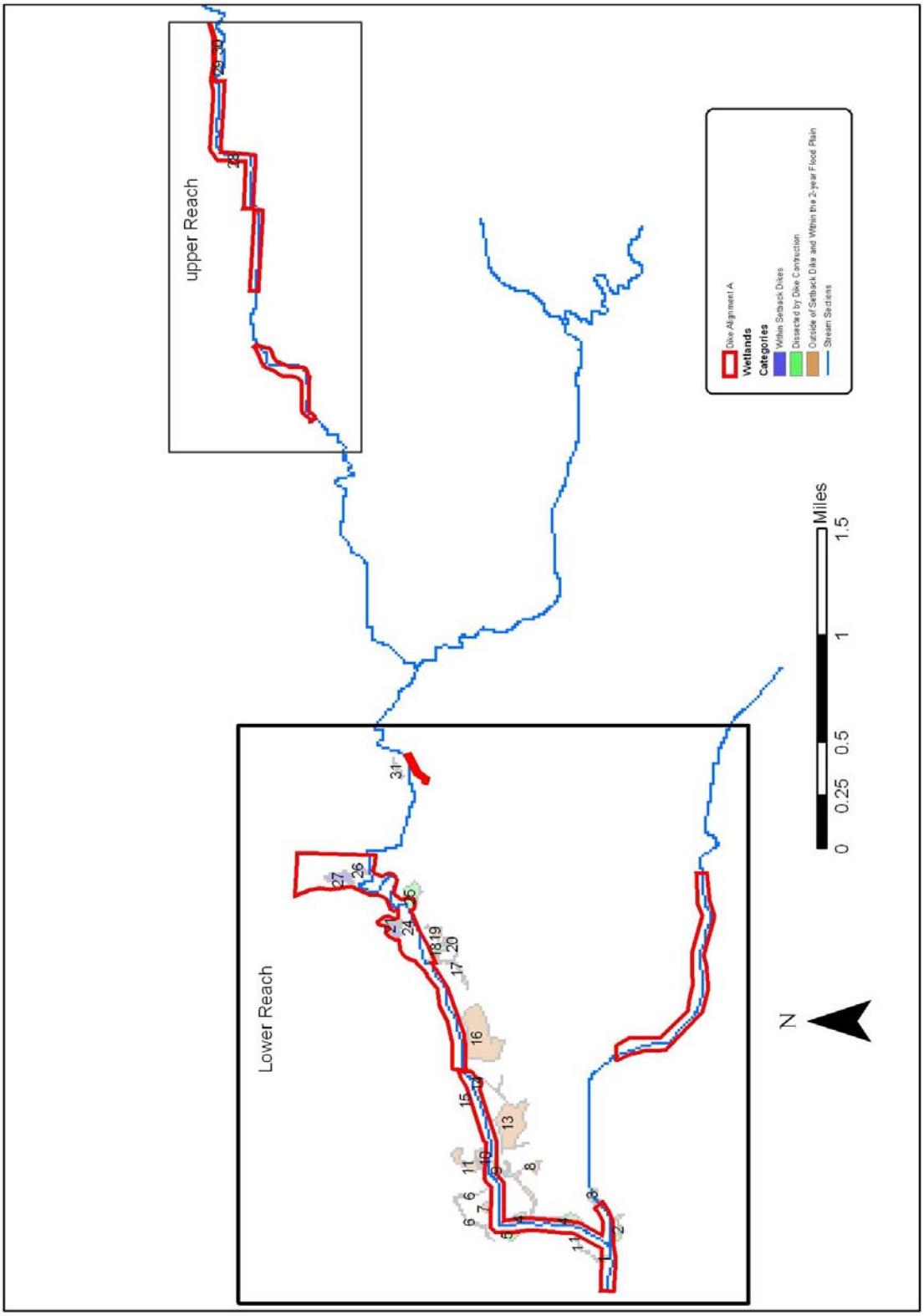


Figure 2D - Location of Wetlands in the Upper Reach

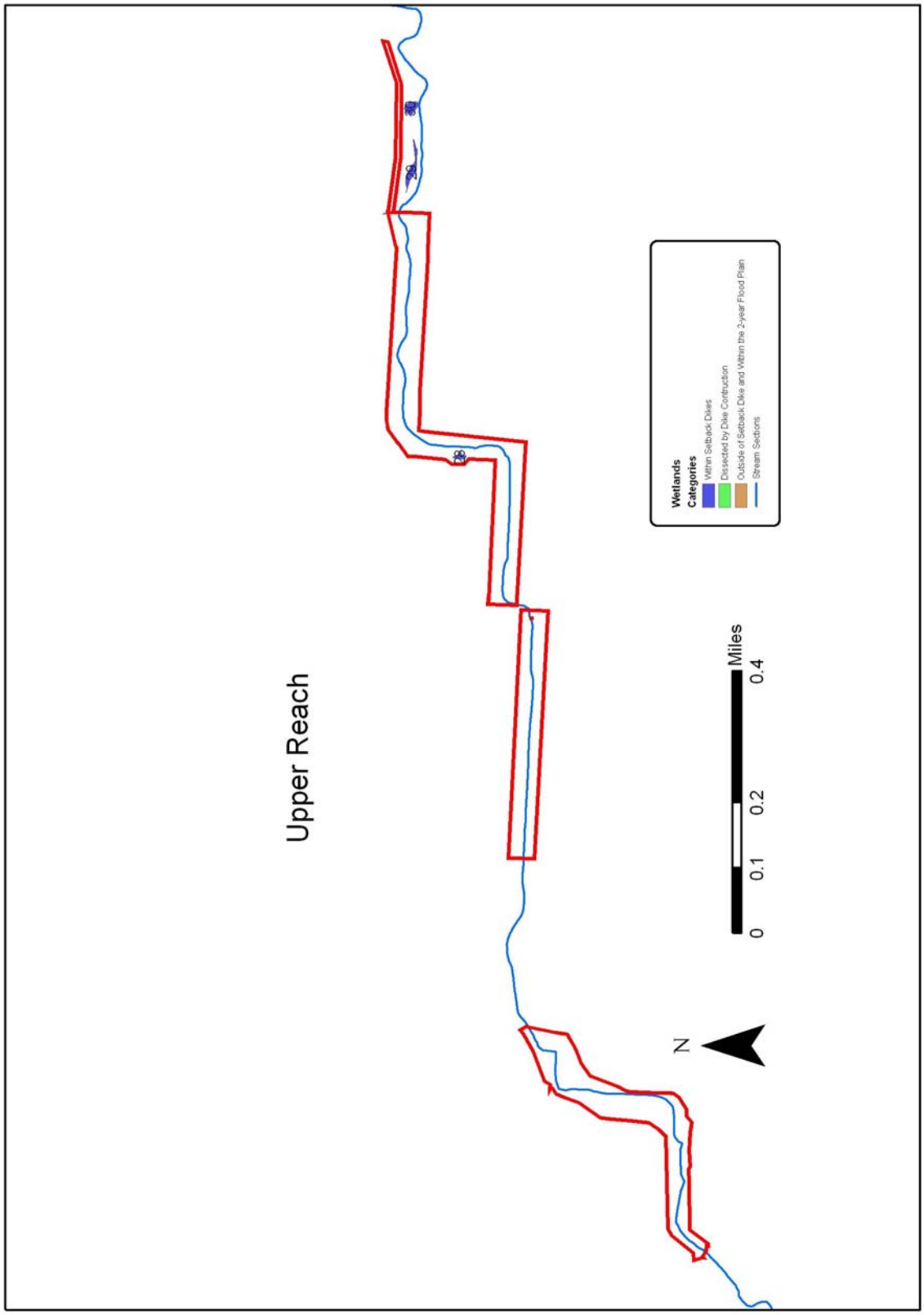


Figure 3D - Location of Wetlands in the Lower Reach

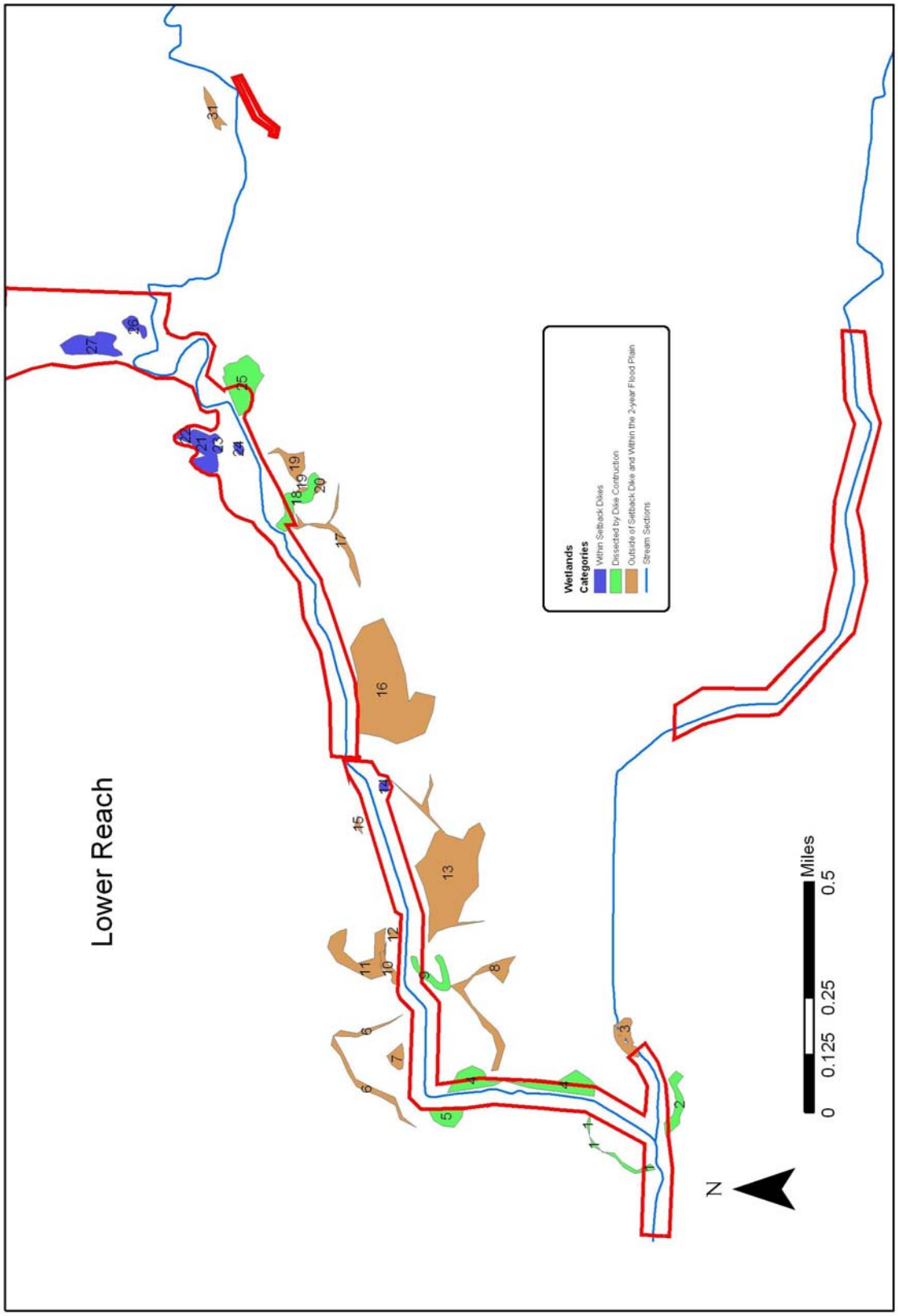


Figure 4D illustrates the three categories of wetland impacts as follows:

Wetland Impact Category 1 – Existing Wetland Between the Dikes - There are 8.5 acres of NWI wetlands lying within the floodplain that will be avoided by the newly constructed dikes. These wetlands will be protected and enhanced. Out of bank flows will recharge these existing natural wetlands and the dikes will impound water in these floodplain wetlands for a longer duration of time.

Wetland Impact Category 2 – Dike Footprint Fill - There are 17.6 acres of wetlands that will be classified as unavoidable compensatory mitigation by the placement of approximately 1.5 acres of earthen fill representing the footprint of the dike dissecting through these existing wetlands within the floodplain. Since wetlands will be left on either side of the newly created dike where possible, it is anticipated that there may be an opportunity for minimizing the impact to these wetlands. It may be possible to mitigate just for the acres of the dike footprint through the wetland. This category also includes the deposition of ditch blocks to restore 280 feet of historic stream meander. The abandoned straight ditch segments between the meander blocks will create deeper pools of water with the newly established vegetative cover within the floodplain. These straight segments may be scraped out to shape more of a circular deep basin for enhanced waterfowl nesting and brooding habitat. Final field determinations will be required to determine what the minimized impacts will be. For now, the entire 17.6 acres of wetlands are calculated as being impacted by the project and subject to compensatory mitigation. There may be additional impacts in this category, which are yet to be determined, when the earthen fill is placed in the channel to create the two new stream meander sites.

Wetland Impact Category 3 – Disconnected From Flood Flows – There are 62.3 acres of depressional hydric soil wetlands occurring in cropped fields in which seasonal temporary flood flows from the channel will be disconnected by the newly constructed dikes. The dike system will create approximately 188 acres of permanent floodplain between them. Since Approximately 100 acres of this is currently in cropland and CRP, it is anticipated that there may also be an opportunity to minimize the impact to these Type 1 and Type 2 Wetlands. If the existing vegetative CRP cover is left undisturbed, and the exisiting cropland areas are established to permanent vegetative cover in hydric soil depressional areas, there may be consideration given to a 1:1 ratio of these 62.3 acres being created, or already existing in the newly established 188 acre floodplain. As with the Category 2 impacts, for now, the entire 62.3 acres of wetlands are calculated as being impacted by the project and subject to compensatory mitigation.

In addition to the three projected Wetland Impact Categories above, the State of Minnesota Wetlands Conservation Act (WCA) requires a 2:1 wetland mitigation related to the resultant function and value for created wetlands compared to the impacted wetlands. This will be related to the classification, hydrophitic vegetation establishment, and the temporary/seasonal ponding regimes. This is addressed in the estimated 2:1 replacement ratio estimated for 5 NWI identified sites on 6.5 acres within the project area of potential effect.

Figure 4D - Typical Wetland Impact Categories

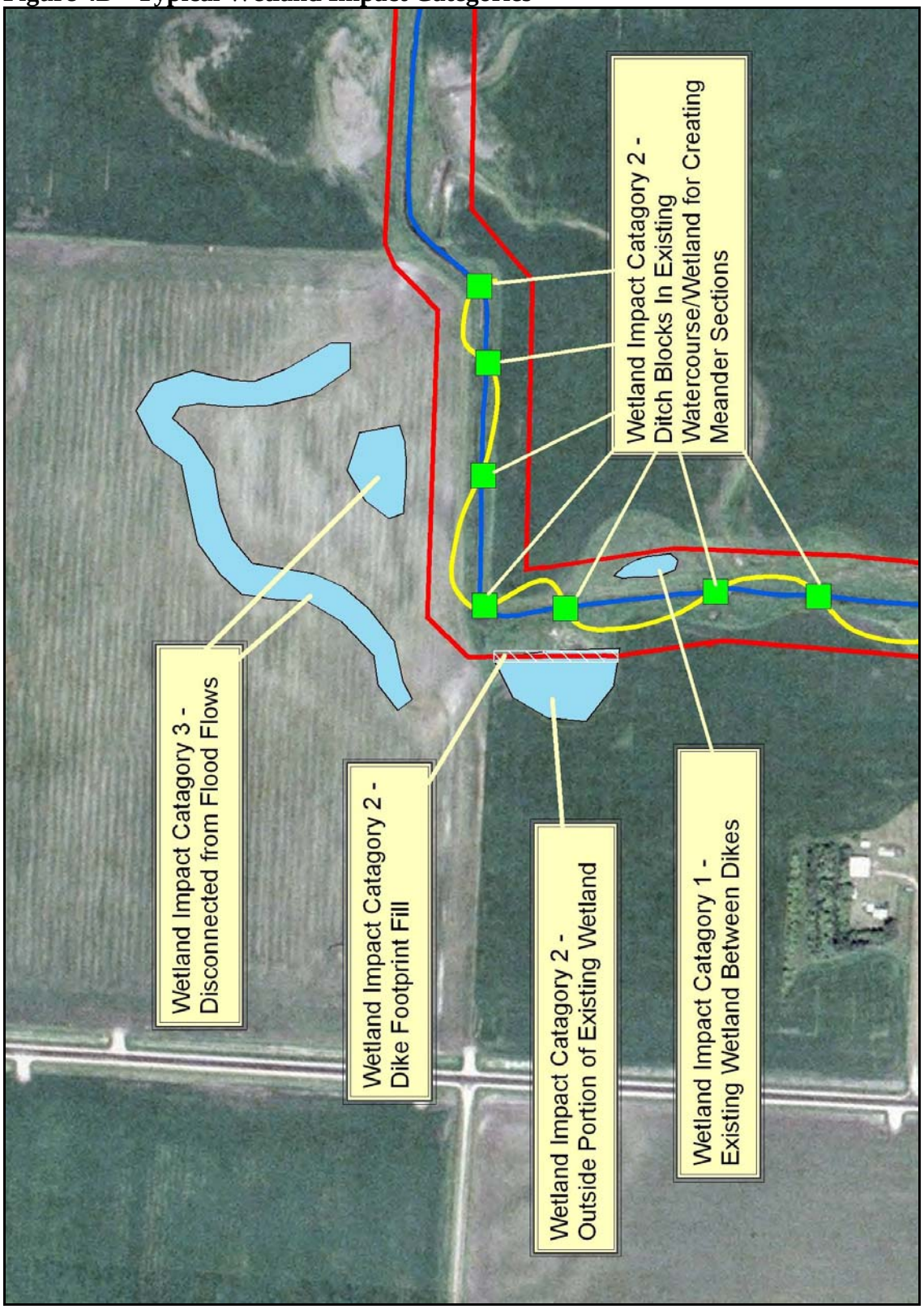


Table 1D on the following page summarizes 31 wetlands that are either impacted, or avoided by the project; what category the wetland is in, the size of the wetland, mitigation ratio, mitigation total, and the proposed mitigation location An estimated total of 77.3 acres of wetlands (Table 1D) are projected to be impacted by construction of **the selected plan 5**.

Table 1D - Breakdown of Wetlands in the Project Area

ID Number[1]	Type[2]	Category[3]	Size (ac)	Mitigation Ratio	Mitigation Total (ac)	Proposed Mitigation Location[4]
1	CW	2	0.77	1:1	0.77	A
2	CW	2	1.63	1:1	1.63	A
3	PEMCd	3	1.66	2:1	3.32	A
4	CW	2	5.24	1:1	5.24	A
5	CW	2	1.58	1:1	1.58	A
6	CW	3	2.36	1:1	2.36	A
7	CW	3	0.81	1:1	0.81	A
8	CW	3	3.24	1:1	3.24	A
9	PEMC	2	1.56	2:1	3.11	A
10	PEMAd	3	0.68	2:1	1.36	A
11	CW	3	3.80	1:1	3.80	A
12	PEMAd	3	0.22	2:1	0.44	A
13	CW	3	14.82	1:1	14.82	A
14	PEMA	1	0.27	Avoidance/Minimization		
15	CW	3	0.16	1:1	0.16	A
16	CW	3	18.98	1:1	18.98	A
17	CW	3	1.77	1:1	1.77	A
18	PEMAd	2	2.37	2:1	4.75	A
19	CW	3	1.60	1:1	1.60	A
20	CW	3	0.23	1:1	0.23	A
21	CW	1	2.37	Avoidance/Minimization		
22	PEMA	1	0.33	Avoidance/Minimization		
23	PEMA	1	0.66	Avoidance/Minimization		
24	PUBGx	1	0.29	Avoidance/Minimization		
25	CW	2	4.40	1:1	4.40	A
26	PEMA	1	0.84	Avoidance/Minimization		
27	PEMAd	1	3.17	Avoidance/Minimization		
28	PEMA	1	0.08	Avoidance/Minimization		
29	PEMC	1	0.26	Avoidance/Minimization		
30	PFO1C	1	0.19	Avoidance/Minimization		
31	CW	3	0.93	1:1	0.93	A
			77.26 total acres impacted		**75.27 total acres mitigated**	

[1] Use the ID Number as a reference to view the exact location of each wetland on Figures 1D, 2D, and 3D.
[2] CW = cropped wetland
PEMC = palustrine, emergent, seasonally flooded
PEMAd = palustrine, emergent, temporarily flooded, partly drained
PEMA = palustrine, temporarily flooded
PFO1C = palustrine, forested, persistent, seasonally flooded
PUBGx = palustrine, unconsolidated bottom, intermittently exposed&permanently flooded, excavated
[3] 1 = Wetlands within the proposed setback dikes
2 = Wetlands impacted by dike construction
3 = Wetlands impacted by reduced floodwater from main channel
[4] A = Between the setback dikes. Land conversion to permanent vegetation.

A summary of the total acres of wetlands impacted by the project then would be as follows:

- 77.3 acres impacted minus 8.5 acres avoided and protected equals 68.8 acres impacted

- 68.8 acres impacted plus the MN State Wetland Conservation Act 2:1 ratio replacement of 6.5 acres equals a total of 75.3 total acres subject to replacement requirements.

All 75.3 acres of wetland mitigation will occur within the newly created 188 acre floodplain between the dikes after minimal effects, if any are credited, can be determined. If no minimal effects can be credited, there is still ample acreage to mitigate all 75.3 acres of wetland impacts in the newly created 188 floodplain between the dikes. Figures 5D and 6D illustrate the areas planned for any wetland mitigation in the upper and lower reaches of the watershed respectively. The light colored areas, between the dikes outlined in red, represent both CRP and cropland areas respectively which will be converted to permanent vegetative cover. For example, all of the 62.3 of Impact Category 2 acres classed as converted wetland (CW) impacted by the project could be mitigated by either leaving the area in the established CRP, or by establishing permanent vegetative cover on the cropland. These areas are predominant hydric soils and, with the return of seasonal flooding and surface ponding of water between the dikes, these acres will return to Type 1 Wetlands.

After mitigation of the 62.3 CW wetland acres, there would be approximately 13 acres of remaining wetlands impacted by the footprint of 1.5 acres of earthen fill placed in them dissecting the wetlands. An undetermined amount of ditch blocks will be placed in the existing channel to create the 2 meander areas of 240 ft. and 230 ft. respectively in Ditch Reaches 2D and 3B respectively. To enhance stream habitat and fish passage, 55 rock riffle areas will also be placed in 4 ditch reaches, 1A, 2D, 3B, and 4C. Since these earthen and rock ditch blocks are being placed in a man-made ditch channel, any negative wetland impacts should be considered as minimized impacts. The abandoned ditch channels, lying within the floodplain with the newly created channel meanders, should be considered to create new wetland habitat areas. The abandoned channel reaches average 3 to 5 ft. in depth. Circular basin shape could be scraped around the channel margins to create Type 4 and 5 wetlands. These wetlands would enhance waterfowl nesting and brooding areas within the newly diked flood plain.

Figure 5D - Possible Areas for Wetland Mitigation in the Upper Reaches of the Watershed

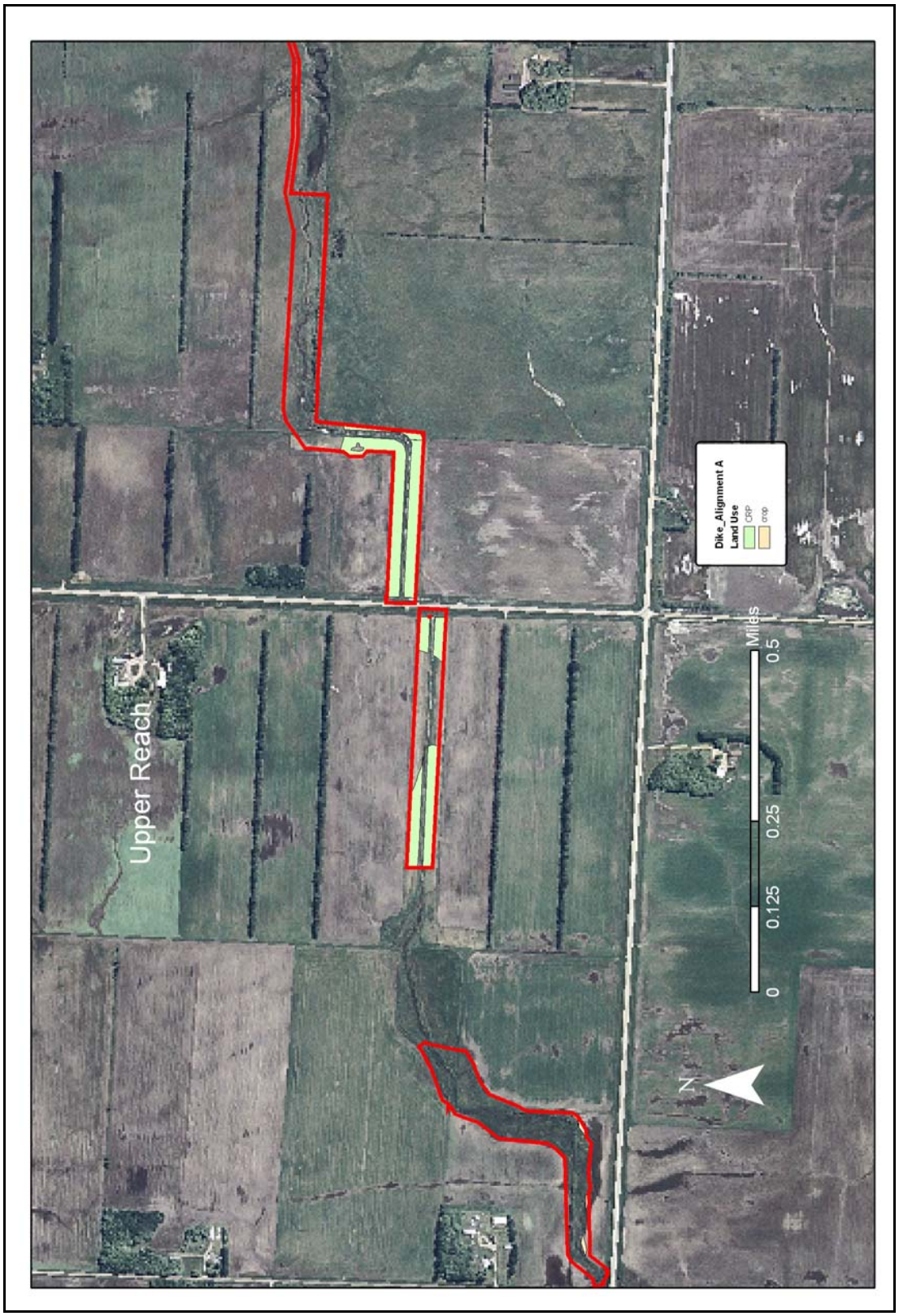
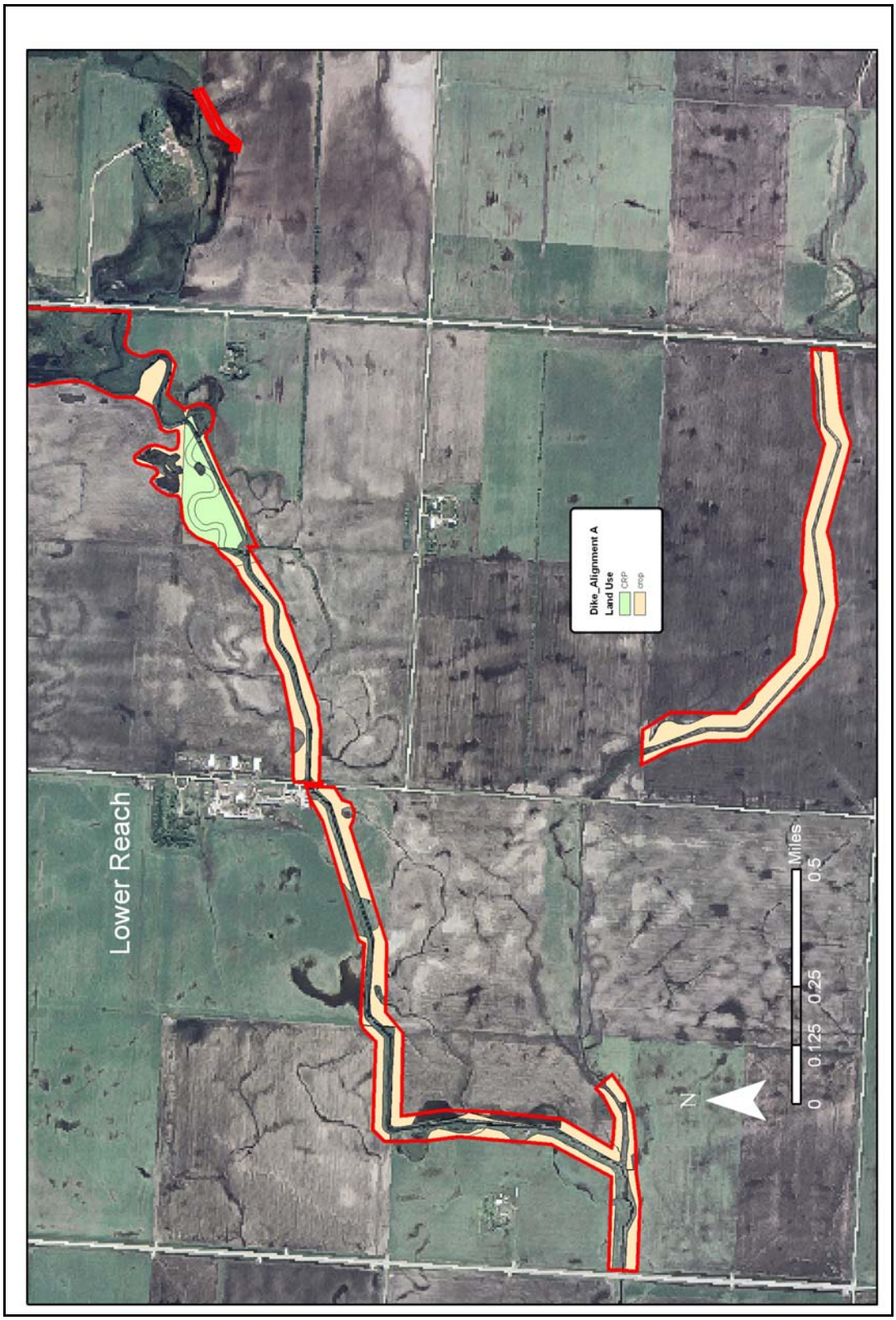


Figure 6D - Possible Areas for Wetland Mitigation in the Lower Reaches of the Watershed



Wetland mitigation work within the flood plain of the 3500 feet of the main ditch channel to create the 270 feet of historic channel meander realignment will have to follow any permit guidelines related to dredged and fill materials within the channel. All new channel bank realignment will need to be monitored for stability. All new vegetative establishments within excavated floodplain areas, and on the new dikes, will also need to be monitored to insure proper germination and desirable vegetative cover establishment to prevent scouring from runoff and bank sloughing. Any wetland mitigation work required within the flood plain of the restored channel meander re-alignment will occur after the flows have been restored to the channel. The success of the channel sinuosity re-alignment will require annual follow up for 3 to 5 years to insure that any modified channel banks remain vegetated and stable. If needed, stream revetments will be placed to maintain channel sinuosity.

The project sponsors have agreed to purchase needed mitigation land at the same time that the total project acreage is purchased. The details of the mitigation schedule are dependent upon completion of the field wetland determinations, the final engineering design, and the schedule of implementation. The project sponsors are working with all of their partners to begin construction of the dikes in the first years of installation. The entire project will be scheduled for completion within a 5-year period including the mitigation measures. The channel meander realignment is scheduled for implementation in the third year of installation when all other project components have been installed and functioning.

This mitigation plan is a joint effort of the Watershed Project Sponsors and NRCS with BWSR, MN-DNR, MPCA, COE, and the FWS. An interagency team will work with the project sponsors in the sequencing of environmental impacts related to proposed project actions. The construction of all mitigation measures, as well as, all structural measures will comply with federal, state, and local regulations concerning air and water pollution.

A mitigation monitoring plan for the wetlands and other mitigation measures will be subject to review by the aforementioned agencies. During the first three years after mitigation is completed, annual inspections will be conducted by an interagency team to insure the successful establishment of the mitigation measures. Needed corrections will be made by mutual agreement of the team. The project Sponsors will seek professional management assistance for monitoring from any of these cooperating agencies, or from non-governmental organizations (NGO'S) such as Ducks Unlimited or the Audubon Society. It may also be desirable to monitor the following resource concerns:

- water quality parameters;
- enhancement to waterfowl nesting and rearing sites within newly enhanced and/or created wetlands;
- possible restored populations of federal T&E Species and their habitat and/or
- possible restored populations of state T&E, and Special Concern species and their habitat.

The wetland mitigation areas, along with the total project acreage, will require legal surveys of the specific boundaries. This is an understanding with the sponsors that they will apply for all the proper permits related to wetlands (i.e., 401 and 404 permits) and the MN-DNR Protected Waters Permit. They also agree to comply with the Minnesota Wetland Conservation Act.

APPENDIX E

DRAFT OPERATION, MAINTENANCE, AND REPLACEMENT AGREEMENT PLAN
Spring Brook Watershed, Minnesota

This agreement, made on the _____ day or _____, 2007, between the Two Rivers Watershed District, City of Karlstad, Kittson County Soil and Water Conservation District, and Spring Brook Township, hereinafter referred to as the Sponsors, and the Natural Resources Conservation, United States Department of Agriculture, hereinafter referred to as NRCS.

The Sponsors and NRCS agree to carry out the terms of this agreement for the operation, maintenance, and replacement of measures. The term of this agreement is for the expected life of the project (100 years) and does not commit the NRCS to assistance of any kind beyond the end of the project life unless agreed to by all parties.

I. <u>General</u>

A. The Sponsors will:

i. Be responsible for operating and performing or having performed all needed maintenance as described in the Operation, Maintenance and Replacement Plan.

ii. Obtain prior approval from NRCS for all plans, designs, and specifications for maintenance work deviating from the O&M&R Plan and of plans and specifications for any alteration to the watershed plan.

iii. Be responsible for the replacement of parts or portions of the measures as needed to function as designed throughout the design life.

iv. Prohibit the installation of any structure or facility between the setback dikes that will interfere with the operation and maintenance of the practices or that would reduce the amount of cross-sectional area that conveys floodwater.

v. Notify NRCS of any agreement to be entered into with other parties for the operation or maintenance of all or any part of the project measures, and provide NRCS with a copy of the agreement after it has been signed by the Sponsors and the other party. Such side agreements can provide for others to perform certain O&M&R items but will not negate Sponsors' responsibilities as stated in item i above.

vi. Provide NRCS personnel the right of free access to the project area at any reasonable time for the purpose of carrying out the terms of the agreement.

B. NRCS will:

i. Provide consulting assistance in the operation, maintenance and replacement of measures.
ii. Participate in joint O&M&R inspections of measures.

II. Inspections and Reports

A. The Sponsors will inspect the measures as specified in the O&M&R Plan.

B. NRCS or any Federal land-administering agency may inspect the measures at any reasonable time during the period covered by this agreement. NRCS personnel will assist the Sponsors with the inspections.

C. A written report will be made of each inspection. The inspecting party will provide a copy of each report to the other party within 10 days of the inspection.

III. Records

The Sponsors will maintain, in a centralized location, a record of all inspections and significant action taken, permits, cost of performance and completion date with respect to operation and maintenance. NRCS may inspect these records at any reasonable time during the term of the agreement.

IV. Time and Responsibility

The Sponsors' responsibility for operation, maintenance and replacement begins when a measure is partially done or completed and accepted or is determined complete by NRCS. Replace components as needed to function as designed throughout the design life of the project. This does not relieve the Sponsors' liability which continues beyond the designed life of the PL-566 project or until such time when the measures are modified to remove potential loss of life or property and all environment consequences are addressed.

V. Setback Dikes

A. This Plan of Operation, Maintenance and Replacement is for the setback dikes of the Spring Brook Watershed Project. The Sponsors will carry out the operation and maintenance activities, referred to as responsibility of the Sponsors OPERATION, MAINTENANCE, AND REPLACEMENT AGREEMENT PLAN.

B. In the operation, maintenance, and replacement of the plan components, consideration shall be given to air and water quality, sediment control, and environmental concerns. The requirements of all necessary federal, state, and local permits shall be met.

C. The Sponsors will establish reserve funds for any necessary operation, maintenance, and replacement costs. These funds will be obtained by levying taxes and/or issuing bonds, or through such financing sources as may be available to the Sponsors.

D. The Sponsors are responsible for the costs of annual operation, maintenance and replacement of the watershed plan. Federal funds cannot be used to pay these expenses.

E. Harvesting or domestic livestock grazing will not be permitted on setback dikes or in the area between the setback dikes and Unnamed Ditch.

F. To prevent erosion, damage to vegetation and adverse effect on wildlife resources all motorized vehicles will be kept off the earthen dike structures and out of the channel. Motorized vehicles required for operation, maintenance or repair are allowed.

G. The structural integrity and function of the earthen dike structures will be maintained.

   i. If the dike embankments erode due to water action, the area shall be repaired.

   ii. Soil removed by burrowing animals where this could result in damage to the structure will be replaced. This area will be repaired and the animals should be removed.

   iii. Vegetative cover will be maintained on the dikes and between the dikes and channel.

   iv. Should the vegetative cover be lost or destroyed, these areas will be reseeded. The areas will be reshaped, fertilized and reseeded according to the original construction specifications or as agreed to by the NRCS.

   v. Trees and brush will be removed from the dikes. Trees and brush should be controlled in the Unnamed Ditch to maintain the designed flow area capacity.

   vi. Repair any unusual seepages, boils or settlements in the dike area.

   vii. Maintain the side water inlet culverts. This includes checking the flap gate and removing any debris from the inlet of the culvert.

   viii. Remove logs and other floating debris carried in the ditch and deposited in the floodway between the setback dikes. They will be disposed of properly.

H. Chemicals used to established or maintain the setback dike or the area between the setback dikes must be federally, state, and locally registered and applied strictly according to authorized registered uses, directions on the label and other Federal, or State policies and requirements. Avoid spray from adjacent fields. Do not apply manure or organic wastes.

I. Noxious weeds, invasive species and other undesirable plants, insects and pests will be controlled.

J. Check for debris jams in area between the setback dikes. These may be removed if they are blocking culverts or creating dangerous hydraulic conditions.

K. Prevent disturbance of the cover during the primary nesting season for wildlife, as established by NRCS wildlife habitat practice standards.

L. The Sponsors and the NRCS will make a joint inspection of the setback dikes and designed channel within two weeks of project completion. Thereafter, the Sponsors and NRCS will make joint inspections annually in May or June, and after unusually severe floods, and after the occurrence of any other unusual conditions which might adversely affect the components of the project.

M. Between inspections, informal surveillance of the setback dikes and designed channel will be performed by county, township, watershed district, NRCS personnel, landowners, or other observers. Any unusual circumstances should be reported immediately to the Two River Watershed District, or the NRCS Field Office in Hallock.

N. When maintenance work is necessary, repair work will be accomplished within 60 days of the inspection. The dikes or channel will be repaired and/or modified to restore it to the original or current NRCS specifications. This includes replacement of components as needed. For extensive repairs, where a 60 day completion is impractical, an agreement between the Sponsors and NRCS will be developed outlining a repair plan and schedule. This agreement will be completed within 30 days of the inspection.

O. A written report will be made of each inspection made under Paragraph L above. The inspecting party will provide a copy of each report to the other party within 10 days of the inspection. The report will describe the conditions found and list any corrective action needed with a time frame to complete each action.

P. The Sponsors will maintain, in a centralized location, a record of all significant actions taken, permits, cost of performance and completion date with respect to operation, maintenance and replacement. As-built plans, copy of the permits, design files, construction files and related materials will be maintained in a permanent file at the NRCS Field Office in Hallock.

APPENDIX F

Project Map

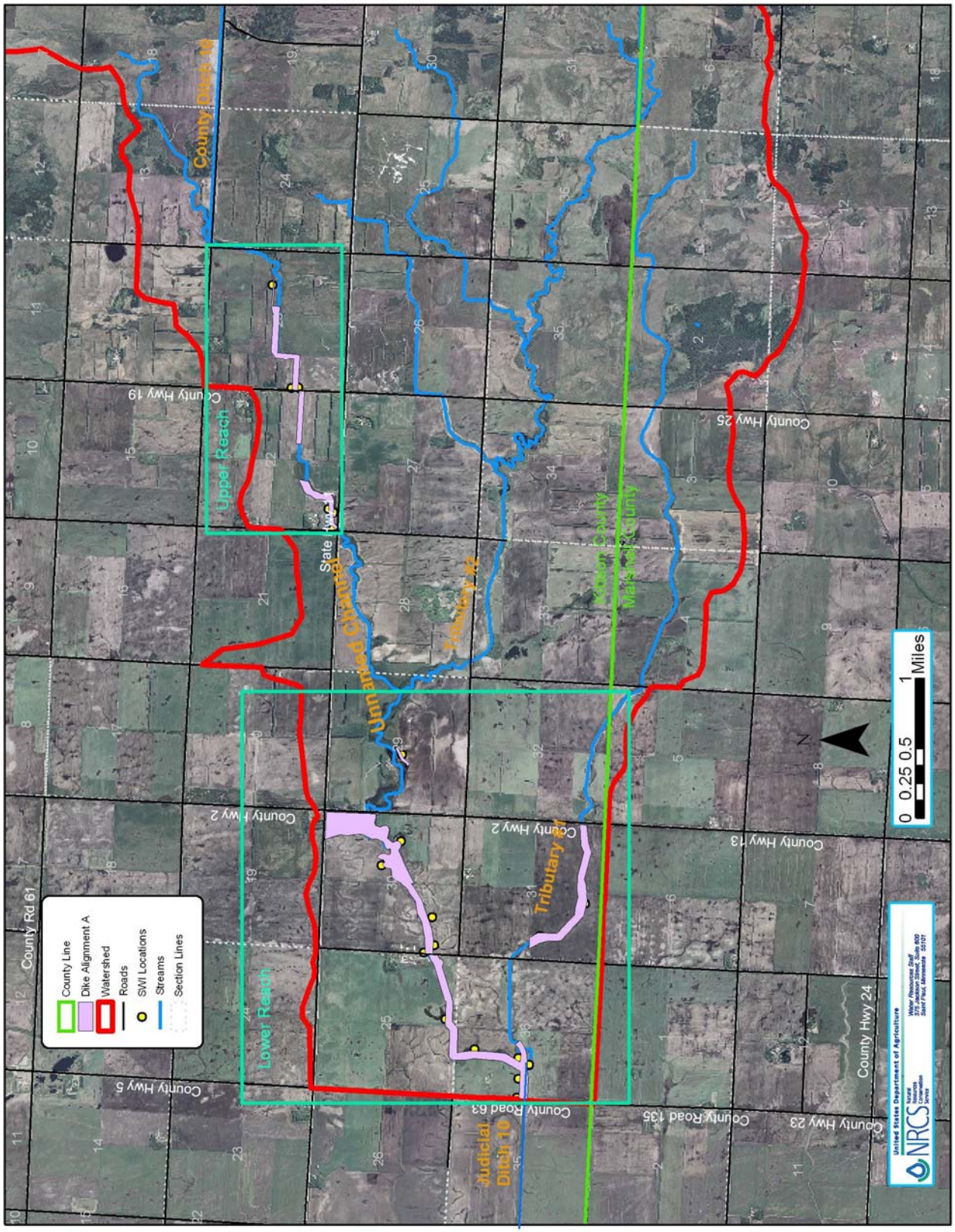



Figure 1F - Spring Brook Watershed Project Map