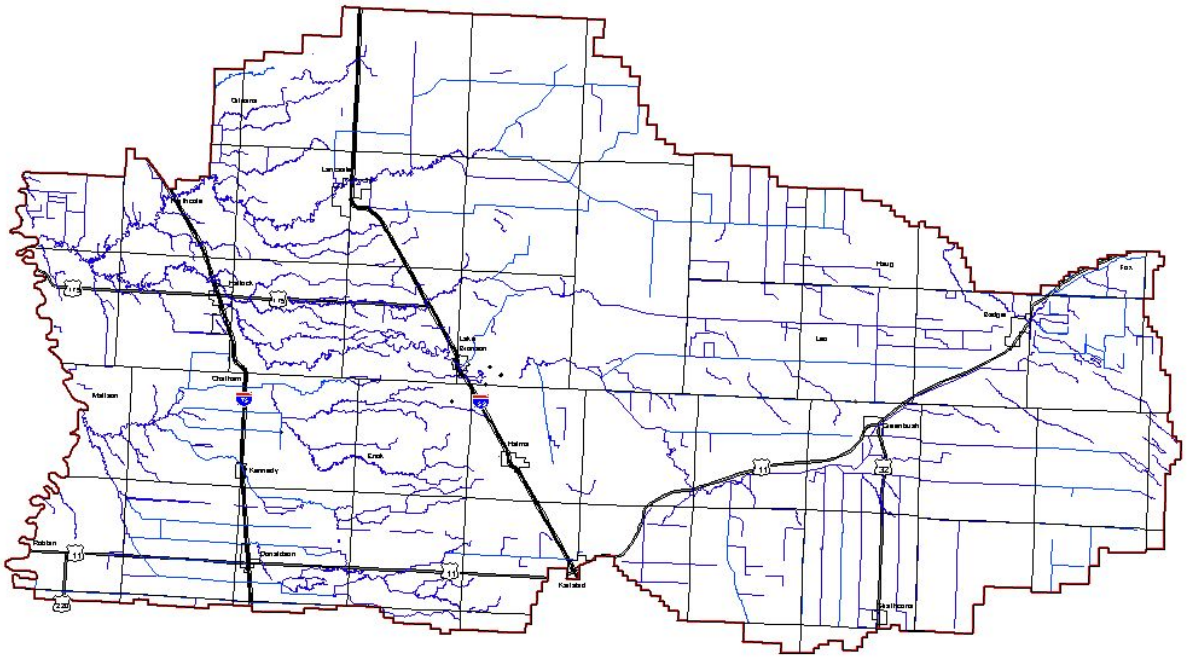
OVERALL PLAN

OF THE

TWO RIVERS WATERSHED DISTRICT



Revised July 6, 2004

Overall Plan of the Two Rivers Watershed District

Board of Managers:

			Term expires
President:	Donald Craigmile	Hallock, MN	2006
Vice President:	Roger Anderson	Drayton, ND	2006
Secretary:	Jim Kukowski	Strathcona, MN	2006
Treasurer:	John Younggren	Hallock, MN	2005
Manager:	Lawrence Lind	Lake Bronson, MN	2004
Manager:	O' Neil Larson	Halma, MN	2004
Manager:	Richard Novacek	Greenbush, MN	2006

Former Managers Harlan Solberg (Greenbush), Steve Harder (Greenbush), and Ron Jacobson (Greenbush) also took part in the planning process.

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Melvin Wang	Rural Greenbush
Wayne Ruud	City of Karlstad
Mike Folland	Rural Karlstad
Ellis Waage	Rural Greenbush
Gary Peterson	Rural Lancaster
Jon Vold	Rural Hallock
Bob Boychuck	Rural Hallock
Rodney Sikorski	Rural Greenbush
Vern Langaas	Rural Greenbush
Glen Lundberg	Rural Kennedy
Beverly Hewitt	Kittson Co. Commission
Mark Foldesi	Roseau Co. Commission
Louis Deere	Mayor – City of Kennedy
Gary Rice	Kittson Emergency Mgmt
Dale Hanson	Hallock Emergency Mgmt
Chris Mortenson	Rural Kennedy
Terry Osowski	Rural Hallock
Dave Klein	Rural Hallock
Brach Svoboda	Rural Badger
John Gaukerud	Rural Badger
Harold Moose	Rural Stephen
Mike Jensen	Rural Donaldson
Jim Pederson	Rural Karlstad
Preston Dagen	Rural Karlstad
Keith Cummins	Rural Karlstad
Harlan Solberg	Rural Greenbush
Ron Jacobson	Rural Greenbush

Technical Advisory Committee

Kelly Bengtson	Kittson Co. Hwy Dept
Brian Kettring	Roseau Co. Hwy Dept.
Holly Anderson	Kittson SWCD
Russ Reisz	The Nature Conservancy
Jeff Koschak	US Army Corps of Engineers
Maggie Anderson	US Fish & Wildlife Service
Jim Schwab	Natural Resources Conservation Service
Jack Frederick	MN Pollution Control Agency
Brian Dwight	MN Board of Water & Soil Resources
Dennis Topp	MN DNR – Fisheries
Donovan Pietruszewski	MN DNR – Wildlife
Chad Konickson	MN DNR – Waters
Blake Carlson	JOR Engineering
Henry Van Offelen	MN Center for Environmental Advocacy
Janine Lovold	Roseau SWCD

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Overall Plan of the Two Rivers Watershed District

I. Introduction

The Two Rivers Watershed District was established as the second watershed district in the State of Minnesota on October 30, 1957 by order of the Minnesota Water Resources Board. Thereafter, in accordance with Minnesota Statutes, Chapter 112, the Minnesota Watershed Act, the Board of Managers adopted an Overall Plan for projects and improvements for reclamation, drainage, erosion and flood control, and improvement of lands, soils, waters, forest, wildlife, and projects therein. The Minnesota Water Resources Board prescribed the Overall Plan on November 14, 1958, and was the first Overall Plan of a watershed district in the State of Minnesota prescribed under Minnesota Statute. This Overall Plan was subsequently revised on November 27, 1970 and this current revision is the second revision to the original plan.

The Two Rivers Watershed District, in its first Overall Plan revision, identified 25 initiatives that were proposed as solutions to water management problems within the District at that time. These solutions were categorized as flood control and prevention, flood plain and channel improvement, ag water management, reforestation and wind erosion protection, wildlife, maintenance of structures, pollution control, and groundwater.

In 1981, the District adopted a set of Rules, which governed projects in the District that affected the water resources. These Rules were updated and amended on June 5, 1997. The amended Rules of the Two Rivers Watershed District require that a permit be granted for any projects that involve ditching, diking, draining, road building, culvert installation or alteration, or any other works which alter the drainage patterns or water quality within the District.

The Two Rivers Watershed District currently has ongoing investigations dealing with water quality and water quantity. The District is actively involved with flood control initiatives, water quality studies, educational initiatives, drainage ditch management, culvert inventories, and other water management activities. These programs and monitoring activities provide the Board of Managers with the data and information they need to make informed decisions regarding the water resources of the District.

General policy of the District as stated in its 1970 Overall Plan is as follows. These general policies continue to be followed by the Board of Managers today:

1. To cooperate with and utilize all help available from any state or governmental subdivision thereof; from any Federal agency; private or public corporation or person. When considered desirable, the Managers of the Watershed District shall enter into a memorandum of understanding with said agencies and subdivisions of government.

2. The Managers shall become acquainted with all existing water problems and programs and shall secure maximum assistance so as to reduce the assessments on local lands.

3. All projects, which are to be paid by assessment upon benefited properties, shall be instituted only upon filing of a valid petition with the Managers.

4. The Managers shall not approve a petition for work unless the following facts are found to exist:

    A. That the proposed improvements are for public interest and welfare as defined by the Minnesota Watershed Act;
    B. That it is practical and in conformity with this Overall Plan;

C. That the total benefits are greater than the total estimated costs and damages;
D. That the proposed project is in compliance with the provisions and purposes of the Minnesota Watershed Act.

5. The Managers shall conscientiously ascertain the benefits to be derived from a proposed project. Assessments on individual property shall be based upon such benefits.

6. The Managers of the Watershed District shall conserve and manage the supply of water in the watershed district for the beneficial use of said water for domestic, industrial, agricultural, recreational, wildlife, and other public uses.

7. Before approving any project, the Managers shall carefully consider the effect of the contemplated project on other areas and other interests within the Watershed District. They shall not approve drainage projects unless they are satisfied that the proposed outlet and the waterway into which it discharges can satisfactorily handle the additional water.

The existing purpose and goals of the District are in conformance with the above policies and are outlined in MS 103D.201 Subd. 2.

II. District Mission

The Two Rivers Watershed District was formed in order to accomplish several goals. Since its inception, the District has undertaken several projects in order to meet these goals. Projects were completed in conjunction with Soil Conservation Service (now known as Natural Resources Conservation Service, or NRCS) and Soil & Water Conservation District (SWCD) and Department of Natural Resources (DNR) to address flood control and wildlife concerns. These projects were extremely effective in carrying out their intended purposes, and they were also very effective in controlling erosion.

One area that has been lacking over the years is in the area of water quality. Historically there is a lack of long-term data available for the Two Rivers. As times have changed, the focus of watershed district has also changed to concentrate on water quality and wildlife concerns. Agencies are beginning to work together more closely to accomplish their shared long-term goals. Therefore, a water quality initiative was undertaken beginning in 1991 to study the river system by monitoring long-term trends and collecting base line water quality data. This study is giving the Managers the data they need to make informed decisions and make policy.

The District to date has operated using a set of goals and general policy statements. It has not adopted any sort of mission statement or statement of purpose. With this Overall Plan update, the following mission statement has been adopted to reflect the goals and objectives of the District and provide guidance to the Managers and staff in this age of changing attitudes. The adopted mission of the Two Rivers Watershed District is as follows:

Two Rivers Watershed District Mission Statement:

It is the stated mission of the Board of Managers of the Two Rivers Watershed District ***to carry out all facets of the Minnesota Watershed Act as set forth in Minnesota Statute, Chapter 103D. It is the District's further mission to carry forth all activities and powers given under the Minnesota Drainage Code in Minnesota Statute, Chapter 103E. In carrying out its mission, the District will encourage the wise use of the water natural resources within its boundaries and promote the general health and welfare of the citizens residing there.***

The powers of watershed districts as set forth under Minnesota Statute are listed as follows;

103D.201 Watershed district purposes.

Subdivision 1. General purposes. To conserve the natural resources of the state by land use planning, flood control, and other conservation projects by using sound scientific principles for the protection of the public health and welfare and the provident use of the natural resources, the establishment of watershed districts is authorized under this chapter.

Subd. 2. Specific purposes. A watershed district may be established for any of the following purposes:

(1) to control or alleviate damage from flood waters;
(2) to improve stream channels for drainage, navigation, and any other public purpose;
(3) to reclaim or fill wet and overflowed land;
(4) to provide a water supply for irrigation;
(5) to regulate the flow of streams and conserve the streams' water;
(6) to divert or change all or part of watercourses;
(7) to provide or conserve water supply for domestic, industrial, recreational, agricultural, or other public use;
(8) to provide for sanitation and public health, and regulate the use of streams, ditches, or watercourses to dispose of waste;
(9) to repair, improve, relocate, modify, consolidate, and abandon all or part of drainage systems within a watershed district;
(10) to control or alleviate soil erosion and siltation of watercourses or water basins;
(11) to regulate improvements by riparian property owners of the beds, banks, and shores of lakes, streams, and wetlands for preservation and beneficial public use;
(12) to provide for hydroelectric power generation;
(13) to protect or enhance the water quality in watercourses or water basins; and
(14) to provide for the protection of groundwater and regulate its use to preserve it for beneficial purposes.

III. Description of the District

A. *Watershed Setting*

1. Location & Size

The Two Rivers Watershed District encompasses an area approximately 1,462 square miles in portions of Roseau, Kittson, and Marshall Counties in extreme northwest Minnesota. The western boundary of the Two Rivers Watershed District is the Red River of the North, which also serves as the North Dakota – Minnesota boundary. The Two Rivers Watershed District begins just south of the Kittson and Marshall county line and follows the Red River to a point about ten miles from the international border with Canada. The District extends sixty-two miles east from the Red River to a point located four miles west of the City of Roseau, Minnesota. From here the border extends twenty-one miles south to a point near the Roseau and Marshall county line. It then makes its way westward back to the Red River.

The District is bordered to the northwest by the Joe River Watershed District, to the north by the province of Manitoba, Canada, and to the northeast, east, and southeast by the Roseau River Watershed District. To the south is the Middle-Snake-Tamarac River Watershed, located in Marshall County and a small portion of Kittson County. The Two Rivers Watershed District is about thirty-three miles wide from north to south at its widest point and sixty-five miles in length from east to west **[See Figure 1]**.

The Two Rivers itself is made up of three branches – the North Branch, Middle Branch, and South Branch. The South Branch arises just south of the City of Badger and flows in a southwest direction along the south side of Minnesota trunk highway #11 to the southeast corner of Pelan Township in Kittson County. At this point it crosses the highway and flows northwesterly to Lake Bronson, and from there westerly to Hallock, and then continues west to the Red River.

Just east of Hallock, the Middle Branch empties into and joins the South Branch. The Middle Branch is fed by State Ditch #50, which in turn is supplied by a series of ditches in Barto and Polonia townships located in western Roseau County. The Middle Branch flows in a general westerly direction through the central portion of Kittson County.

The North Branch of the Two Rivers arises about eight miles to the northeast of Lancaster, and is fed by a series of county and state ditches extended east into Juneberry and Soler Townships of Roseau County. The North Branch flows through the cities of Lancaster and Northcote and joins the South Branch to form the main stem at a location seven miles west of Hallock and three miles east of the Red River of the North.

An area encompassing about 360 square miles, located in the south western portion of the District, is a stand-alone drainage area consisting of numerous drainage ditches and intermittent watercourses, known as coulees (pronounced koo-lees). These coulees join together and enter the Red River approximately ten miles south of where the Two Rivers enters the Red River. This system encompasses the cities of Karlstad and Donaldson in Kittson County.

In addition, a few areas, which did not naturally drain to the Two Rivers, have been included within the boundaries of the District. Among these is a fifty square mile area where Badger Creek and Skunk Creek (located north of Badger, Minnesota) were diverted from their natural course to the Roseau River via a lateral to State Ditch #95 and into the Two Rivers system. Another area of about sixty square miles and located in the upper reaches of the Joe River was diverted into the Two Rivers North Branch via Kittson County Ditch #22. This diversion included the Little Joe River and several smaller coulee systems.

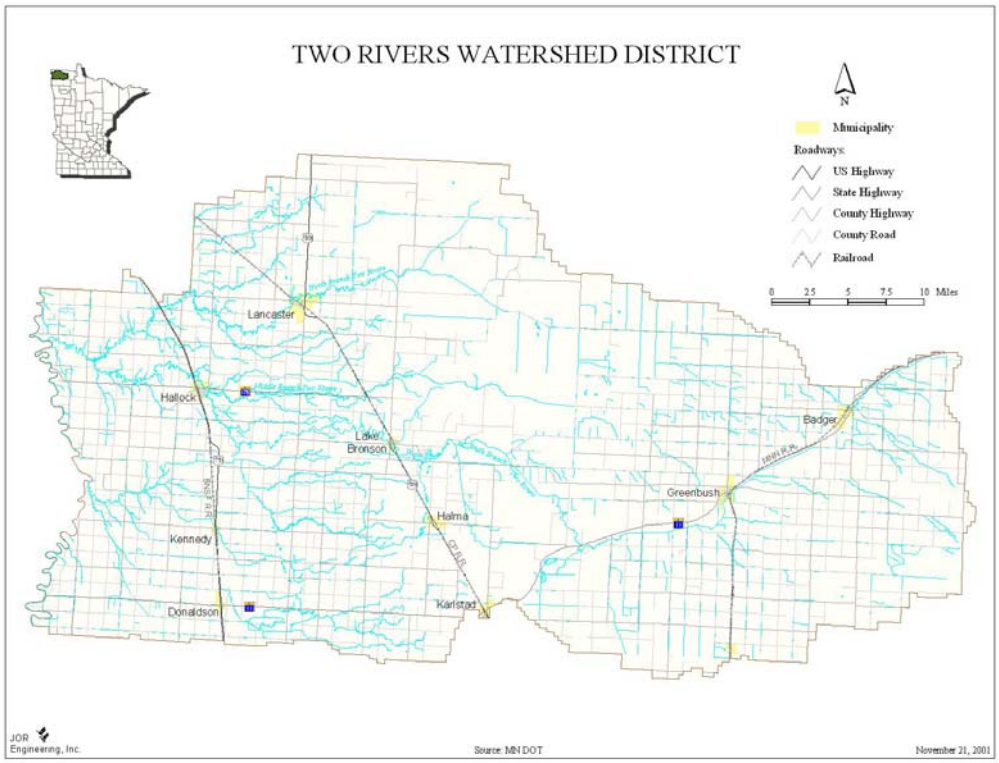


Figure 1. Two Rivers Watershed District

2. Political Units Within the District

Numerous international, federal, state, and local units of government exist within the Two Rivers Watershed District. Listed below are the political units within the District that deal with water resources and their management. The website for each entity is listed as a reference.

International – Regional:

International Joint Commission (IJC):	**www.ijc.org**
Red River Basin Commission	**www.redriverbasincommission.org**
Red River Watershed Management Board (RRWMB):	**www.rrwmb.org**

Federal:

U.S. Army Corps of Engineers (USACE):	**www.mvp.usace.army.mil**
U.S. Geological Survey (USGS):	**http://mn.water.usgs.gov**
Federal Emergency Management Agency (FEMA):	**www.fema.gov**
U.S. Fish & Wildlife Service (USFWS):	**www.usfws.gov**
Natural Resources Conservation Service (NRCS):	**www.mn.nrcs.usda.gov**
Farm Service Agency (FSA):	**www.fsa.usda.gov/mn/**
Environmental Protection Agency (EPA):	**www.epa.gov/region5/water/**
National Weather Service	**www.crh.noaa.gov/fgf/**

State:

Board of Water & Soil Resources (BWSR):	**www.bwsr.state.mn.us**
Department of Natural Resources (DNR):	**www.dnr.state.mn.us**
Pollution Control Agency (MPCA):	**www.pca.state.mn.us**
MN Department of Agriculture (MDA):	**www.mda.state.mn.us**
Minnesota Geological Survey (MGS):	**www.geo.umn.edu/mgs/**
Minnesota Department of Health (MDH):	**www.health.state.mn.us**

Local:

Information on local units of government can be found at the Northwest Regional Development Commission's web page:

www.nwrdc.org

The following Counties, Cities, and special Districts are active within the Two Rivers Watershed District. Not listed but noteworthy are the township governments, of which there are 55 within the District. Information on all of the following entities can be found on the above website.

Kittson County	**Roseau County**	**Marshall County**
Kittson SWCD	**Roseau SWCD**	**Marshall SWCD**
City of Hallock	**City of Greenbush**	
City of Kennedy	**City of Badger**	
City of Donaldson	**City of Strathcona**	
City of Lancaster	**Village of Haug**	
City of Lake Bronson	**Village of Leo**	
City of Halma	**Village of Fox**	
City of Karlstad		
Village of Orleans		
Village of Northcote		
Village of Robbin		
Village of Pelan		

3. Population

In general, population of the cities and towns within the western 2/3 of the District, as well as the rural areas, has experienced a steady decline since the 1950's and 1960's. The exception is the Karlstad, Greenbush, and Badger areas, located in the eastern 1/3 of the District. Business and industry are growing in the Roseau and Warroad, Minnesota areas, located just outside of the eastern boundary of the District. This growth is reflected in the population statistics for that area.

Meanwhile, in the western areas of the District, massive flooding during the 1990's has taken its toll on the predominantly farming related industry. Rural residents have moved away from flood prone areas and the declining farm economy has shut down many smaller family farms. Farm operations are now larger than ever before and the equipment used requires less farm labor. Therefore, population trends in these areas are on the downswing. **Table 1** at the right shows population statistics from 1970 to 2000 for Kittson & Roseau Counties and the cities within each.

City / County	1970	1980	1990	2000
Roseau County	11569	12574	15026	16338
Badger	327	320	378	470
Greenbush	787	817	790	784
Strathcona	31	47	34	29
Kittson County	6853	6672	5767	5285
Donaldson	69	84	55	41
Hallock	1477	1405	1350	1196
Halma	96	97	59	78
Karlstad	727	934	910	794
Kennedy	424	405	324	255
Lake Bronson	325	298	262	246
Lancaster	382	268	337	363

Table 1. Two Rivers Watershed District Demographic Information. Source: U.S. Census

4. The Economy

Agriculture: The economy of the entire area of the District, including all cities and villages, is driven by agriculture. According to the Minnesota Agricultural Statistics Service, all counties within the Two Rivers Watershed District ranked within the top ten in Minnesota during 1997 for crop production of wheat, oats, barley, sunflowers, sugar beets, rye, flax, dry edible beans, and potatoes. Livestock, mainly beef cows, is also produced in the eastern portions of the District. Roseau County ranked number ten in Minnesota in 1997 for beef cow production. Farm related statistics for Roseau & Kittson Counties as reported in the 2002 Minnesota Agricultural Statistics report (available from the Department of Agriculture) are listed in **Table 2.**

County	Number of Farms	Total Acres in Farms	Ave. Farm Size – Acres	Total Acres in Cropland	Ave. Age of Farmers	Cash Receipts – Crops	Cash Receipts – Livestock	Cash Receipts – Gov. Payments
Roseau								
1992	891	536,299	602	439,145	51			
1997	1051	577,455	549	466,711	53			
2000						$38,262	$19,506	$29,974
Kittson								
1992	521	482,991	927	413,926	49			
1997	558	501,466	899	430,887	52			
2000						$68,558	$6,816	$25,742
Marshall								
1992	1,012	744,710	736	671,123	49			
1997	1,144	774,342	677	690,774	52			
2000						$106,922	$10,441	$52,583

Table 2. Farm Statistics
(Cash Receipts are reported in thousands of dollars)
(Source: Bureau of Economic Analysis, U.S. Dept. of Commerce, Washington, D.C.)

Land values within the District vary from west to east as the land changes from the flat Red River Valley to the beach ridge area to the eastern upstream areas of the District. According to 2002 perpetual payment rates for cropland for the Reinvest in Minnesota program, which are based on 90% of the average assessed market value of all lands within a township, land values in the western half of Kittson County ranged from $220 to $586 per acre. Land values in the eastern half of Kittson County ranged from $135 to $466 per acre. In the eastern half of Roseau County, the values range form $156 to $336 per acre.

Industry: Industry within the District is limited. Because of the beach ridges that occur in the District, the mining of sand and gravel is predominant in these areas. Numerous gravel pits – both public and private, exist in Kittson, Roseau, and Marshall counties. Other industrial development companies that are in operation include a welding and manufacturing plant in Lancaster, a company which produces vehicle tracks is located in Karlstad, and a wood burning furnace operation is located in Greenbush. Motor Coach Industries, which assembles charter buses, is located in Pembina, North Dakota and employs many citizens who live in the District. There are three natural gas pipeline companies with pipelines running through the District. Two power companies are located in the area, as well as two telephone companies. High speed internet is provided by two area companies. Each city has a number of farm related businesses, including implement and parts dealers, hardware stores, farm chemical and fertilizer companies, several elevators and seed companies, car dealerships, atv and snowmobile dealerships, and supply stores.

Transportation:

1. Highways: Most areas of the District are accessible by some sort of Federal, State, County, or Township road. Two U. S. Highways, numbered 75 and 59, run north and south through Kittson County. Highway #75, otherwise known as the "King of Trails", connects Winnipeg, Manitoba, Canada to Hallock, Kennedy, and Donaldson. It then continues south to Crookston and then crosses the entire nation. Highway #59 also connects to Winnipeg, but it travels through eastern Kittson County to Lancaster, Lake Bronson, Karlstad, and southward to Thief River Falls and other points south. State Highway #11 runs east and west through the District, connecting Drayton, North Dakota, Donaldson, Karlstad, Greenbush, and Badger. It then continues east to Roseau and Warroad. State Highway #32 runs south from Greenbush to Thief River Falls and beyond. County, Township, and private roads are too numerous to mention.

2. Railways: The Burlington Northern Santa Fe Railway runs in a north and south direction across the western portion of the District. Created by James J. Hill in the 1800's, this line connects the cities of Winnipeg, Manitoba, Canada to Hallock, Kennedy, and Donaldson, and played a major role in the early settlement of the region. The Burlington Northern Santa Fe railway also runs a line through the eastern portion of the District connecting Thief River Falls, Greenbush, Badger, and Roseau.

   The Soo Line railway parallels U.S. Highway #59 through the central portion of the District connecting the cities of Lancaster, Lake Bronson, Karlstad, and Thief River Falls.

   These railways principally ship grain and other cargo. There are no passenger trains within the District.

3. Airports: Municipal airports are operated near the cities of Hallock, Greenbush, and Roseau. Landing strips are also located at Lake Bronson and Karlstad. A number of private landing strips are also located throughout the

District. Commercial air traffic and major airports are located outside the District at Grand Forks, ND, Winnipeg, MB, and Thief River Falls, MN.

Recreation: Outdoor recreational opportunities within the District are numerous and vary with the seasons. Summer and fall activities include camping, fishing, swimming, bird watching, canoeing, hunting, archery, golfing, tennis, tubing, and others. In the winter, outdoor enthusiasts can enjoy skating, snow shoeing, trapping, cross country skiing, snowmobiling, and ice fishing. Facilities are also available for curling and bowling.

The State of Minnesota – DNR owns thousands of acres within the District which are open for public use of the land. Among the wildlife management areas located wholly or partially within the District are the Caribou, Skull Lake, Beaches Lake, Twin Lakes, Devils' Playground, Pelan, Halma Swamp, Nereson, and Palmville Wildlife Management Areas (see GIS database). Also located within the District are Lake Bronson State Park and the Lake Bronson Aspen Parkland Scientific and Natural Area. In addition, the Roseau County Recreation Area is available for public use.

The Kittson County Trailblazers and similar snowmobile clubs in Roseau and Marshall Counties operate and maintain hundreds of miles of groomed snowmobile trails within the District. Cross-country ski trails are maintained at Lake Bronson State Park. In addition, an ATV club recently has been formed in Kittson County and surrounding areas and is advocating a trail system.

Hunting opportunities are numerous in the fall. White tail deer and black bear are the main big game animal, although populations of moose and elk do exist. Due to a decline in the moose population, the hunting season is closed. Similarly, there is no season for elk. For the bird hunter, many species are present. These include ruffed and sharp-tailed grouse, Canada geese, various duck species, snow, blue, and Ross' geese, Hungarian partridge and woodcock, to name a few . Bird watchers can spot bald eagles, great blue herons, sandhill cranes, and marbled godwit, as well as more common species. Fur bearing animals of note include timberwolf, beaver, mink, muskrat, and numerous others.

The Two Rivers and Red River support a very large and diverse fishery. The South Branch Two Rivers and its only lake, Lake Bronson, support northern pike, walleye, perch, sauger, crappie, sunfish, bass, catfish, bullhead, carp, sucker, and various other species. Limited fishing opportunities exist on the North and Middle Branches. The Red River supports all of the above and in addition is famous for its trophy size channel catfish. Public access is available on the Red River at the Minnesota Highway #175 crossing and at Catfish Haven campground and on the Two Rivers at Hallock, Lancaster, and Lake Bronson State Park (two accesses).

Camping opportunities within the District are numerous. City parks are located at Lancaster, Karlstad, Kennedy, and two in Hallock. In addition, the privately owned Catfish Haven campground is located on the Red River west of Kennedy. Lake Bronson State Park is located just east of Lake Bronson on the Two Rivers.

Nine hole golf courses are located in Lancaster, Greenbush, Karlstad, and Hallock. The City of Hallock also has a curling club and bowling alley. Tennis courts are located in Hallock, Karlstad, and Greenbush. Swimming pools are located in Hallock and Greenbush. Other recreational information can be obtained by contacting each city's Chamber of Commerce.

B. *Physical Features*

1. Climate

   Generally speaking, the climate of the Two Rivers Watershed District can be classified as sub-humid. Weather patterns are influenced most of the year by upper level winds traveling from west to east. At the surface the wind direction is predominantly westerly. Rapid changes in weather can frequently happen in the region because of influence from the Pacific northwest and also the Gulf of Mexico areas. The two areas are drastically different – cold air in the northwest vs. warm gulf air – and thus can cause drastic weather changes.

Temperatures within the District vary drastically from an average January temperature of 0.6º F to an average July temperature of 69.2º F. These averages, supplied by the Minnesota Climate office are based upon 1961-1990 data at Hallock, Minnesota. For the same period at Warroad, located to the east of the District the January temperature is -1.1º F and July is 67.3º F. At Agassiz National Wildlife Refuge, which is located just to the south of the District, for the same time period the January mean temperature is 3.1º F and the July mean is 68.4º F.

At Hallock, the record high for the period 1899 to 1996 was 109° F on July 11, 1936 and the record low was – 51° F on February 11, 1914. Average number of days above 32º F at Hallock is 129. On average, spring ends on May 20, and fall begins on September 23, based upon information gathered between 1961 and 1990.

Precipitation within the District also varies by region. At Hallock, mean precipitation from 1961-1990 varied from 0.48" in February to 3.15" in June. At Warroad for the same period the range was 0.49" in February to 3.66" in June. Agassiz Refuge recorded precipitation in February of 0.39" and in June of 3.75". Average precipitation for the year is 18.53" at Hallock, 20.75" at Warroad, and 21.55 at Agassiz National Wildlife Refuge. This shows that the western portions of the District are generally more arid than the eastern portions.

2. Topography

The land in the watershed district is very flat. The land in the western part, and particularly from the City of Hallock to the Red River, is flat, open land devoted entirely to the raising of small grains, sugar beets, sunflowers, soy beans, canola, and other crops. From Hallock to the east the land is not as flat and there is more brush and popple growth. Because of steeper slopes, sandier soils, and other factors, this area of the District is more diverse with regard to land use.

In the eastern portion of the watershed the fall is toward the west. The fall is quite rapid and as much as twelve to fifteen feet per mile. Some portions of the District, associated with beach ridges, experience 20 to 30 feet per mile drop. In the westerly twelve to fifteen miles of the watershed the lands are flat and the drop is not more than one or two feet to the mile.

Although the countryside appears flat in the watershed, there is a considerable difference in elevation between the headwaters and the mouth of the Two Rivers. In general, the land is at about elevation 790' above mean sea level (msl) near the mouth of the Two Rivers; elevation 800' above msl near Northcote; elevation 815' above msl near Hallock; 900' above msl near Lancaster; and elevation 1,030' above msl near Leo. Elevations at Kennedy are 827' abaove msl; Karlstad 1035' above msl; Greenbush 1075' above msl, Badger 1082' above msl; and are somewhat greater than 1,120' above msl near Strathcona. In the eastern edge of the watershed the elevation is 1210' above msl in section 20 of Poplar Grove Township, Roseau County. This is a 420 foot drop from the highest point in the District to the lowest point. [See Figure #2]

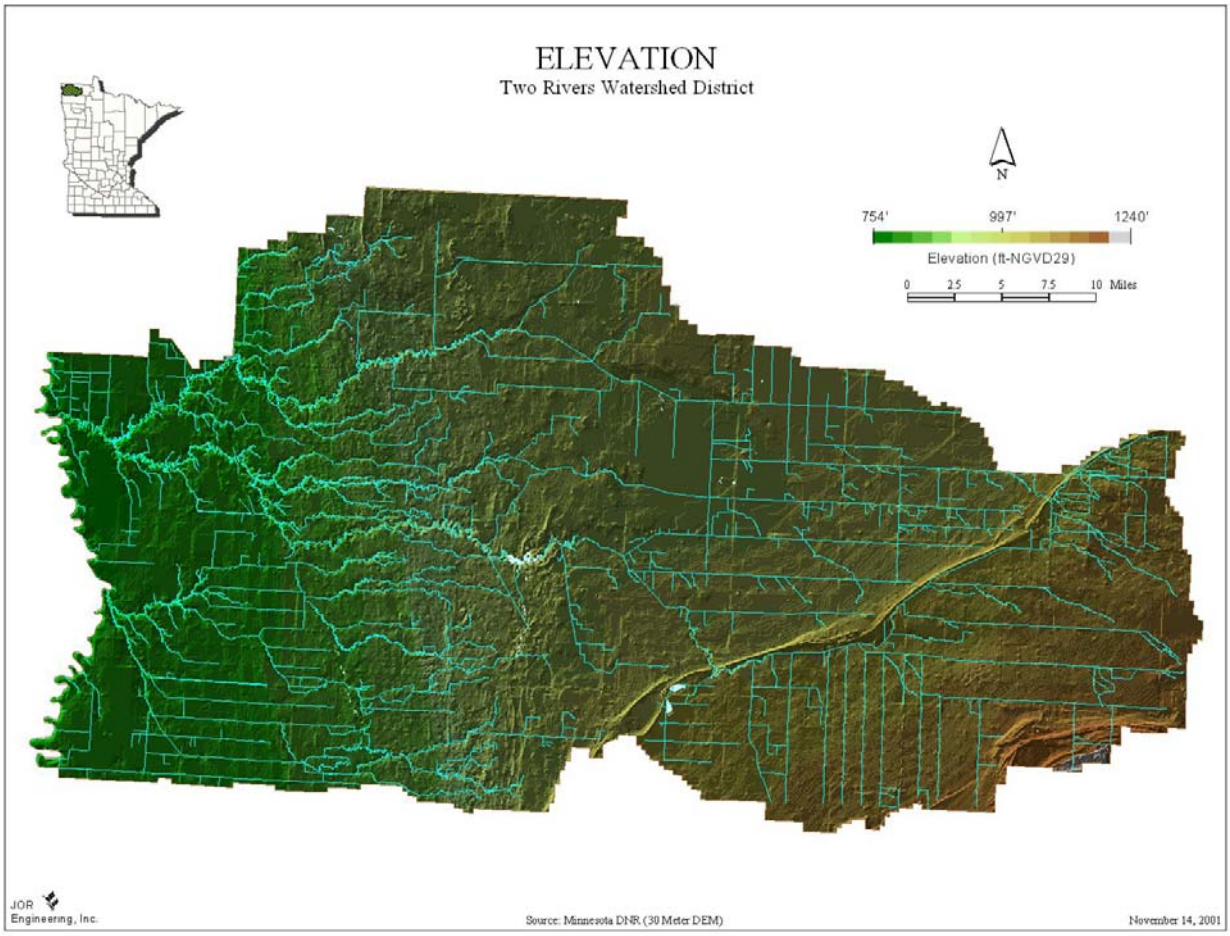


Figure 2. Elevation

3. Geology

The entire watershed lies within the limits of Glacial Lake Agassiz and this accounts for the flat topographic characteristic of the watershed. Lake clay has been deposited in the western area of the District, west of a north south line located 2 miles east of Lancaster. This is characterized by clay, gray to blue gray, plastic, dense, and contains lenses of silt and very fine sand. Small areas of lake clay occur locally in the till area. The lake clay makes up some of the richest soils suited to farming in the world.

Glacial till makes up about 2/3 of the District, beginning in the Lancaster area and covering much of the area of the District located in eastern Kittson County and western Roseau County. This is a heterogeneous mixture of ice deposited clay, silt, sand, and gravel. It is largely calcareous sandy clay containing scattered pebbles and cobbles. The upper 5 to 15 feet of till is commonly oxidized to a buff-tan color and is more permeable than the underlying unweathered gray till. Lenses of sand occur throughout the till. Thin, discontinuous deposits of clay, silt, sand, and peat overlie the till at numerous localities. The till ranges in thickness from 40 feet to over 200 feet.

Several beaches of Lake Agassiz occur, which were formed at various times as Lake Agassiz receded across the watershed. One that is especially prominent, the Campbell Beach, crosses the extreme southeastern part of Kittson County and follows the route of State Trunk Highway #11 through the cities of Karlstad, Greenbush and Badger. This beach is a high ridge,

which is an obstacle to the flow of water from the southeast to the northwest. This deposit is predominantly fine to medium sand with lenses of fine to medium gravel. Deposits commonly form low beach ridges that range in height from less than 5 feet to as much as 30 feet. Widths of ridges range from a few hundred feet to about a half mile. Beach ridges are highest and widest near local sources of surficial sand. At most places beaches are underlain by clayey till.

A surficial channel outwash occurs in a north – south band, about 6 miles wide, located just east of Lancaster. This is a lenticularly bedded deposit of sand, gravel, and clay. Sand and gravel is most abundant in the middle of the channel near Lake Bronson. Deposits are largely silt and clay along west edge of the channel.

Two Areas of buried sand and silt lenses within till occur south of the City of Greenbush. One is characterized by having higher relative amounts of sand and gravel, and the other is characterized as having large amounts of clay associated with silt deposits. Depth of these is about 60 feet.

An area of buried sand and clay within till exists north of the City of Greenbush. The deposit consists of lenses of sand, silty clay, and gravel in till. Test holes penetrated 10 feet of sand and gravel at a depth below the land surface from 45 to 55 feet. **[see figure 3, geomorphology]**

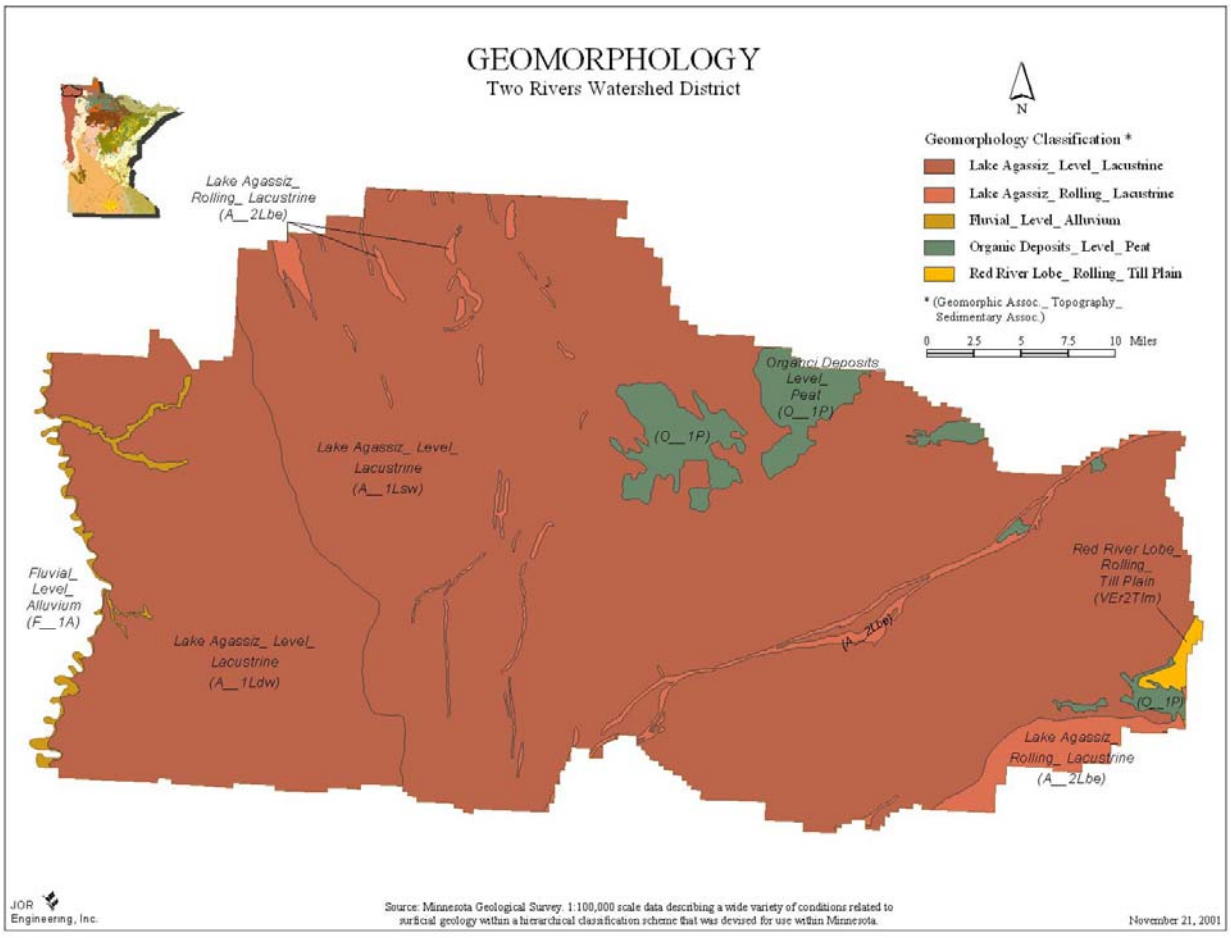


Figure 3. Geomorphology

4. Soils

Great ice sheets once moved across the District, acting like giant bulldozers. They scraped and leveled the area they touched. As the ice melted and receded northward, water accumulated in the southern part of the basin. The District was entirely covered by Lake Agassiz [See Figure 4. Lake Agassiz]. Waves and currents smoothed off the drift to nearly plane surface. The beach ridges are in the eastern half of the District marking the successive shorelines of the glacial Lake Agassiz, whose water occupied the basin of the Red River for several thousand years during the close of the last ice age.

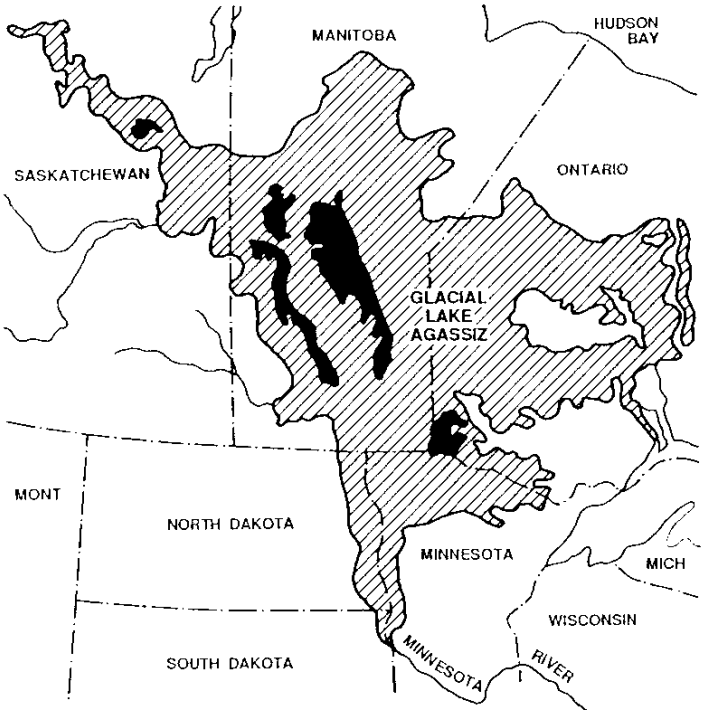


Figure 4. Glacial Lake Agassiz

Soils developed in time and were greatly influenced by the climate and living matter acting on the glacial drift. Water moves through soils in varying amounts and at varying rates. Soils in depressions are flooded with large amounts of water whereas hilltops shed water to lower slopes. As water moves through soils, it dissolves and moves the finer materials to deeper depths. This weathering moves fine size clays into the layer called subsoils and soluble minerals may be washed from the surface layer. The kind of vegetation growing on soils influenced the amount of organic matter. Timber soils formed under trees are light colored and low in organic matter. Prairie soils formed under grass are high in organic matter and are dark colored. In Kittson County, dark colored soils are relatively high in organic matter. Nearly level, wet timber silts are light colored, leached of soluble bases, and are usually slightly acid to neutral. Erosion moves soil materials from one place to another and damages growing crops, fills drainage ditches, and pollutes the air and water.

Soils within the District are very diverse from the eastern areas to the western areas. The soil textures are shown in **figure 5**. Generally, textures are coarse – loamy in the eastern 1/3 of the District, where the till plain exists. A narrow band of loamy – skeletal soils diagonally

crosses this area following the beach ridge of glacial Lake Agassiz of which Minnesota Highway 11 is built upon. The middle 1/3 of the District is also a till plain and is home to mostly sandy textured soil, with pockets of sapric soils associated with the large wetland areas. In the western 1/3 of the District, very – fine soil textures are found, associated with the flat lake plain areas of glacial Lake Agassiz.

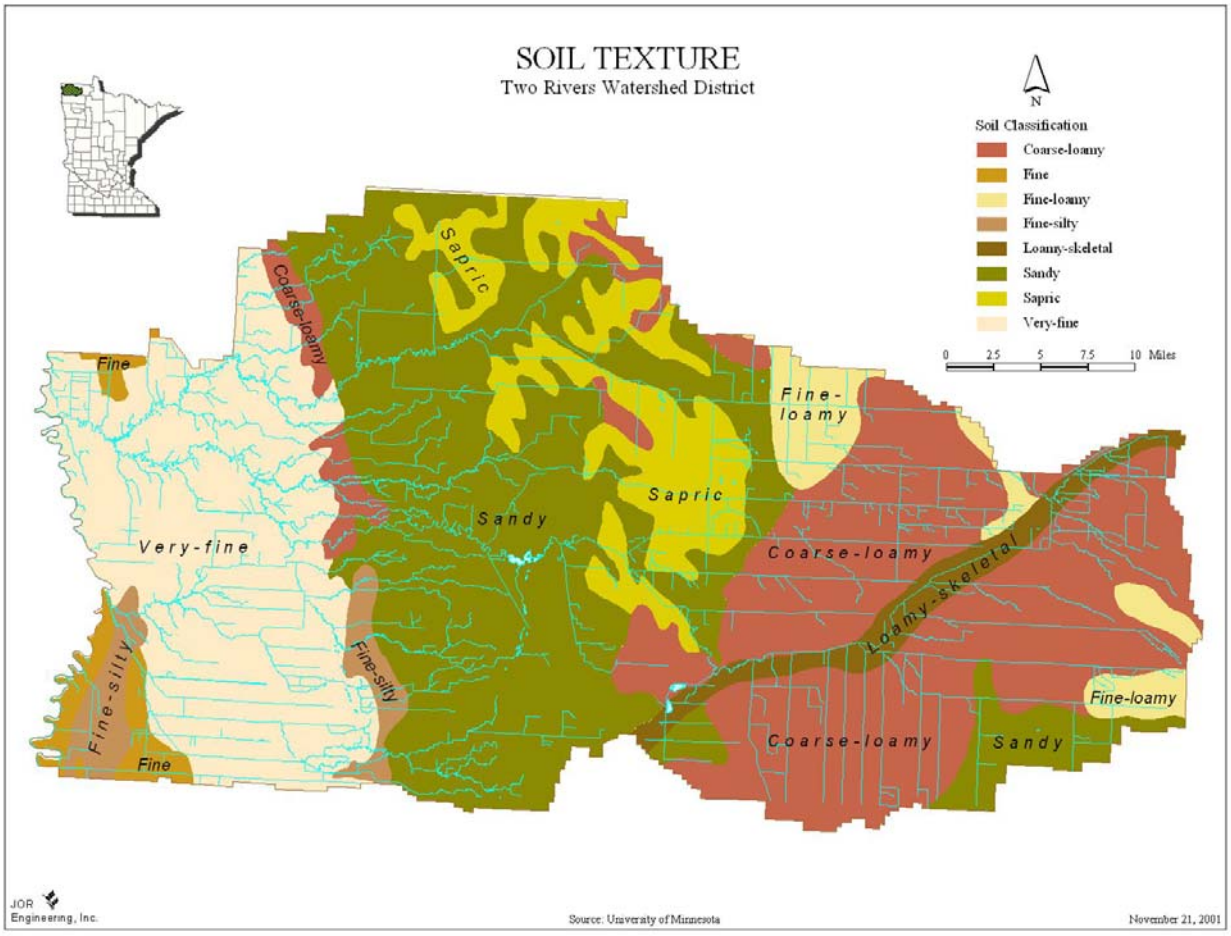


Figure 5. Soil Texture

Soil types within the District are very diverse. A soil survey of soils in Kittson County was published in 1979 by the Soil Conservation Service (now known as the Natural Resources Conservation Service), for Marshall County in 2000, and for Roseau County in 2002. Soil survey data is available upon request from NRCS, County SWCD's, or the TRWD.

Fifteen different soil associations are identified for areas of the District, as follows:

1. Northcote: Poorly drained, nearly level clayey soils formed in lake laid clays. This association exists in the western 1/3 of the District west of a north south line approximately 5 miles east of U.S. Highway #75.

2. Bearden-Fargo: Moderately well drained to poorly drained, nearly level and gentle sloping soils, formed in lake laid silts and clays. This association mainly exists in the southwestern and south central areas of Kittson County.
3. Hegne-Northcote: Poorly drained, nearly level clayey soils with a micro relief condition. This association is interspersed within the Northcote association in the western areas of Kittson County.
4. Wheatville Augsburg: Moderately well and poorly drained, nearly level soils formed in very fine sands over clay or deep very fine sands. This association exists in the south central portion of Kittson County.
5. Grimstad-Rockwell: Moderately well and poorly drained, nearly level soils formed in fine sands over glacial till. Located mainly in the north central portion of Kittson County.
6. Ulen-Arveson: Nearly level, poorly and moderately well drained calcareous soils formed in fine lake laid sands. Located in a narrow north south band through the center of Kittson County.
7. Poppleton-Redby-Cormant: Moderately well drained and poorly drained, nearly level noncalcareous soils formed in deep lake laid sands. Interspersed in the east central portion of Kittson County.
8. Enstrom-Grygla: Moderately well and poorly drained, nearly level noncalcareous soils formed in lake laid sands over loamy glacial till. Interspersed in the east central portion of Kittson County.
9. Dune land-Lohnes: Excessively to well drained, nearly level to sloping soils formed in wind blown sands or gravelly beach ridges. Located in areas near the City of Lancaster, the City of Halma, the City of Karlstad, and along the beach ridge of which Minnesota Highway #11 follows.
10. Fram-Percy: Moderately well and poorly drained, nearly level loamy soils formed in glacial till. Located along the eastern edge of the Northcote Association, in extreme northeast Kittson County, and extreme southeast Kittson County.
11. Mavie-Foxhome: Moderately well and poorly drained, nearly level soils formed in loamy material over glacial till with an intervening gravelly layer. Interspersed in the northeast and southeast portions of Kittson County.
12. Deerwood-Cathro-Markey: Nearly level, slightly depressional, very poorly drained soils formed in organic material or organic material over loamy till or sands. Interspersed in the extreme eastern areas of Kittson County.
13. Nereson-Rollis-Mavie: Derived from limy clay loam glacial till that has been reworked by lake waters. The topsoil is thin and of a loam texture. Locally there are areas of sandy soils. Frequently occur at depths ranging from 12 to 18 inches, a layer of coarse gravel and cobblestone is encountered. This layer ranges from a few to over 12 inches in thickness; it rests directly on the limy clay loam till material that has been reworked by lake waters. Surface stones and boulders are common. Located largely in the State Ditch #91 and the State Ditch #95 subwatersheds.
14. Mavie-Rockwell-Grimstad: An area of medium to moderately coarse textured lacustrine sediments overlying a layer of sand and / or gravel which is from 8 inches to 2 feet thick. This in turn lays on limy clay loam till. Closely intermingled with these soils are generally small areas of medium textured soils that do not have this identifying layer. The topography is level, consequently the external drainage is slow. Internal drainage is somewhat poor to very poor. Surface stones are numerous throughout the area. Located just north of the beach ridge along which MN Highway 11 follows and also in the west central portion of the State Ditch #91 subwatershed.
15. Hiwood-Redby-Cormant-Faunce: This area is a combination of deep light-colored sands and shallow peat. Drainage ranges from good to poor on the sands and

very poor on the peat. Because of the sandy nature of the soil, this area has limited value for agriculture. Located in the very extreme eastern portion of the Badger Skunk Creek subwatershed.

5. Land Use / Public & Private Land Ownership

Figure 6 shows the land use within the District as of 1990. Agriculture is the predominant land use within the District, comprising the majority of the area that makes up the District. The District can be divided into three very distinct areas.

The eastern 1/3 of the District is a mixture of agriculture, open grassland, forested areas, and grassland – shrub mix. The soils are sandy but not so sandy that they cannot support agriculture.

The middle 1/3 of the District is comprised of large blocks of forest, wetland and grassland. Soils are either too sandy or too wet to produce consistently high quality crops. Vast areas of land in this region have been acquired by the DNR and by The Nature Conservancy for the purposes of managing for native prairie, forest, and wildlife. Much of the area that was cropland is now either pasture/hayland or has been enrolled into the CRP program.

The western 1/3 of the District is predominantly agriculture. This is the area of thick lake laid clays that comprise some of the richest soil in the world. Therefore, the land use is to grow cash crops. The only areas of forest or grassland occur along the river systems or other watercourses and road ditches.

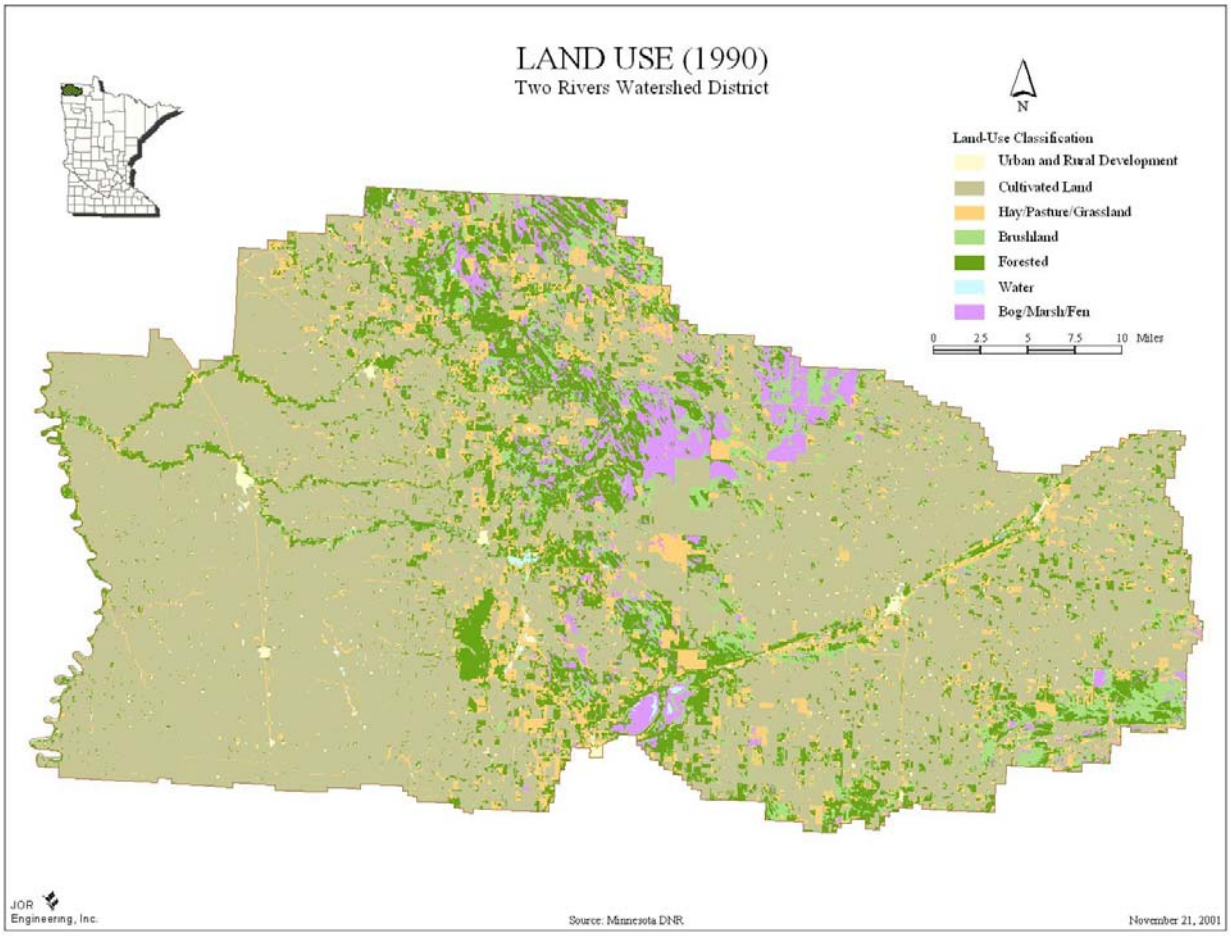


Figure 6. Land Use

6. Natural Resources

Natural resources are somewhat diversified within the Two Rivers Watershed District. In the eastern 1/3, agriculture is prevalent. There are, however, certain identified habitat blocks in the eastern 1/3 suited to wildlife and natural resource issues. These habitat blocks consist of wetland, grassland, and forest land and are beneficial to various wildlife species. The middle 1/3 of the District is the most diverse relating to wildlife. Several large habitat blocks exist where it is not feasible to farm the land. These habitat blocks consist of deciduous forest, wetland complexes, and open grassland. Some of the ecosystems present include the aspen parkland, northern tall grass prairie, and northern Minnesota wetlands. The western 1/3 of the District, located in the lake plain of glacial Lake Agassiz, is devoted to farming and virtually no habitat blocks exist. Wildlife corridors in this area exist along the river, coulee, and ditch systems. Grassland areas also exist along roads, highways, and railways.

Game animals prevalent within the District include whitetail deer, black bear, moose, elk, fox, sharp-tailed and ruffed grouse, woodcock, various duck species, Canada, snow, blue, and Ross' geese, and many fur-bearing animals (such as beaver) that may be trapped or hunted. A significant fishery exists on the Two Rivers, benefiting from the resource of the Red River. Field survey work was done by the Minnesota DNR during the summer of 2001. This work identified 33 species of fish within the District, including walleye, northern pike, channel catfish, largemouth bass, black crappie, bluegill, sauger, and various other species.

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, garter snake, various frog species, American bittern, marbled godwit, loon, and many others.

Several renewable and non renewable resources exist within the District. The most prominent non renewable resource is gravel. The Kittson SWCD performed a gravel pit inventory in 1999, tallying 61 gravel pits with Kittson county. Several additional public and private pits exist in Roseau County. These pits are found primarily along the beach ridge areas left by Lake Agassiz. The gravel is extracted by excavating large open pits and utilized for various projects, mostly relating to road construction.

Renewable resources that are utilized within the District include timber. The area designated as aspen parkland has many areas that are being logged for aspen, which is used as pulpwood by various paper companies and others in the timber industry. This logging activity has become prominent in the last 10 years. Of course, the major renewable resource produced within the District is agricultural crops. Also of note is the harvesting of native prairie grass seed in the Skull Lake Wildlife management area and also on private farms in the Halma region.

C. Existing Water Management Plans & Programs

Local:

- County Comprehensive Local Water Plans: These are plans written and maintained by the Soil & Water Conservation Districts for each County. Water management initiatives addressed include water quality monitoring, well sealing, water supply, and protection of the resource.

- Operation of County, State, and Judicial Ditch Systems: In Minnesota a ditch authority is either a county or a watershed district. Ditch authorities are responsible for inspecting, maintaining or otherwise ensuring the ditch is functioning for the purpose it was built. This includes inspections and maintenance plans.

- Soil & Water Conservation District Plans: Each County SWCD is required to write and periodically update their plans. These plans detail conservation initiatives dealing with soil and water erosion control and best management practices to curb erosion and soil loss.

- County Emergency Management Plans: Each county is required to have an updated emergency management plan. These plans relate to flooding and other types of emergencies, and what course of action to take during these emergencies.

- Various Rural Water Systems: The North Kittson and Kittson-Marshall Rural Water Systems supply drinking water to most cities and residences in Kittson & Marshall Counties. As such, they are responsible for wellhead protection plans and other initiatives relative to drinking water and groundwater supplies.

- Various City Stormwater and Wastewater Systems: Each city has plans for their storm sewers and sanitary sewer systems and lagoons. Lagoons are discharged usually 2 times per year into a receiving water body, which can affect flows and water quality.

State:

- ❖ Various programs and initiatives of the DNR, MPCA, BWSR, LMIC, EQB, LCMR, Dept. of Ag, and others

Federal:

- ❖ Various programs and initiatives of the USFWS, NRCS, USACE, EPA, and others

III. Major Sub-Watersheds of the District

For the purposes of this plan, the Two Rivers Watershed District has been divided into 14 major subwatersheds. These are identified according to Figure 8 and are listed below. This plan has attempted to describe the watershed setting, environmental factors, and water management problems associated with each. The narratives that follow will describe each area, discuss the existing conditions and related problems and opportunities in each, summarize the perceived problems identified by the public, and describe goals and objectives that have been identified for each.

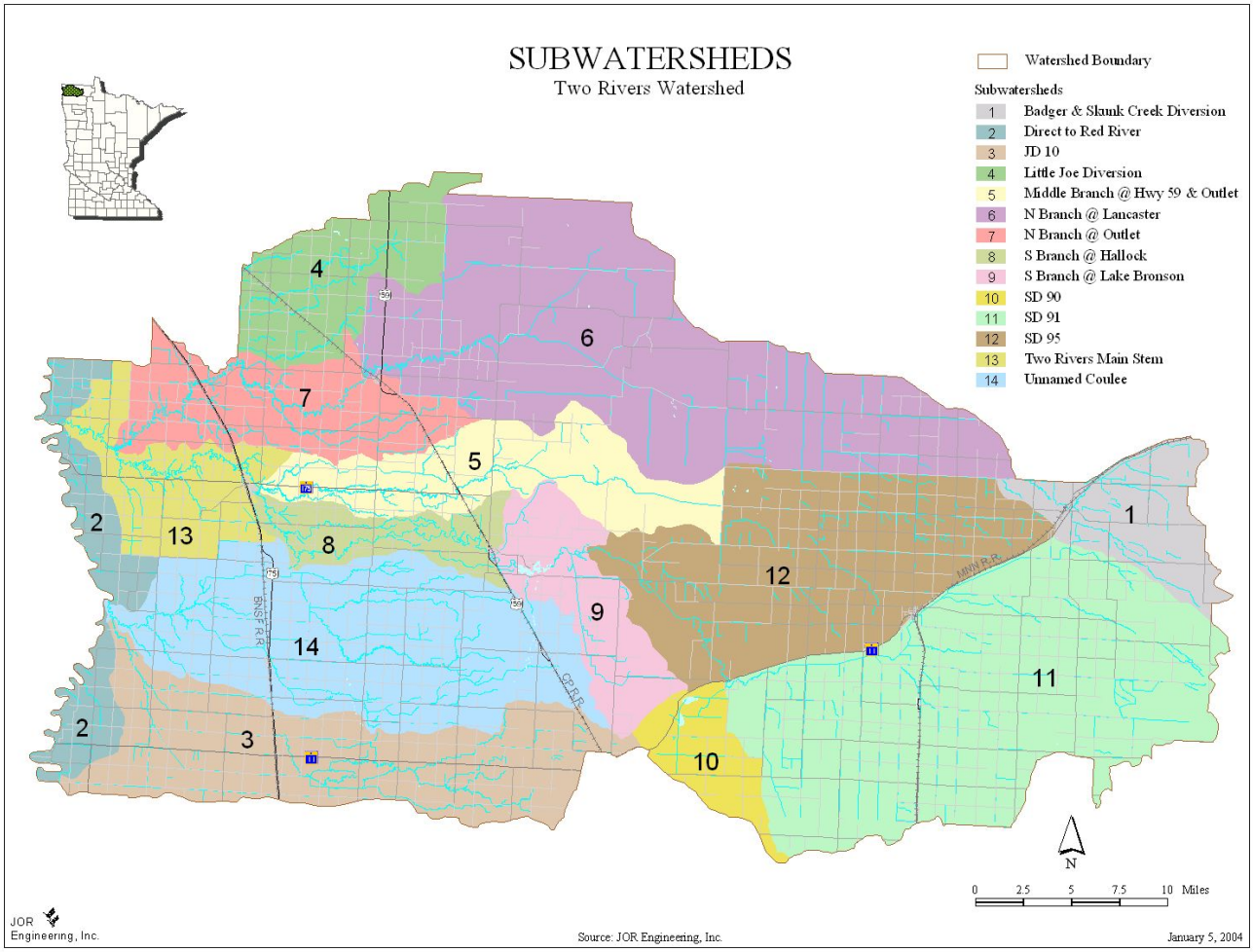


Figure 8. Sub Basins

Badger & Skunk Creek Diversion

A. Water Resources

1. Major Sub Watershed Areas

The Badger & Skunk Creek Diversion subwatershed consists of an approximately 50 square mile area. The Badger and Skunk creeks originally outletted into the Roseau River system, but were diverted in the early 1900's by the construction of the State Ditch #95 system. The SD #95 system is now the outlet for these two creeks, which in turn outlets into the South Branch Two Rivers upstream of Lake Bronson. The diversion is located in the extreme upper reaches of the Two Rivers Watershed District. The diversion is located within the Red River Valley ecoregion, but is bordered by the Northern Minnesota Wetlands ecoregion. Soil textures range from loamy-skeletal to coarse-loamy. The area consists largely of agricultural land, but is also made up of wetland, urban, and grassland. Some gravel mining is occurring along the beach ridge on the northern border of this subwatershed.

2. Surface Waters

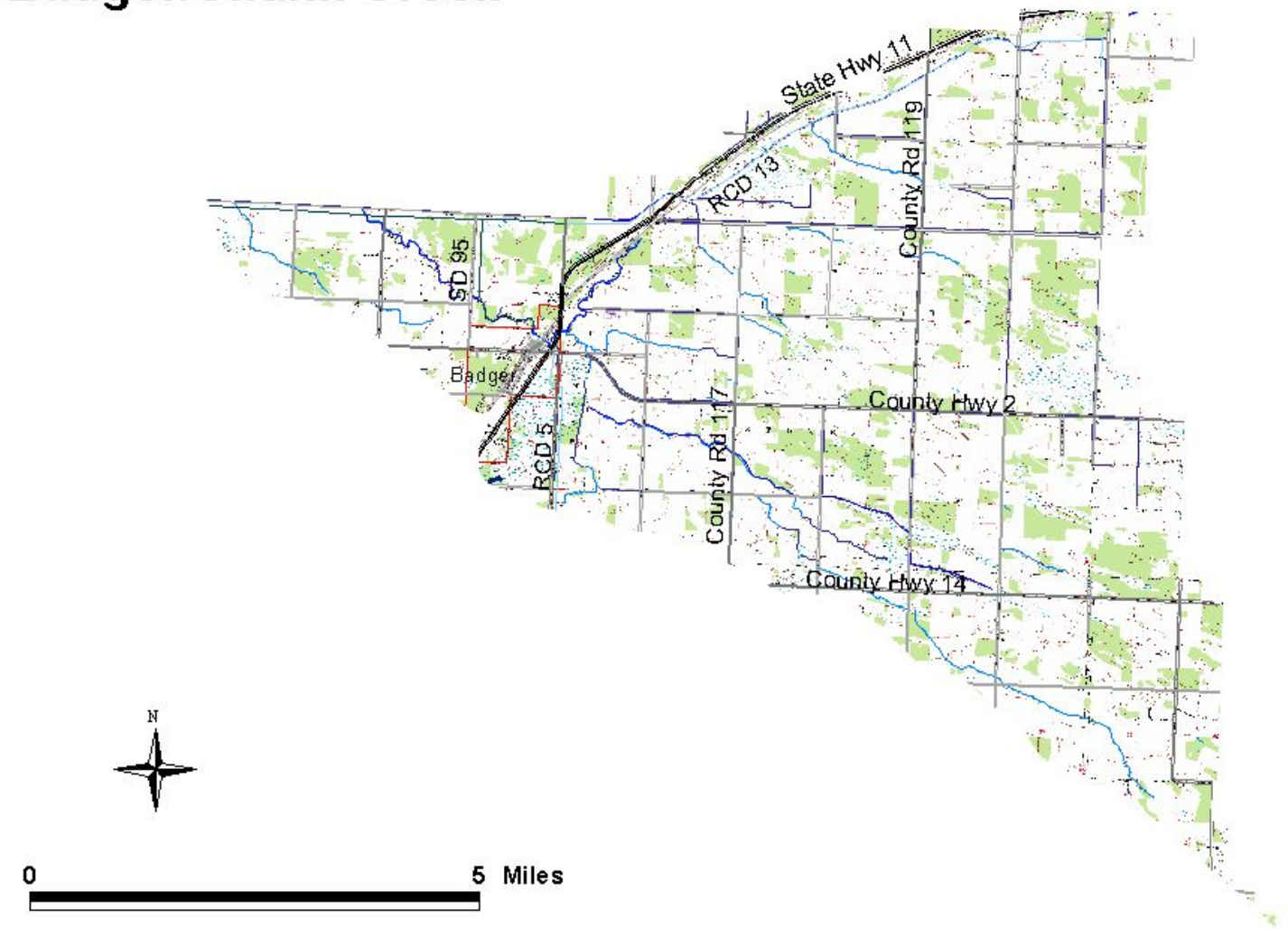
This subwatershed is comprised of four smaller subwatersheds. Three of the subwatersheds consist of unnamed coulee systems, road ditches, and field drainages. The fourth is the area drained by Roseau County Ditch #13. The Badger & Skunk Creek Diversion area is bordered along its north boundary by a beach ridge, of which Minnesota Highway #11 follows between the cities of Badger and Roseau. All of the drainage within the area crosses this beach ridge either in the city of Badger or at a point about 1.5 miles northeast of Badger. All of the water comes together and enters a lateral of State Ditch #95 about 1 mile northwest of Badger.

There are no lakes present in the Badger & Skunk Creek Diversion. Wetland areas are scattered throughout the area and are somewhat arranged in "lobes" that run in a northwesterly – southeasterly fashion. These wetland areas are somewhat denser in the extreme southeastern portion of the subwatershed. Many of these wetlands have been altered by farm drainage, and many wetlands have been drained for the purposes of agricultural production.

Two legal drainage systems exist within this subwatershed. Roseau CD #13 begins in the section 24 of Ross Township near the village of Fox, and travels westerly along the south side of the beach ridge. It then passes through the beach ridge just northeast of the city of Badger, and outlets into a lateral 1 of State Ditch #95. Roseau CD #5 is about a 3 mile long system beginning south of Badger and running straight north to outlet into Badger creek. Both ditch systems are under the administration of Roseau County.

Water quality monitoring has been done by the District at three sites associated with the Ross Impoundment and at another site on the downstream end of this subwatershed. Monitoring has been done since 2000 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. There are no impaired stream reaches as identified by the Minnesota Pollution Control Agency in this subwatershed.

Badger/Skunk Creek



3. Groundwater

Generally, the geologic material is till, which is a heterogeneous mixture of ice deposited clay, silt, sand, and gravel. It is largely calcareous sandy clay containing scattered pebbles and cobbles. The upper 5 to 15 feet of till is commonly oxidized to a buff-tan color and is more permeable than the underlying unlettered gray till. Lenses of sand occur throughout the till. Thin, discontinuous deposits of clay, silt, sand, and peat overlie the till at numerous localities. The till section of the ground water reservoir is essentially saturated, however, locally dry zones can be found below the water table in areas of unusually well compacted till. Till aquifers are confined except for the shallow, permeable, oxidized zone.

Glacial drift aquifers in this area consist of a surficial beach and shoreline deposit underlying the beach ridge upon which Minnesota Highway #11 follows. This deposit is predominantly fine to medium sand with lenses of fine to medium gravel. Deposits commonly form low beach ridges that range in height from less than five feet to as much as thirty feet. Widths of ridges range from a few hundred feet to about a half mile. Beach ridges are highest and widest near local sources of surficial sand. At most places beaches are underlain by clayey till. The beach deposits are from 0 to 30 feet thick, and can yield 20 gallons per minute or more. The saturated part of higher beach ridges ranges from 10 to 20 feet. Wells in lower beaches generally go dry in late summer, and the water in the deposit is unconfined. The water quality is suitable for domestic and stock use if not locally contaminated. The water is very hard, with total dissolved solids measurements generally less than 500 parts per million.

The bedrock aquifer in this area is made up of shale and sandstone. This is a dark gray, soft clay shale and coarse grained, poorly sorted, lignitic sandstone material. The aquifer thickness is less than 50 feet, and at most places the water yield to potential wells tapping sandstone would yield from 5 to 50 gallons per minute. The water quality is poor to good with soft to moderately hard water common. At places boron exceeds 3 parts per million making the water unsuitable for irrigation.

Information regarding the Badger city wells, water quality analysis results, and the aquifer that serves as the water supply can be obtained from the City of Badger and the Minnesota Geological Survey.

4. Natural Resources and Unique Water & Land Related Resources

Existing Resources: This small sub watershed is dominated by natural resource features common for a beach ridge area because the Campbell beach ridge runs through this sub-watershed. Land use changes and gravel mining have altered the quality and quantity of natural resources in this sub watershed. A few large habitat blocks or conservation lands are present in this sub-watershed and several wetland complexes have been drained (MCEA report). CRP grasslands are quite common. Lack of large habitat blocks and a lack of connectivity between existing grasslands, wetlands, brushlands, and woodlands limit the function of the terrestrial resources in this subwatershed.

The waterways in this subwatershed are headwaters to lateral 1 of the state ditch 95 system which becomes the Middle Branch. Almost all natural waterways have been converted to ditches. The remaining natural waterways and the ditches provide some fish and aquatic habitat but most of these are probably limited to seasonal use. These small waterways are likely to provide spawning and rearing habitat for northern pike and a limited variety of other species. Flashy flows,

susceptibility to extended low flow or no flow periods, unstable channels, and a lack of riparian habitat limit the function of these aquatic resources.

In addition to these general habitat features, one Natural Heritage element has been documented in this sub watershed. Natural heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated "outstanding resource value waters" or "critical vegetated habitats" as defined in state statutes have been found in this sub-watershed.

Gravel is the major non renewable resource available for consumption in this subwatershed, and is actively being mined, mostly along the beach ridge area. Renewable resources in the subwatershed include expanses of aspen, which is being logged mostly on private lands.

Resource improvement opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is good. In particular, actions should be taken to protect existing upland habitats (grassland, wetland, brushlands, woodlands), create some large habitat blocks, protect existing stable waterways, and stabilize existing unstable waterways. Reclamation of gravel pits should be considered whenever possible.

B. Water Use

1. Surface & Ground Waters

There are no known major surface water users in this area. All of the waterways are intermittent in nature, drying up during periods when there is no runoff. Groundwater usage is prevalent with the presence of individual, on farm wells for domestic and livestock use. Also, the City of Badger as mentioned above has city wells to appropriate groundwater for domestic use. The City of Badger also utilizes sewage treatment ponds to deal with its wastewater. These ponds outlet into Badger Creek.

C. Existing Conditions, Related Potential Problems, and Solution Alternatives [Assessment & Issue Identification]

The following issues were discussed at a public meeting held in Badger, Minnesota specifically to hear comments on the Badger & Skunk Creek subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ Overland Flooding during the spring and summer was ranked as the number 1 problem in the area. This highly severe problem impacts farmland, roads, and infrastructure in the area where CD #13 meets Lateral 1 of SD #95. It was identified that the extent of the problem covers the tributaries feeding CD #13, and that Skunk Creek is plugged.

- ✓ The outlet to the systems of this subwatershed, mainly where CD 13 meets Lateral 1 of SD #95, is in disrepair. It was noted that if this system was maintained to the level of its original construction, the entire drainage system would function adequately.
- ✓ The number 3 problem identified was the delay in spring planting of cropland, flooding of cropland in the summer, and limited accessibility to pastures due to flooding. These problems are widespread on the western side of the area, and limited specifically along tributary waterways in the east. It was noted that the problem has repeatedly occurred four of the last five years.
- ✓ Ditch bank erosion, ranked #5, is a problem as ditch and stream banks erode, slough into the channel, and willows and other vegetation begin to grow. It was identified that a maintenance plan needs to be implemented in these areas, side slopes should be leveled, and culvert sizes should be reviewed.
- ✓ Stream flows were identified as problem area #6, as the high flows are too high, and the low flows are too low. This results in an unnatural situation. It was noted that it would be better to develop a more sustained water flow in the channels throughout the year.
- ✓ The extreme eastern boundary of the subwatershed (and the District) needs to be evaluated and possibly re-drawn. It was noted that in some areas there is water coming into the District from the Roseau River Watershed District and in other areas there seems to be water leaving the Two Rivers District and entering the Roseau River District.
- ✓ Natural resource issues identified include degraded in stream fishery habitat due to unstable watercourse causing erosion & sedimentation, beaver problems blocking waterways, and problems with fish passage at culverts. Recreational issues were noted that where snowmobile trails cross ditches, the ditch does not open up in the spring, causing blockages.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Flood Water Detention: Temporary storage of flood water until after the flood.

Flood Water Retention: Semi-permanent storage of flood water for other beneficial use such as water supply, wetlands, or recreation.

Ring Dikes: Dikes constructed to defend individual homes or farmsteads.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control the flow of water.

Watershed Treatment: Implement land management practices that reduce runoff potential and control erosion.

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

WATERSHED DISTRICT PROJECTS:

At the present time there are no water management structures present. However, the Two Rivers Watershed District is contemplating a flood control impoundment, known as Ross #7, to be located in sections 32 & 33 of Ross Township. This proposed impoundment would control water from a 17 square mile drainage area, and provide flood control protection for about a 4-inch runoff event. The impoundment would be a gated structure to hold water during flooding, and then water would be slowly released after flooding has subsided downstream. The impoundment would be drained dry when no flooding is occurring. This impoundment is fully funded, and is currently proceeding through the mediation project work team planning process and the permitting process.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Wetland Restoration: See above.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, impoundments, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Specific NRE Alternatives:

- Restore reach of stream (T-41, R-161, S19; Stokes off take #3) that was recently illegally improved.
- Support and implement Ross #7 multi-purpose impoundment.
- Promote waterway buffers, priority given to CD 13 and CD 5.
- Wetland restorations where feasible and prudent targeted near existing CRP lands.
- Stabilize stream and ditches to reduce sedimentation and erosion.
- Gravel pit reclamation

STATE DITCH #95 SUBWATERSHED

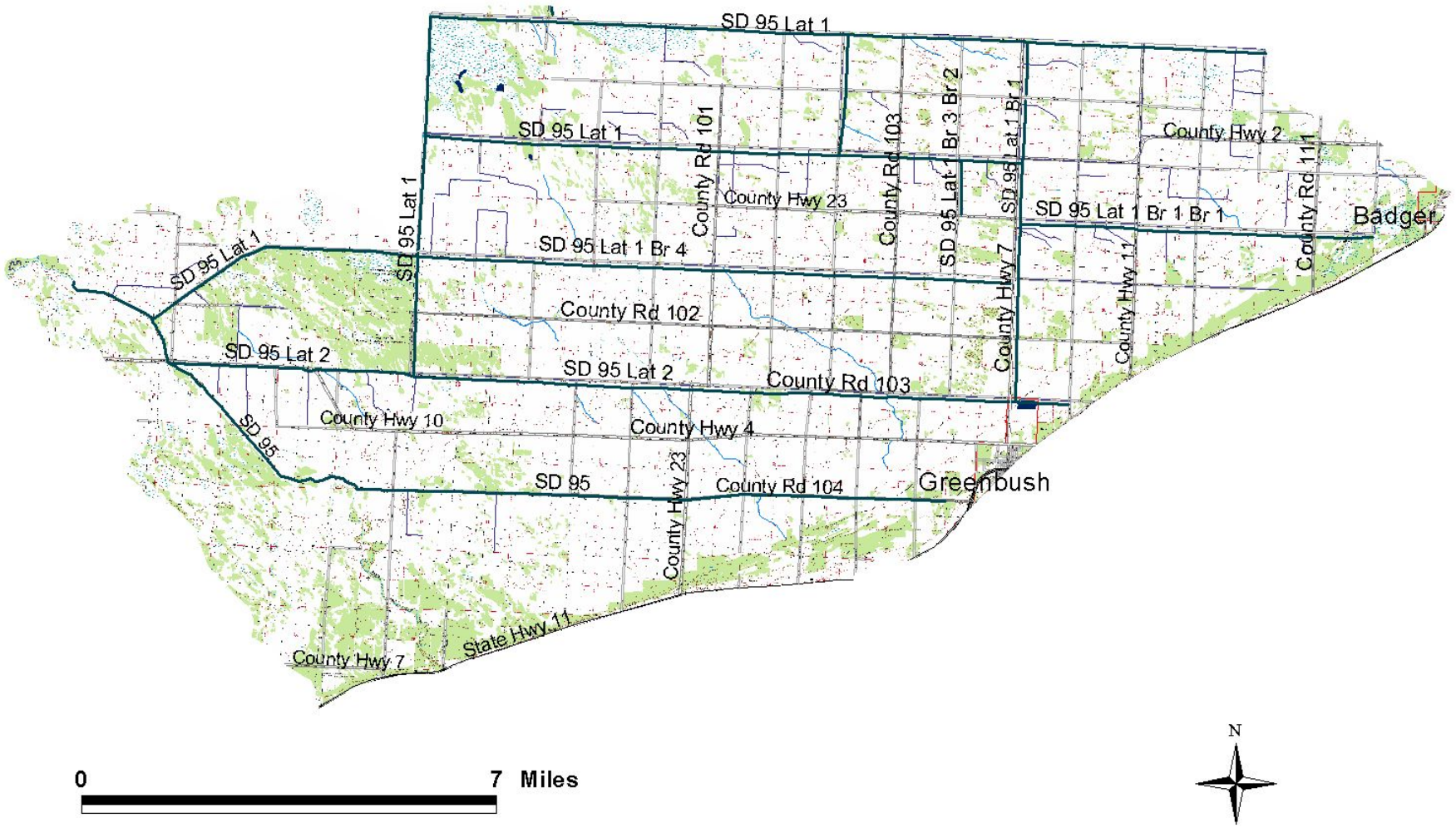
A. Water Resources

1. Major Sub-watersheds of the District

The State Ditch #95 subwatershed comprises about 107 square miles in drainage area. The waterways that make up the drainage system consist of State Ditch #95 and six separate laterals to the main ditch. The downstream end of this system consists of SD #95 main stem, which is actually a channelized section of the South Branch Two Rivers, located between the village of Pelan and Lake Bronson. This system lies in both the Red River Valley and in the Northern Minnesota Wetlands ecoregions.

The area is characterized by straight line ditches flowing westerly on each section line. These ditches were constructed in the early 1900's in order to drain the wetlands to provide for agricultural production. The area today consists of both agricultural land interspersed with wetland areas. While the area is predominantly farmland, some areas have seen enrollment in the Federal Conservation Reserve Program. Soils textures in the area are mainly coarse-loamy, with some pockets of fine-loamy in the east and north. Toward the western edge of the subwatershed are areas of sandy and sapric soil textures.

SD 95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Badger
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7 Miles
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2. Surface Waters

There are nine smaller subwatersheds that make up the State Ditch #95 subwatershed area. Six of these subwatersheds are comprised of laterals to the SD #95 system, and a seventh is the main stem SD#95. Another of the watersheds is the main stem of the South Branch of the Two Rivers in the area of Pelan, and another is a coulee system that serves as a tributary. The South Branch Two Rivers is the only river channel in the area, and it has been partially channelized to form the main stem SD #95. This system outlets back into the river upstream of Lake Bronson.

There are no lakes present in this subwatershed area. Wetland areas are concentrated along the northern edge of the subwatershed and also in the southwestern portion. Large expanses of wetlands are connected in the northern areas. These are mainly of the scrub shrub variety, categorized by types 2 and 6 wetlands. Many wetlands have been drained in this area by the construction of the SD #95 system in the early 1900's.

Drainage systems in the area are dominated by the aforementioned SD #95 system, which is under the administration of Roseau County. The County is responsible to maintain the ditch to its originally constructed condition. In addition to the legal drainage system, numerous county and township roads have ditches on either side, and most of the agricultural fields have private drainage systems installed to carry excess water off of the farm fields.

Water quality monitoring has not been done by the District at any locations within this subwatershed. However, monitoring is taking place both upstream and downstream of this subwatershed on the South Branch Two Rivers. Monitoring has been done since 2000 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. There is one impaired stream reach as identified by the Minnesota Pollution Control Agency in this subwatershed, beginning on the South Branch Two Rivers at Pelan on the Roseau – Kittson County line and ending just upstream of Lake Bronson State Park. The affected use of this impairment is aquatic life and the indicator is biota.

3. Groundwater

This area consists of a till layer, a glacial drift aquifer consisting of a buried sand and clay lens within the till, and both a shale – sandstone and granite bedrock aquifers. The buried sand and clay lens within the till is a deposit consisting of lenses of sand, silty clay, and gravel in till. Test holes penetrated 10 feet of sand and gravel at depths from 45 to 55 feet below the land surface. There is little data available on the yield of this aquifer, but is believed to be from 5 to 20 gallons per minute. The aquifer is confined with a few flowing wells. Water quality is generally good, suitable for domestic and agricultural purposes. The water is very hard with the iron content from 1 to 5 parts per million and total dissolved solids less than 1000 parts per million.

The granite bedrock aquifer does not bear water, and the upper surface is the base of the groundwater reservoir. This smaller aquifer is about 40 square miles in area and is located in the north central portion of the subwatershed. The remaining portion of the watershed consists of a shale & sandstone bedrock aquifer.

4. Natural Resources and Unique Water & Land Related Resources

Existing Resources: Land use changes have altered the quality and quantity of natural resources in this sub watershed. Agricultural lands dominate this subwatershed particularly in the western and southern portions. The Campbell beach ridge runs along the southern border. A few large habitat blocks and conservation lands (4 WMA's and 2 SNA's) are present in this sub-watershed. Habitats in these lands include rich fens, lowland shrub lands, and mesic prairies. Some CRP lands are also present with their greatest density in the northern and eastern portions of this sub watershed. Some wetland areas remain but most areas have been drained (see MCEA report). Fire suppression in some areas has degraded some habitats. A grassland and forestland corridor exists along State Hwy 11. An overall lack of large habitat blocks and a lack of connectivity between existing grasslands, wetlands, brushlands, and woodlands limit the function of the terrestrial habitats in this sub watershed.

The waterways in this subwatershed flow into Ditch 95 which becomes the South Branch Two Rivers. Almost all natural waterways have been converted to ditches. The remaining natural waterways and the ditches provide some fish and aquatic habitat but most of these are probably limited to seasonal use. Small waterways here are likely to provide spawning and rearing habitat for northern pike and a limited variety of other species. Flashy flows, susceptibility to extended low flow or no flow periods, unstable channels, and a lack of riparian habitat limit the function of these aquatic resources.

Non renewable resources present within the subwatershed historically have been gravel. Some remnant gravel pits exists, however actively mined pits are few. Renewable resources within the subwatershed include the harvesting of aspen.

In addition to these general habitat features, thirty four Natural Heritage elements have been documented in this sub watershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated "outstanding resource value waters" or "critical vegetated habitat" as defined in state statutes have been found in this sub-watershed.

Resource improvement opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is good. In particular, actions should be taken to protect existing upland habitats (grassland, wetland, brushlands, forests), create some large habitat blocks, protect existing stable waterways, and stabilize existing unstable waterways. Stream rehabilitation of ditch 95 between Pelan and Lake Bronson would connect this reach to natural habitats found upstream and downstream. The water quality monitoring program will be utilized to assess the current condition of waters identified as being impaired and formulate strategies to address the issue.

B. Water Use

1. Surface & Ground Waters

There are no known major surface water users in this area. All of the waterways are intermittent in nature, drying up during periods when there is no runoff. Groundwater usage is prevalent with the presence of individual, on farm wells for domestic and livestock use. The City of

Greenbush's water supply is taken from wells located near town. The City utilizes two treatment ponds for disposal of sewage. These are periodically dumped into lateral 2 of State Ditch #95.

C. Existing Conditions, Related Potential Problems, and Solution Alternatives [Assessment & Issue Identification]

The following issues were discussed at a public meeting held in Greenbush, Minnesota specifically to hear comments on the State Ditch #95 subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ The number one ranked flood control issue within this subwatershed was the insufficient capacity of the main stem and laterals to the State Ditch #95 system. This contributes to out of bank flows and overland flooding, causing damage to ag land and infrastructure. This problem exists subwatershed wide.
- ✓ The second ranked problem was the crossover of drainage systems from the north into the SD #95 system. This deals with the water that overflows from the Roseau River and enters the Two Rivers via the State Ditch #72 and its laterals.
- ✓ Crop loss was the third ranked problem. This occurs over the entire subwatershed and is mostly a concern during the summer growing season.
- ✓ Overland flooding within the SD #95 system from the southeast and inefficient drainage southwest of Badger were equally ranked as the fourth highest problem. Lateral 1 of SD #95 is subject to outflow to the south during runoff events, and Lateral 3 needs to be extended.
- ✓ Road & culvert washouts were ranked as the number 5 problem. This happens annually as of late and specifically impacts the Juneberry road (County Road #7).
- ✓ Cattail & sediment blockage of existing drainage systems and field erosion were equally ranked #6. These were viewed as subwatershed wide problems that happen frequently.
- ✓ Two separate problems, but equally ranked at number seven, were a high water table resulting in housing & crop loss problems, and reduced stream flows. These problems are happening across the entire subwatershed.
- ✓ Drought was viewed as a problem that is a concern when it happens. Problems arise with pasture and crop loss and also the capacity of shallow wells becomes limited.
- ✓ Natural resources and wildlife issues that were identified included erosion problems where fields enter main ditches, ditch bank erosion and sloughing, high level of suspended solids during runoff, flooding of nesting habitats, high population and dispersement of beavers, loss of upland habitat due to flooding and excessive rains, and high in stream flows too high and low flows too low.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be

completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Flood Water Detention: Temporary storage of flood water until after the flood.

Flood Water Retention: Semi-permanent storage of flood water for other beneficial use such as water supply, wetlands, or recreation.

Ring Dikes: Dikes constructed to defend individual homes or farmsteads.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control the flow of water.

Watershed Treatment: Implement land management practices that reduce runoff potential and control erosion.

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

Floodways: A relatively confined area on either side of the channel used to help convey flood flows.

Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

WATERSHED DISTRICT PROJECTS:

The Two Rivers Watershed District has no water active management structures present in this subwatershed area. Several years ago, a project known as Klondike 2 was investigated and a preliminary design and plan was drawn up that would have created an off channel storage project. The District purchased and still owns land in the vicinity of this project. There has been no activity on this project, and further investigations may take place after the construction of higher priority impoundments.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Wetland Restoration: See above.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, impoundments, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Specific NRE Alternatives:

- Consider rehabilitation of ditch 95 in Pelan township, Kittson County, downstream of reach that has not been channelized.
- Buffer all waterways.
- Restore wetlands where feasible and prudent using existing incentive program (e.g. WRP).
- Support and promote agricultural Best Management Practices that reduce erosion and sedimentation.
- Support and promote active management of existing vegetation on public and private lands (i.e., prescribed burning).

STATE DITCH #91 SUBWATERSHED

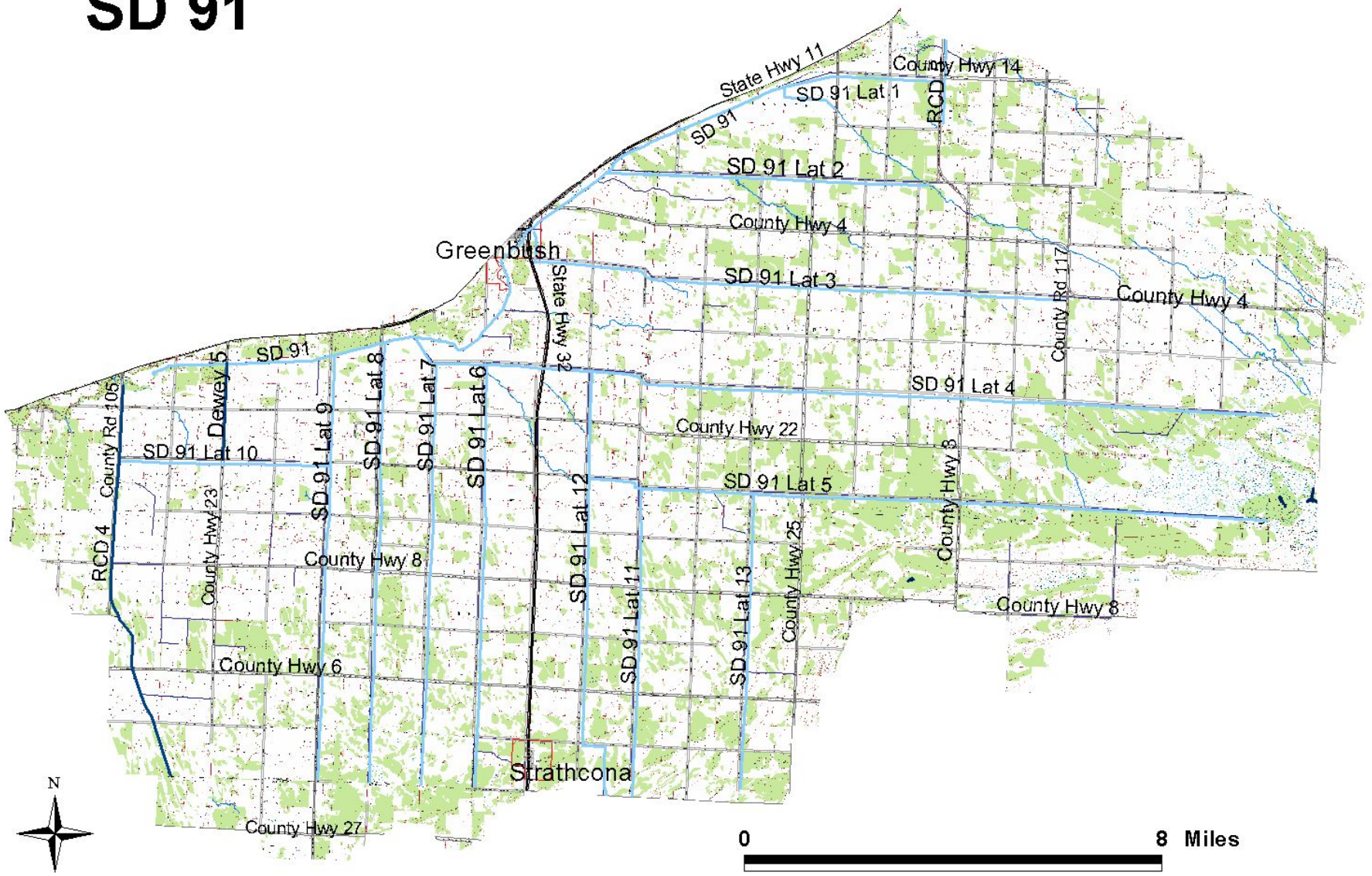
A. Water Resources

1. Major Sub Watershed Areas

The State Ditch #91 sub watershed area consists of approximately 232 square miles, located in seven different townships in the extreme south west portion of Roseau County (the extreme south east portion of the District). Sixteen ditches, including the main stem State Ditch #91, Roseau County Ditch #4, Dewey Ditch #5, and 12 different laterals of SD #91 comprise the drainage of this subwatershed. The main stem of SD #91 from Badger to about three miles east of the Roseau & Kittson County line is actually a channelized portion of the South Branch Two Rivers.

The ecoregions present in this area are the Northern Minnesota Wetlands and the Red River Valley. The Northern Minnesota Wetlands are present only on the eastern edge of the subwatershed, while the Red River Valley comprises 90% of the subwatershed. Agriculture is the predominant land use of the area, which has been extensively ditched and drained to improve crop production. Other land uses include forest, brush, hay & pasture, and bog / marshland.

SD 91


State Hwy 11
County Hwy 14
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SD 91
RCD
SD 91 Lat 2
County Hwy 4
Greenbush
SD 91 Lat 3
County Hwy 4
State Hwy 32
County Rd 117
SD 91
SD 91 Lat 4
Dewey 5
SD 91 Lat 8
SD 91 Lat 7
SD 91 Lat 6
County Hwy 22
County Rd 105
SD 91 Lat 10
SD 91 Lat 9
SD 91 Lat 12
County Hwy 8
SD 91 Lat 5
RCD 4
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County Hwy 8
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SD 91 Lat 13
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County Hwy 27
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8 Miles

Soil textures in this area range from an area of fine – loamy in the east to sandy in the south, to loamy-skeletal along the beach ridge area. Eighty percent of the area is made up of coarse-loamy soil textures. Geomorphologic regions include the Lake Agassiz level lacustrine and the Lake Agassiz rolling lacustrine areas. In addition, small pockets of organic deposits level peat and the Red River Lobe rolling till plain exist.

2. Surface Waters

The SD #91 system was a channelization project which straightened the South Branch of the Two Rivers. The joint watercourse (SD #91 & S. Branch Two Rivers) follows along the south side of the beach ridge on which Minnesota Highway #11 follows from Badger to Karlstad. On the downstream end of this subwatershed (about 6 miles northeast of Karlstad), the river crosses the beach ridge and flows northwestward to Lake Bronson. About 4 miles east of this location, the SD #91 project ends and the system becomes natural unaltered river. As mentioned earlier, upwards of 200 square miles of runoff must enter channelized ditch systems, and then pass through the unaltered area of river. This, as detailed later in this section, creates problems relating to drainage, flood control, erosion, water quality, and wildlife.

About nineteen smaller subwatershed areas have been identified and are documented in the geographic information data available through the Minnesota DNR. These include laterals 1 through 12 of the State Ditch #91 system, the Roseau County Ditch #4 system, the Dewey #5 system, and several coulees and smaller drainage systems.
Most of the extensive network of ag ditches were established during the late 1800's and the early 1900's for the purpose of agricultural production. These legal ditch systems were constructed either by the State of Minnesota or Roseau County. All of the ditches in the subwatershed are either now maintained by Roseau County or the Two Rivers Watershed District.

Large areas of wetlands exist in the extreme eastern areas of this subwatershed. Because of the extensive farming and ditch systems, most wetlands have been altered or drained in the middle and western areas of the subwatershed. No lakes are present.

Water quality monitoring has been done by the District at three sites in this subwatershed – one at Greenbush on the South Branch Two Rivers, another also on the South Branch Two Rivers at Pelan, and one at the Nereson Impoundment on Lateral 4 of SD 91. Monitoring has been done since 2000 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. There is one impaired stream reach as identified by the Minnesota Pollution Control Agency in this subwatershed, located on the South Branch Two Rivers between Greenbush and Pelan. The affected use of this impairment is aquatic life and the indicator is biota.

3. Groundwater

Generally, the geologic material is till, which is a heterogeneous mixture of ice deposited clay, silt, sand, and gravel. It is largely calcareous sandy clay containing scattered pebbles and cobbles. The upper 5 to 15 feet of till is commonly oxidized to a buff-tan color and is more permeable than the underlying unweathered gray till. Lenses of sand occur throughout the till. Thin, discontinuous deposits of clay, silt, sand, and peat overlie the till at numerous localities. The till section of the ground water reservoir is essentially saturated, however, locally dry zones

can be found below the water table in areas of unusually well compacted till. Till aquifers are confined except for the shallow, permeable, oxidized zone.

Glacial drift aquifers in this area consist of a surficial beach and shoreline deposit, which is underlying the beach ridge upon which Minnesota Highway #11 follows, and two areas of buried sand and silt lenses within till – one with relative concentrations of sand and gravel and one with large amounts of clay associated with silt deposits. The surficial beach & shoreline deposit is predominantly fine to medium sand with lenses of fine to medium gravel. Deposits commonly form low beach ridges that range in height from less than five feet to as much as thirty feet. Widths of ridges range from a few hundred feet to about a half-mile. Beach ridges are highest and widest near local sources of surficial sand. At most places beaches are underlain by clayey till. The beach deposits are from 0 to 30 feet thick, and can yield 20 gallons per minute or more. The saturated part of higher beach ridges ranges from 10 to 20 feet. Wells in lower beaches generally go dry in late summer, and the water in the deposit is unconfined. The water quality is suitable for domestic and stock use if not locally contaminated. The water is very hard, with total dissolved solids measurements generally less than 500 parts per million.
In the buried sand and silt lenses, the depth to the top of the aquifers is about 60 feet. The thickness of these aquifers ranges from 40 to 45 feet. Few data area available on well yields, however, well owners report adequate water for domestic uses and dairying. The aquifer is entirely saturated and confined under pressure. Head is about 50 feet above the top of the aquifer. Yields of wells estimated to range from less than 5 gallons per minute to more than 30 gallons per minute in both areas. The water quality of these aquifers is fair to good, suitable for both domestic and stock uses. Total dissolved solids generally are less than 1000 parts per million.

The bedrock aquifer in this area is made up of shale and sandstone. This is a dark gray, soft clay shale and coarse grained, poorly sorted, lignitic sandstone material. The aquifer thickness is less than 50 feet, and at most places the water yield to potential wells tapping sandstone would yield from 5 to 50 gallons per minute. The water quality is poor to good with soft to moderately hard water common. At places boron exceeds 3 parts per million making the water unsuitable for irrigation.

4. Natural Resources and Unique Water & Land Related Resources

Existing Resources: Land use changes have altered the quality and quantity of natural resources in this sub watershed. Agricultural lands are common in this subwatershed. The south east portion of the watershed is a large diverse habitat block and additional habitat is located along the southern border of this subwatershed. Habitats in these lands include woodlands, rich fens, lowland shrub lands, and mesic prairies. CRP lands are also present throughout this subwatershed. Some wetland areas remain but most areas have been drained (see MCEA report). A grassland and forestland corridor exists along State Hwy 11. Fire suppression in some areas has degraded some habitats. A lack of connectivity between existing grasslands, wetlands, brushlands, and woodlands limit the function of the terrestrial habitats in this sub watershed.

The waterways in this subwatershed flow into Ditch 91 which is the South Branch of the Two Rivers. Almost all natural waterways have been converted to ditches. The remaining natural waterways and the ditches provide some fish and aquatic habitat but most of these are probably limited to seasonal use. Small waterways here are likely to provide spawning and rearing habitat for northern pike and a limited variety of other species. Flashy flows, susceptibility to extended low flow or no flow periods, unstable channels, and a lack of riparian habitat limit the function of these aquatic resources.

While few gravel pits are active in this subwatershed, gravel mining has been the main activity associated with non renewable resources. Harvesting of aspen on both private and state managed lands is the major activity regarding renewable resources, as well as farming.

In addition to these general habitat features, 20 Natural Heritage elements have been documented in this sub watershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated "outstanding resource value waters" or "critical vegetated habitat" as defined in state statutes have been found in this sub-watershed.

Resource improvement opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is good. In particular, actions should be taken to protect existing upland habitats (grassland, wetland, brushlands, forests), create and connect some large habitat blocks, protect existing stable waterways, and stabilize existing unstable waterways. Land use changes, wetland restorations, and impoundments could be sited near the upper reaches of waterways in this watershed to reduce runoff during high flow periods and augment base flows during low flow periods. The water quality monitoring program will be utilized to assess the current condition of waters identified as being impaired and formulate strategies to address the issue.

B. Water Use

1. Surface & Ground Waters

There are no known major users of surface water within this subwatershed. Some cattle operations use limited amounts of water for watering stock. The bulk of groundwater appropriation is done by the City of Greenbush for their city water supply. One golf course is located in Greenbush and it is assumed that they appropriate water for irrigation. Detailed information on the City's and related water appropriations can be obtained either from the City or from the Minnesota DNR.

C. Existing Conditions, Related Potential Problems, and Solution Alternatives [Assessments & Issue Identification]

The following issues were discussed at public meeting held in Greenbush, Minnesota specifically to hear comments on the State Ditch #91 subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ Water backing up at the outlet of State Ditch #91 because of inefficient channel capacity was the number 1 ranked issue of this subwatershed. The problem occurs during a spring snowmelt or summer rainfall runoff event, and the effect is that water backs up and waffles through Dewey and Hereim Townships.

- ✓ Crop loss was ranked as the number 2 problem. The most severely affected area of the subwatershed is the northwest quadrant.
- ✓ Road and culvert washouts were ranked number 3. This is viewed as a high problem that has happened annually across the entire subwatershed area.
- ✓ Overland flooding, field erosion and sedimentation, and blockage of existing drainage systems were all viewed equally as the number 4 ranking issue. Overland flooding prevails from the southeastern portion of the watershed, field erosion is most severe in the northwest, and blockage of drainage systems occurs over the entire subwatershed.
- ✓ The 5th ranked issues were reduced flows, which allow for vegetative growth in drainage channels and high water table, which results in housing problems and crop loss. Reduced flows occur subwatershed wide, and the high water table occurs mainly in the western portion of the subwatershed.
- ✓ Ranked number 6 were the drought problems of pasture and crop loss and shallow wells. These are severe problems when drought is occurring, and are widespread throughout the subwatershed.
- ✓ Natural resource issues listed for this subwatershed include erosion and sedimentation issues detailed above and their affects on the food chain, high levels of suspended solids affecting water quality, flooding of nesting habitats in springtime, a flashy hydrograph, loss of upland habitats, beaver control issues, high water affects on wildlife affecting wild game numbers and access to hunting lands, and log jams affecting boating and canoeing.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Maintenance of Existing Ditch Systems: Ditch authorities responsible for the maintenance of ditch systems (i.e. Roseau County, Kittson County, & the Two Rivers Watershed District) should organize and execute annual ditch maintenance plans, including ditch inspections, repair work, and maintenance activities (removing silt, spraying for cattail & other vegetation).

Flood Water Detention: Temporary storage of flood water until after the flood.

Flood Water Retention: Semi-permanent storage of flood water for other beneficial use such as water supply, wetlands, or recreation.

Ring Dikes: Dikes constructed to defend individual homes or farmsteads.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control the flow of water.

Watershed Treatment: Implement land management practices that reduce runoff potential and control erosion.

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

Floodways: A relatively confined area on either side of the channel used to help convey flood flows.

Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

WATERSHED DISTRICT PROJECTS:

The District operates one water management structure in this subwatershed, known as the Nereson Impoundment. The impoundment is located in section 28 of Nereson Township in the eastern end of the District. The impoundment consists of a main dike and outlet structure, which was completed in the early 1980's. This was a cooperative effort between Roseau County, the Minnesota DNR, the Red River Watershed Management Board, and the Two Rivers Watershed District. In 1987, a second, sub-impoundment was designed and construction was started to add to the flood control and wildlife benefits of the original impoundment. Because of extremely wet conditions the construction of the sub-impoundment was not substantially completed until fall of 2003. Together, the main impoundment and the sub-impoundment will control the runoff from approximately 17 square miles along laterals 4 and 5 of SD #91. An operating plan has been written and agreed to by all concerned parties. This plan calls for the operation of the outlet structures to be done by the DNR, with input from a flood control standpoint given by the Two Rivers Watershed District.

Two of the legal ditch systems located in this subwatershed are under the jurisdiction of the Two Rivers Watershed District. Roseau County Ditch #4 begins on the Marshall – Roseau County line in section 34 of Lind Township and travels approximately 7.5 miles in a north – northwesterly direction and outlets into the South Branch Two Rivers (State Ditch #91). The Dewey #5 ditch system begins in the SW corner of section 35 Dewey Township and travels 1 7/8 miles north to outlet into the SD 91 system. In 2002 a petition was received from landowners to improve the Dewey #5 system. This will be done in conjunction with a Roseau County highway project within the next 5 years.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Wetland Restoration: See above.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and

state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Specific NRE Alternatives:

- Develop a set of flood damage reduction and natural resource enhancement projects along the south branch, ditch 91 and its laterals. This could include storage on or adjacent to ditches, strategic culvert sizing, wetland restoration, etc.
- Promote rehab. of gravel mines/pits.
- Promote use of buffers along waterways.
- Promote wetland restorations where practical and feasible using existing conservation programs (e.g. CRP, WRP, RIM, CREP)
- Reduce erosion and sedimentation in existing waterways.
- Promote active vegetation management activities.

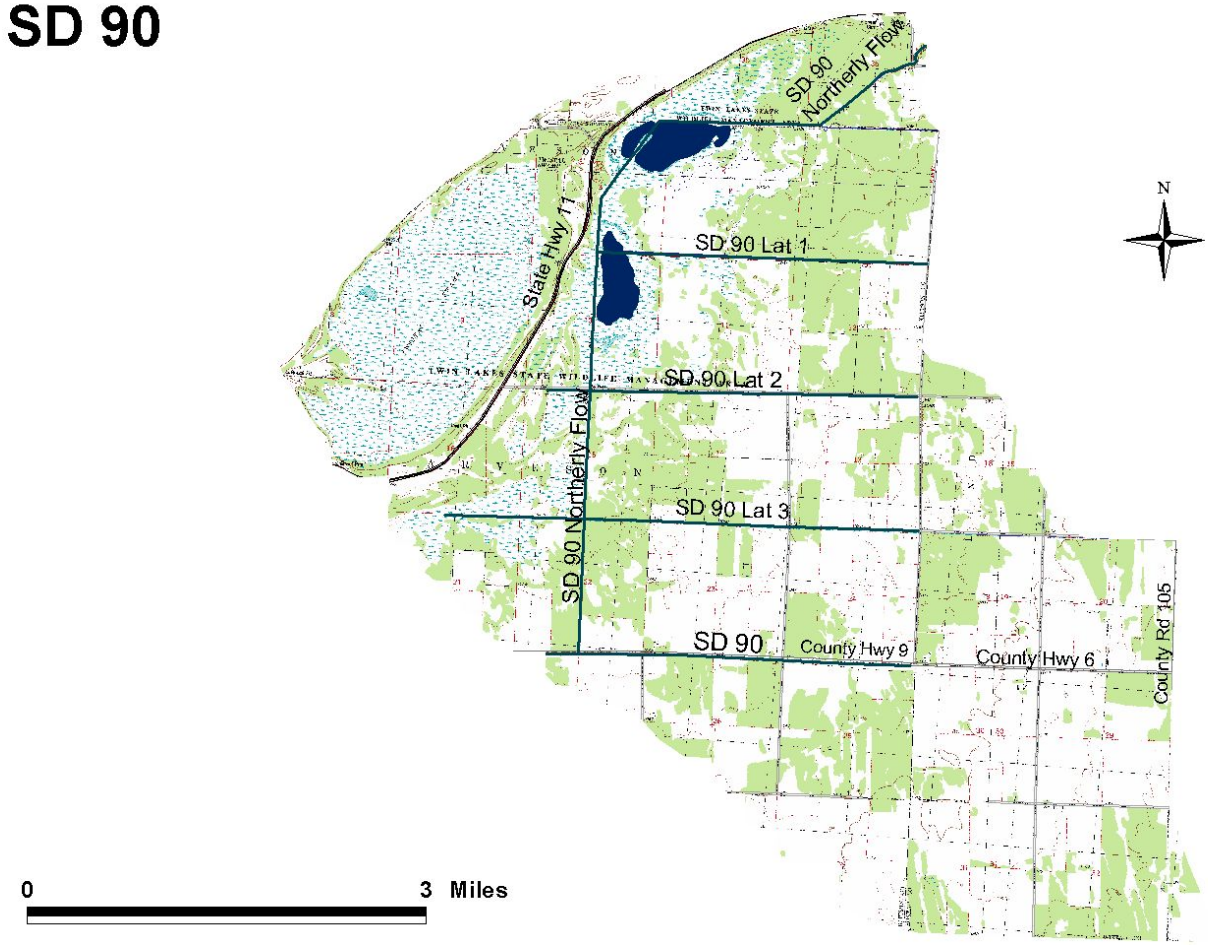
State Ditch #90 Subwatershed

A. Water Resources

1. Major Sub Watersheds

The State Ditch #90 subwatershed is located in the southeastern portion of Kittson County and the southwestern portion of Roseau County. The subwatershed comprises about 24 square miles. The area includes the Twin Lakes Wildlife Management Area and the Twistal Swamp, both under the ownership and management of the MN DNR Division of Wildlife. About ½ of the area is on the WMA and ½ is agriculture. Water from State Ditch #90 is a split flow, with some entering this subwatershed and some exiting the Two Rivers Watershed District and flowing south into the Tamarac system.

This subwatershed is entirely within the Red River Valley ecoregion. The geomorphologic regions within this area include the Lake Agassiz level Lacustrine and the Lake Agassiz Rolling Lacustrine classifications. The latter exists within the beach ridge area that Minnesota Highway 11 follows, between Karlstad and Greenbush. Soil textures vary between Coarse-loamy, Sandy, and Loamy-skeletal. Areas of peat generally less than 5 feet thick and underlain by clayey till are located in the Twistal Swamp and Twin Lakes areas. Till material consisting of silty and sandy soil with some gravel underlain by clayey till exists in the eastern portion of this subwatershed. Land use within the subwatershed is largely bog/marsh/fen, with areas of forested, and cultivated land.



2. Surface Water

The State Ditch #90 subwatershed is divided into three smaller subwatersheds. The State Ditch #90 ditch system, the Twistal Swamp area, and a smaller area to the south which drains into SD #90. State Ditch #90 begins on the Kittson & Roseau County line and flows westerly along the north edges of sections 25, 26, & 27 in Arveson Township of Kittson County. It then splits and a portion of the flow travels north into south Twin Lake, North Twin Lake, and outlets into the South Branch of the Two Rivers. The other split continues west for 2.5 miles and turns southwest, exiting the Two Rivers Watershed District and entering the Tamarac River flowage. Laterals 1, 2, and 3 of State Ditch #90 enter the main branch just south of the South Twin Lake. All three of these laterals flow from their origin near the county line easterly to outlet into the

main SD #90. Although the outlet for this subwatershed is the South Branch Two Rivers, there are no rivers present in the subwatershed.

Twistal Swamp is located in the northwest portion of this subwatershed and comprises upwards of 4 square miles. This beach ridge separates the Twin Lakes from the Swamp, but water transfer takes place underground through the ridge. There is no defined outlet for Twistal Swamp, but it has been documented that water seeps out to the north and also surface water exits to the west. Discussions have been held over the past few years between the DNR and the TRWD to possibly manage the water in the swamp by means of a controlled outlet. This would provide opportunities for both flood control and wildlife management.

The Twin Lakes consist of a south basin and a north basin. The lakes are shallow, open water wetlands with cattail and sedge marshes adjacent to and along the littoral areas. These lakes are only approximately 2' to 5' in depth and do not consistently support a fishery. Recreational opportunities that exist include waterfowl hunting, trapping, birdwatching, and canoeing, among others. The land area is part of the Twin Lakes Wildlife Management Area and as such the shorelines of these lakes are undeveloped.

Wetlands in the subwatershed increase in number size and diversity as one travels from east to west. The eastern 1/3 is largely drained and this is where most of the agricultural production takes place. In the central and western portions, land is controlled and managed by the DNR and thus wetlands have not been impacted to the extent as the eastern 1/3. Most of the wetlands are either type 2 or type 6.

Water quality monitoring has not been done by the District in this subwatershed. However, monitoring is done at one site immediately downstream and at other points further downstream. Monitoring has been done since 2000 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. There are no impaired stream reaches as identified by the Minnesota Pollution Control Agency in this subwatershed.

3. Groundwater

Generally, the geologic material is till, which is a heterogeneous mixture of ice deposited clay, silt, sand, and gravel. It is largely calcareous sandy clay containing scattered pebbles and cobbles. The upper 5 to 15 feet of till is commonly oxidized to a buff-tan color and is more permeable than the underlying unweathered gray till. Lenses of sand occur throughout the till. Thin, discontinuous deposits of clay, silt, sand, and peat overlie the till at numerous localities. The till section of the ground water reservoir is essentially saturated; however, locally dry zones can be found below the water table in areas of unusually well compacted till. Till aquifers are confined except for the shallow, permeable, oxidized zone.

Glacial drift aquifers in this area consist of a surficial beach and shoreline deposit, which is underlying the beach ridge upon which Minnesota Highway #11 follows, and an area of buried sand and silt lenses within till that consists of large amounts of clay associated with silt deposits. The surficial beach & shoreline deposit is predominantly fine to medium sand with lenses of fine to medium gravel. Deposits commonly form low beach ridges that range in height from less than five feet to as much as thirty feet. Widths of ridges range from a few hundred feet to about a half-mile. Beach ridges are highest and widest near local sources of surficial sand. At most places

beaches are underlain by clayey till. The beach deposits are from 0 to 30 feet thick, and can yield 20 gallons per minute or more. The saturated part of higher beach ridges ranges from 10 to 20 feet. Wells in lower beaches generally go dry in late summer, and the water in the deposit is unconfined. The water quality is suitable for domestic and stock use if not locally contaminated. The water is very hard, with total dissolved solids measurements generally less than 500 parts per million.

In the buried sand and silt lenses, the depth to the top of the aquifers is about 60 feet. The thickness of these aquifers ranges from 40 to 45 feet. Few data area available on well yields, however, well owners report adequate water for domestic uses and dairying. The aquifer is entirely saturated and confined under pressure. Head is about 50 feet above the top of the aquifer. Yields of wells estimated to range from less than 5 gallons per minute to more than 30 gallons per minute in both areas. The water quality of these aquifers is fair to good, suitable for both domestic and stock uses. Total dissolved solids generally are less than 1000 parts per million.

Two different bedrock aquifers exist in this subwatershed. One bedrock aquifer, located in the eastern 1/3 of the subwatershed, is made up of shale and sandstone. This is a dark gray, soft clay shale and coarse grained, poorly sorted, lignitic sandstone material. The aquifer thickness is less than 50 feet, and at most places the water yield to potential wells tapping sandstone would yield from 5 to 50 gallons per minute. The water quality is poor to good with soft to moderately hard water common. At places boron exceeds 3 parts per million making the water unsuitable for irrigation.

The other bedrock aquifer in the subwatershed is under the Twin Lakes and Twistal Swamp areas, and is a limestone, mudstone, sandstone, and shale bedrock aquifer. There are three units of this aquifer, with the upper unit consisting of limestone and calcareous mudstone about 235 feet thick. The top 135 feet consists of cherty, slightly dolomitic yellow and tan limestone. These limestones contain solution openings which are especially abundant in the upper 40 feet. The lower 100 feet consists of clayey and silty limestone and dolomitic mudstone. These rocks have a dense texture. Color varies from dark gray and brown to purple. The middle unit consists of white, well sorted medium grained sandstone about 70 feet thick. The lower unit consists of varicolored shale and a few beds of poorly sorted sandstone.

Water yields in the bedrock aquifers range from less than 5 gallons per minute to more than 60 gallons per minute from flowing wells. Much greater yields could be developed. The most productive aquifers occur in the upper porous zone in the dolomitic limestone and in the middle sandstone unit. Water quality is poor, consisting of brine and highly saline water, unsuitable for nearly all uses. Total dissolved solids are greater than 35,000 parts per million in the lower part of the Paleozoic rocks.

4. Natural Resources and Unique Water & Land Related Resources

Existing Resources: Quality natural resources features are relatively common in this sub watershed. About 50 percent of the landscape is in few large habitat blocks and conservation lands in this sub-watershed (Twin Lakes WMA and Twistal Swamp WMA). A few tracts of CRP lands are also present. Increasing connectivity between existing grasslands, wetlands, brushlands, and woodlands in this sub watershed would provide significant benefits to the existing features.

The waterways in this subwatershed flow into the Ditch 90 which flows into the South Branch Two Rivers. Almost all natural waterways have been converted to ditches. The remaining natural waterways and the ditches provide some fish and aquatic habitat, but most of these are

probably limited to seasonal use. Small waterways here are likely to provide spawning and rearing habitat for northern pike and a limited variety of other species. Flashy flows, susceptibility to extended low flow or no flow periods, unstable channels, and a lack of riparian habitat limit the function of these aquatic resources.

In addition to these general habitat features, 51 Natural Heritage elements have been documented in this sub watershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated "outstanding resource value waters" or "critical vegetated habitat" as defined in state statutes have been found in this sub-watershed.

Resource improvement opportunities: The potential to improve fish and wildlife habitat in this subwatershed is good. In particular, actions should be taken to protect existing upland habitats (grassland, wetland, brushlands, woodlands), protect existing stable waterways, and stabilize existing unstable waterways. Land use changes, wetland restorations, and impoundments could be sited near the upper reaches of waterways in this watershed to reduce runoff during high flow periods and augment base flows during low flow periods.

B. Water Use

1. Surface & Ground Waters

The City of Karlstad is not physically located within this subwatershed, but the possibility exists that the groundwater within this area interacts with or influences the city's wells. The TRWD lacks sufficient information to make any determination. Further information should be requested from the City of Karlstad, the MN Geological Survey, the Kittson County CLWP, or other state and federal agencies with groundwater related information.

There are no municipal wastewater treatment systems within this subwatershed. Individual farm residences rely on individual sewage treatment systems to dispose of sewage waste water.

Several farmsteads are located in the subwatershed, and most rely on wells for their source of domestic water. Also, several livestock operations rely on wells as source of water.

Surface water in the area is not largely used. Most ditches and other waterways in the area are intermittent. The Twistal Swamp and Twin Lakes are not used for water appropriations. It is possible that appropriations could be made from these areas in times of drought to provide for livestock or low flow augmentation of streams.

C. Existing Conditions, Related Potential Problems, and Solution Alternatives [Assessments & Issue Identification]

The following issues were discussed at public meeting held at Lake Bronson State Park to specifically hear comments on the State Ditch #91 subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ Seepage from Twin Lakes into Twistal Swamp and seepage from the ridge area after heavy precipitation was the number one ranked issue. This was identified as a problem particularly during summer rain events. Twistal Swamp impacts cropland in the immediate area and adds water to the downstream systems.
- ✓ Beaver dams on ditch systems and other waterways were the number two ranked issue. This is a problem on the SD #90 system in particular and the dams also affect cropland in the Twistal Swamp and Twin Lakes areas.
- ✓ Flood damages to croplands and pastures ranked #3. This is particularly a problem northwest of the ridge.
- ✓ A number of homes are located in low areas north and east of the City of Karlstad. These need to be looked at to avoid flood damages to these residences.
- ✓ Road damages were ranked number five, and of particular concern is an area in the northwest corner of section 26, Arveson Township. Also mentioned was the potential for road damages downstream in Springbrook Township.
- ✓ The number 6 issue was that water levels seem to be too high in Twin Lakes. This was attributed to beaver dams and also to excessive rainfall.
- ✓ Overland flooding and seepage affecting residential homes north of the Karlstad golf course is a moderate problem.
- ✓ Bad odors in well water was the number 8 issue. This could be addressed with testing of private wells.
- ✓ The final issue listed was that the water in Twin Lakes was not present prior to the 1980's. This is a problem in periods of drought.
- ✓ Natural resources related issues that were identified included potential erosion concerns on the downstream Kittson CD #10 ditch system, water quality issues, rough fish getting into the Twin Lakes having a negative effect on waterfowl production, recreational opportunities within Twin Lakes, and too many mosquitoes.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Flood Water Detention: Temporary storage of flood water until after the flood.

Flood Water Retention: Semi-permanent storage of flood water for other beneficial use such as water supply, wetlands, or recreation.

Diversion Channels: Channels constructed to provide an alternate or additional route for stream flows.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control (meter) the flow of water.

Watershed Treatment: Implement land management practices that reduce runoff potential.

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

WATERSHED DISTRICT PROJECTS:

The District has been approached by the Minnesota DNR to investigate a potential wildlife and flood control project to be located at Twistal Swamp, in sections 4, 8, 9, 16, &17 of Arveson Township. Preliminary investigations and discussions have taken place, and the project has been looked at by the Mediation Project Work Team. Further investigations are needed before this project can proceed.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Wetland Restoration: See above.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, impoundments, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Specific NRE Alternatives:

- Water level management for wildlife and flood damage in the Twin Lakes WMA is limited by the current condition of Ditch 90. Effected landowners should work with the ditch authority and DNR to resolve these issues.
- Promote combination FDR/NRE project in the Twistal swamp area. Review DNR management of existing control structure.
- Promote use of buffers along waterways.
- Promote wetland restorations using existing conservation programs (e.g. CRP, RIM, WRP)
- Reduce erosion and sedimentation in existing waterways.
- Promote active vegetation management activities.

NORTH BRANCH AT LANCASTER SUBWATERSHED

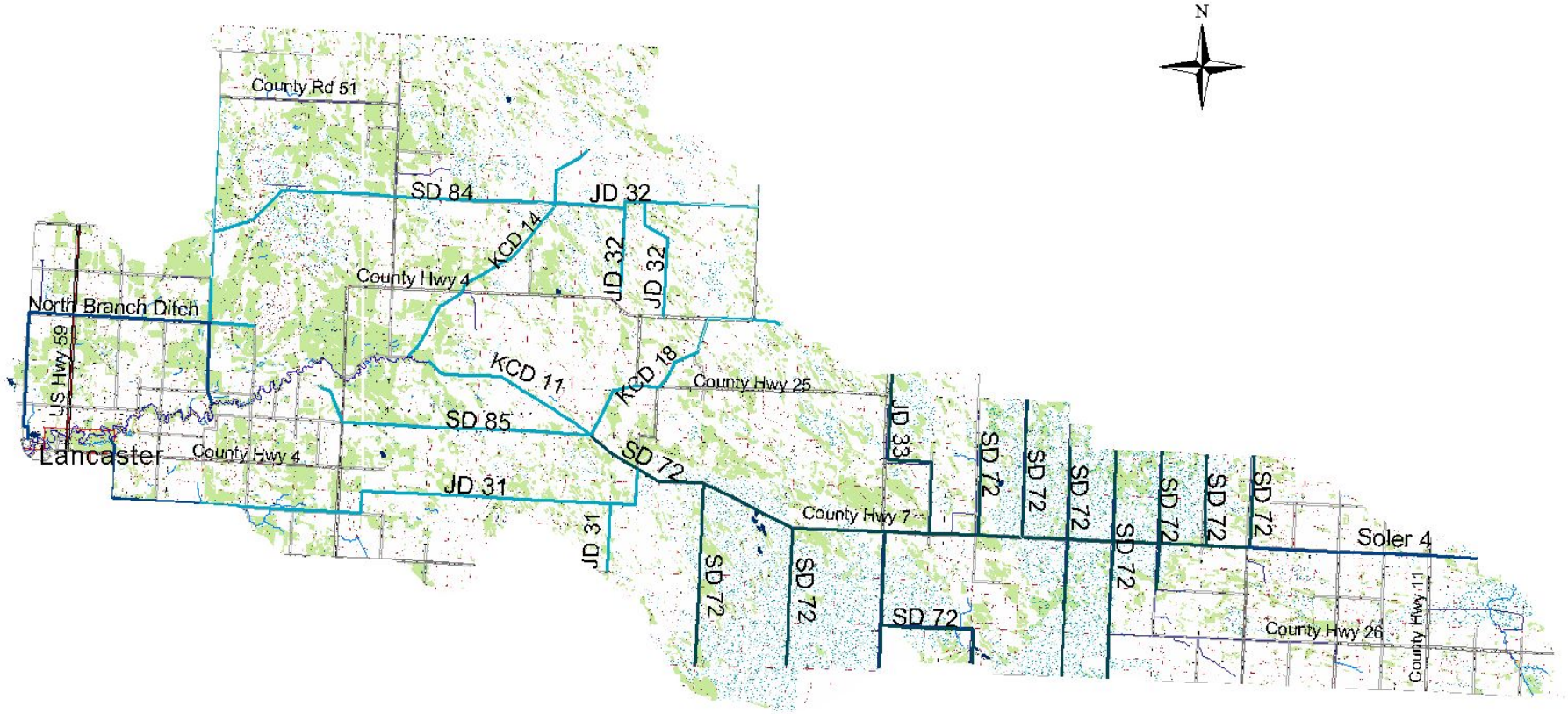
A. Water Resources

1. Major Sub-Watersheds of the District

The North Branch at Lancaster subwatershed comprises approximately 254 square miles within parts of 9 different townships in Roseau and Kittson Counties. The drainage area includes the Soler #4, State Ditch #72, State Ditch #85, State Ditch #84, Judicial Ditch #31, Judicial Ditch #32, Kittson County Ditch #11, #14, & #18 systems. Each of these systems outlet into the North Branch of the Two Rivers upstream of the City of Lancaster. The upper end of the subwatershed originates in Moose Township of Roseau County, and passes through Soler & Juneberry Townships in Roseau County, and Caribou, McKinley, St. Joseph, Klondike, Peatland, Cannon, and Poppleton Townships of Kittson County.

The upstream and northern portions of this subwatershed are located in the Northern Minnesota Wetlands ecoregion. The downstream, western reaches of the subwatershed are located in the Red River Valley ecoregion. Aspen parklands also exist in the eastern and northern areas. Soils within this subwatershed consist of coarse – loamy and fine – loamy in the east to sandy in the

North Branch @ Lancaster



west with pockets of sapric soils interspersed. The geomorphologic features that are present include areas of organic peat deposits associated with the wetland areas, Lake Agassiz level lacustrine areas, and Lake Agassiz rolling lacustrine lobes.

The land use of the subwatershed is very diverse, ranging from large areas of bog/marsh/fen to areas of cultivated land to brushland / forested to hay / pasture to cultivated. In short, this subwatershed is one of the most diverse subwatersheds within the District, and therefore many land management opportunities exist for both flood control and natural resources.

2. Surface Waters

The North Branch at Lancaster subwatershed is comprised of approximately 23 smaller subwatersheds. Included in these are several legal ditch systems as mentioned above. In the upstream areas most of the flow is channelized into the State Ditch #72 system, which flows from Roseau County into Kittson County. SD #72 outlets into the SD #85 system about six miles west of the county line, and SD #85 outlets into the North Branch Two Rivers about 5 miles east of the City of Lancaster. Along the northern ½ of this subwatershed, the SD #84 system carries water through Caribou, McKinley, and St. Joseph Townships. This system outlets into the North Branch in two locations, one at Lancaster, and one 3 miles upstream (east) of Lancaster. Several County ditches, coulee systems, and private ditches also are tributary to the main systems just described.

As stated, a portion of this subwatershed is located in the Northern Minnesota Wetlands ecoregion. As such, a large area located near the upstream end of the subwatershed is mostly wetlands. Other areas of wetlands exist in the central and northern areas of the subwatershed. Wetland sizes, types, and integrity range from very pristine to drained basins. A large proportion of the wetlands are of the type 2 and type 6 variety.

Water quality monitoring has been done by the District at four locations in this subwatershed. One site is on State Ditch #72, one on the North Branch Two Rivers about 9 miles east of Lancaster, one on the North Branch Two Rivers just downstream of Lancaster, and one at the outlet of the Skull Lake wildlife impoundment on State Ditch #84. Monitoring has been done since 1991 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. The North Branch Two Rives from Lancaster to about 9 miles east is an impaired stream reach as identified by the Minnesota Pollution Control Agency. The affected use of the impairment is aquatic life and the indicator is biota.

3. Groundwater

The general soils material that makes up this subwatershed consists of till in the eastern and northeastern areas, peat in the central areas, and sand in the central and western areas. The till is silty and sandy with some gravel, underlain by clayey till. Small areas of peat in the eastern part of the basin exist. Till has slow drainage with the water table at or near the surface. The peat is characterized by being generally less than 5 feet thick, underlain by clayey till, and located in the central part of the basin. Peat is poorly drained, with the water table either at or near the surface. Sand areas are generally less than 5 feet thick, are underlain by clayey till, and located in the west

central part of the basin. Many small areas of peat are located within the sand areas. The sand has moderate surface runoff, and is well drained by natural channels.

Generally, the geologic material is till, which is a heterogeneous mixture of ice deposited clay, silt, sand, and gravel. It is largely calcareous sandy clay containing scattered pebbles and cobbles. The upper 5 to 15 feet of till is commonly oxidized to a buff-tan color and is more permeable than the underlying unweathered gray till. Lenses of sand occur throughout the till. Thin, discontinuous deposits of clay, silt, sand, and peat overlie the till at numerous localities. The till section of the ground water reservoir is essentially saturated; however, locally dry zones can be found below the water table in areas of unusually well compacted till. Till aquifers are confined except for the shallow, permeable, oxidized zone.

Glacial drift aquifers in the North Branch at Lancaster include the buried sand and clay lens within till, which consist of lenses of sand, silty clay, and gravel in till. Test holes in the eastern part penetrated 10 feet of sand and gravel at depth from 45 to 55 feet below land surface. Few data is available on yield, however well owners report supplies are adequate. The aquifer is confined, and a few wells are flowing wells. The water quality of the aquifer is suitable for domestic and agricultural purposes. The water quality is very hard with iron content 1 to 5+ parts per million and total dissolved solids less than 1000 parts per million.

One other glacial drift aquifer occurs in the western 1/3 of the sub watershed, and this is the surficial channel outwash. This consists of lenticularly bedded deposits of sand, gravel, and clay. Deposits are largely silt and clay along the west edge of the channel. The thickness of this aquifer is 280+ feet. Yields of 1000 gallons per minute can be developed from thick coarse part of the aquifer. Yields of 50 to more than 100 gallons per minute can be developed from sand zone near Lancaster. The deposit is saturated below 5 feet. The aquifer is largely unconfined except along the western margin. Water quality is good – suitable for domestic, stock, and irrigation uses. The water is very hard, containing as much as 5 parts per million iron. Water from deeper wells contains hydrogen sulfide gas. Dissolved solids generally are less than 500 parts per million.

Bedrock aquifers of this area are 1) shale and limestone, 2) limestone, mudstone, sandstone, and shale, and 3) granite. The granite's upper surface is the base of the ground water reservoir, and is not water bearing. The shale and sandstone aquifer consists of dark gray, soft clay shale and coarse grained, poorly sorted, lignitic sandstones. The thickness of this aquifer is less than 50 feet, and at most places yields to potential wells tapping sandstone would yield 5 to 50 gallons per minute. The water quality ranges from poor to good. The water is commonly soft to moderately hard, and at places boron exceeds 3 parts per million making the water unsuitable for irrigation.

The limestone, mudstone, sandstone, and shale bedrock aquifer consists of three units – an upper, middle, and lower. The upper unit consists of limestone and calcareous mudstone about 235 feet thick. The top 135 feet consists of cherty, slightly dolomitic yellow and tan limestone. These limestones contain solution openings which are especially abundant in the upper 40 feet. The lower 100 feet consists of clayey and silty limestone and dolomitic mudstone. These rocks have a dense texture. Color varies from dark gray and brown to purple. The middle unit consists of white, well sorted medium grained sandstone about 70 feet thick. The lower unit consists of varicolored shale and a few beds of poorly sorted sandstone. The thickness of the entire aquifer can be from 0 to 500 feet. Yields rage from less than 5 gallons per minute to more than 60 gallons per minute from flowing wells. Much greater yields could be developed. Most productive aquifers occur in the upper porous zone in the dolomitic limestone and in the middle sandstone unit. The water quality is poor, consisting of brine and highly saline water, unsuitable

for nearly all uses. Total dissolved solids greater than 35,000 parts per million exist in lower part of Paleozoic rocks.

4. Natural Resources and Unique Water & Land Related Resources

Existing Resources: Land use changes have altered the quantity and quality of some of these habitats but those that remain can support diverse fish, wildlife, and related natural resources. Some of the most diverse and unique habitats in the entire Two Rivers watershed are found in this subwatershed. These habitats on public and private lands include large contiguous tracts of native prairie/brush prairie, large contiguous wet prairies (i.e. sedge meadows, etc), and the dry prairies and sand dunes found in Skull Lake and Caribou WMA's. These terrestrial habitats provide seasonal and year round support to elk, moose, deer, sandhill crane, marbled godwit, Wilson's Phalaropes, a variety of rails and bitterns (especially the yellow rail), sharp-tailed and ruffed grouse, and many other species. Recreational opportunities include hunting, trapping, canoeing, bird watching and others.

Some of the best remaining stream and aquatic habitat in the entire Two Rivers Watershed is also found in this sub watershed. This reach of the North Branch Two Rivers is a relatively stable sinuous channel with an intact riparian area that supports a small but diverse fish population. Diversity and abundance of fish populations are limited by extended periods of low flow and downstream structures that may inhibit fish passage to this reach.

Harvesting of aspen and farming are the major activities involving renewable resources within this subwatershed. Farming practices range from traditional harvesting of small grains to cattle – pasture – haying operations. Also, unique to this subwatershed is the harvesting of native grass seed.

In addition to these general fish and wildlife features, 139 Natural Heritage elements have been documented in this subwatershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated "outstanding resource value waters" or "critical vegetated habitat" as defined in state statutes have been found in this sub-watershed.

With good stewardship, the integrity of these resources can be maintained or improved. The natural resource enhancement alternatives section found below lists a variety of strategies to help maintain and improve the remaining natural resources in this sub watershed.

Resource improvement opportunities: The water quality monitoring program will be utilized to assess the current condition of waters identified as being impaired and formulate strategies to address the issue.

B. Water Use

1. Surface & Ground Waters

There are no known major users of surface water within this subwatershed. Riverside Golf Course, located north of the City of Lancaster along the North Branch of the Two Rivers, appropriates water from the river for irrigating the golf course. This occurs between the months of May and September. Water appropriation reports are on file with the Minnesota DNR,

Division of Waters. Other surface water users include a few livestock operation which may utilize either the river or ponds as a source of water. The City of Lancaster operates a 2 stage lagoon for collection of its wastewater. This lagoon outlets into the State Ditch #84 system which in turn outlets into the North Branch Two Rivers. The City also maintains one direct storm sewer outlet to the North Branch Two Rivers.

Groundwater use in the subwatershed is limited. In the past, the City of Lancaster operated wells for its source of water supply. The City has discontinued use of these wells and they have been sealed. Presently the City water supply comes from the North Kittson Rural Water System, which operates water supply wells near Lake Bronson, in the South Branch at Lake Bronson subwatershed. Several rural farmsteads in this subwatershed utilize wells for their source of water supply. It is not known the number or density of private wells.

C. Existing Conditions, Related Potential Problems, and Solution Alternatives [Assessment & Issue Identification]

The following issues were discussed at public meeting held at Lancaster to specifically hear comments on the North Branch at Lancaster subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ The number one issue for the subwatershed was the potential for the Roseau River to overflow and enter into the North Branch at Lancaster subwatershed from the north. This occurs frequently during high runoff events, mainly during the springtime.
- ✓ Crop losses, damage to hay land, and pasture damage were the number two ranked issues.
- ✓ Township and County road washouts, ranked number 3, were noted as a high problem and occur specifically along the north and south banks of State Ditch #84 and also in sections 1 and 12 of Poppleton Township.
- ✓ Debris in the river channel is restricting flow. This was listed as a moderate problem that occurs along the main river channel.
- ✓ Beaver dams causing water to flow overland from JD #32 and SD #84 in the Skull Lake and Horseshoe Lake areas were identified as the number 5 ranked issue. It was noted that landowners, township officials, TRWD, DNR, and The Nature Conservancy should work together to identify mutually beneficial solutions.
- ✓ Agricultural ditching by private landowners in the upstream areas has added to the flooding problem. Specific reference was made to ditches previously installed on land that has now been purchased by The Nature Conservancy. It was noted to work with TNC on this issue.
- ✓ Drought concerns and flashy stream flows were both identified and ranked as the number 7 issue. These were viewed as low in severity.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Drainage Ditches: Channels constructed to collect surface runoff and convey it to a point downstream

Flood Water Detention: Temporary storage of flood water until after the flood.

Flood Water Retention: Semi permanent storage of flood water for other beneficial use such as water supply, wetlands, or recreation.

Diversion Channels: Channels constructed to provide an alternate or additional route for stream flows.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control (meter) the flow of water.

Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

Watershed Treatment: Implement land management practices that reduce runoff potential.

WATERSHED DISTRICT PROJECTS:

The District, in cooperation with the Kittson SWCD and the Natural Resources Conservation Service installed a water management and flood control project under the federal PL – 566 program in the late 1960's. This project, known as the North Branch Project, is located in St. Joseph and Poppleton Townships, northeast of Lancaster, Minnesota. This project installed 11.13 miles of channel improvements on two different legal ditch systems, two grade stabilization structures to provide erosion control, and one single purpose wildlife structure. The channel improvement measures provide protection from 10 year frequency discharges and help reduce damages from higher frequency discharges.

One water management structure is present in the area, known as Skull Lake. This consists of a dike system, outlet structure, and emergency spillway, located in St. Joseph Township of Kittson County. The structure was installed as a part of a federal PL 566 project and was completed in September of 1969. Partners in this project were the Two Rivers Watershed District, Natural Resources Conservation Service, MN Department of Natural Resources, and Kittson County Soil & Water Conservation District. The impoundment covers 351 acres at elevation 974.2 msl, and 590 acres at elevation 977.1 msl. The structure is located on SD #84.

The Soler #4 project is a 5 mile long ditch system upstream of State Ditch #72, located in Soler Township. The ditch was built in 1979 as a result of a petition from landowners to the District. The project purpose was for flood control and to provide agricultural drainage.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Specfic NRE alternatives

Skull Lake impoundment: Work with the DNR Division of Wildlife to reconsider the design and operation of this existing PL-566 project to increase temporary storage capacity and enhance wildlife habitats.

Vegetative management: Work with other agencies to provide information and education on the value and need to actively manage grasslands, wetlands, shrublands, and woodlands for wildlife (e.g., prescribed burns, mowing, grazing, etc)

LITTLE JOE DIVERSION

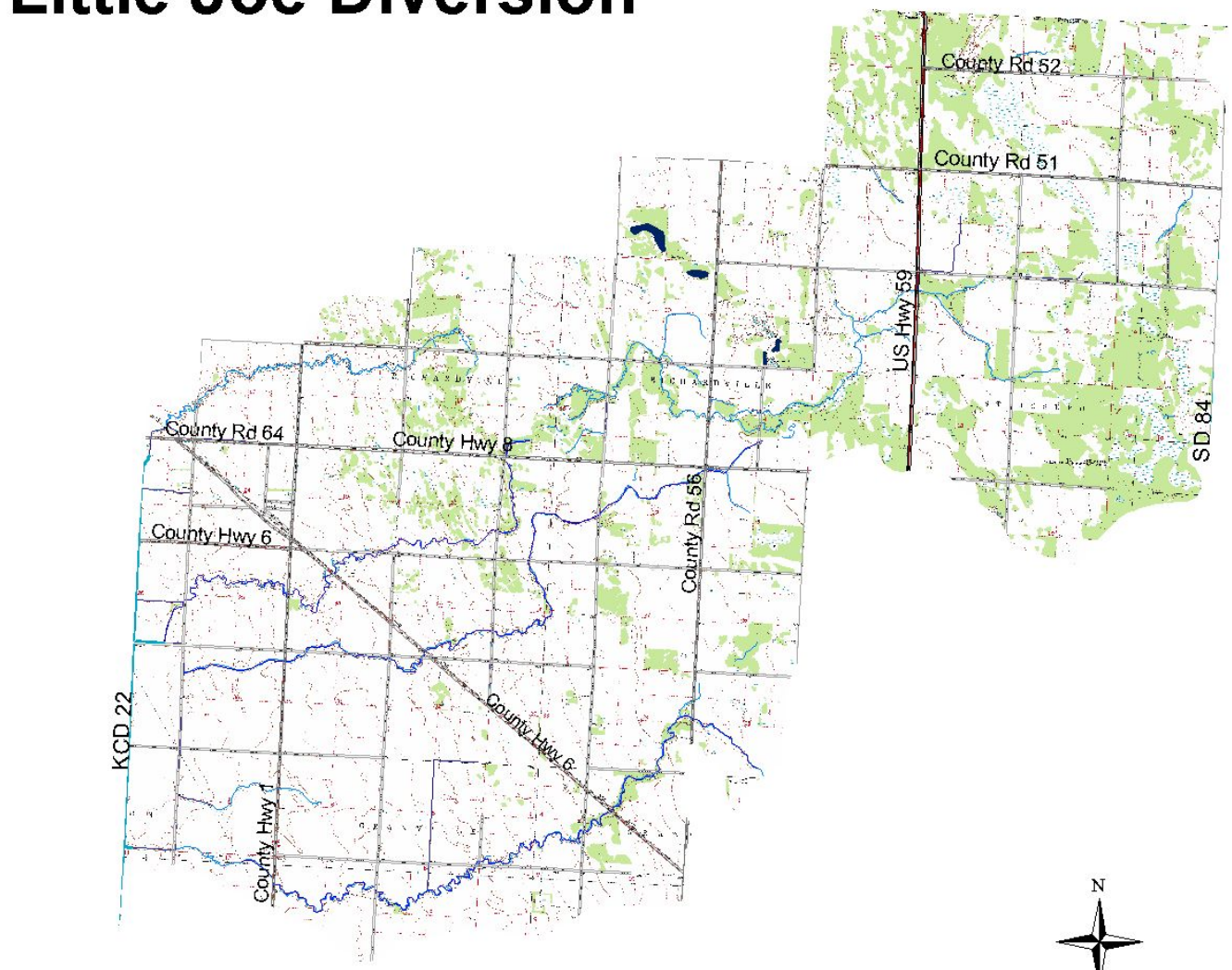
A. Water Resources

1. Major Sub Watershed Areas

The Little Joe Diversion consists of approximately 61 square miles of drainage area. The subwatershed consists of the Little Joe River and three other intermittent coulee systems. Most of these systems originally flowed west to outlet into the Joe River, but were diverted by the construction of Kittson County Ditch #22, which cut off the four systems and brought the water directly south into the North Branch Two Rivers. These coulee systems are characterized by ridges in the upstream areas with steeper slopes. The downstream ends of the waterways flatten out to generally less than 5 feet of drop in one mile.

The geomorphology of the Little Joe Diversion consists of mainly Lake Agassiz Level Lacustrine formations, with intermittent Lake Agassiz Rolling Lacustrine deposits associated with remnant beach ridges. Soil textures of this subwatershed range from sandy in the eastern areas (with small areas of sapric soils) to very fine in the western areas. A narrow band of coarse – loamy soils separates the eastern till areas from the western lake plain. The subwatershed is located entirely within the Red River Valley ecoregion, and the land use is predominantly cultivated land. However, some forest and grassland occurs in the upstream areas to the east.

Little Joe Diversion



2. Surface Waters

The Little Joe Diversion consists of several natural watercourses which all outlet in to Kittson County Ditch #22. Of these, an unnamed coulee arises in sections 8 and 9 of Richardville Township and flows westward about 4 miles to outlet into the upper end of CD #22. Another coulee, known as the Little Joe River, begins in section 1 of Richardville Township and travels approximately 11 miles to outlet into CD #22. Yet another unnamed coulee arises in section 27 of Richardville Township and travels approximately 4 miles, outletting into CD #22 in section 35 of Clow Township. The final coulee begins in section 25 of Richardville Township and travels about 8.5 miles to CD #22, outletting in section 11 of Hampden Township.

County Ditch #22 begins at the north end of section 23, Clow Township and travels straight south a distance of 4.75 miles, outletting into the North Branch Two Rivers in section 11 of Hampden Township. This ditch is the boundary between the Two Rivers Watershed District and the Joe River Watershed District. All of the above mentioned coulees flowed west to the Joe River before CD #22 was constructed.

No naturally occurring lakes occur in the Little Joe Diversion. However, a series of large pits have been excavated for the purpose of mining gravel. These are located in sections 3, 10, and 11 of Richardville Township. One of the pits is known as the Lost River Lake.

Wetlands within this subwatershed are more densely located in the eastern portion of the subwatershed, and are interspersed uniformly. Density noticeably decreases going from east to west. Most of the wetlands are either a type 2, type 6, or type 7 as identified by the U.S. Fish & Wildlife Service. A type 2 is identified as an inland fresh meadow, characterized by having soil without standing water during most of the growing season, but is saturated below the surface. Vegetation includes grasses, sedges, rushes, and various broad leaved plants. Type 6 wetlands are shrub swamps. The soil is usually waterlogged during much of the growing season, and is often covered with as much as six inches of water. Vegetation includes alders, willows, buttonbush, dogwoods, leather leaf and swamp-privet. Type 7 wetlands are forested swamps. The soil is waterlogged to within a few inches of the surface during the growing season, and can be covered with as much as a foot of water. Typical vegetation includes tamarack, white cedar, arborvitae, black spruce, balsam, red maple and black ash.

There are no water management structures located in this subwatershed. The only legal ditch located in the area is CD #22. However, several private ditches and road ditches exist and carry water during times of runoff.

Water quality monitoring has not been done by the District in this subwatershed. However, monitoring has been done at several sites downstream since 1991 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. There are no impaired stream reaches as identified by the Minnesota Pollution Control Agency in this subwatershed.

3. Groundwater

Lithologic characteristics of this area range from a surficial channel outwash area in the northeast to a band of till through the central areas to lake clays in the west. The surficial channel outwash is characterized by lenticularly bedded deposits of sand, gravel, and clay. Deposits are largely silt and clay along the west edge of the channel. The thickness of this aquifer is 280+ feet. Yields of 1000 gallons per minute can be developed from thick coarse part of the aquifer. Yields of 50 to more than 100 gallons per minute can be developed from sand zone near Lancaster. The deposit is saturated below 5 feet. The aquifer is largely unconfined except along the western margin. Water quality is good – suitable for domestic, stock, and irrigation uses. The water is very hard, containing as much as 5 parts per million iron. Water from deeper wells contains hydrogen sulfide gas. Dissolved solids generally are less than 500 parts per million.

The till is characterized by a heterogeneous mixture of ice deposited clay, silt, sand, and gravel. It is largely calcareous sandy clay containing scattered pebbles and cobbles. The upper 5 to 15 feet of till is commonly oxidized to a buff-tan color and is more permeable than the underlying unweathered gray till. Lenses of sand occur throughout the till. Thin, discontinuous deposits of clay, silt, sand, and peat overlie the till at numerous localities. The till section of the ground water reservoir is essentially saturated, however, locally dry zones can be found below the water table in areas of unusually well compacted till. Till aquifers are confined except for the shallow, permeable, oxidized zone.

The area of lake clay in the west is composed of gray to blue gray clay that is plastic, dense, and contains lenses of silt and very fine sand. Small areas of lake clay occur locally in the till area. The clay layers a between 0 and 150 feet thick. The clay yields no water to wells. Silt and very fine sand lenses yield less than one gallon per minute to large diameter dug wells. These wells commonly go dry during late summer and fall. The water quality is poor with a salty, bitter taste. It is unsuitable for human consumption. Chloride content generally is 500 to 1000 parts per million and total dissolved solids exceed 2000 parts per million in water from shallow wells.

Bedrock aquifers in this subwatershed are a shale and sandstone in the extreme northeastern areas and a limestone, mudstone, sandstone, and shale aquifer over the rest of the area. The shale and sandstone aquiver is a dark gray, soft clay shale and coarse grained, poorly sorted, lignitic sandstone, less than 50 feet thick. At most places yields to potential wells tapping sandstone would yield 5 to 50 gallons per minute. The water quality ranges from poor to good. The water is commonly soft to moderately hard, and at places boron exceeds 3 parts per million making the water unsuitable for irrigation.

The limestone, mudstone, sandstone, and shale bedrock aquifer consists of three units – an upper, middle, and lower. The upper unit consists of limestone and calcareous mudstone about 235 feet thick. The top 135 feet consists of cherty, slightly dolomitic yellow and tan limestone. These limestones contain solution openings which are especially abundant in the upper 40 feet. The lower 100 feet consists of clayey and silty limestone and dolomitic mudstone. These rocks have a dense texture. Color varies from dark gray and brown to purple. The middle unit consists of white, well sorted medium grained sandstone about 70 feet thick. The lower unit consists of varicolored shale and a few beds of poorly sorted sandstone. The thickness of the entire aquifer can be from 0 to 500 feet. Yields rage from less than 5 gallons per minute to more than 60 gallons per minute from flowing wells. Much greater yields could be developed. Most productive aquifers occur in the upper porous zone

in the dolomitic limestone and in the middle sandstone unit. The water quality is poor, consisting of brine and highly saline water, unsuitable for nearly all uses. Total dissolved solids greater than 35,000 parts per million exist in lower part of Paleozoic rocks.

4. Natural Resources and Unique Water & Land Related Resources

Land use changes have altered the quality and quantity of natural resources in this sub watershed. Agricultural lands are common in the western and southern portions of this subwatershed while some large blocks of grassland and woodland habitats are common in the northern and eastern portions of this subwatershed. A beach ridge runs through this subwatershed and some gravel pits are present. Some wetland areas remain but most areas have been drained (see MCEA report). An overall lack of large habitat blocks and a lack of connectivity between existing grasslands, wetlands, brushlands, and woodlands limit the function of the terrestrial habitats in this subwatershed.

The waterways in this subwatershed flow into Kittson county Ditch 22 which in turn flows into the North Branch of Two Rivers. Many natural waterways have been converted to ditches. The remaining natural waterways and the ditches provide some fish and aquatic habitat but most of these are probably limited to seasonal use. Small waterways here are likely to provide spawning and rearing habitat for northern pike and a limited variety of other species. Flashy flows, susceptibility to extended low flow or no flow periods, unstable channels, and a lack of riparian habitat limit the function of these aquatic resources.

Gravel mining and logging of aspen are the main activities relative to renewable and non renewable resources in this subwatershed. There is potential to do reclamation activities in old gravel pits not in use anymore.

In addition to these general habitat features, twenty one natural heritage elements have been documented in this subwatershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated “outstanding resource value waters” or “critical vegetated habitat” as defined in state statutes have been found in this sub-watershed.

B. Water Use

1. Surface & Ground Waters

There are no major cities or villages within this subwatershed, and therefore there are no major water users of either surface or groundwater. A few on farm wells exist in the eastern areas. Most farms are served by the North Kittson Rural Water system, which operates wells located in the Lake Bronson area. Most waterways are intermittent in nature, drying up during the summer months. Most farmsteads utilize individual sewage treatment systems for the disposal of their wastes.

C. Existing Conditions, Related Potential Problems, and Solution Alternatives [Assessment & Issue Identification]

The following issues were discussed at public meeting held at Lancaster to specifically hear comments on the Little Joe Diversion subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ Water that once drained to Canada now flows west and then south into the Kittson County Ditch #22 system. This was identified as due to culvert restrictions and beaver dams, and was ranked as the number 1 issue for this subwatershed.
- ✓ Water overflows from the State Ditch #84 system add to the problems stated above. This was the number 2 issue, and was perceived to be of greater importance when runoff exceeds 5".
- ✓ A dike and / or road that was built in Canada is restricting the natural flow to the northwest from this subwatershed. This issue was the ranked number 3.
- ✓ Overland flooding, especially in the area of CD 22 and causing water quality problems in gravel pits.
- ✓ Losses to agricultural land due to flooding and excessive rainfall, including crop losses, damaged hay land, and damaged pasture land (including damage to fences).
- ✓ Damage to infrastructure, including township and county roads, and associated culverts and bridges.
- ✓ Beaver dams cause backup of water and related flooding on the Little Joe River and other intermittent waterways.
- ✓ Inconsistent culverts sizes for subwatersheds. Generally, culverts in upstream areas should be of a smaller size and proportionately increased as water travels downstream, according to drainage area. Culverts need to be inventoried, analyzed and changed appropriately.
- ✓ Ineffective ditch systems. Legal, private, and road ditches should be analyzed and maintained to handle excessive flows.
- ✓ Interaction between surface and ground water could affect levels in gravel pit lakes. This was an issue relating to drought, and was ranked number 10.
- ✓ Relating to flood damages, access to gravel pits is limited. Access points should be built up and maintained.
- ✓ During drought and dry years, water supply for livestock producers is a concern.
- ✓

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be

completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Drainage Ditches: Channels constructed to collect surface runoff and convey it to a point downstream

Flood Water Detention: Temporary storage of flood water until after the flood.

Flood Water Retention: Semi permanent storage of flood water for other beneficial use such as water supply, wetlands, or recreation.

Agricultural Levees: Dikes constructed to defend crop land

Diversion Channels: Channels constructed to provide an alternate or additional route for stream flows.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control (meter) the flow of water.

Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

Watershed Treatment: Implement land management practices that reduce runoff potential.

WATERSHED DISTRICT PROJECTS

A petition was received in 2001 from landowners to improve Kittson County Ditch #22 by enlarging it to handle inflows from upstream areas. In 2002, an engineer's report was completed and it was discovered that there was not an adequate outlet for an improvement. At the request of Kittson County and local landowners, the District is completing a feasibility study for an upstream impoundment in Richardville Township.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Resource improvement opportunities: The potential to significantly improve fish and wildlife habitat in this subwatershed is good. In particular, actions should be taken to protect existing upland habitats (grassland, wetland, brushlands, forests), create some large habitat blocks, restore & reclaim gravel pits, protect existing stable waterways, and stabilize existing unstable waterways.

Specific NRE Alternatives:

- Increase the average width of the natural habitat corridor along the river.
- Create at least one large habitat block near the river corridor.
- Monitor water quality.
- Promote use of buffers along waterways.
- Promote wetland restorations using existing conservation programs (e.g. CRP, WRP)
- Reduce erosion and sedimentation in existing waterways.
- Promote active vegetation management activities.
- Promote BMP's to improve water quality.

NORTH BRANCH AT OUTLET

A. Water Resources

1. Major Sub Watersheds

The North Branch at Outlet subwatershed is located mainly to the south and west of the City of Lancaster, and is drained by the portion of the North Branch Two Rivers that is between Lancaster and the confluence of the North Branch and the Main Stem Two Rivers. The subwatershed can be broken into 8 smaller subwatersheds, which are made up mostly of coulee systems, the main river channel, and one county ditch. All of the watercourses tributary to the North Branch are intermittent in nature, drying up by mid to late summer and only carrying flow during a runoff event. The land area encompassed by this subwatershed is approximately 75 square miles. The City of Lancaster is partially located within this subwatershed, otherwise there are no population centers. Northcote, which used to be a village and is the site of the former James J. Hill farm, is also located within this subwatershed, and is home to a small concentration of residents.

This subwatershed is located entirely within the Red River Valley ecoregion, and the associated geomorphologic regions include mainly the Lake Agassiz Level Lacustrine, with areas of Fluvial Level Alluvium and Lake Agassiz Rolling Lacustrine. Soil textures range from sandy in the eastern areas to very fine in the western areas. A narrow band of coarse-loamy soils lies between the eastern sands and the western very fines. The predominant land use is agriculture. A few beef cattle operations exist in the eastern areas, otherwise the ag related use is small grains and row crops. Areas of deciduous forest interspersed with hay-pasture-grassland exist in the east, and along the entire reach of the river channel the land classification is forest.

North Branch @ Outlet

2. Surface Water

Several major coulee systems occur within the North Branch at Outlet subwatershed. These are located 1) in an area south of Lancaster and south of the North Branch, 2) in an area south of Northcote – also south of the North Branch, 3) in an area west of Lancaster and north of the North Branch, and 4) a ditch system west of Northcote – north of the North Branch. These systems are characterized by a winding low flow channel with a wide grassy floodplain channel. Each of these coulees are direct tributaries to the North Branch and are intermittent, meaning they dry up during times of low flow. Kittson County Ditch #13 is a southerly flowing ditch tributary to the North Branch, and is located two miles west of Northcote. It is approximately 4 miles in length and is under the jurisdiction of Kittson County.

The North Branch itself in this subwatershed is very entrenched in the landscape in the upper reaches. As the river proceeds to the west, the banks become less steep and the channel is very meandered. The North Branch meets with and joins the South Branch at a point approximately 3 miles east of the Red River of the North, in section 2 of North Red River Township, Kittson County.

Existing wetlands are mostly located in the eastern portions of the subwatershed and in the west along the river and coulee channels. The predominant wetland type is type 2 and type 6, with some type 7 and type 3 wetlands interspersed. As in most other subwatersheds, farm drainage has eliminated many wetland areas to provide for crop production.

There are no lakes or water management structures within this subwatershed. One low dam exists on the Two Rivers North Branch, located near Northcote at the site of the former James J. Hill farm. This apparently was installed by Hill in the late 1800's or early 1900's for the purpose of water supply.

Water quality monitoring has been done by the District at one site in this subwatershed. The site, located on Highway 75 at Northcote, has been monitored since 1991 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. One stream reach, located on the North Branch Two Rivers between Lancaster and just upstream of Northcote, has been identified by the Minnesota Pollution Control Agency as impaired in this subwatershed. The affected use of the impairment is aquatic life and the indicator is biota.

3. Groundwater

Soil types in the upper watershed near Lancaster consist of sand generally less than 5 feet thick, underlain by clayey till. Many small areas of peat exist. Moderate surface runoff, well drained by natural channels. Just west of Lancaster is a transition area consisting of silt generally only a few feet thick, underlain by clayey till or clay. Moderate surface runoff, well drained by natural channels. West of this area is the large Lake Plain formed by glacial Lake Agassiz. This is made up of clay which is dense, impermeable, and underlain by more than 100 feet of lake clay. Slow surface runoff, locally improved by

large ditches, discharge mainly by evaporation. Often flooded in spring and early summer.

In the eastern watershed, an area of surficial channel outwash exists. This is defined by lenticularly bedded deposits of sand, gravel, and clay. Sand and gravel is most abundant in the middle of the channel. Deposits are largely silt and clay along the west edge of the channel. An area of till exists only a few miles wide in the Lancaster area. This is a heterogeneous mixture of ice deposited clay, silt, sand, and gravel. It is largely calcareous sandy clay containing scattered pebbles and cobbles. The upper 5 to 15 feet of till is commonly oxidized to a buff-tan color and is more permeable than the underlying unweathered gray till. Lenses of sand occur throughout the till. Thin, discontinuous deposits of clay, silt, sand, and peat overlie the till at numerous localities. The till section of the ground water reservoir is essentially saturated, however, locally dry zones can be found below the water table in areas of unusually well compacted till. Till aquifers are confined except for the shallow, permeable, oxidized zone.

The western area of the Lake Plain is made up of Lake Clay. This is clay, gray to blue gray, plastic, dense, contains lenses of silt and very fine sand. Small areas of lake clay occur locally in the Till area. The lake clay is 0 to 150 feet thick and yields no water to wells. Silt and very fine sand lenses yield less than 1 gallon per minute to large diameter dug wells. These wells commonly go dry during late summer and fall. The water quality is poor with a salty, bitter taste. It is unsuitable for human consumption, and chloride content is generally 500 to 1000 parts per million. Total dissolved solids exceed 2000 parts per million from shallow wells.

The bedrock aquifer of this subwatershed is made up of limestone, mudstone, sandstone, and shale. The limestone, mudstone, sandstone, and shale bedrock aquifer consists of three units – an upper, middle, and lower. The upper unit consists of limestone and calcareous mudstone about 235 feet thick. The top 135 feet consists of cherty, slightly dolomitic yellow and tan limestone. These limestones contain solution openings which are especially abundant in the upper 40 feet. The lower 100 feet consists of clayey and silty limestone and dolomitic mudstone. These rocks have a dense texture. Color varies from dark gray and brown to purple. The middle unit consists of white, well sorted medium grained sandstone about 70 feet thick. The lower unit consists of varicolored shale and a few beds of poorly sorted sandstone. The thickness of the entire aquifer can be from 0 to 500 feet. Yields rage from less than 5 gallons per minute to more than 60 gallons per minute from flowing wells. Much greater yields could be developed. Most productive aquifers occur in the upper porous zone in the dolomitic limestone and in the middle sandstone unit. The water quality is poor, consisting of brine and highly saline water, unsuitable for nearly all uses. Total dissolved solids greater than 35,000 parts per million exist in lower part of Paleozoic rocks.

4. Natural Resources and Unique Water & Land Related Resources

This subwatershed is dominated by agricultural lands. No blocks of natural habitats are found in this subwatershed. Several large tracts of CRP land are present near Hwy 59 and a few other tracts are found near Hwy 75. Quality natural habitats are found in the rather narrow river corridor along the North Branch. A lack of large habitat blocks limits the potential of the terrestrial habitats.

The North Branch is the primary waterway in this subwatershed. Most natural tributaries in this subwatershed remain intact and have not been converted to ditches. These natural waterways and the ditches provide some fish and aquatic habitat but most of these are probably limited to seasonal use. Small waterways here are likely to provide spawning and rearing habitat for northern pike and a limited variety of other species. The reach of the North Branch in this subwatershed provides quality habitat for a variety of fish species. Flashy flows, susceptibility to extended low flow or no flow periods, unstable channels, beaver dams, and a lack of riparian habitat limit the function of these aquatic resources.

In addition to these general habitat features, four Natural Heritage elements have been documented in this sub watershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated "outstanding resource value waters" or "critical vegetated habitat" as defined in state statutes have been found in this sub-watershed.

Resource Improvement Opportunities: The water quality monitoring program will be utilized to assess the current condition of waters identified as being impaired and formulate strategies to address the issue.

5. Unique Water & Land Related Resources

Many century farms occur in this subwatershed. These are a unique historical item and a need has been identified to preserve these farms. In addition, the James J. Hill farm site has a very large historical value, and holds a place in Minnesota history, as James J. Hill was integral in developing the railroad through this area and operating a bonanza farm at Northcote.

B. Water Use

1. Surface & Ground Waters

There are no major users of surface or ground water within this subwatershed. No municipal water supply or wastewater treatment systems exist. Individual farm residences rely on either the North Kittson Rural Water System or on private wells for their water supply. Farm residences generally rely on individual sewage treatment systems to dispose of sewage waste water. Livestock operations rely either on rural water, dug ponds, wells, or natural watercourses for their source of water.

C. Existing Conditions, Related Potential Problems, & Solution Alternatives [Assessments & Issue Identification]

The following issues were discussed at public meeting held at Hallock to specifically hear comments on the North Branch at Outlet subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ Overflows from the Roseau River watershed add to the flooding on the North Branch. This is the number one ranked issue for this subwatershed.
- ✓ Inconsistent culvert sizes contribute to overland flooding from the east. Consistent culvert sizing needs to be done along the course of drainage systems.
- ✓ Road washouts lead to annual maintenance costs and present dangerous situations to the traveling public.
- ✓ Loss of agriculture and pasture land from continued flooding is an annual problem.
- ✓ Residential losses from flooding mainly during the spring runoff.
- ✓ Sedimentation of field ditches and road ditches caused by flooding. This occurs mainly on the western side of the watershed and in some isolated areas on the eastern side.
- ✓ Loss of population and tax revenue is a problem that has resulted from the continued flooding.
- ✓ Ice jams and log jams on the main channel of the North Branch Two Rivers cause water to back up and raise water levels locally during runoff events. These ice and log jams can also cause damage to bridges, culverts, and other public structures.
- ✓ Slope failures on legal ditch systems due to large amounts of runoff and erosive water velocities.
- ✓ Sedimentation due to wind erosion causes blockages to waterways.
- ✓ High flows are perceived to be too high and low flows are too low. There needs to be more controlled runoff.
- ✓ Crop loss due to drought is an issue, but ranks as a low priority.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Drainage Ditches: Channels constructed to collect surface runoff and convey it to a point downstream

Flood Water Detention: Temporary storage of flood water until after the flood.

Flood Water Retention: Semi permanent storage of flood water for other beneficial use such as water supply, wetlands, or recreation.

Ring Dikes: Dikes constructed to defend individual homes or farmsteads.

Agricultural Levees: Dikes constructed to defend crop land

Diversion Channels: Channels constructed to provide an alternate or additional route for stream flows.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control (meter) the flow of water.

Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

Watershed Treatment: Implement land management practices that reduce runoff potential.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Resource improvement opportunities: There is a high potential to significantly improve fish and wildlife habitat in this subwatershed. In particular, actions should be taken to

protect the existing river corridor, create some large habitat blocks along this corridor, protect existing stable waterways, and stabilize existing unstable waterways. Water storage in upstream subwatersheds would also help attenuate high flows and increase base flows in the reach of the North Branch here.

Specific NRE Alternatives:

- Review existing condition of dam and bypass at hill farm. Develop a plan to provide long term fish passage and stream stability at this site.
- Increase the average width of the natural habitat corridor along the river.
- Create at least one large habitat block near the river corridor.
- Monitor water quality.
- Promote use of buffers along waterways.
- Promote wetland restorations using existing conservation programs (e.g. CRP, WRP)
- Reduce erosion and sedimentation in existing waterways.
- Promote active vegetation management activities.
- Promote BMP's to increase water quality (grazing?).

MIDDLE BRANCH

A. Water Resources

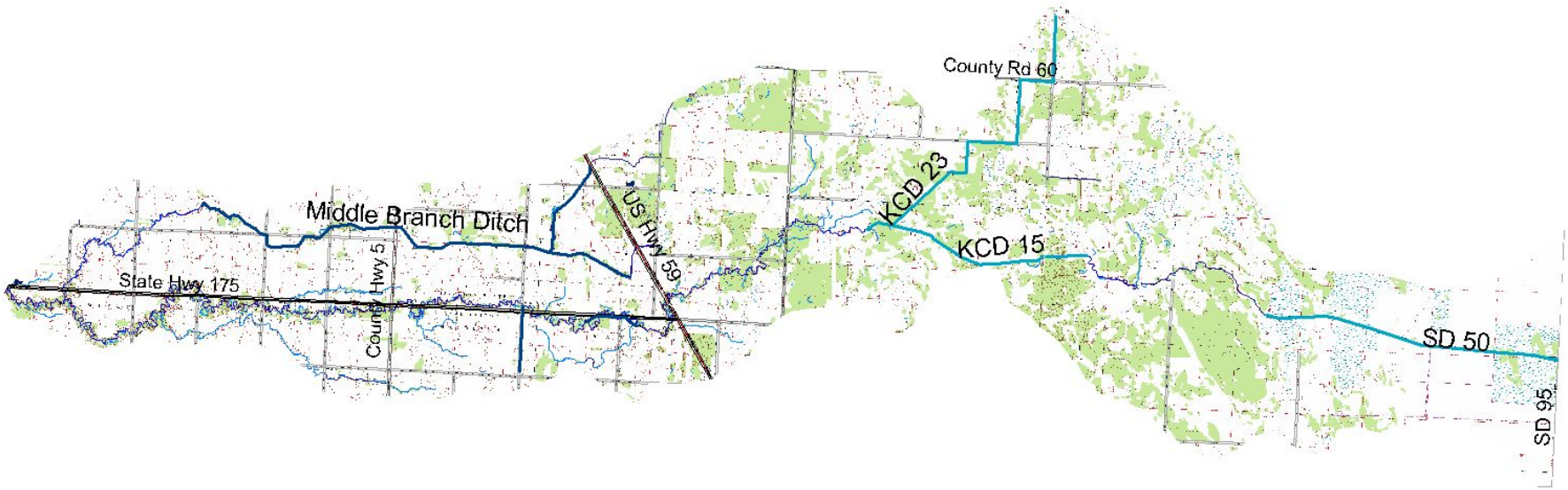
1. Major Sub Watersheds

The Middle Branch of the Two Rivers is divided up into two major subwatersheds. These are the Middle Branch at Highway 59 and the Middle Branch at Hallock. These two sub watersheds have been combined for purposes of discussion within this plan.

The Middle Branch at Highway 59 begins on the Roseau and Kittson County line and flows west through a series of ditches and natural watercourses to the point where the river crosses U.S. Highway 59 in the east central part of Kittson County, 10 miles east of the City of Hallock. This system is made up of three smaller subwatersheds as identified by the Minnesota DNR. Most of this subwatershed lies within the Northern Minnesota Wetlands ecoregion, with the exception of the very western portion, which is in the Red River Valley ecoregion. Soils textures range from sapric in the eastern half to sandy in the western half. Geomorphologic features present include an area of organic peat deposits in the east and the Lake Agassiz Level Lacustrine area in the west. Land use is primarily deciduous forest, wetland, and hay-pasture-grassland. There are very little cultivated crops in this subwatershed.

The Middle Branch at Hallock is a more transitional area made up of two smaller subwatersheds. This subwatershed begins at U.S. Highway 59 and flows west to outlet in the South Branch Two Rivers at the City of Hallock. The subwatershed is located entirely within the Red River Valley ecoregion, and the Lake Agassiz Level Lacustrine geomorphologic area. Soil textures are sandy in the eastern half and very fine in the

Middle Branch



N

0 7 Miles

west. A narrow band of coarse-loamy soils is located in the middle portion of the subwatershed. Land use varies from a mixture of deciduous forest – wetland – grassland in the east to predominantly agriculture in the west. A narrow band of forest follows along the course of the Middle Branch Two Rivers for its entire reach.

2. Surface Water

The Middle Branch at Highway 59 is made up of several different watercourses. This subwatershed begins on the Roseau and Kittson County line and receives water from the State Ditch #95 system. This water enters the State Ditch #50 system and flows west, into the Beaches Lake area. It then discharges from Beaches Lake as a natural watercourse that has not been channelized by ditching. About three miles west of Beaches Lake, the watercourse then enters the Kittson County Ditch #15 system, and flows for about 4 miles, where it is joined by Kittson County Ditch #23, which drains an area to the north. About ½ mile downstream from the confluence of these two ditches, the watercourse becomes a natural winding river again and is intersected by Highway 59 approximately three miles downstream.

Beaches Lake is an impoundment created by the Minnesota DNR and Duck's Unlimited in 1989, and is operated as a wildlife management area. The primary purpose of the project is to impound and stabilize water levels in the marsh that was drained by SD 50 to enable the DNR to improve and manage wetland habitat for waterfowl and aquatic furbearers. The DNR is responsible for all operations and maintenance. The impoundment consists of a 60 foot long steel sheet pile weir with earthen abutments and rock riprap upstream and downstream. Water levels are controlled with 1 drawdown bay (facilitates total wetland drawdowns to the channel bottom or 999.35 msl) and 9 stoplog bays (allow water manipulation between 1,005.66 msl and 1,007.0 msl). A 400 foot long earthen embankment extends from the weir. The emergency spillway is 100 feet wide, 660 feet long, and is at elevation 1007.5 msl. The impoundment is 650 acres in size with a storage at maximum control elevation of about 1,320 acre-feet. The projected peak pool for a 10 year flood is 1,008.1 msl and 1008.76 for a 100 year flood. Recreational opportunities include canoeing and boating, hunting, trapping, birdwatching and other activities.

The Middle Branch at Hallock begins at Highway 59 and flows straight west for approximately 11 miles, winding back and forth across Minnesota Highway 175, joining the South Branch Two Rivers at Hallock. Several coulee systems enter the river system from the south along this reach. One legal drainage system drains an area to the north of the river and enters the river about 1 mile east of Hallock. This system is known as the Middle Branch Project.

Wetlands within the Middle Branch at Highway 59 and the Middle Branch at Hallock are predominantly in the eastern areas, and occur less frequently in the western areas. The wetlands that are present in the eastern areas include types 2, 3, 6, & 7 as described in the U.S. Fish & Wildlife Service's *Circular 39*. Wetlands in the western portions have been drained for the purpose of developing the land for agriculture.

Water quality monitoring has been done by the District at two sites in this subwatershed. One site, located where the Middle Branch intersects U.S. Highway 59 10.5 miles east of the City of Hallock, has been monitored since 1991 for several parameters, including

dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The other site, located at the outlet of Beaches Lake, has been monitored since 2000. The District periodically prepares a water quality report, and results are available upon request in the District office. One stream reach, located along the 10.5 mile segment from U.S. Highway 59 to the City of Hallock, has been identified by the Minnesota Pollution Control Agency as impaired in this subwatershed. The affected use of the impairment is aquatic life and the indicator is biota.

3. Groundwater

Soil types in the very eastern edge of the Middle Branch are peat, which is generally less than 5 feet thick, underlain by clayey till. The peat is poorly drained and the water table is at or near the surface. This is consistent with the area known as Northern Minnesota Wetlands. Moving west in the subwatershed, sandy soils are predominant from about the Beaches Lake area to Kittson County State Aid Highway #5. These sands are generally less than 5 feet thick, and are underlain by clayey till. Many small areas of peat are interspersed. Surface runoff is moderate, and the sand is well drained by natural channels. A two mile wide band of silt is located just west of Highway #5. This is generally only a few feet thick, underlain by clayey till or clay. Moderate surface runoff occurs and is well drained by natural channels. Beginning four miles east of the City of Hallock and running all the way to the Red River is the lake plain, with clay as the predominant soil type. This is a dense, impermeable layer underlain by more than 100 feet of lake clay at the western edge. Slow surface runoff, locally improved by large ditches, discharge mainly by evaporation. It is often flooded in spring and early summer.

Generally, till exists in the east and lake clay exists in the west, with the division line roughly along Kittson County Highway #5. The till is a heterogeneous mixture of ice deposited clay, silt, sand, and gravel. It is largely calcareous sandy clay containing scattered pebbles and cobbles. The upper 5 to 15 feet of till is commonly oxidized to a buff-tan color and is more permeable than the underlying unweathered gray till. Lenses of sand occur throughout the till. Thin, discontinuous deposits of clay, silt, sand, and peat overlie the till at numerous localities. The till section of the ground water reservoir is essentially saturated; however, locally dry zones can be found below the water table in areas of unusually well compacted till. Till aquifers are confined except for the shallow, permeable, oxidized zone.

The Lake Clay area is clay, gray to blue gray, plastic, dense, contains lenses of silt and very fine sand. Small areas of lake clay occur locally in the Till area. The lake clay is 0 to 150 feet thick and yields no water to wells. Silt and very fine sand lenses yield less than 1 gallon per minute to large diameter dug wells. These wells commonly go dry during late summer and fall. The water quality is poor with a salty, bitter taste. It is unsuitable for human consumption, and chloride content is generally 500 to 1000 parts per million. Total dissolved solids exceed 2000 parts per million from shallow wells.

The only glacial drift aquifer that exists in the Middle Branch is a surficial channel outwash aquifer. This is about 5 miles wide and exists just east of U.S. Highway 59. It is characterized by lenticularly bedded deposits of sand, gravel, and clay. Sand and gravel is most abundant in the middle of the channel. Deposits are largely silt and clay along west edge of the channel. It is from 0 to 280 feet thick and the deposit is saturated below 5 feet. The aquifer is largely unconfined except along the western margin, and yields of

1000 gallons per minute can be developed from thick coarse part of the aquifer. The water quality is good, meaning it is suitable for domestic, stock, and irrigation uses. The water is very hard, containing as much as 5 ppm iron.

Bedrock aquifers present are the are the limestone, mudstone, sandstone, and shale aquifer in the east and a shale and sandstone aquifer in the west. The limestone, mudstone, sandstone, and shale bedrock aquifer consists of three units – an upper, middle, and lower. The upper unit consists of limestone and calcareous mudstone about 235 feet thick. The top 135 feet consists of cherty, slightly dolomitic yellow and tan limestone. These limestones contain solution openings which are especially abundant in the upper 40 feet. The lower 100 feet consists of clayey and silty limestone and dolomitic mudstone. These rocks have a dense texture. Color varies from dark gray and brown to purple. The middle unit consists of white, well sorted medium grained sandstone about 70 feet thick. The lower unit consists of varicolored shale and a few beds of poorly sorted sandstone. The thickness of the entire aquifer can be from 0 to 500 feet. Yields rage from less than 5 gallons per minute to more than 60 gallons per minute from flowing wells. Much greater yields could be developed. Most productive aquifers occur in the upper porous zone in the dolomitic limestone and in the middle sandstone unit. The water quality is poor, consisting of brine and highly saline water, unsuitable for nearly all uses. Total dissolved solids greater than 35,000 parts per million exist in lower part of Paleozoic rocks.

The shale and sandstone aquifer in the west is a dark gray, soft clay shale and coarse grained, poorly sorted, lignitic sandstone. The aquifer is less than 50 feet thick and at most places wells tapping the sandstone produce yields between 5 and 50 gallons per minute. The water quality is poor to good with commonly soft to moderately hard water. At places boron exceeds 3 ppm making the water unsuitable for irrigation.

4. Natural Resources and Unique Water & Land Related Resources

The western half of this subwatershed is dominated by agricultural lands. The eastern half of this subwatershed is dominated by large blocks of natural habitats (e.g. Beaches WMA). These natural habitats include rich fens, lowland shrub lands, and aspen woodlands. CRP lands are also present in this watershed with their greatest density in the area just west of Hwy 59. Some wetland areas remain but most areas have been drained (see MCEA report). A lack of large habitat blocks in the western portion of this subwatershed limits the function of the terrestrial habitats. Overflow from the Roseau watershed also limits the active management of vegetation on state wildlife lands in this subwatershed (during and after very extreme runoff events).

The Middle Branch of the Two Rivers is the primary waterway in this subwatershed. Almost all natural tributaries have been converted to ditches. The remaining natural waterways and the ditches provide some fish and aquatic habitat but most of these are probably limited to seasonal use. Small waterways here are likely to provide spawning and rearing habitat for northern pike and a limited variety of other species. Flashy flows, susceptibility to extended low flow or no flow periods, unstable channels, beaver dams, and a lack of riparian habitat limit the function of these aquatic resources.

In addition to these general habitat features, seven Natural Heritage elements have been documented in this sub watershed. These heritage elements, found on public and private

land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated "outstanding resource value waters" or "critical vegetated areas" as defined in state statutes have been found in this sub-watershed.

Resource improvement opportunities: There is a high potential to significantly improve fish and wildlife habitat in this subwatershed. In particular, actions should be taken to protect existing upland habitats (grassland, wetland, brushlands, woodlands), create some large habitat blocks in the western portion of the watershed, create some multipurpose impoundments in the eastern portion, protect existing stable waterways, and stabilize existing unstable waterways. Water storage in upstream watersheds and in the Roseau River watershed should be explored. The water quality monitoring program will be utilized to assess the current condition of waters identified as being impaired and formulate strategies to address the issue.

5. Unique Water & Land Related Resources

It has been identified that the area where the Middle Branch at Highway 59 is located, may have some unique qualities. This area at one time was designated as a rich fen by the Minnesota DNR. The area has some natural resource qualities that may be beneficial to protect and preserve, which could have a tourism benefit for the area. At the same time, the same area has potential as a key location for an impoundment for flood control. The District has studied this area in the past for flood control and currently owns property in the eastern edge of the subwatershed. More study and consideration is needed to determine the feasibility of developing both the flood control and natural resources of this area.

B. Water Use

1. Surface & Ground Waters

There are no major users of surface or ground water within this subwatershed. No municipal water supply or wastewater treatment systems exist. Individual farm residences rely on either the North Kittson Rural Water System or on private wells for their water supply. Farm residences generally rely on individual sewage treatment systems to dispose of sewage waste water. Livestock operations rely either on rural water, dug ponds, wells, or natural watercourses for their source of water.

C. Existing Conditions, Related Potential Problems, and Solution Alternatives [Assessments & Issue Identification]

The following issues were discussed at public meeting held at Lake Bronson to specifically hear comments on the Middle Branch at Highway 59 and Middle Branch at Hallock subwatersheds. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were

present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ Beaver dams blocking drainage systems, coulees, and other waterways is the biggest issue within the subwatershed.
- ✓ Flooding at the confluence of Kittson County Ditch #15 and Kittson County Ditch #23. This affects crop land, hay land, and pasture.
- ✓ The Middle Branch at Hallock subwatershed has experienced flooding problems associated with the river breaking out of its channel and affecting adjacent lands. This leads to crop loss and other associated problems.
- ✓ Debris in the river channel is restricting the flow. The river is narrow in spots, allowing for log jams and beaver to block the channel.
- ✓ The Middle Branch west of highway 59 has a significant impact on and contributes to flooding in Hallock. This may be a timing issue that should be looked at.
- ✓ Stream flows are too "flashy'. The high flows are too high and the low flows are too low. Stream flows should be more constant.
- ✓ Flooding is an issue in the Middle Branch at Highway 59 subwatershed, but due to the land use the flooding poses only isolated problems to crops, infrastructure, and residences.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Flood Water Detention: Temporary storage of flood water until after the flood.

Flood Water Retention: Semi permanent storage of flood water for other beneficial use such as water supply, wetlands, or recreation.

Urban Levees: Dikes constructed to defend individual communities.

Agricultural Levees: Dikes constructed to defend crop land

Diversion Channels: Channels constructed to provide an alternate or additional route for stream flows.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control (meter) the flow of water.

Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

Watershed Treatment: Implement land management practices that reduce runoff potential.

WATERSHED DISTRICT PROJECTS:

The Middle Branch Project was constructed as a PL-566 project jointly by the Two Rivers Watershed District, the Natural Resources Conservation Service, and the Kittson County Soil & Water Conservation Service. This project is located in Hazelton and Thompson Townships of Kittson County and was built in the late 1960's. The project encompasses 9.62 miles of channel improvements for flood protection and agricultural water management, and one mile of channel improvement for flood prevention only. The 9.62 miles is designed to pass a 10 –year frequency flood discharge, and the one-mile (located on the main channel of the Middle Branch) is designed for a 25 year frequency discharge. The project is inspected and maintained by the District.

In the early 1990's, the District investigated an impoundment in sections 1, 2, 11, & 12 of Klondike Township, known as the Klondike I. This was an off channel, gated project. Together with the Klondike II project, 6,631 acre feet of storage could be constructed. This project is currently on hold pending further review and the construction of the Ross project.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Specific NRE Alternatives:

- Develop combination FD/NRE project in this subwatershed in area previously considered for the Juneberry Ridge Project.
- Develop rehabilitation plan for this reach of the Middle Branch in Percy township, Kittson County.
- Buffers -
- Wetland restorations
- Reduce erosion and sedimentation in existing channel
- Active vegetation management (all east of 59).
- Upstream BMP's to increase water quality.
- Stabilize/repair stream channel in Hazelton Twp, Kittson County, Sections 16, 17, 18

SOUTH BRANCH AT LAKE BRONSON

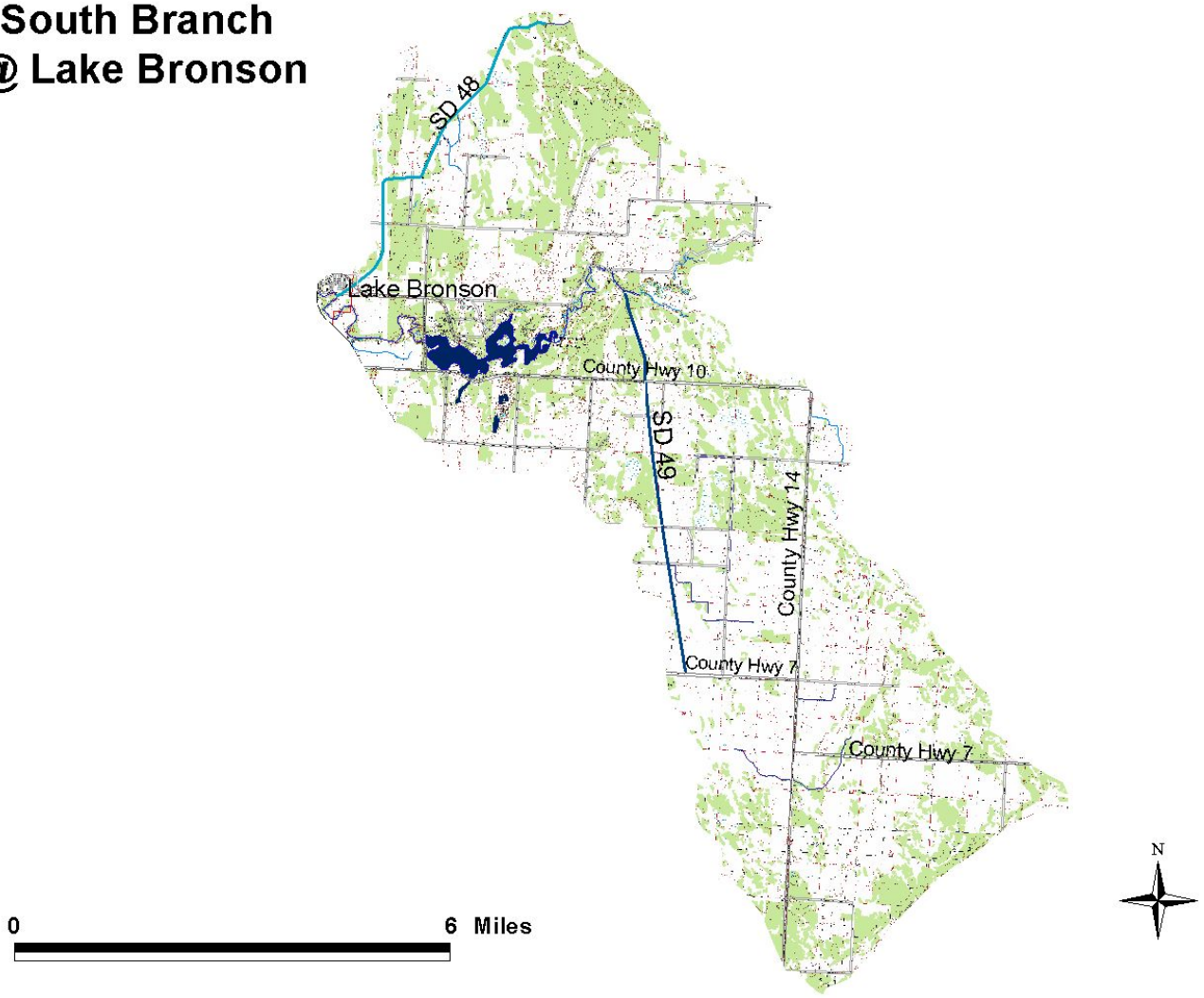
A. Water Resources

1. Major Sub Watershed Areas

This subwatershed consists of approximately 53 square miles encompassing 7 smaller subwatersheds. It follows the main stem of the south branch Two Rivers beginning just downstream from the end of State Ditch #95, through Lake Bronson, and ends at the City of Lake Bronson. Two major tributaries within this subwatershed are the State Ditch 48 system and the State Ditch 49 system.

The Northern Minnesota wetlands ecoregion covers the northern portion of this subwatershed, and the Red River Valley ecoregion encompasses the remaining area. The main geomorphologic area of the subwatershed is the Lake Agassiz Level Lacustrine region. The northern edge of the subwatershed may be in the Organic Deposits Level Peat region. Soil textures range from coarse-loamy in the southeast to sapric along the eastern edge to sandy in the west and north. The land use is diverse, with a slight majority being cultivated land, and the rest a mixture of deciduous forest, open grassland/hay/pasture, brushland, and wetland.

South Branch @ Lake Bronson



2. Surface Waters

Surface waters within the South Branch at Lake Bronson subwatershed include the main stem Two Rivers, State Ditch #48, State Ditch #49, and Lake Bronson. The area is comprised of 7 smaller subwatersheds. The State Ditch #48 system begins north of the city of Lake Bronson, drains 10.8 square miles, and outlets into the South Branch inside the City. The ditch is operated and maintained by the Kittson County Board of Commissioners. The other major tributary is State Ditch #49. This ditch drains most of the southern portion of the subwatershed, 21.7 square miles in all. The ditch is operated and maintained by the Two Rivers Watershed District.

Lake Bronson is a 318 acre man made lake that was formed by a construction of the Lake Bronson dam. It was originally constructed for the purpose of water supply for the City of Hallock and surrounding areas. Wells had gone dry in the 1930's and therefore construction of the dam began in 1936 by the Works Progress Administration. An observation / water tower and other facilities were also constructed around the same time, and the area was turned over to the state in 1937. In 1945 it was named Lake Bronson State Park. The dam today maintains the lake for recreational purposes only. The dam is operated by the Minnesota DNR Division of Parks.

Wetlands within the subwatershed exist mainly in the State Ditch 48 and State Ditch 49 drainages. Wetland types are mainly type 2 and type 6, with a few type 7 wetlands interspersed. Wetland types are classified according to the U.S. Fish & Wildlife Services *Circular 39.*

Water quality monitoring has been done by the District at one site in this subwatershed. The site, located at the downstream end of the subwatershed where the South Branch intersects U.S. Highway 59 in the City of Lake Bronson, has been monitored since 1991 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. There are no reaches that have been identified by the Minnesota Pollution Control Agency as impaired in this subwatershed.

Of note is the water quality concerns on Lake Bronson. This lake, created by the Works Progress Administration in the late 1930's was created by constructing a dam across the South Branch Two Rivers. The lake is managed and the dam operated by the Minnesota DNR in conjunction with Lake Bronson State Park. The lake is subject to sediment and nutrient loading from several upstream state and county ditches. A significant algae bloom during early July of each year and is most likely due to the current inflow conditions.

3. Groundwater

The predominant soil type is sand, with a few small pockets of sand and gravel and peat. The sand areas are generally less than 5 feet thick and are underlain by clayey till. Sand has moderate surface runoff, and is well drained by natural channels. The sand and gravel areas exist just north of the lake. These are five to thirty feet thick, and are underlain by clayey till. They are well drained. The peat is located just east of state ditch

49, and is generally less than five feet thick. It is underlain by clayey till. Peat is poorly drained, with the water table at or near the surface.

Generally, a till area exists over the entire area of the subwatershed. The till is a heterogeneous mixture of ice deposited clay, silt, sand, and gravel. It is largely calcareous sandy clay containing scattered pebbles and cobbles. The upper 5 to 15 feet of till is commonly oxidized to a buff-tan color and is more permeable than the underlying unweathered gray till. Lenses of sand occur throughout the till. Thin, discontinuous deposits of clay, silt, sand, and peat overlie the till at numerous localities. The till section of the ground water reservoir is essentially saturated; however, locally dry zones can be found below the water table in areas of unusually well compacted till. Till aquifers are confined except for the shallow, permeable, oxidized zone.

One glacial drift aquifer, the surficial channel outwash, exists as a 5 mile wide band in the area of the lake. It is characterized by lenticularly bedded deposits of sand, gravel, and clay. Sand and gravel is most abundant in the middle of the channel. Deposits are largely silt and clay along west edge of the channel. It is from 0 to 280 feet thick and the deposit is saturated below 5 feet. The aquifer is largely unconfined except along the western margin, and yields of 1000 gallons per minute can be developed from thick coarse part of the aquifer. The water quality is good, meaning it is suitable for domestic, stock, and irrigation uses. The water is very hard, containing as much as 5 ppm iron.

Two bedrock aquifers exist – a limestone, mudstone, sandstone, and shale aquifer and a shale and sandstone aquifer. The limestone, mudstone, sandstone, and shale bedrock aquifer consists of three units – an upper, middle, and lower. The upper unit consists of limestone and calcareous mudstone about 235 feet thick. The top 135 feet consists of cherty, slightly dolomitic yellow and tan limestone. These limestones contain solution openings which are especially abundant in the upper 40 feet. The lower 100 feet consists of clayey and silty limestone and dolomitic mudstone. These rocks have a dense texture. Color varies from dark gray and brown to purple. The middle unit consists of white, well sorted medium grained sandstone about 70 feet thick. The lower unit consists of varicolored shale and a few beds of poorly sorted sandstone. The thickness of the entire aquifer can be from 0 to 500 feet. Yields rage from less than 5 gallons per minute to more than 60 gallons per minute from flowing wells. Much greater yields could be developed. Most productive aquifers occur in the upper porous zone in the dolomitic limestone and in the middle sandstone unit. The water quality is poor, consisting of brine and highly saline water, unsuitable for nearly all uses. Total dissolved solids greater than 35,000 parts per million exist in lower part of Paleozoic rocks.

The shale and sandstone aquifer in the west is a dark gray, soft clay shale and coarse grained, poorly sorted, lignitic sandstone. The aquifer is less than 50 feet thick and at most places wells tapping the sandstone produce yields between 5 and 50 gallons per minute. The water quality is poor to good with commonly soft to moderately hard water. At places boron exceeds 3 ppm making the water unsuitable for irrigation.

4. Natural Resources and Unique Water & Land Related Resources

Existing Resources: Quality natural resources features are relatively common in this sub watershed. Large habitat blocks and conservation lands are present throughout this sub-watershed. A large amount of CRP lands are also present. Increasing connectivity

among existing grasslands, wetlands, brushlands, and woodlands in this subwatershed would provide significant benefits to the existing features.

The South Branch is the primary waterway in this subwatershed, although State Ditch #48 and State Ditch #49 are primary tributaries. Almost all natural waterways have been converted to ditches. The remaining natural waterways and the ditches provide some fish and aquatic habitat but most of these are probably limited to seasonal use. These small waterways are likely to provide spawning and rearing habitat for northern pike and a limited variety of other species. The South Branch itself has some high quality fish habitats. Lake Bronson (an artificial lake created by damming the Two Rivers) provides a largemouth bass, panfish, northern pike, and walleye fishery. Flashy flows, extended low flow or no flow periods, unstable channels, dams, and a lack of riparian habitat limit the function of these aquatic resources.

The Lake Bronson dam and the dam downstream in Hallock limit the diversity and abundance of fish in this subwatershed. The stability of the reach of stream below Lake Bronson is dependent upon the management of flows at the Lake Bronson dam. Water quality within the lake is a concern. The lake experiences large inflows of sediment during spring runoff and summer rainfall events. This contributes to sediment and phosphorous loading and could be a primary cause of summer algae blooms each year.

Mining of gravel, logging of aspen, and farming are the main activities relative to non renewable and renewable resources in this subwatershed.

In addition to these general habitat features, 101 Natural Heritage elements have been documented in this sub watershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated “outstanding resource value waters” or “critical vegetated areas” as defined in state statutes have been found in this sub-watershed.

Resource improvement opportunities: The potential to improve fish and wildlife habitat in this subwatershed is good. In particular, actions should be taken to protect existing upland habitats (grassland, wetland, brushlands, woodlands), protect existing stable waterways, and stabilize existing unstable waterways. Land use changes, wetland restorations, and impoundments could be sited near waterways in this watershed and in upstream watersheds to reduce runoff during high flow periods and augment base flows during low flow periods. Removal or modification of the Lake Bronson dam would provide fish passage in this reach. Removal or modification of the Hallock dam would provide more consistent fish passage to this reach. Water quality monitoring should be continued and results evaluated in an attempt to reduce nutrient and sediment loadings to Lake Bronson.

5. Unique Water & Land Related Resources

Noteworthy is the fact that the North Kittson Rural Water system has located all of its wells in this area. These wells are the water supply for most of Kittson County, including the cities of Lake Bronson, Lancaster, Humboldt, and Hallock. It is of utmost importance

to protect these wells and the integrity of the surficial channel outwash aquifer that they draw from.

Much historical value is associated with Lake Bronson State Park, the dam, and other structures, as they were constructed under the WPA in the 1930's.

B. Water Use

1. Surface & Ground Waters

As noted above, the North Kittson Rural Water System operates two well fields and supplies water to the cities of Lake Bronson, Lancaster, Humboldt, Hallock, and supplements the Kittson Marshall Rural Water System, which supplies Kennedy and Stephen. In addition most of the rural farmsteads associated with these cities are also supplied by Rural Water. Approximately 1500 residences utilize the North Kittson Rural Water System, not counting those supplied and residing within the Marshall Kittson Rural Water area.

Two wells are located approximately ½ mile north of the Lake Bronson Dam. The capacity of each well is 375 gallons per minute. Both wells were constructed in 1979. One well is 128 feet, and the second well is 125 feet deep. Another well field was constructed 3 miles east and ½ mile north of the first well field in the early 1990's which expanded the total well field capacity to 2,250 gpm.

Well water is processed through a 2250 gpm capacity treatment plant located near the City of Lake Bronson. This treatment plant aerates the water and removes iron and manganese by gravity filter. Filtered water is both chlorinated and fluoridated, then pumped to a ground storage tank located adjacent to the treatment plant. Backwash water is pumped to a rapid infiltration backwash detention pond. Hardness of finished water is 396 mg/l, and complies with all the water quality standards enforced by the Minnesota Department of Health.

Agricultural irrigation wells for potatoes exist in an area located south and east of the lake. Water appropriation for other uses is limited.

C. Existing Conditions, Related Potential Problems, and Solution Alternatives [Assessment & Issue Identification]

The following issues were discussed at public meeting held at Lake Bronson to specifically hear comments on the South Branch at Lake Bronson subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ Overland flooding associated with the State Ditch #49 system was ranked as the #1 issue. The ditch is unable to handle excessive water and spills over into the next subwatershed to the west. There was noted a need to study the contributions of the SD #95 system from the east.
- ✓ Crop land and pasture damage occurs west and northwest of the State Ditch #49 system. A separate issue, but equally important is beaver dams affecting pastures and farmsteads along State Ditch #48 & SD #49.
- ✓ Added pressure on the Lake Bronson dam was the number 3 issue. It was noted that long term monitoring and discussions are needed, including better communications between DNR & downstream interests and an operation and maintenance plan.
- ✓ Damage to roads, infrastructure, and homes in Norway, Deerwood, and Jupiter Townships and the City of Halma is due in part to water that overflows from this subwatershed.
- ✓ During periods of low flow on the river (August), algae blooms and larger concentrations of phosphorous are high within the lake. Lake Bronson is classified as a eutrophic lake.
- ✓ There is evidence of and potential for future sedimentation of the upper reaches of the lake. It has been noted that this issue needs to be studied and that the influence of the dam should be considered.
- ✓ The campgrounds and trail system at Lake Bronson State Park has experienced flooding in the past.
- ✓ The effects of chemigation on the groundwater is unknown, but should be studied due to the sandy nature of the soils and location of water supply wells.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Flood Water Detention: Temporary storage of flood water until after the flood.

Flood Water Retention: Semi permanent storage of flood water for other beneficial use such as water supply, wetlands, or recreation.

Agricultural Levees: Dikes constructed to defend crop land

Diversion Channels: Channels constructed to provide an alternate or additional route for stream flows.

Floodways: A relatively confined area on either side of the channel used to help convey flood flows.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control (meter) the flow of water.

Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

Watershed Treatment: Implement land management practices that reduce runoff potential.

WATERSHED DISTRICT PROJECTS:

As mentioned above, State Ditch #49 is under the jurisdiction of the Two Rivers Watershed District. This is 5.25 miles in length, beginning at Kittson County State Aid Highway #7 at a point 2.5 miles east of the City of Halma. The ditch travels northwest through parts of Norway and Percy Townships in Kittson County, and outlets into the South Branch Two Rivers just upstream of Lake Bronson.

The District investigated a potential impoundment upstream of SD 49 that could have benefits for the SD 49 system and the village of Halma. However, the project was dropped due to the high price of land in the vicinity.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, and best management practices to reduce transport of sediment into

watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Monitoring: Monitoring programs can be utilized to assess the condition of the watershed and certain key indicators can be used to help make the assessments. Data collected can be utilized to analyze the present conditions and to formulate strategies to maintain and improve healthy systems.

Specific NRE Alternatives:

- Monitor water quality and suggest potential solutions to improve water quality in Lake Bronson.
- Promote use of buffers along waterways.
- Promote wetland restorations using existing conservation programs (e.g. CRP, WRP, RIM, CREP)
- Reduce erosion and sedimentation in existing waterways.
- Promote active vegetation management activities.
- Promote BMP's to increase water quality.
- Review the operating plan for the Lake Bronson dam with MN DNR parks and fisheries and suggest updates.

SOUTH BRANCH AT HALLOCK

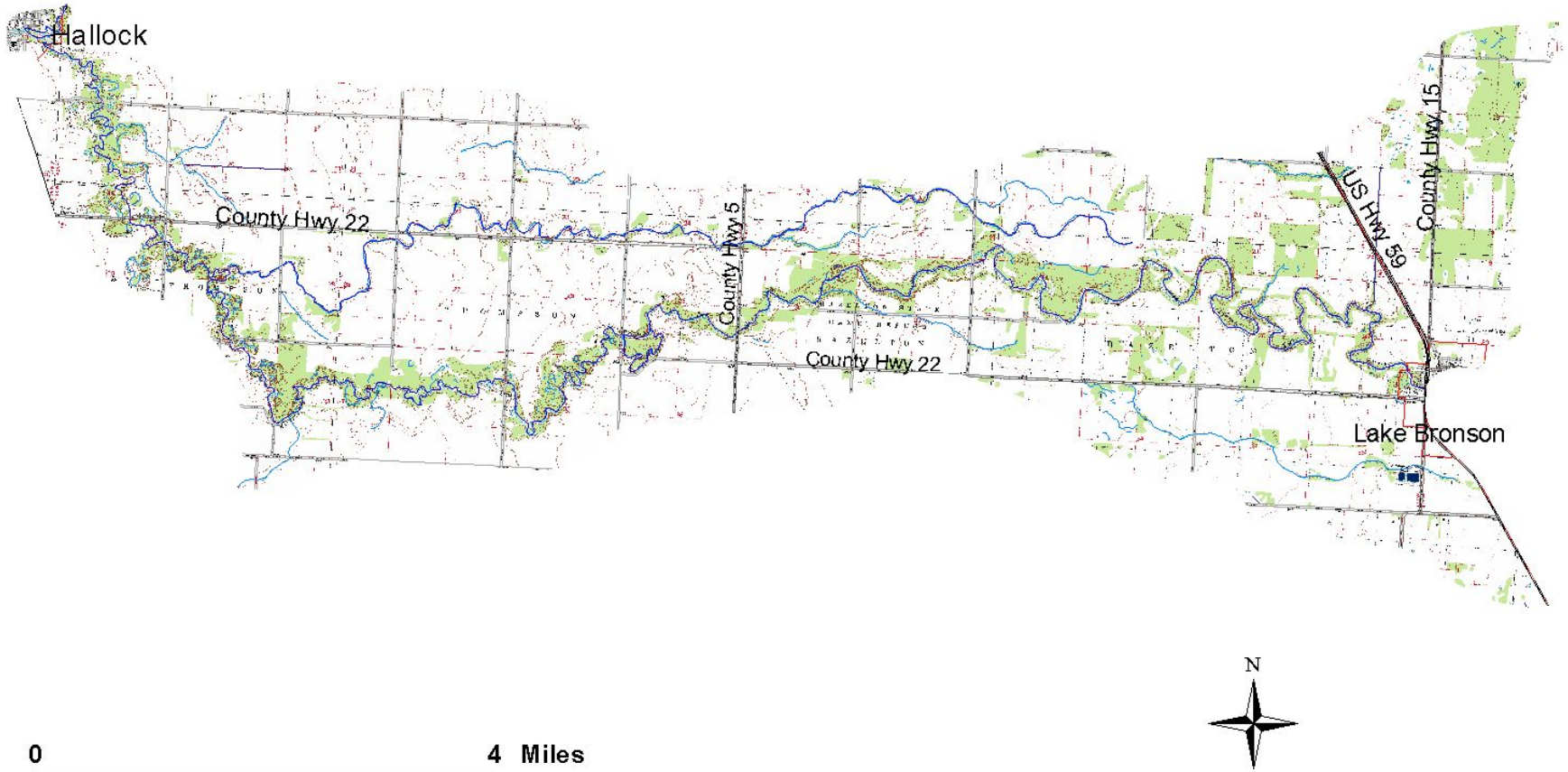
A. Water Resources

1. Major Subwatersheds of the District

The South Branch at Hallock encompasses the main river channel between the City of Lake Bronson and the City of Hallock. The land area is approximately 35 square miles. Several coulee systems that are tributary to the Two Rivers are also included. The DNR identifies two smaller subwatersheds within the South Branch at Hallock, one encompassing four square miles and the other 31 square miles.

The subwatershed is exclusively within the Red River Valley ecoregion, and the main geomorphologic class is the Lake Agassiz Level Lacustrine. Soil textures in the eastern ½ are sandy and in the western ½ are very fine. A narrow band of coarse-loamy textured soils separate the east from the west. Land use is predominantly agricultural, with a few areas of hay-pasture-grassland on the eastern side. Along the course of the South Branch is a corridor of forest. Urban areas exist at Lake Bronson and at Hallock. Elevation change from Lake Bronson to Hallock is dramatic, falling 128 feet in 13 miles.

South Branch @ Hallock



2. Surface Waters

The river channel between Lake Bronson and Hallock is a segment of river that is in its most natural, unaltered state. The channel undergoes a series of riffles and pools, and provides excellent fish & wildlife habitat. Water quality monitoring indicates that this segment is relatively healthy. No major ditch systems enter the river in this area, and only a few coulee systems are tributary. No lakes exist in this segment.

Besides the dam located upstream at Lake Bronson, a dam is in place at Hallock. It was constructed for the purpose of water supply for the City. This dam has an upstream influence on the river relative to backwater of less than one mile. A cement spillway was constructed to divert some water around the dam during times of high water. At times during the mid 1990's water was observed flowing through the spillway and also directly over the top of the dam. While not utilized as a City water supply any more, the dam has value for recreation. Also, the Two River Golf Club appropriates water from the river upstream from the dam, but within the backwater influence of the dam.

Wetlands are not prevalent, existing mostly in oxbows along the river, and also along coulee systems. A few small pockets of type 2 and type 6 wetlands exist in the eastern areas. Wetlands along the river are type 5, 6, or 7. Many wetlands have been drained for the purposes of agriculture.

Water quality monitoring has not been done by the District at any sites in this subwatershed. However, one monitoring site is located immediately upstream in Lake Bronson and another immediately downstream in Hallock. These have been monitored since 1991 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. There are no reaches that have been identified by the Minnesota Pollution Control Agency as impaired in this subwatershed.

3. Groundwater

In the Lake Bronson area, the predominant soils are sand. This is generally less than 5 feet thick, underlain by clayey till. Surface runoff is moderate, well drained by natural channels. About half way between Lake Bronson and Hallock is a narrow band of silt, 3 miles wide. This is generally only a few feet thick, underlain by clayey till or clay. Surface runoff is moderate, well drained by natural channels. West of the silt area is the lake plain, consisting of clay soils. These are dense, impermeable, and underlain by more than 100 feet of lake clay. Surface runoff is slow, locally improved by large ditches. The main discharge is by evaporation.

From Lake Bronson to about 7 miles west is the area of glacial till. The till is a heterogeneous mixture of ice deposited clay, silt, sand, and gravel. It is largely calcareous sandy clay containing scattered pebbles and cobbles. The upper 5 to 15 feet of till is commonly oxidized to a buff-tan color and is more permeable than the underlying unweathered gray till. Lenses of sand occur throughout the till. Thin, discontinuous deposits of clay, silt, sand, and peat overlie the till at numerous localities. The till section of the ground water reservoir is essentially saturated, however, locally dry zones can be

found below the water table in areas of unusually well compacted till. Till aquifers are confined except for the shallow, permeable, oxidized zone.

From the point where the till ends all the way west to the Red River, is the area of lake clay. This is made up of clay, gray to blue gray, plastic, dense, and contains lenses of silt and very fine sand. The lake clay ranges from 0 to 150 feet in thickness. It yields no water to wells. Silt and very fine sand lenses yield less than 1 gallon per minute to large diameter dug wells. These wells commonly go dry during late summer and fall. The water quality is poor with a salty, bitter taste. It is unsuitable for human consumption. Chloride content is generally 500 to 1000 ppm and total dissolved solids exceed 200 ppm in water from shallow wells. Before the rural water system came to be, residents of this area were dependent on surface water, many having to haul water from the City of Hallock.

One bedrock aquifer covers the entire subwatershed. The Shale and sandstone aquifer is a dark gray, soft clay shale and coarse grained, poorly sorted, lignitic sandstone. The aquifer is less than 50 feet thick and at most places wells tapping the sandstone produce yields between 5 and 50 gallons per minute. The water quality is poor to good with commonly soft to moderately hard water. At places boron exceeds 3 ppm making the water unsuitable for irrigation.

4. Natural Resources and Unique Water & Land Related Resources

Existing Resources: Land use changes have altered the quality and quantity of natural resources in this subwatershed. Agricultural lands are common in this subwatershed. Large habitat blocks and conservation lands are only found along the eastern edge of this sub-watershed. CRP lands are also common in the eastern portion of this subwatershed. An overall lack of quality habitat limits the function of the terrestrial habitats in this sub watershed.

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The South Branch is the primary waterway in this subwatershed. Very few natural waterways have been converted to ditches. These natural waterways and the ditches provide some fish and aquatic habitat but most of these are probably limited to seasonal use. These small waterways are likely to provide spawning and rearing habitat for northern pike and a limited variety of other species. The South Branch here has some high quality fish habitats but the channel has reaches that are quite unstable. Flashy flows, extended low flow or no flow periods, unstable channels, the dam at Hallock, and a lack of riparian habitat limit the function of these aquatic resources. The dam in Hallock limits the diversity and abundance of fish in this subwatershed.

In addition to these general habitat features, four Natural Heritage elements have been documented in this sub watershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated “outstanding resource value waters” or “critical vegetated habitat” as defined in state statutes have been found in this sub-watershed.

Resource improvement opportunities: The potential to improve fish and wildlife habitat in this subwatershed is good. In particular, actions should be taken to protect existing

habitats along waterways (grassland, wetland, brushlands, woodlands), protect existing stable waterways, and stabilize existing unstable waterways. Land use changes and wetland restorations could be sited near waterways in this watershed and in other upstream watersheds to reduce runoff during high flow periods and augment base flows during low flow periods. Removal or modification of the Hallock dam would provide more consistent fish passage to this reach.

B. Water Use

1. Surface & Ground Waters

As mentioned above, the City of Hallock no longer utilizes surface water from the reservoir created by the dam. The City now utilizes water provided by the North Kittson Rural Water system, from wells located east of Lake Bronson (See discussion in the South Branch at Lake Bronson section). There are no other major users of surface or ground water within this subwatershed. Most rural areas are serviced by rural water.

C. Existing Conditions, Related Potential Problems, and Solution Alternatives [Assessment and Issue Identification]

The following issues were discussed at public meeting held at Lake Bronson to specifically hear comments on the South Branch at Hallock subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ Debris in the river channel is restricting flow. This includes log jams, beavers, and ice jams in the spring. The problem mainly is associated with bridges.
- ✓ Out of bank flow during spring events affected by ice and debris affects the Two River Golf Course, Gilbert Olson Park, and three to four homes upstream of Hallock.
- ✓ Erosion and road washouts are affecting bridges in Thompson Township at three specific sites.
- ✓ Residential and infrastructure damages is a potentially high risk in the City of Hallock, should their dikes fail.
- ✓ Damage to public sites in and around Hallock is a maintenance problem.
- ✓ Loss of life to livestock has been a problem along the river between Lake Bronson and Hallock during spring runoff and summer rainfall events due to flooding.
- ✓ High flows are to high and low flows are too low, resulting in an unnatural hydrograph.

- ✓ Water breaks out of the river at Kittson County CSAH #22 crossover into the next subwatershed to the west during major runoff events.
- ✓ Low flows during drought cause a water supply problem and cause economic impact to the golf course.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Flood Water Detention: Temporary storage of flood water until after the flood.

Flood Water Retention: Semi permanent storage of flood water for other beneficial use such as water supply, wetlands, or recreation.

Urban Levees: Dikes constructed to defend individual communities.

Agricultural Levees: Dikes constructed to defend crop land

Diversion Channels: Channels constructed to provide an alternate or additional route for stream flows.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control (meter) the flow of water.
Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

Watershed Treatment: Implement land management practices that reduce runoff potential.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Monitoring: Monitoring programs can be utilized to assess the condition of the watershed and certain key indicators can be used to help make the assessments. Data collected can be utilized to analyze the present conditions and to formulate strategies to maintain and improve healthy systems.

Specific NRE Alternatives:

- Evaluate the Hallock dam and develop a plan to modify or remove the dam while providing for the needs of the City of Hallock.
- Develop a large habitat corridor along the South Branch.
- Monitor water quality
- Promote use of buffers along waterways.
- Promote wetland restorations using existing conservation programs (e.g. CRP, WRP, RIM)
- Reduce erosion and sedimentation in existing waterways.
- Promote active vegetation management activities.
- Promote BMP's to increase water quality.

TWO RIVERS MAIN STEM

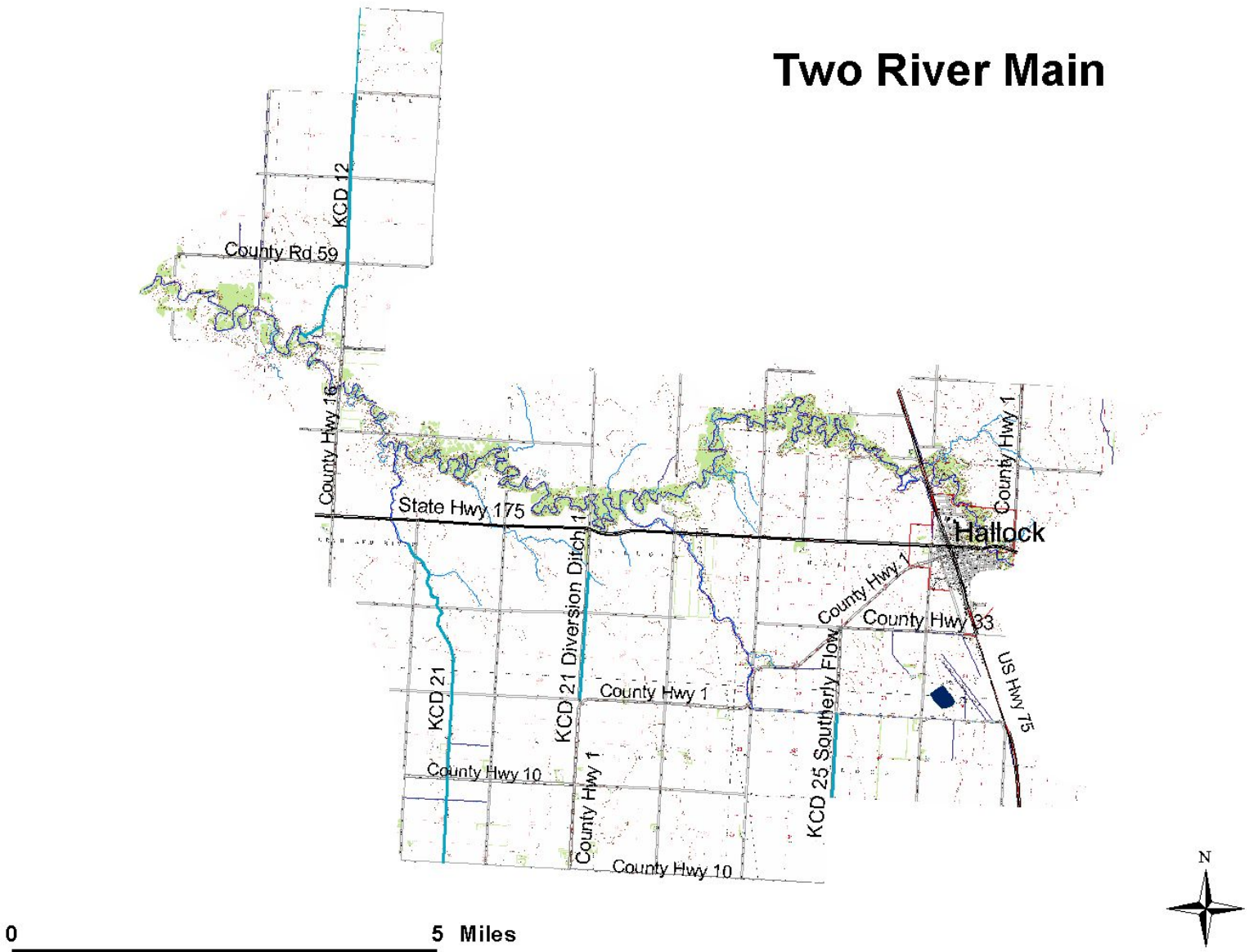
A. Water Resources

1. Major Subwatersheds of the District

The Two Rivers Main Stem is a small system consisting of about 47 square miles and is located downstream of the City Hallock after the Middle and South Branches have converged. It also takes in the drainage to the north and west of where the North Branch enters the main stem. There are two smaller subwatersheds that make up the main stem, as identified by the DNR. However, several coulee systems enter from the south, along with two county ditches.

The Main Stem is located exclusively within the Red River Valley ecoregion. The geomorphologic areas present are the Lake Agassiz Level Lacustrine area and the Fluvial Level Alluvium (along and adjacent to the river itself). Soil textures of this subwatershed are mostly very – fine, with a small area of fines in the northwestern reaches. The land use is almost exclusively cultivated land, with sugar beets and small grains the main crops. Along and adjacent to the river is a narrow band of forested area.

Two River Main



2. Surface Water

The main stem of the Two Rivers consists of natural river channel between the City of Hallock and the point at which the Two Rivers enters the Red River of the North. Four coulee systems enter this river channel from the south. Two county ditches are present within the subwatershed. Kittson County Ditch #12 originates in section 23 of Hill Township and runs for 3 to 4 miles in a southerly direction and outlets into the main stem in section 3 of North Red River Township. Kittson County Ditch #21 begins in section 36 of North Red River Township and runs about 3.5 miles in a northerly direction and outlets into a coulee system in section 11 of North Red River Township. The coulee in turn outlets into the main stem one mile north.

Most of the original wetlands in this area have been drained for the production of agricultural crops. Wetlands that remain are mostly associated with and located along the river channel or along coulee and ditch systems. These wetlands are in oxbows of the river or located within the floodplain. These wetlands are mainly of types 3, 4, and 5. There are no lakes or water management structures within this subwatershed.

Water quality monitoring has been done by the District at two sites in this subwatershed. One site is located where the river intersects U.S. Highway 75 just north of the City of Hallock and the other is located where the river intersects Kittson CSAH #16 about seven miles west of Hallock. These have been monitored since 1991 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. There are no reaches that have been identified by the Minnesota Pollution Control Agency as impaired in this subwatershed.

3. Groundwater

Soil types are exclusively clay, characterized by dense, impermeable soils underlain by more than 100 feet of lake clay at the western edge. Slow surface runoff, locally improved by large drainage ditches, discharge mainly by evaporation. The area is often flooded in the spring and early summer.

Ground water quality is very poor. Lithologic characteristics of the subwatershed is exclusively lake clay, which is gray to blue gray clay, plastic, dense, and contains lenses of silt and very fine sand. It is from 0 to 150 feet thick, and yields no water to wells. Silt and very fine sand lenses yield less than 1 gallon per minute to large diameter dug wells. These wells commonly go dry during late summer and fall. The water quality is poor with a salty bitter taste. It is unsuitable for human consumption. The chloride content is generally 500 to 1000 ppm and total dissolved solids exceed 2000 ppm in water from shallow wells.

The bedrock aquifer present is composed of limestone, mudstone, sandstone, and shale. This aquifer consists of three units – an upper, middle, and lower. The upper unit consists of limestone and calcareous mudstone about 235 feet thick. The top 135 feet consists of cherty, slightly dolomitic yellow and tan limestone. These limestones contain solution openings which are especially abundant in the upper 40 feet. The lower 100 feet consists of clayey and silty limestone and dolomitic mudstone. These rocks have a dense

texture. Color varies from dark gray and brown to purple. The middle unit consists of white, well sorted medium grained sandstone about 70 feet thick. The lower unit consists of varicolored shale and a few beds of poorly sorted sandstone. The thickness of the entire aquifer can be from 0 to 500 feet. Yields rage from less than 5 gallons per minute to more than 60 gallons per minute from flowing wells. Much greater yields could be developed. Most productive aquifers occur in the upper porous zone in the dolomitic limestone and in the middle sandstone unit. The water quality is poor, consisting of brine and highly saline water, unsuitable for nearly all uses. Total dissolved solids greater than 35,000 parts per million exist in lower part of Paleozoic rocks.

4. Natural Resources and Unique Water & Land Related Resources

This subwatershed is dominated by agricultural lands. No large blocks of natural habitats are found in this subwatershed. Several tracts of CRP land are present near the confluence with the Red River and near the confluence with the North Branch. Quality natural habitats are found primarily in the rather narrow river corridor along the two Rivers main stem. A lack of large habitat blocks limits the potential of the terrestrial habitats in this subwatershed.

The Two Rivers main stem is the primary waterway in this subwatershed. Some of the natural tributaries have been converted to ditches. The remaining natural waterways and the ditches provide some fish and aquatic habitat but most of these are probably limited to seasonal use. Small waterways here are likely to provide spawning and rearing habitat for northern pike and a limited variety of other species. The reach of the Two Rivers in this subwatershed provides quality habitat for a variety of fish species. Flashy flows, susceptibility to extended low flow or no flow periods, unstable channels, beaver dams, high turbidity, and a lack of riparian habitat limit the function of these aquatic resources.

In addition to these general habitat features, three Natural Heritage elements have been documented in this sub watershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated “outstanding resource value waters” or “critical vegetated habitat” as defined in state statutes have been found in this sub-watershed.

Resource improvement opportunities: There is a high potential to significantly improve fish and wildlife habitat in this subwatershed. In particular, actions should be taken to protect the existing river corridor, create some large habitat blocks along this corridor, protect existing stable waterways, and stabilize existing unstable waterways. Water storage in upstream subwatersheds would also help attenuate high flows and increase base flows in the reach of the Two Rivers here.

5. Unique Water & Land Related Resources

Several farmsteads have been present in this area in excess of 100 years. There is a historical value to this and a uniqueness to justify the preservation of these farmsteads.

B. Water Use

1. Surface & Ground Water

There are no major water users located within this subwatershed. The City of Hallock and most farmsteads procure water supplies from the North Kittson Rural Water System. A few cattle or buffalo operations exist, which may utilize water from the river.

The City of Hallock discharges its sewage treatment ponds into a private ditch which in turn outlets into a coulee system which in turn outlets into the main stem. This is done twice per year. The City also outlets its storm sewer from the city streets directly into the main stem. Individual farmsteads within this subwatershed rely on individual sewage treatment systems for disposal of sewage and other waste.

C. Existing Conditions, Related Potential Problems, & Solution Alternatives [Assessments & Issue Identification]

The following issues were discussed at public meeting held at Hallock to specifically hear comments on the Main Stem subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ Excessive duration of flooding along the Red River compounded by local flooding from the eastern areas of the District.
- ✓ Overflows from the Roseau River add to the flooding on the Two Rivers. This affects the area downstream of where the North Branch enters the Main Stem.
- ✓ Overland flooding from the east because of inconsistent culvert sizes contributes to Red River flooding.
- ✓ Road washouts from flooding.
- ✓ Loss of agricultural and pasture lands due to flooding.
- ✓ Losses of residential homes and buildings due to excessive flooding.
- ✓ Sedimentation caused by flooding.
- ✓ Loss of population and tax revenue due to flooding. Because of the recurrent and excessive flooding, North Red River Township has lost all of its residents.
- ✓ Ice jams and log jams in the spring and summer contribute to high water levels on the rivers, coulees, and out on the land.
- ✓ Slope failure on legal ditches causes banks to fail and large amounts of sediment to enter the system.
- ✓ Sedimentation due to wind erosion fills natural watercourses and ditches and adds to water pollution during runoff events.
- ✓ Crop losses during summer runoff events cause financial hardship to landowners.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Drainage Ditches: Channels constructed to collect surface runoff and convey it to a point downstream

Flood Water Detention: Temporary storage of flood water in areas upstream of this subwatershed until after the flood.

Flood Water Retention: Semi permanent storage of flood water in areas upstream of this subwatershed for other beneficial use such as water supply, wetlands, or recreation.

Ring Dikes: Dikes constructed to defend individual homes or farmsteads.

Agricultural Levees: Dikes constructed to defend crop land

Diversion Channels: Channels constructed to provide an alternate or additional route for stream flows.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control (meter) the flow of water.

Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

Watershed Treatment: Implement land management practices that reduce runoff potential.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Specific NRE Alternatives:

- Increase the average width of the natural habitat corridor along the river.
- Create at least one large habitat block near the river corridor.
- Monitor water quality.
- Promote use of buffers along waterways.
- Promote wetland restorations using existing conservation programs (e.g. CRP, WRP, RIM)
- Reduce erosion and sedimentation in existing waterways.
- Promote active vegetation management activities.
- Promote BMP's to increase water quality (grazing).

UNNAMED COULEE

A. Water Resources

1. Major Sub Watersheds

The unnamed coulee subwatershed consists of 8 smaller subwatersheds as identified by the Minnesota DNR covering a total of 171 square miles. These smaller subwatersheds are a network of coulee systems, legal ditches, and private ditches. They all come together to outlet into one channel, which joins another coulee system and in turn outlets into the Red River in section 15 of South Red River Township, Kittson County.

The ecoregion of this subwatershed is the Red River Valley, and the geomorphology consists of the Lake Agassiz Level Lacustrine with pockets of the Lake Agassiz Rolling Lacustrine (near Karlstad) and Fluvial Level Alluvium (along the major coulee channel near the Red River). Soil textures range from sandy in the east to very fine in the west. A narrow band of fine – silty occurs in the middle portion of the sub watershed and also near the outlet. Land use is almost exclusively cultivated for the production of agricultural crops. The exception is in the eastern edge where hay / pasture/ grassland is prevalent. An 8 square mile area located west of Halma known as the Halma Swamp is forested and harbors wetlands. Extensive gravel pit mining operations have been developed in the beach ridge areas near Halma and also in a ridge area 4 miles east of Kennedy. The main activity is currently in the Halma area.

Great erosion potential exists in the eastern ½ of this subwatershed where the fall is 20 to 30 feet per mile and the soils are sandy. In the western ½, the fall is from 2 to 10 feet in a mile and the soils are clay. The eastern ½ of this subwatershed is the highest priority to control water erosion and prevent annual damages to infrastructure and cropland.

Unnamed


KCD 25
Northerly Flow
KCD 25
Southerly Flow
KCD 8
SD 1
KCD 31
KCD 1
KCD 27
KCD 9
KCD 4
US Hwy 75
County Hwy 1
County Hwy 13
County Hwy 7
County Hwy 10
County Hwy 5
County Hwy 2
County Hwy 19
County Hwy 7
County Hwy 7
County Rd 61
Kennedy
Halma
County Hwy 20
US Hwy 59
N
0
8 Miles

2. Surface Water

The unnamed coulee subwatershed does not have any river system, rather it has a multitude of coulees and legal ditch systems. The coulees are characterized by a winding, shallow, grassy channel, which serves as a collector for agricultural ditches, road ditches, and legal ditches. Sometimes the legal ditches will outlet into the coulees, and sometimes the coulees will outlet into the legal ditches. In places the coulees / ditches are wide and have a grass strip on either side of them, and in other places they are narrow and are farmed up to the edge of the channel.

The subwatershed is home to several legal ditch systems. These include Kittson County ditches 1, 4, 8, 9, 25, 27, and 31, and State Ditch #1. These ditch systems range in length and areas they drain. Most were constructed in the early to mid 1900's for the purposes of agricultural drainage for crop production. Virtually all of them outlet into one main unnamed coulee system which flows into the Red River of the North. All of these legal ditch systems at the present time are under the jurisdiction of the Kittson County Commissioners.

Lakes or other bodies of water are present in the subwatershed in the form of gravel pits. A series of large gravel pits were mined several years in the past and are now abandoned. They exist now as open pits which collect and hold surface water, providing aquatic habitat for insects, fish, invertebrates, migratory waterfowl, beaver, muskrat, and other water loving species. These lakes are not used for recreation on any large scale, and all are either privately owned or owned by Kittson County. There are no water management structures in this subwatershed.

Wetlands are prevalent in the eastern 1/3 of the subwatershed. The extensive drainage systems in the western 2/3 have drained most of the pre settlement wetlands. The Halma Swamp area and areas east of U.S. Highway #59 are home to mostly types 2 and 6 wetlands. Gravel pit areas hold types 4 & 5. In the western areas wetlands only exist along the coulee channels as types 2, 3, and 4.

Water quality monitoring has been done by the District at two sites in this subwatershed. One site is located where the coulee intersects a township road approximately 1.5 miles east of the Red River and the other is located where the coulee intersects a township road in the NE corner of section 19 of Skane Township. These have been monitored since 1991 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. There are no reaches that have been identified by the Minnesota Pollution Control Agency as impaired in this subwatershed.

3. Groundwater

Soils within this subwatershed are sands in the east, underlain by clayey till. The sands have moderate surface runoff, being well drained by natural channels. In the central portion of the subwatershed is a band of silt. This is generally only a few feet thick, underlain by clayey till or clay. These have moderate surface runoff, also well drained by natural channels. The western portion of the subwatershed is clay, which is dense, impermeable, and underlain by more than 100 feet of lake clay towards the Red River.

Surface runoff is slow, locally improved by large ditches. This area is often flooded in the spring.

Generally, the Unnamed Coulee subwatershed is made up of a “shoreline area” in the east and a “lake plain” in the west. The shoreline area consists of shallow water and shoreline deposits remnant from glacial Lake Agassiz. These are made up of interbedded clay, silt, and fine sand. Predominantly clay near the lake plain area gradually changing to fine sand in the eastern part of the shoreline area. Unsaturated except for lower few feet in western part of shoreline area. The shoreline area also includes unmapped sand and gravel deposits as much as 20 feet thick. This area yields little to no water at most places, but the sand and gravel areas may yield up to 20 gpm to wells. The water quality is poor to fair, hard and commonly high in chloride in the area near the lake plain.

The lake plain area consists of deep water lake deposits of clay, gray to blue gray. These deposits are plastic and dense, containing lenses of silt and very fine sand. They are largely impermeable, but transmit some water in the silt and very fine sand lenses. This area is from 0 to 100 feet thick, yielding no water to wells in the clay areas. Silt and very fine sand lenses yield less than 1 gpm to large diameter dug wells. These wells commonly go dry in the summer months. Water quality is poor and high in chloride and sulfate. It is unsuitable for domestic use.

Surficial aquifers present are buried channel outwash deposits in the Halma area, and beach and bar deposits in scattered in the eastern ½ of the subwatershed. The buried channel outwash is predominantly sand to medium gravel but includes beds of silt and clay toward the channel margins. The coarser materials occur in thicker parts and include cobble and boulder beds. Deposit is almost completely saturated and water is unconfined. At low places deposit is entirely saturated. This aquifer is from 0 to 130 feet in thickness and provides moderate to large yields – more than 1000 gallons per minute from thick sections of coarser deposit. The water is hard, and low in chloride.

The beach and bar deposits are fine to coarse sand with lenses of gravel. Deposits from northward trending ridges that range in length from a few hundred feet to more than 10 miles and range in width from less than 200 feet to more than half a mile. Heights of ridges range from a few feet to more than 25 feet. Some beaches, such as the one east of Kennedy, overlie channel deposits of sand and gravel. At most places the beaches are underlain by till. In general, the larger beaches contain coarser and more permeable deposits than smaller beaches or bars. Saturated thickness ranges from less than one foot in smaller bars to more than 10 feet in larger beaches. Near Kennedy the saturated thickness of these deposits is more than 35 feet. Water is unconfined. The yield is small to moderate – more than 50 gpm in places where beach deposits overlie shallow channel deposits. Yields of less than 20 gpm are obtained from wells in larger beach ridges underlain by till. The water is hard and low in chloride.

Outside of the buried channel outwash deposit, the rest of the subwatershed to the west is largely a stratified sedimentary rock aquifer made up of shale, sandstone, siltstone, limestone, and dolomite. This is a confined aquifer with yields unknown. Pressure head in wells tapping permeable bed is more than 10 feet above land surface at most places. The water is highly mineralized and unsuitable for use. Chloride ranges from 2,000 to 6,000 parts per million.

4. Natural Resources and Unique Water & Land Related Resources

Existing Resources: Most of the fish and wildlife habitat in this subwatershed has been altered due to land use changes, drainage, and channel modifications. Fish habitat is particularly limited by channelization of most waterways and a flow regime characterized by short periods of high flow and lengthy periods of extremely low flows that sporadically support aquatic life. Wildlife habitat is limited by a lack of grassland and wetland habitat and limited connectivity of the habitat that remains. CRP land is almost exclusively limited to the eastern portions of this subwatershed.. A few remnant grassland habitat blocks are present in this sub-watershed and most wetlands have been drained (MCEA report).

In addition to these general habitat features, 41 Natural Heritage elements have been documented in this sub watershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated "outstanding resource value waters" or "critical vegetated habitat" as defined in state statutes have been found in this sub-watershed.

Resource Improvement Opportunities: The potential to significantly improve fish and wildlife habitat in this sub-watershed is high. In particular, rehabilitating existing degraded channels (existing coulees) and buffer them with grasses has the potential to benefit fish and wildlife in this subwatershed. Creation of one or two large grassland habitat blocks adjacent to a buffered waterway would provide substantial habitat in this subwatershed. Land use changes, wetland restorations, and impoundments sited near the upper reaches of waterways in this watershed, where practical and feasible, could help reduce runoff during high flow periods and augment base flows during low flow periods. Opportunities exist in this subwatershed to reclaim abandoned or unused gravel pits.

B. Water Use

1. Surface and Ground Waters

Presently there are no known major users of surface water within the Unnamed Coulee system. The intermittent nature of the streams, ditches, and other watercourses makes it prohibitive to utilize surface water.

Groundwater is utilized as a major source of drinking water by the Kittson – Marshall Rural Water system. This system provides water to the Cities of Kennedy, Donaldson, and Stephen. The system operates two wells located in section 11 of Davis Township, Kittson County. Each is 35 feet in depth, and capable of producing 250 gpm. Three ground storage units combine for a total of 120,000 gallons. A treatment plant filters the water with a gravity type filter to remove iron and manganese. The water is fluoridated and chlorinated. Water is distributed via a pressure system through pvc pipe ranging in size from 1.5 to 6 inch in diameter. Two boost stations are located within the system. The system is also supplemented with water from the North Kittson Rural Water system, located near Lake Bronson.

Of note is the presence of agricultural irrigation in the Halma area. Several locations utilize wells and center pivot irrigation systems to provide water to crops such as potatoes and native grasses. Most residences in the Halma area utilize wells for their source of water.

The City of Halma is an unsewered community. Its residents rely on individual sewage treatment systems to dispose of waste. As with the community of Halma, all of the farmsteads within this subwatershed also rely on individual sewage treatment systems. The City of Kennedy relies on a sewage collection system an utilizes sewage treatment ponds located one mile west of the City. These ponds are generally emptied twice per year, using Kittson County Ditch #27 as their outlet. This system is monitored and permitted by the Minnesota Pollution Control Agency.

C. Existing Conditions, Related Potential Problems, and Solution Alternatives [Assessments & Issue Identification]

The following issues were discussed at public meeting held at Kennedy to specifically hear comments on the Unnamed Coulee subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ The Red River does not provide an adequate outlet for the systems that drain to it.
- ✓ The ditch and coulee systems that occur within the sub-watershed are inadequately designed and cannot carry the high flows, resulting in overland flooding.
- ✓ In locations where ditch systems outlet into a coulee, a redesign of the system is needed to provide sufficient capacity to handle runoff from summer rainfall events.
- ✓ Trees, brush, and other vegetation are becoming prevalent within coulee systems and needs to be removed in order for the systems to carry water.
- ✓ Overland flooding that crosses from subwatershed to subwatershed is affecting infrastructure and individual farmsteads.
- ✓ As a result of spring runoff from snow melt, roads, culverts, bridges, and other infrastructure are damaged annually.
- ✓ Waterways designated on the DNR Protected Waters map need to be maintained.
- ✓ Legal and private ditch systems are incurring damage to their side slopes. Maintenance needs to be done to keep the ditches properly functioning.
- ✓ Because of spring flooding, it is becoming an annual problem that spring planting of crops is delayed.
- ✓ In the ridge areas in the upstream parts of the sub-watershed, overland flooding and resultant erosion is a problem.
- ✓ Water levels in gravel pits are a problem for the owners & operators of these pits. Gravel pit dewatering is a potential problem for downstream landowners. These problems need to be addressed.
- ✓ High stream flows seem to be too high and low flows seem to be too low. A more constant flow is desirable.

- ✓ Wind erosion needs to be addressed. Some areas blow during the winter and spring resulting in siltation of the waterways and loss of topsoil.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Drainage Ditches: Channels constructed to collect surface runoff and convey it to a point downstream

Flood Water Detention: Temporary storage of flood water in areas upstream of this subwatershed until after the flood.

Flood Water Retention: Semi permanent storage of flood water in areas upstream of this subwatershed for other beneficial use such as water supply, wetlands, or recreation.

Ring Dikes: Dikes constructed to defend individual homes or farmsteads.

Agricultural Levees: Dikes constructed to defend crop land

Diversion Channels: Channels constructed to provide an alternate or additional route for stream flows.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control (meter) the flow of water.

Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

Watershed Treatment: Implement land management practices that reduce runoff potential.

WATERSHED DISTRICT PROJECTS:

The District received a petition from the City of Kennedy in 2002 for a flood control project. The waterway that runs through the City currently does not have enough capacity to handle the water that is directed to it from upstream areas. Therefore, the waterway overflows its banks and inundates areas within the city. This project was designed to provide flood control for the city by enlarging the channel and providing an adequate outlet for the water that enters the city. A portion of the construction began on a one mile stretch of the channel immediately downstream from town in the fall of 2001.

The project is currently on hold pending investigations regarding the upstream contributing watershed of Kittson County Ditch #4.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Specific NRE Alternatives:

- Buffers
- Field windbreaks
- Erosion control
- Wetland restorations where practical and feasible
- Strategic culvert sizing
- Waterway stabilization and rehabilitation
- Create large grassland habitat block where practical and feasible
- Gravel pit reclamation

JUDICIAL DITCH #10

A. Water Resources

1. Major Sub-Watersheds of the District

This sub-watershed is located in the southwestern portion of the Two Rivers Watershed District, encompassing about 136 square miles and including the City of Donaldson and a portion of the City of Karlstad. Drainage systems located in this area include Kittson County Ditches 7, 10, 16, and 19, and Judicial Ditches 3 and 10. Several unnamed coulee systems also exist and are interconnected with the drainage systems named above. Most of these systems share a common outlet into an unnamed coulee which in turn outlets into the Red River of the North. In all, 24 separate subwatersheds exist within the Judicial Ditch #10 Subwatershed.

The entire subwatershed lies within the Red River Valley aquatic ecoregion. Land use is predominantly cultivated agricultural land, with some areas of pasture – hayland – grassland in the eastern most areas. The geomorphologic areas present are the Lake Agassiz Level Lacustrine with narrow bands of Lake Agassiz Rolling Lacustrine (in the beach ridge areas in the eastern portion of the subwatershed). Soil textures range from sandy in the eastern ½ to a narrow band of fine-silty in the middle area to very-fine in the western ½. Small pockets of fine and fine-silty soil are located in the southwestern areas of the subwatershed.

JD #10


KCD 19
KCD 7
KCD 16
JD 10
JD 10
JD 10
JD 10
JD 3
JD 10
KCD 10
Donaldson
State Hwy 11
State Hwy 220
County Hwy 1
County Hwy 13
US Hwy 75
County Hwy 2
County Hwy 19
County Hwy 20
County Hwy 11
US Hwy 59
Karlstad
N
0
9 Miles

2. Surface Waters

There are no rivers present within the Judicial Ditch #10 subwatershed. Generally, the main drainage through the area begins at the City of Karlstad where Kittson County Ditch #10 arises. It travels straight west for 6.5 miles where it outlets into an intermittent waterway, or unnamed coulee. This coulee winds its way approximately 8 miles in a southwestern direction and in turn outlets into Judicial Ditch #10. JD #10 travels about 13 miles west – northwest and outlets into another intermittent unnamed coulee. This coulee then travels about 5 miles in a northerly direction where it meets the Red River of the North. One other main drainage is located on the Marshall and Kittson County line and consists of Judicial Ditch #3 and Judicial Ditch #10. This arises 16 miles east of the Red River and flows directly west along the county line where it outlets into the Red River.

There are no lakes in this portion of the District. Wetlands mainly exist in the extreme eastern ¼ of the subwatershed in the vicinity of the City of Karlstad. Wetland types consist mainly of type two, six, and seven. Traveling west through the subwatershed, wetlands become less prevalent and exist mainly only along the coulee systems. Due to the extensive agricultural lands, drainage is a necessity and therefore most of the western ¾ of the subwatershed was drained in the early 1900's as crop production became a priority.

As mentioned above, several legal drainage systems exist within the subwatershed. In addition to the legal drainage systems, a network of roadway ditches and private agricultural ditches cris-crosses the area. Each type of ditch is utilized to carry water from upper lands through lower lands and ultimately to the Red River. As rainfall or snowmelt enters onto either ag land, grassland, or other types of land use, it finds its way into field ditches or natural draws. These typically enter into either township, county, state or federal road ditches. The water then enters legal drainage ditches, coulee systems, or the river. Therefore, each and every type of ditch system is interconnected with the others, and must be managed accordingly. There are no water management structures or impoundments located within this subwatershed.

Water quality monitoring has been done by the District at one site in this subwatershed. The site is located one mile from the coulee outlet at a township road in section 22 of South Red River Township. This has been monitored since 2003 for several parameters, including dissolved oxygen, pH, turbidity, chloride, nitrate, phosphate, alkalinity, and conductivity, among others. The District periodically prepares a water quality report, and results are available upon request in the District office. There are no reaches that have been identified by the Minnesota Pollution Control Agency as impaired in this subwatershed.

3. Groundwater

Soils within this subwatershed are sands in the east, underlain by clayey till. The sands have moderate surface runoff, being well drained by natural channels. In the central portion of the subwatershed is a band of silt. This is generally only a few feet thick, underlain by clayey till or clay. These have moderate surface runoff, also well drained by natural channels. The western portion of the subwatershed is clay, which is dense, impermeable, and underlain by more than 100 feet of lake clay towards the Red River.

Surface runoff is slow, locally improved by large ditches. This area is often flooded in the spring.

Generally, the Judicial Ditch #10 subwatershed is made up of a “shoreline area” in the east and a “lake plain” in the west. The shoreline area consists of shallow water and shoreline deposits remnant from glacial Lake Agassiz. These are made up of interbedded clay, silt, and fine sand. Predominantly clay near the lake plain area gradually changing to fine sand in the eastern part of the shoreline area. Unsaturated except for lower few feet in western part of shoreline area. The shoreline area also includes unmapped sand and gravel deposits as much as 20 feet thick. This area yields little to no water at most places, but the sand and gravel areas may yield up to 20 gpm to wells. The water quality is poor to fair, hard and commonly high in chloride in the area near the lake plain.

The lake plain area consists of deep water lake deposits of clay, gray to blue gray. These deposits are plastic and dense, containing lenses of silt and very fine sand. They are largely impermeable, but transmit some water in the silt and very fine sand lenses. This area is from 0 to 100 feet thick, yielding no water to wells in the clay areas. Silt and very fine sand lenses yield less than 1 gpm to large diameter dug wells. These wells commonly go dry in the summer months. Water quality is poor and high in chloride and sulfate. It is unsuitable for domestic use.

Surficial aquifers present are buried channel outwash deposits in a small area west of Karlstad, and beach and bar deposits scattered in the eastern ½ of the subwatershed. The buried channel outwash is predominantly sand to medium gravel but includes beds of silt and clay toward the channel margins. The coarser materials occur in thicker parts and include cobble and boulder beds. Deposit is almost completely saturated and water is unconfined. At low places deposit is entirely saturated. This aquifer is from 0 to 130 feet in thickness and provides moderate to large yields – more than 1000 gallons per minute from thick sections of coarser deposit. The water is hard, and low in chloride.

The beach and bar deposits are fine to coarse sand with lenses of gravel. Deposits from northward trending ridges that range in length from a few hundred feet to more than 10 miles and range in width from less than 200 feet to more than half a mile. Heights of ridges range from a few feet to more than 25 feet. Some beaches, such as the one east of Kennedy, overlie channel deposits of sand and gravel. At most places the beaches are underlain by till. In general, the larger beaches contain coarser and more permeable deposits than smaller beaches or bars. Saturated thickness ranges from less than one foot in smaller bars to more than 10 feet in larger beaches. Near Kennedy the saturated thickness of these deposits is more than 35 feet. Water is unconfined. The yield is small to moderate – more than 50 gpm in places where beach deposits overlie shallow channel deposits. Yields of less than 20 gpm are obtained from wells in larger beach ridges underlain by till. The water is hard and low in chloride.

Subsurface aquifers present include an area of ‘sand bed within till’ in the Karlstad area and area of with ‘buried channel deposits’ located about 5 miles west of Karlstad. The ‘sand bed within till’ area is predominantly fine to medium sand containing small lenses of sand and gravel. Coarser deposits occur along the longitudinal axis. Till overlying aquifer ranges in thickness from less than 5 feet to more than 30 feet. This is a confined aquifer, and that is 0 to 50 feet thick and yields up to several hundred gallons per minute in the coarser deposits located in the thicker part of the aquifer. Water quality is hard and low in chloride.

The Buried Channel Deposits consist of interbedded sand, silt, and clay. They are predominantly fine sand in upper part grading to silt and clay in lower part. The thickness of the sandy upper part ranges from 5 to 40 feet thick. A surficial cover of lake clay ranging in thickness from 20 to 60 feet overlies the aquifer at most places. The water is confined under moderate pressure. Yields of more than 20 gpm probably could be developed by drilling large diameter wells that are screened and sand packed in the thicker sand zones. The water quality is hard and chloride content in water from the sand zone was up to 320 ppm. Chloride content probably decreases toward the north. Gas pockets were tapped during drilling of several auger holes.

Outside of the buried channel outwash deposit, the rest of the subwatershed to the west is largely a stratified sedimentary rock aquifer made up of shale, sandstone, siltstone, limestone, and dolomite. This is a confined aquifer with yields unknown. Pressure head in wells tapping permeable bed is more than 10 feet above land surface at most places. The water is highly mineralized and unsuitable for use. Chloride ranges from 2,000 to 6,000 parts per million.

4. Natural Resources and Unique Water & Land Related Resources

Existing Resources: Most of the fish and wildlife habitat in this subwatershed has been altered due to land use changes, drainage, and channel modifications. Fish habitat is particularly limited by channelization of most waterways and a flow regime characterized by short periods of high flow and lengthy periods of extremely low flows that support little aquatic life. Wildlife habitat is limited by a lack of grassland and wetland habitat and limited connectivity of the habitat that remains. CRP land is almost exclusively limited to the eastern portions of this subwatershed. A few remnant grassland habitat blocks are present in this sub-watershed and most wetlands have been drained (MCEA report).

In addition to these general habitat features, 17 Natural Heritage elements have been documented in this sub watershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated “outstanding resource value waters” or “critical vegetated habitat” as defined in state statutes have been found in this sub-watershed.

Resource Improvement Opportunities: In particular, rehabilitating existing degraded channels (existing coulees) and buffer them with grasses has the potential to benefit fish and wildlife in this subwatershed. Creation of one or two large grassland habitat blocks adjacent to a buffered waterway would provide substantial habitat in this subwatershed. Land use changes, wetland restorations, and impoundments sited near the upper reaches of waterways in this watershed could help reduce runoff during high flow periods and augment base flows during low flow periods.

B. Water Use

1. Surface and Ground Waters

Presently there are no known major users of surface water within the Unnamed Coulee system. The intermittent nature of the streams, ditches, and other watercourses makes it prohibitive to utilize surface water.

Groundwater is utilized as a major source of drinking water by the Kittson – Marshall Rural Water system. This system provides water to the Cities of Kennedy, Donaldson, and Stephen. The system operates two wells located in section 11 of Davis Township, Kittson County. Each is 35 feet in depth, and capable of producing 250 gpm. Three ground storage units combine for a total of 120,000 gallons. A treatment plant filters the water with a gravity type filter to remove iron and manganese. The water is fluoridated and chlorinated. Water is distributed via a pressure system through pvc pipe ranging in size from 1.5 to 6 inch in diameter. Two boost stations are located within the system. The system is also supplemented with water from the North Kittson Rural Water system, located near Lake Bronson.

The City of Karlstad operates and maintains its own city supply wells. Information regarding these wells can be obtained from the City of Karlstad. The City's storm sewer and its sanitary sewer are discharged into Kittson County Ditch #10. The storm sewer is outletted directly, while the sanitary sewer is treated and discharged into the City's settling ponds, which in turn are dumped periodically into Kittson County Ditch #10. This is a permitted situation through the Minnesota Pollution Control Agency and with the Two Rivers Watershed District.

Most farm residences within the area rely either upon the Kittson Marshall Rural Water System or upon private wells for potable water.

C. Existing Conditions, Related Potential Problems, and Solution Alternatives [Assessment & Issue Identification]

The following issues were discussed at public meeting held at Kennedy to specifically hear comments on the Unnamed Coulee subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ The Red River is not an adequate outlet for the drainage systems, coulees, and rivers that outlet into it. This is most apparent in Teien, South Red River, Svea, and Skane Townships.
- ✓ The ditch and coulee systems have inadequate designs to handle the water that comes to them.
- ✓ Road, culvert, and bridge washouts are a problem in the springtime.
- ✓ Crop damage during summer rainfall events.

- ✓ Outlets to ditch and coulee systems need to be redesigned to handle summer rainfall events, especially in the western portion of the subwatershed and where ditches outlet into coulee systems.
- ✓ Maintenance needs to be coordinated and performed on watercourses designated as DNR protected waters.
- ✓ Overland flooding leads to erosion problems, especially in the areas where there is a beach ridge.
- ✓ Maintenance needs to be done on ditch systems that are experiencing side slope damage or sedimentation of the ditch bottom.
- ✓ The common outlet for Kittson County ditches 7, 16, and 19 and Judicial Ditch #10 needs to be evaluated and a maintenance plan needs to be developed.
- ✓ Wind erosion needs to be addressed. Commonly wind erodes topsoil from ag fields and deposits it in waterways causing blockage and degraded water quality.
- ✓ Stream flows are too high during runoff events and too low during other times of the year. It is more desirable to have a more constant rate of flow.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Drainage Ditches: Channels constructed to collect surface runoff and convey it to a point downstream

Flood Water Detention: Temporary storage of flood water in areas upstream of this subwatershed until after the flood.

Flood Water Retention: Semi permanent storage of flood water in areas upstream of this subwatershed for other beneficial use such as water supply, wetlands, or recreation.

Ring Dikes: Dikes constructed to defend individual homes or farmsteads.

Agricultural Levees: Dikes constructed to defend crop land

Diversion Channels: Channels constructed to provide an alternate or additional route for stream flows.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control (meter) the flow of water.

Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

Watershed Treatment: Implement land management practices that reduce runoff potential.

WATERSHED DISTRICT PROJECTS:

The Two Rivers Watershed District is the ditch authority on Kittson County Ditches #7 and #10, and Judicial Ditches #3 and #10. As such, the District is responsible for the operation, repair, and maintenance of each. In 1998 the District undertook repair work on Kittson CD #10 as a result of major disasters in 1996 and 1997. Eight grade stabilization structures were constructed in the ditch to slow down erosive flows and stabilize erosion that had occurred within the ditch. Likewise, in 2003 the District undertook major repair work on Judicial Ditch #10. Extensive sloughing of the side slopes had occurred in the 1999 and 2001 disasters and these slopes were repaired utilizing grant funding from FEMA.

In the late 1990's landowners submitted a petition to create a ditch out of the unnamed coulee that lies between Kittson CD 10 and JD 10. The engineer's report showed that the project was feasible, however the projected costs were above what the project petitioners were willing to pay. In 2002, the project was submitted for Federal funding under the PL-566 program through the Natural Resource Conservation Service. The project is currently being surveyed and is in the design phase.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Wetland Restoration: Restore drained wetlands and create new wetlands with the intent to control runoff, provide wildlife benefits, recharge groundwater, and provide water quality benefits.

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Stream Restoration: Restore channelized and diked streams to more natural dimensions, patterns, and profiles and to reconnect them to their floodplain and riverine areas. Re-establishing these natural characteristics restores critical ecological functions and stability.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, and best management practices to reduce transport of sediment into

watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

NRE Alternatives:

- Buffers
- Field windbreaks
- Erosion control
- Wetland restorations where practical and feasible
- Strategic culvert sizing
- Waterway stabilization and rehabilitation where practical and feasible
- Create large grassland habitat block where practical and feasible
- Rehabilitate waterway between CD 10 and JD 10 with setback levees

DIRECT TO RED RIVER

A. Water Resources

1. Major Sub Watershed Areas

The Direct to Red River subwatershed is an area made up of 3 individual smaller subwatershed areas, totaling 46.5 square miles. As the name indicates, all of these areas drain directly to the Red River via either direct runoff or coulee drainage. One ditch system, Kittson County Ditch #26, is located in the northern most area of this subwatershed. The other areas of this subwatershed are directly drained by coulee systems, private field ditches, or road ditches. Most areas of this subwatershed are very flat, with less than 2 feet of drop in a mile. The exception is along the edges of the coulees where the banks are well developed and there is good slope from adjacent fields into the waterways.

Geomorphologic regions of the areas direct to the Red River include the Lake Agassiz Level Lacustrine and the Fluvial Level Alluvium. The latter exists right next to the main channel of the Red River. Soil textures in the area consist of very fine, fine – silty, and fine. Northcote Clay is the primary soil association, consisting of poorly drained, nearly level clayey soils formed in lake – laid clays. The entire subwatershed is located in the Red River Valley aquatic ecoregion. Land use is predominantly cultivated cropland, however areas adjacent to the Red River are forested or grassed.

Red River


KCD 26
County Rd 59
State Hwy 175
County Hwy 16
County Hwy 10
County Rd 75
County Hwy 7
State Hwy 11
N

2. Surface Waters

The areas direct to the Red River are made up of six smaller subwatersheds. One legal ditch system, Kittson County Ditch #26, is located in the northern reaches of the subwatershed in Hill Township. The rest of the subwatershed consists of a drainage network of private field ditches that drain agricultural lands. These ditches usually outlet into a road ditch, which in turn usually outlets into a coulee system, which then in turn outlets into the Red River.

There are no water management structures located in this region. Very few wetlands remain in the region. Most pre settlement wetlands were drained in the early 1900's for the production of agriculture. Remaining wetlands generally exist along coulee systems or the Red River. There has been no water quality monitoring by the District in this subwatershed. The Minnesota Pollution Control Agency has listed the Red River as impaired, with mercury and pcb's the pollutants.

3. Groundwater

The general soil material within the subwatershed is clay, a dense, impermeable material underlain by more than 100 feet of lake clay. The surface runoff is slow, locally improved by large ditches. Water discharge is mainly through evaporation, and the area is often flooded in the spring and early summer.

Generally, the lake clay material is gray to blue gray in color, has a physical characteristic of plasticity, is dense, and contains lenses of silt and very fine sand. There is no glacial drift aquifer present. A bedrock aquifer does exist, consisting of limestone, mudstone, sandstone, and shale. This consists of three units – the upper unit consists of limestone and calcareous mudstone about 235 feet thick. The top 135 feet consists of cherty, slightly dolomitic yellow and tan limestone. These limestones contain solution openings which are especially abundant in the upper 40 feet. The lower 100 feet consists of clayey and silty limestone and dolomitic mudstone. These rocks have a dense texture. Color varies from dark gray and brown to purple. The middle unit consists of white, well sorted medium grained sandstone about 70 feet thick. The lower unit consists of varicolored shale and a few beds of poorly sorted sandstone.

Water yields from the aquifer range from less than 5 gallons per minute to more than 60 from flowing wells. The most productive aquifers occur in the upper porous zone in the dolomitic limestone and in the middle sandstone unit.

Water quality is poor, consisting of brine and highly saline water, which is unsuitable for nearly all uses. Total dissolved solids are greater than 35,000 parts per million in the lower part of Paleozoic rocks.

4. Natural Resources and Unique Water & Land Related Resources

Existing Resources: Most of the fish and wildlife habitat in this subwatershed has been altered due to land use changes, drainage, and channel modifications. Fish habitat is somewhat limited by channelization of some waterways and a flow regime characterized by periods of high flow and inundation and lengthy periods of extremely low flows that support little aquatic life. The

remaining natural waterways and the ditches provide some fish and aquatic habitat but most of these are probably limited to seasonal use. Small waterways here are likely to provide spawning and rearing habitat for northern pike and a limited variety of other species. Wildlife habitat is limited by a lack of grassland and wetland habitat and a loss of connectivity of the habitat that remains. Little or no CRP land is located in this subwatershed. A small corridor of habitat is located along the Red River. Most wetlands have been drained (MCEA report). Extensive flooding for long periods of time affects this subwatershed.

In addition to these general habitat features, six Natural Heritage elements have been documented in this sub watershed. These heritage elements, found on public and private land, include rare and endangered birds, mammals, insects, and unique habitats (DNR heritage database). No known state designated "outstanding resource value waters" or "critical vegetated habitat" as defined in state statutes have been found in this sub-watershed.

Resource Improvement Opportunities: In particular, rehabilitating existing degraded channels (existing coulees) and buffering them with grasses has the potential to benefit fish and wildlife in this subwatershed. Creation of one or two large habitat blocks adjacent to the Red River Corridor would provide substantial habitat in this subwatershed. These habitat blocks must be planted with flood tolerant vegetation to prevent the invasion of noxious weeds and undesirable plants. Land use changes, and some wetland restorations could help reduce flood damages during high flow periods. The water quality monitoring program will be utilized to assess the current condition of waters identified as being impaired and formulate strategies to address the issue.

B. Water Use

1. Surface & Ground Waters

There are no known major users of surface or ground water within this subwatershed. As explained above, the water quality of the aquifer present is such that the water is unsuitable for all uses. All of the rural farmsteads present receive their water either from the North Kittson Rural Water system or the Kittson Marshall Rural Water System. Of note, however, is the City of Drayton, North Dakota, located along the bank of the Red River. The City utilizes the Red River for its source of drinking water by pumping it, treating it, and distributing it to city users. A sugar processing plant operated by American Crystal Sugar also utilizes the Red River for its source of water.

C. Existing Conditions, Related Potential Problems, & Solution Alternatives [Assessment & Issue Identification]

The following issues were discussed at public meeting held at Hallock to specifically hear comments on the Direct to Red River subwatershed. Members of the Two Rivers WD Citizen Advisory and Technical Advisory Committees as well as township officials and local citizens were present. Once the comments were heard and listed, they were then given a priority ranking by the CAC & TAC. These are listed below.

1. Water Quantity, Water Quality, Erosion & Sedimentation, Fish & Wildlife, Water Based Recreation, & Unique Water or Land Related Resources.

- ✓ The duration of the flooding along the Red River is excessive and is compounded by local flooding from the east and the south.
- ✓ Overland flooding from the east (from Two Rivers) and the south (from the Red River). This is the number one issue for this subwatershed.
- ✓ Sizes of culverts within the floodplain should be unrestricted to allow the land to drain out in a timely manner after floodwaters have receded. This is to allow cropland to be seeded.
- ✓ Road washouts of township, county, and state roads.
- ✓ Debris left by flooding accumulates on road shoulders, in culverts, on fields, and on ring dikes.
- ✓ Frequency and duration of flooding causes a loss of ag and pasture land as well as a loss of crops that have been planted prior to the flood.
- ✓ Frequency and duration of flooding causes a loss of residential property and also contributes to a loss of population and tax revenue.
- ✓ Sedimentation caused by flooding is a problem in watercourses and on the land.
- ✓ Wet conditions lead to a higher water table which causes problems with crops and cropland.
- ✓ High stream flows are too high during flooding and consequently fall too low during other times. It is desirable to have a more constant and sustained stream flow in watercourses.
- ✓ Sedimentation of ditches, coulees, and watercourses due to wind erosion is a problem.
- ✓ Because of the loss of population due to flooding, buildings and farmsteads are left vacant, and vandalism of these buildings becomes a problem.

2. Solution Alternatives

The following solution alternatives are listed here to discuss the range of possible solutions. These are not listed in any order, and a preferred alternative is not identified. The TRWD Board of Managers will utilize this listing of possible solutions to discuss and formulate a specific plan of action for this subwatershed. Action items will be completed with regard to prioritization and how they fit into the overall watershed district goals and objectives.

FLOOD DAMAGE REDUCTION ALTERNATIVES

Drainage Ditches: Channels constructed to collect surface runoff and convey it to a point downstream

Channelization: Enlarging and / or straightening a natural waterway.

Flood Water Detention: Temporary storage of flood water in areas upstream of this subwatershed until after the flood.

Flood Water Retention: Semi permanent storage of flood water in areas upstream of this subwatershed for other beneficial use such as water supply, wetlands, or recreation.

Ring Dikes: Dikes constructed to defend individual homes or farmsteads.

Agricultural Levees: Dikes constructed to defend crop land

Diversion Channels: Channels constructed to provide an alternate or additional route for stream flows.

Floodways: A relatively confined area on either side of the channel used to help convey flood flows.

Culvert Sizing: Utilizing road embankments and culverts in the watershed to control (meter) the flow of water.

Flood Plain Management: Allowing only flood proof, flood tolerant, or essential development within flood prone areas.

Watershed Treatment: Implement land management practices that reduce runoff potential.

NATURAL RESOURCES ENHANCEMENT ALTERNATIVES

Buffer Strip Establishment: Erosion and sedimentation can be curbed by establishing vegetative buffer strips on either side of field ditches, coulee systems, rivers, legal ditches, and road ditches. This will also provide for wildlife habitat and travel corridors.

Best Management Practices: Work with farm operators to encourage practices that reduce soil erosion & sediment runoff, protect & improve water quality, increase profits by reducing costs, provide wildlife habitat or food sources, and improve air quality.

Preserve Remnant Natural Areas: Native prairie, fens, groundwater recharge zones, wetlands, and historic hydrology have been identified and targeted for protection by various federal and state agencies and private organizations. These initiatives would provide unique habitat for mammals, birds, plants, reptiles, amphibians, insects, and microscopic organisms.

Improve Water Quality & Aquatic Habitat: Utilize wetland restorations, flood storage easements, and best management practices to reduce transport of sediment into watercourses and to provide habitat for various mammals, birds, amphibians, and aquatic organisms.

Wildlife Priorities: Stabilize at risk populations and sensitive species, maintain huntable levels of game, improve habitat, and preserve fish & mussel diversity.

Specific NRE Alternatives:

- Participate and provide input to the Greenway on the Red project to create habitat corridor.
- Buffers
- Field windbreaks
- Erosion control
- Wetland restorations where practical and feasible
- Waterway stabilization and rehabilitation

V. Overall Watershed Goals, Objectives, & Desired Outcomes

During the development of this *Overall Plan*, a Citizen's Advisory Committee (CAC) and a Technical Advisory Committee (TAC) were convened to provide input, analyze data, and provide comment on the various aspects of the plan. The prior section contained the results of meetings that were held in each of the subwatersheds that comprise the Two Rivers Watershed District. The CAC & TAC collected the results of those meetings, analyzed the comments, and prioritized them as they related to the entire watershed district as a whole. This was done by organizing a matrix of all of the issues brought up in the public meetings. The issues that were heard time and again in most of the subwatersheds became a higher priority for the watershed as a whole. Those issues that were only heard in one or a few watersheds maybe would be a high priority in that subwatershed, but would be a lower priority for the watershed district as a whole. The results have been organized into Flood Damage Reduction goals and Natural Resource goals, and are discussed below.

A. Flood Damage Reduction

GOAL: Coordinate with other Boards the delivery of flow to the Red River.

PRIORITY ISSUE: Address spring and summer runoff events.

STRATEGIES:

1) Support work of the RRBFDRWG and RRBC to identify "the basin strategy" and identify how much each tributary contributes to main stem Red River flooding.

2) Determine the contribution and timing of each branch of the Two Rivers to the main stem Two Rivers. Based upon this, set targets for flow reduction on each branch.

3) Establish water retention areas (impoundments) and set aside funding to pay landowners to promote this type of practice. Utilize the Technical Advisory and Citizen's Advisory Committees to review potential impoundment sites, identify new sites, and follow through to construction two (2) impoundments in the next 10 years.

PREFERRED OUTCOMES: Lower the peak and duration of flooding, resulting in less damage to agricultural land and public infrastructure (roads & bridges), and cities. Specific target numbers or percentages for flow reduction will be discussed once hydrologic modeling and other factors are analyzed.

POTENTIAL PARTNERS: Landowners, Township Boards, County Boards, SWCD, FSA, RRWMB, NRCS, RRBFDRWG, RRBC, DNR, BWSR, USGS, USACE

GOAL: Maintain, modify, construct, or improve properly functioning watercourses to provide protection to agricultural land for a 10 - year event, while ensuring that there are no resulting downstream adverse impacts.

PRIORITY ISSUE:

Legal (Public) Systems:

- Reduce the number of drainage systems with outlets that are in disrepair.
- Address beaver dams on ditches and natural watercourses.
- Address problem of debris in river channels.
- Address blockages in drainage systems from sediment, vegetation, and other causes.
- Reduce "flashiness" of the hydrograph related to ditches and natural watercourses.
- Reduce damages to legal ditch systems by preventing or correcting slope failures.

Natural Systems:

- Reduce the number of drainage systems with outlets that are in disrepair.
- Address beaver dams on ditches and natural coulees.
- Address problem of debris in river channels.
- Address blockages in drainage systems from sediment, vegetation, and other causes.
- Reduce the "flashiness" of the hydrograph related to ditches and natural watercourses.
- Reduce damages to natural systems by preventing or correcting slope failures.

Private Systems:

- Reduce the number of drainage systems with outlets that are in disrepair.
- Address beaver dams on ditches and natural coulees.
- Address blockages in drainage systems from sediment, vegetation, and other causes.
- Reduce the "flashiness" of the hydrograph related to ditches and natural watercourses.
- Follow all necessary permitting procedures
- Ensure proper construction to prevent erosion problems such as gullies, side slope failures, and washouts.

Road Ditches:

- Reduce the number of drainage systems with outlets that are in disrepair.
- Address beaver dams on ditches and natural coulees.
- Address blockages in drainage systems from sediment, vegetation, and other causes.
- Reduce the "flashiness" of the hydrograph related to ditches and natural watercourses.
- Reduce damages to legal ditch systems by preventing or correcting slope failures.

STRATEGIES:

1) For legal ditch systems, an annual inspection should be done on each system, which identifies the general ditch condition and specific problems, including any restrictions, condition of outlets, bank and bed failures, sedimentation issues, water quality issues, fish & wildlife issues, and any other issues. A ditch operations and maintenance plan should be written for each ditch system and should address annual cattail spraying, beaver dams and maintenance of them, removal of woody vegetation and debris, cover crops on adjacent fields, riparian buffer strips, CRP, wetland restorations, funding needed for maintenance, and other issues deemed appropriate. For systems that have chronic problems, investigate the feasibility of establishing a storm water management unit or water management district and set up of a storm water utility.

2) For natural systems, an inventory should be completed similar to a ditch inventory & once complete work with DNR to investigate delegating permitting authority. Clean outs of sediment should be done as necessary, and water flow from ditches into natural systems should be controlled by utilizing side pipe inlets or other means. Other maintenance should include brush management, prescribed burning to control vegetation, no farming up to waterway edges, and perpetual easements through programs such as EWP, RIM, & CREP.

3) For private systems, the *Rules of the Two Rivers Watershed District* should be reviewed and adjusted if necessary. Also, an inventory of sites should be completed and an effort made to identify who is responsible for maintenance, and work with them to do the maintenance. Other strategies include encouraging farmers not to farm to bottoms of ditches and watercourses, cost share on side pipe inlets, riparian buffer strips, sediment traps, fencing to eliminate cattle in ditches, and grassed waterways.

4) For road ditches, the TRWD should work with road authorities (MNDOT, County Highway Dept., & Townships) to identify trouble spots (i.e. where field ditches outlet into road ditches), develop a corrective action plan, and a policy agreement to address capacity of future road construction and maintenance activities. Also, road ditches could be included as a part of (lateral to) legal drainage systems in order to facilitate maintenance. In addition, upstream projects should be incorporated that address timing of flows such as stream restorations and gated storage. Measures should be taken to address sedimentation of ditches due to erosion from adjacent fields resulting from poor tillage practices or lack of cover crop. Maintenance issues include roadside mowing, buffer strips, elimination of the practice of farming ditch bottoms, incorporating wetland projects, and eliminating livestock in ditch systems.

PREFERRED OUTCOMES: All systems within the District should eventually have capacity to carry a 10 year frequency storm event (3.5 – 4 inches runoff in 24 hrs). Reduction of erosion and sedimentation, leading to less complaints and less ditch cleaning, reducing maintenance costs.

POTENTIAL PARTNERS: Soil & Water Conservation Districts, County Commissioners, County Highway Departments, Townships, DNR, BWSR, FSA, NRCS

GOAL: Reduce the duration, peak, and frequency of overland flooding

PRIORITY ISSUE:

Public Infrastructure:

- Reduce road & culvert damages from flooding.

Agricultural Land:

- Reduce damages to cropland from flooding (delayed planting or destroyed crops).
- Reduce damages to pastures from flooding.

General:

- Address issues associated with crossover flooding from the Roseau River.
- Address beaver dams on ditches and natural watercourses.

STRATEGIES:

1) For Public Infrastructure, expand on the current District culvert sizing policy by implementing a complete culvert sizing project in one or more subwatersheds to effectively size all culverts from upstream to outlet to control the 10 year runoff event. In areas east of U.S. Highway #59, promote land use practices that reduce runoff, promote natural landscape storage activities (wetland & prairie restoration), stream & river rehabilitations to slow down stream flows, incorporation of ag levies where appropriate, install gated storage immediately east of Hwy 59 (in North Branch and Middle Branch subwatersheds) – by doing so in conjunction with other activities the needed acre feet of storage can be reduced. In areas west of U.S. Highway #59, utilize riparian buffers, stream rehabilitation with ag levies, field windbreaks to reduce snow & sediment deposits in drainage systems (will allow ditches to open earlier in spring), immediately west of Hwy 59 utilize off channel gated storage, and emphasize best management practices (conservation tillage & residue management). In areas west of U.S. Hwy 75, investigations regarding the feasibility of improving drainage channels should continue. This type of channel work would be designed to remove local water from the land in advance of the peak of the Red River flooding.

2) For Agricultural Land, utilize the same strategies as stated in #1 above. This should be done by slowing down water from upstream areas with respect to the 10 year runoff event for ag lands. Pasture management plans should be developed which include tolerant seed mixtures, rotational grazing, and livestock exclusion from streams.

3) For the general category, the same strategies as listed above should be considered. Also, partnerships should be created with the Roseau River WD and Canada to identify issues related to crossover flooding and agree upon possible solutions, including impoundments, diversions, and dike building. A watershed district wide beaver control program should be investigated, with incentives for trappers and payments for beavers in widespread areas, not just on legal drainage systems.

PREFERRED OUTCOMES: Significant reduction in damages to residential, public infrastructure, and private property.

POTENTIAL PARTNERS: SWCD, Townships, Counties, County Highway Dept., NRCS, DNR, BWSR, FSA, USACE, Roseau River Watershed District, International Joint Commission, Red River Basin Commission.

GOAL: Reduce damages to and loss of residential areas from flooding for a 100 year event (minimum)

PRIORITY ISSUE: Reduce damages and losses to urban and rural residents from flooding.

STRATEGIES: Discourage building within the 100 year floodplain and other flood prone areas.

Utilize the farmstead ring dike program and other programs to protect farm residences and out-buildings.

Assess each community's flood protection needs, and implement flood damage reduction projects both upstream from and within municipalities.

PREFERRED OUTCOMES: Protection of rural and urban residential areas from a 100 year frequency flow event. By reducing the damages, a reduction in the cost to repair will occur, resulting in less public and private money needed for disaster assistance.

POTENTIAL PARTNERS: Planning & Zoning, Townships, DNR, RRWMB, FEMA, NRCS, Cities, USACE, Counties, MN Department of Public Safety

GOAL: Minimize effects of drought relative to land use practices

PRIORITY ISSUE:

- Address losses to pasture and cropland associated with drought
- Address issues related to wind erosion

STRATEGIES: Utilize soil moisture and erosion control practices including but not limited to tree plantings (wind breaks), cover crops, buffer strips, policy changes, conservation tillage practices, and wetland restorations. Suggestion: Plowing should be eliminated and a 25% residue cover should be enforced. The TRWD will consult the CAC and TAC to target specific key subwatersheds where this should be implemented.

PREFERRED OUTCOMES: Minimize to the extent possible the effects of drought on crop and pasture production and minimize the increased potential of soil erosion due to wind. Ensure that agricultural operations can endure periods of extended drought. Reduce the impacts of sedimentation to watercourses from wind erosion.

POTENTIAL PARTNERS: NRCS, SWCD, DNR, FSA, BWSR, Landowners

GOAL: Enhance and protect ground water supplies.

PRIORITY ISSUE: Maintain an adequate water supply and sustain healthy water quality levels

STRATEGIES:

- Delineate critical recharge areas
- Protect recharge areas using BMP's and land use controls
- Protect surface waters including wetlands from sedimentation, nutrients, and ag. Chemicals
- Delineate surface and groundwater relationships especially in areas where ground water serves as public water supplies
- Coordinate source water protection and wellhead protection efforts with the Rural Water Systems according to Minnesota Department of Health parameters.
- Regulate water appropriations by Watershed District rule and permit program
- Utilize wetland restorations to filter and protect groundwater systems
- Support well water testing programs

PREFERRED OUTCOMES: Ensure that a viable and permanent source of drinking water for domestic and industrial uses exists within the District.

POTENTIAL PARTNERS: SWCD, NRCS, DNR, North Kittson Rural Water, Kittson Marshall Rural Water, County Water Planners, MDH, MPCA

B. Natural Resources

GOAL: Improve and sustain surface water quality

PRIORITY ISSUE: 1) Erosion & Sedimentation

- Reduce erosion & sedimentation to waterways & wetlands
- Restore more natural hydrographs to waters in the watershed – reduce the "flashiness"
- Restore & rehabilitate unstable stream channels in the watershed

2) Total Maximum Daily Load's (TMDL) & Water Quality Monitoring

STRATEGIES: 1) Erosion & Sedimentation

- Utilize best management practices to install buffer strips along ditch systems adjacent to ag fields
- Identify susceptible areas via monitoring, impaired lists, and Total Maximum Daily Load activities
- Grassed waterways
- Restoration of drained wetlands & creation of new ones

- Reduced field drainage and increase temporary storage in fields designed to hold water for short periods and then release it
- Installation of shelter belts to reduce wind erosion
- Institution of land use controls where necessary & practical
- Stream bank bio-engineering and riparian restoration to create sinuosity, pools, and riffles along watercourses
- Where practical and feasible, promote fencing of cattle and other livestock away from rivers & streams

2) TMDL's & Water Quality Monitoring

- Improve upon the watershed wide monitoring program utilizing input from state & local agencies
- Develop a TMDL watershed strategy
- Coordinate monitoring and preparation of load allocations with local committees, Riverwatch, RRWMB and the MPCA
- Participate with state and local entities in implementing TMDL adopted strategies and load allocation scenarios
- Consider land use control adoption and enforcement where deemed appropriate

PREFERRED OUTCOMES:

1) Erosion & Sedimentation

- Filtration of sediment to reduce sedimentation
- Reduce amount of cattail and other vegetation where sediment normally deposits
- Reduce the need for ditch maintenance
- Promote wildlife travel corridors and migrational habitat
- Achieve compliance for water quality standards on reaches that have been identified as being impaired
- Total Maximum Daily Load allocation plans and strategies for impaired reaches
- Meet state mandated water quality standards such as 25 NTU's for Turbidity, 5 mg/l for Dissolved Oxygen, etc.

2) TMDL's & Monitoring

- Same as for Erosion & Sedimentation
- Reduced load allocation to impaired reaches and improved surface water quality within the watershed and/or target reaches within the watershed

POTENTIAL PARTNERS: SWCD, NRCS, MPCA, DNR, FSA, EPA, BWSR, MN Dept. of Ag, USFWS, USGS, County Water Planners, Others

GOAL: Reduce erosion & sedimentation

PRIORITY ISSUE:

- Restore more natural hydrographs to waters in the watershed – reduce the "flashiness"
- Restore & rehabilitate unstable stream channels in the watershed
- Establish and maintain functional buffers along ditches. This should include the use of side inlets to minimize erosion from fields
- Land use practices (i.e. tillage)

STRATEGIES:

- Same strategies as listed for surface water quality
- Riparian buffers, best management practices for tillage, and grassed waterways for problem areas as identified in the MCEA report and by SWCD's
- Coordinate the establishment of a watershed wide surface water quality monitoring network with MPCA, River Watch, RR Basin Institute, RR Basin Commission, & SWCD (this would include TMDL activities on a temporary basis)
- Regulate and enforce setbacks, buffers and investigate the need for a soils loss limit ordinance
- Protect areas and / or tracts of land that currently function as buffers or filters.

PREFERRED OUTCOMES:

- Approach acceptable levels of soil loss as indicated through NRCS
- Convert "T" to reductions in pounds per acre for total suspended solids, phosphorous, and reduction in concentrations for surface waters
- Include in TMDL load allocation scenarios where appropriate for measurable goals and results
- Soil loss reductions in pounds per acre

POTENTIAL PARTNERS: SWCD, Counties, MPCA, DNR, BWSR, MN Dept. of Ag, RRBI, RRBC, RRWMB, NRCS, FSA, EPA, USFWS, others

GOAL: Participate in efforts to enhance, establish, and protect stream corridors and riparian areas

PRIORITY ISSUE:

- Restore & rehabilitate unstable stream channels in the watershed
- Identify and protect existing riparian corridors / areas
- Enhance / widen / improve degraded riparian corridors / areas

- Establish functioning riparian areas along all waterways in the watershed
- Establish and maintain functional buffers along ditches. This should include the use of side inlets to minimize erosion from fields.

STRATEGIES:

- SEE STRATEGIES UNDER IMPROVE/SUSTAIN SURFACE WATER QUALITY
- Reduce high water velocities & thereby reduce siltation and flashiness of hydrograph
- Incentive programs to establish buffers, storm water detention
- Inventory & identify priority areas
- Connect riparian areas & establish corridors while addressing erosion & sedimentation, plus surface water issues

PREFERRED OUTCOMES: Identify how many miles or how many acres established or restored. Establishment of wildlife habitat in western end of the watershed. Improved wildlife use (i.e. gray partridge). Improved sustainability of natural waterways.

POTENTIAL PARTNERS: SWCD, Counties, MPCA, BWSR, DNR, MN Dept. of Ag, NRCS, FSA, USFWS, EPA, USACE

GOAL: Participate in efforts to enhance, provide, & protect habitats

PRIORITY ISSUE:

1) Aquatic

- Restore more natural hydrographs to waters in the watershed. Reduce the flashiness of the hydrograph.
- Restore and rehabilitate unstable stream channels in the watershed
- Maintain and restore fish passage in streams throughout the watershed
- Identify and protect existing wetland habitats
- Enhance degraded wetland habitats (identify them first)
- Establish new wetlands (identify where & for what purpose)

2) Terrestrial

- Establish and maintain functional buffers along ditches. This should include the use of side inlets to minimize erosion from fields
- Establish large habitat blocks of grassland, wetland, and forest
- Identify and protect existing upland habitats

STRATEGIES:

1) Aquatic

- Connect fish habitats & encourage habitat diversity
- Denote priority areas of concern or areas of greatest opportunity in conjunction with other natural resource enhancement issues
- Further investigate index of biotic integrity surveys for priority areas
- Utilize programs like continuous CRP, WRP, and others
- Use existing programs to achieve habitat goals
- Provide technical assistance to agencies and property owners

2) Terrestrial

- Connect upland habitats, provide habitat blocks, and encourage habitat diversity
- Utilize CRP, WRP, grassed waterways, wetland restorations, and other programs
- Same criteria as used for aquatic habitats

PREFERRED OUTCOMES:

1) Aquatic

- Monitor aquatic life in waterways
- Monitor the habitat for changes resulting from proposed actions
- Achieve more consistent waterfowl and wetland wildlife use
- Reference stream standards for Index of Biotic Integrity's
- Create healthier and more diverse fish populations throughout the TRWD

2) Terrestrial

- Observe growth of wildlife populations or use in current non-use areas
- More hunting or other outdoor recreational activities observed
- See expansion of sharp tailed grouse to west (i.e. use buffer areas or habitat blocks where there currently are none)

POTENTIAL PARTNERS: SWCD, DNR, MPCA, BWSR, NRCS, FSA, EPA, USFWS, Private Groups (DU, Audubon, TNC, etc.)

GOAL: Support the expansion of water based recreation

PRIORITY ISSUE: Public access for boats, canoes, hunting, recreational vehicles, etc.

STRATEGIES: Increase public awareness of issues and opportunities

PREFERRED OUTCOMES: Increase the accessibility of recreational areas to the public; balance conflicting uses by providing equal opportunity for each kind of activity

POTENTIAL PARTNERS: DNR, Counties, private organizations (DU, Ruffed Grouse Society, birding groups, MN Deer Hunters, ATV & Snowmobile clubs, etc.), other agencies

GOAL: Provide educational and outreach opportunities

PRIORITY ISSUE: Increase public knowledge and understanding of watershed district activities and programs

STRATEGIES:

- Develop a demonstration site to be used for future promotion of conservation and flood issues
- Participate in the *Envirothon, Riverwatch,* and other educational activities
- Continue to contribute to quarterly newsletter, *Northland Conservation News* and provide periodic news releases to area media as needed

PREFERRED OUTCOMES: Educate the public in order to facilitate a better understanding of the scientific and natural processes that affect water management and the environment

POTENTIAL PARTNERS: SWCD,

VI. CONFLICT & / OR COORDINATION BETWEEN EXISTING PROGRAMS / POLICIES OF OTHER ORGANIZATIONS

SWCD's long range plans; The District will strive to coordinate its programs with those of the Kittson, Roseau, and Marshall County Soil & Water Conservation Districts and their long range plans. The District will collaborate with these agencies whenever possible to prevent overlap in planning activities and reduce any duplication of efforts. Cooperation will also help to reduce costs of implementing conservation activities.

Comprehensive Local Water Planning: It is the intent of the Two Rivers Watershed District to whenever practicable and feasible to coordinate water management efforts with the Comprehensive Local Water Plans of Roseau, Kittson, and Marshall Counties. This will include eliminating overlap of this Overall Plan with each county's CLWP. Efforts will be made to share staff, funding, and other resources in accomplishing the stated goals and objectives of these plans.

DNR Protected Waters: In meeting with local officials and landowners during the update of this Overall Plan, it became apparent that one of the issues local people have is the difficulty in obtaining a permit to do cleaning of sediment in coulee systems and natural watercourses that are designated by the DNR as protected. In most cases, the permit fee for this type of activity (because of the amount of sediment removed) is $500, plus added expenses to obtain required survey information and other data. In at least one case, a landowner opted to install a new ditch along and adjacent to the watercourse in order to accommodate floodwater that leaves the coulee system because it is blocked with sediment and obtaining a DNR permit was too cumbersome and time consuming.

In light of the above situation and the many complaints voiced by local landowners, the District will attempt to address this problem with the Minnesota DNR. Discussion and negotiation will be initiated by the District with the DNR to address this issue and possibly stream line the permitting process to allow for maintenance activity, if done according to specific guidelines. This issue should be brought to the Mediation Project Work Team to discuss the pros and cons, and look at options to address the problem. In doing so, discussions will be held pertaining to natural systems, upstream sources of sediment loading, ditch systems that outlet into natural systems, survey and data collection requirements, and other issues.

County Ditch Systems: The District will work with and cooperate with each of the counties within the District to coordinate water management efforts with regard to flood control and ditch systems. This is essential because of the vast network of ditches and their interrelation with water management activities.

VII. POLICIES & PROPOSED ACTIONS OF THE DISTRICT

A. Project Identification & Investigation

i. Potential & Proposed Projects

Impoundments

It shall be the duty of the Board of Managers before any works of construction, repair, or improvement are commenced, to cause to be made proper surveys of the Watershed District and to utilize all existing surveys, and in all cases proper engineering standards shall be set up and followed. Potential storage sites tributary to and upstream of all three branches of the Two Rivers system should be considered for development. Dams to create impounding reservoirs will be operated so as to conserve flood waters and release the water for various purposes. Flood prevention measures shall be taken by the District and should consist of flood water retarding structures, floodways, and development.

The flood water retarding structures should be planned for multiple purpose use. Floodways constructed for prevention of flood water damage on the flood plain and damage from overland flooding should also serve as outlets for surface drainage. Both temporary detention and permanent storage are needed to provide flood protection and water supply. The flood water retarding structures should, if possible, have capacity for storage of both flood water and water supply. The sites of such structures would require complete investigation with reference to foundation, general material, available storage, and their exact location.

Several potential impoundment areas have been examined by the District and are listed below along with the status of each.

- **Ross #7:** This proposed impoundment would have gated storage of 3300 acre feet and un-gated storage of 800 acre feet, which is equivalent to 3.6 and 0.9 inches respectively, of runoff from the drainage area of 17.2 square miles. The main portion of the impoundment would be located in section 32 and 33 of Ross Township in Roseau County. Along the northwest boundary of the impoundment is a ridge which is an old beach ridge from glacial Lake Agassiz. Presently, runoff from the area to the east flows in culverts that pass through the ridge in section 32. The water would be impounded by the ridge on the northwest side, a constructed dike on the west side, and another constructed dike on the south side. The main outlet would be located just upstream from the culverts through the ridge.

  The configuration of the main outlet structure would be such that there would be automatic release of water beginning about 0.8 foot below the emergency spillway elevation. The automatic discharge would equal the capacity of the downstream ditch at a stage equal to the elevation of the emergency spillway.

  As of December 2003, the District was moving forward with purchasing the necessary land for this project and obtaining the necessary permits. Construction could possibly start as early as summer of 2004. Step 2 funding has been secured from the Red River Watershed Management Board and 50% funding has been approved by the Minnesota Legislature. Total cost of the project is estimated to be $2 million. The impoundment is designed to alleviate downstream flooding along

Lateral 1 of State Ditch #95. The project is in response to, and an alternative to a ditch petition that was submitted by residents of Polonia and Barto Townships of Roseau County.

- **Nereson Sub Impoundment:** Construction was substantially completed in 2003 on the Nereson Sub-Impoundment, located in sections 33 & 34 of Nereson Township, Roseau County, Minnesota. This project began in 1991 and has been severely hampered by severe rainfall, extreme snowmelt conditions, and other factors, including several federal disaster declarations.

  The project is an extension of the original Nereson impoundment, which was installed in 1981 under a joint effort of Roseau County, the District, DNR, and the Red River Watershed Management Board. The project purpose is for both flood control and wildlife, and is located on the Nereson Wildlife Management Area, which is owned and operated by the DNR. Construction activities include a dike, outlet control, wildlife weir, emergency spillway, and other minor items.

  The original Nereson project provided 2,550 acre feet of storage with a drainage area of 16.1 square miles. It consisted of approximately 5 miles of earth dike with two diversion channels that divert water from State Ditch #91 into the impoundment. The Sub Impoundment construction altered the main outlet and constructed a 530 acre impoundment upstream of the original impoundment with the capacity to hold 900 acre feet of floodwater. A detailed operating plan for both the main impoundment and the sub impoundment has been developed with the DNR which will be evaluated on a regular basis to determine if modifications are needed to account for what has been learned from observations made during actual runoff events.

- **Klondike 1 & 2:** The Klondike project is a two pool off-channel storage project proposed in Klondike Township, Kittson County. These lands frequently flood from upstream water flowing out of the ditches. The project concept is to trap the floodwater which currently flows onto the land, holding it until the flood-wave has passed. Gated inlets will allow the floodwater to enter onto the land as the flood peak arrives but then not allow the water to exit. An automatic outlet will drain the water off when the outlet ditch is below flood stage. The diked impoundment will store the water for a sufficiently long time period so that this water no longer contributes to downstream flood damage.

  The proposed inlet gates will operate as a low head loss, one way valve letting water onto the site (as the floodwater arrives) and then trapping it there. The proposed outlet gates will be set for automatic discharge when the flows in the outlet ditch have decreased below flood damage levels (downstream and upstream). The project will benefit the State Ditch #95 system by providing approximately 6,631 acre feet of storage at a cost of approximately $1.5 million.

  Land was obtained for this project in the early 1990's and the project concept design was also drafted at that time. The project has been put on hold indefinitely pending the progression of the Ross #7 project.

- **Stokes 18:** This proposed impoundment area would be located just south of the City of Badger is section 18 of Stokes Township, Roseau County. The District has put together some very preliminary numbers and at this time has looked at 3 different

impoundment scenarios. The following table lists the three alternatives and data regarding each.

Alternative	Drainage Area (Sq. mi)	Storage (Acre – Feet)	Runoff Storage (In)	Dike Elevation	Max Height (Ft)	Cost Est.	Cost Per Ac-ft
#1	21.3	2155	1.9	1078.0	10	$938,800	$436
#2	21.3	6005	5.3	1083.0	15	$1,909,400	$318
#3	21.3	1130	1.0	1073.4	5.4	$237,900	$211

This project is currently on hold pending construction of the Ross #7 project and further investigations.

- **Kittson CD 22:** The District received a petition from area landowners to improve this ditch system, located in Clow and Hampden Townships, Kittson County. The ditch is a diversion ditch which intercepts several coulee systems and delivers the water to the North Branch Two Rivers. The ditch currently has insufficient capacity to handle the water that enters it and consequently adjacent lands undergo flooding. Upon review, it was determined that the improvement of the ditch was not feasible because it would increase downstream flooding. Therefore, the District was asked to do a feasibility study on upstream impoundments. The District subsequently hired an engineering firm, who studied the upstream area using field visits, computer modeling, and discussions with landowners The study found that an upstream impoundment at one suggested location would not have a significant impact on downstream flooding. A report is being written to distribute to the project petitioners and affected landowners. This project has been put on hold indefinitely. Future investigations could focus on wetland restoration, culvert sizing, or other means of detaining water upstream.

- **Skull Lake:** This proposed impoundment is located in sections 14 & 15 of St. Joseph Township, Kittson County, on land owned by the Minnesota DNR as part of the Skull Lake Wildlife Management Area. A permanent pool was installed in the late 1960's as part of a PL-566 project sponsored by the NRCS, Kittson SWCD, DNR, Two Rivers WD, Kittson County, and City of Lancaster. The primary purpose of the project was for waterfowl production and flood control. A fixed elevation weir was installed along with a dike system and emergency spillway. Since the installation, the project has not achieved or realized its original waterfowl expectations.

  The Minnesota DNR has reviewed the project area with the Two Rivers Watershed District, County and Township officials, & local landowners. The DNR's preferred alternative is to alter the existing structure to be able to draw it down and restore the pre-existing type 2/6 scrub shrub wetland. The area would then be managed for sharptail grouse, moose, and deer. The area could be used as a dry impoundment to store flood water in times of severe runoff.

Discussions are currently taking place regarding this project. It is anticipated that alterations can be made to the existing structure to accomplish the proposed goals at a relatively low cost. The District is tentatively moving forward with this project.

- **Twistal Swamp:** The Twistal Swamp is an area located along an old beach ridge of glacial Lake Agassiz adjacent to MN Highway 11 just northeast of the City of Karlstad, on land owned and managed by the DNR. In the late 1960's, the DNR attempted to inundate the swamp with additional water brought in via a diversion channel from nearby Twin Lakes. The purpose of the project was to create a large open water area for the production of waterfowl. This worked for the first few years, but a floating mass of cattail and other vegetation took over the pool, and it now is not accomplishing what originally was intended.

  The swamp currently has no outlet. Water does exit the swamp either by seeping through a ridge in a northerly direction and also by overland flow to the west. This, in extremely wet years poses somewhat of a problem for downstream areas. To address the problem, the DNR has approached the District with a preliminary plan to establish an outlet with a gated control structure. This would allow the DNR to draw down the swamp and remove the cattail either by burning, mechanical means, or naturally by removing the water source. Flood control benefits for the South Branch Two Rivers could be achieved by diverting water from the State Ditch #90 system into the Twistal Swamp, holding it there, and releasing it after the flood. This could conceivably lower the flood peak near Pelan and areas downstream.

  This project is in the stage of review and data collection. Issues may exist with Kittson County Ditch #10 and areas downstream, which would serve as the outlet for the project. Flooding currently occurs in these areas and that needs to be addressed before the project can move forward.

- **Percy 9-10:** A potential impoundment site in sections 9 and 10 of Percy Township, Kittson County was investigated for feasibility. A brief investigation showed that about 6400 acre feet could be stored at an approximate cost of $2.76 million. The site would alleviate flooding to the Middle Branch of the Two Rivers. Before progressing, further information and data needs to be collected regarding this site. The project is on hold and is a lower priority to the above mentioned impoundments.

Ditches

Potential ditch projects and their status are listed below. With regard to these and all other projects, there is a need to protect the outlets of all waterways, natural or artificial, entering into the major streams. Consideration should be given to installation of de-silting basins and outlet control structures at the junction of ditches with the major stream channels. River channel bank stabilization is needed at several points along the various branches of the Two Rivers in order to avoid jeopardizing farm buildings now located along said river. Side pipe inlets to ditches and waterways should be researched and

installed where feasible to control flood waters and to protect cropland. The District will take over jurisdiction of any existing county, state, or judicial ditch if so directed or asked by the county ditch authority.

- **Dewey #5 Improvement:** The Dewey #5 ditch is a watershed district ditch that was installed in the early 1980's. The District received a petition from area landowners to improve the ditch on September 5th, 2000, which stated that the ditch had insufficient capacity, was not functioning properly, and needed enlargement. The District followed Minnesota Statute by appointing an engineer, appointing viewers, holding the necessary public hearings, and acting on the project petition. The Project was approved in October, 2002. Minor construction activity consisting of lowering a culvert was done in 2003, with the bulk of the work to follow within the next few years to coincide with a Roseau County Highway project on the adjacent County Road #23.

- **State Ditch #85 Improvement:** The District received a petition to extend State Ditch #85 from landowners on May 1, 2002. The petition asks that the ditch be extended less than one mile from its present terminus to a new terminus at the outlet into the North Branch Two Rivers. The District, following Minnesota Statute, has appointed an engineer and has received a preliminary engineer's report. A panel of three Viewers have been appointed to look at the benefited area and assign benefits to contributing parcels of land. The project will proceed according to ditch law.

- **Kittson County Ditch #22 Improvement:** A project petition was received on August 23rd, 2001 from landowners asking that the ditch be enlarged because the existing ditch does not have sufficient capacity, is not functioning properly, and has affected the utility and value of adjacent lands for agriculture. Following ditch law the District appointed a project engineer, who has now prepared a preliminary report. The report indicates that the proposed enlargement would not be feasible because the outlet is not adequate, and thus the project could increase downstream flooding.

  In light of the findings of the project engineer, the petitioners have thus asked the District to look at the feasibility of upstream impoundments. The District has gathered information pertinent to topography, soils, land use, and other items in carrying out the requested investigation. It has been determined that an upstream impoundment would not have significant downstream impacts, and other types of flood control would need to be investigated. All activity on this project has been put on hold.

- **Springbrook Ditch / PL 566:** A petition was received from landowners in Springbrook and Davis Townships, Kittson County on January 28, 1998 to designate a natural coulee system as a legal ditch. The system is situated downstream from Kittson County Ditch #10 and upstream from Judicial Ditch #10, and has undergone severe and extreme flooding, resulting in erosion, sedimentation, and overland flooding, causing maintenance problems and high costs to local landowners.

  This particular watercourse also is listed as protected on the DNR Protected Waters Inventory. As such, permits are needed before any type of work is done that would alter the course, current, or cross section of the watercourse. Because of the repeated and severe flooding, several landowners along the course of the waterway undertook

repair and improvement activities without securing a permit, which resulted in violations. In an effort to mediate the violations and at the same time address the flooding and erosion problems, the TRWD introduced the idea, in conjunction with the ditch petition, to re-establish the meandering channel, but to also construct levees set back on either side of the channel. These levies would contain the overflows from a 10 year runoff event. The area between the levies was suggested to be planted to a grass mixture and be removed from crop production, serving as a buffer and wildlife corridor. This idea was received very well by the DNR.

A project engineer was appointed and the resulting preliminary engineer's report gave a project proposal and cost estimate. The estimate was deemed too high by the project petitioners and therefore the District put the petition on hold while other avenues of funding were sought. This has resulted in the project being submitted to the NRCS for funding under their Public Law – 566 program. The NRCS is currently reviewing the project and collecting information to determine the project feasibility. The project application has been approved and NRCS will now be doing detailed survey work and analysis.

- **Kennedy #6 – Kittson CD 4/27:** A petition from the City of Kennedy was presented to the District on May 16, 2000 to address flooding in the City by creating a flood control project between the upstream Kittson County Ditch #4 and the downstream Kittson County Ditch #27. The preliminary engineer's report noted the proposed project details and included a cost estimate. The project, because it would affect both ditch #4 and ditch #27, is currently on hold pending discussions with the ditch authority, Kittson County. It may be necessary to look at redetermining the benefits on the affected ditches, and potentially bringing in lands to the east that currently drain into the system, but are not paying benefits. This may also be addressed through the creation of a water management district or a stormwater utility.

- **Polonia – Barto Ditch Petition:** This petition was received in April, 1998 and was for a new system 12 miles in length located along the south side of sections 1 –12 in both Polonia and Barto Townships. Upon review by the engineer, it was determined that the outlet was not adequate. Alternatives were then proposed relating to impoundments both upstream and downstream. This resulted in the siting of the Ross #7 impoundment. Potential impoundments downstream include the Klondike #1 & #2. The petition has been tabled pending further investigation.

ii. Miscellaneous Studies, Investigations, & Inventories

- **Ditch Inspections**

The Two Rivers Watershed District shall complete an annual inspection of all ditch systems under its jurisdiction. This inspection will include a site visit of the entire reach of ditch either by vehicle or by foot to visually inspect the condition of the ditch. A ditch inspection report shall be written and submitted into the ditch file. This report will note the general condition of the ditch, including any damages such as sloughing, erosion, sedimentation, culvert problems, or any other damages and their location along the ditch. The report will also note any vegetation problems such as blockages by cattail and willow or beaver dam locations. As a result of these annual inspections, the District will be able to hire contractors and do maintenance

work as necessary. In addition, the TRWD will do a survey of the grade (profile) and cross sections every five years to each ditch system. This will enable the District to determine if and when mechanical cleaning of the ditch is necessary.

It is the intention of the TRWD to develop and keep a detailed record of activities related to each ditch system. In addition to paper files, the District will develop detailed GIS maps and information regarding each ditch. This will include the benefit area, the benefit amount, parcel number, and other information available from the ditch files or the county Auditors. The District will periodically meet with and share information with County Commissioners to coordinate ditch maintenance activities.

- **Flood Impacts to Municipalities**

Several communities within the District are currently subject to severe and prolonged flooding. The most highly affected communities include Kennedy, Halma, Greenbush, Lancaster and Hallock. Each of these communities have taken some measures to varying degrees to protect themselves. However, if prolonged flooding occurs or the in-place structures were to fail, serious flood damages could occur. Therefore, the TRWD deems it important to assist as best it can in planning for flooding and implementation of projects to reduce the peak and duration of flooding for these communities. Therefore, the District will utilize existing information, hydraulic modeling, and data collection to analyze the current situation for these communities and assist in preparing plans and strategies to reduce the flood impacts.

- **Review of Existing Project Operating Plans**

Several water control structures are currently present in the District and are operated by various entities. Of these, 4 are the responsibility of the DNR – Div. Of Wildlife, 1 is under the DNR – Div. Of Parks & Recreation, and 1 is operated by the City of Hallock. Two are located on the South Branch Two Rivers, one on the Middle Branch Two Rivers, one on a tributary to the North Branch Two Rivers, and two are tributary to the South Branch Two Rivers.

The purposes for which these were built range from flood control to recreation to wildlife habitat to water supply. However, there may be some merit to coordinate efforts to operate them together to provide flood control relief during large scale flooding events. Because of the various entities involved and the different reasons for their existence, this may or may not be possible. It is the District's intent to review these existing water control structures, determine the feasibility of operating them to provide flood relief for major events, and attempt to coordinate efforts to operate them in conjunction with one another.

- **Beaver Control Policy**

The District adopted a policy on beavers and beaver dams on January 4, 1994. The policy states that "the Two Rivers Watershed District will remove any beaver dams from ditches under the administration of the District, and any other dams will be

evaluated on a dam by dam basis with the approval of the District before removal." This means that any bills for beaver dam removal sent to the Two Rivers Watershed will not be paid unless the removal has been approved by the District prior to the work. The District currently pays a beaver bounty, as set by the Board of Managers and adjusted from time to time, for animals trapped out of ditch systems under the jurisdiction of the District.

During the course of the planning process, several comments were heard pertinent to beaver problems. Over the past several years, the State of Minnesota has funded a program to remove problem beavers. This has been utilized by Kittson County, but the funding level is not large enough to deal with the very large beaver problem. Through the planning process and in discussing the situation with township officials, it may make sense to work with Township, DNR and County officials to develop a strategy to control beavers on ditches, streams, rivers, and other waterways where beaver inhabit and become a problem relative to public infrastructure. The strategy should include a bounty on individual beavers and a policy on methods used to remove beaver dams, beaver lodges, and individual animals. This policy should be developed within the next 2 years.

B. Regulation of Activities by Watershed

i. Rules of the Two Rivers Watershed District

The *Rules of the Two Rivers Watershed District* were adopted in 1981 and amended on June 5th, 1997. These rules were written according to Minnesota Statute Chapter 103D and govern projects which have a potential effect on the water resources of the District and specifically relate to drainage, flood control, water use, and water quality. Projects of this nature require a permit from the Two Rivers Watershed District before any work is done. There is no charge for the permit, however projects which are commenced or completed without a permit will require a $100 fee. Specific works which require a permit are listed below. A complete set of Rules and a permit application form can be obtained at the District office located in the Kittson County Courthouse at Hallock MN.

- *Drainage:* Any construction or alteration of any drain tile or drainage ditch that drains an area in excess of 20 acres. Also, any artificial drainage way which delivers water from one sub-watershed into another sub-watershed, and any drainage of water by any means into any legal drainage system from any land not assessed to that drainage system.

- *Construction:* Any construction or alteration of any bridge, dike, culvert, or drain across any drainage way, lake, wetland, or other water body.

- *Dikes:* Any construction, alteration, or removal of any dike or reservoir.

- *Utilities:* Any sanitary sewer system which discharges to surface water, storm sewer, or other major utility project which affects surface water within the District.

- *Roads:* Any street, road, or highway construction project which by means of its construction has any effect on the quality or quantity of water runoff.

- *Water Appropriation:* Any artificial or mechanical transfer of water from a water source including but not limited to gravel pits, ponds, rivers, wetlands, and other reservoirs consistent with the general purposes of the District.

- *Wetlands:* Any works which include draining, filling, excavation, or dredging of any type 3, 4, 5, or 8 wetland as defined by the U.S. Fish & Wildlife Service's *Circular #39.*

The District keeps a detailed record of all permits issued including paper files, electronic spreadsheet, and geographic information system. All permit locations are mapped and the data base is updated as permits are issued. Beginning in 2003, the District implemented spot checking of all permits issued. A random sampling of permits is pulled from the permits issued the previous year to be field checked to see if the project was completed and if the project was done according to the permit. 10% of all permits issued each year will be checked in this manner.

C. Resource Management Programs

i. Data Collection & Monitoring

- **Water Quality Monitoring Program:** The Two Rivers Watershed District has provided technical and financial assistance since 1991 to the Kittson SWCD for the purpose of planning, developing, and implementing a water quality monitoring plan on the North, Middle, and South branches of the Two Rivers and also on an unnamed coulee system. This program, conducted by the Kittson SWCD from 1991 to 2002 and by the Two Rivers WD from 2003 to present, consists of sampling and analyzing water samples at 10 different locations in Kittson County using both field testing kits and sending samples to a State of Minnesota certified laboratory for analysis. Parameters tested include dissolved oxygen, nitrogen, phosphorous, alkalinity, pH, chloride, fecal coliform bacteria, and total suspended solids. In addition, site conditions monitored include temperature and depth.

  In 2000, the Two Rivers Watershed District began monitoring 2 additional sites in Kittson County and 7 additional sites in Roseau County. These were added because they constitute areas in the upper watershed that were not ever monitored and also some sites associated with water holding facilities on wildlife management areas. The Two Rivers Watershed District monitors these using field testing kits for temperature, depth, dissolved oxygen, conductivity, turbidity, pH, nitrogen, phosphorous, alkalinity, and chloride. The purpose of this monitoring program is to determine long term water quality trends and compile a data base of existing conditions.

In the next 10 years, water quality issues will come more and more to the forefront of water management. Therefore, this monitoring program will need to continue to grow and adapt to changing needs and issues. The District over the next 10 years will establish 6 sites on the North, Middle, and South branches of the Two Rivers and one site on the unnamed coulee to biologically monitor for macro-invertebrates. This will include the establishment of sites, field collection, and analysis of samples. This information will add to the chemical data that is already being collected and will hopefully provide a better picture of the health of the rivers and streams.

As mentioned earlier in this plan, the District intends to work with the MPCA regarding the Total Maximum Daily Load program. Through this effort, monitoring efforts can be coordinated, streamlined, and utilized more efficiently to provide needed data. The data can then be analyzed by all involved to determine the health of the watershed, and then strategies can be developed to protect and improve the waters of the District.

The District each year will analyze the data that is being collected and quantify the results. A yearly water quality report will be written and distributed to interested governmental agencies, private organizations, and the general public. This will help to inform and educate agencies and the public on the water quality issues facing the District. Within the next ten years, the District hopes to establish 4 continuous recording data logging stations located near the outlets of the North, Middle, and South branches and also on the unnamed coulee. This will also help the District get a better understanding of the water quality picture within the watershed. From the data and through cooperation with other agencies, the District will be able to do assessments of each of the subwatersheds within the District. Within the next ten years, 5 assessments will be done.

- **Stream Flow Monitoring**: The District has implemented a stream flow monitoring program since 1996. This program to date has only focused on monitoring flows during runoff events resulting from either spring snow melt or from summer rainfall events. The program has not focused so far on monitoring summer low flows.

  The District monitors between 25 and 30 sites. A staff gage has been erected at each site and wherever possible a local resident nearby is utilized as a volunteer staff gage reader to monitor water levels during an event. The District at various times during the event will visit each site and use a flow meter to measure the velocity and volume of the stream flow. Rating curves are being developed for each site.

  Information collected under this program is immediately forwarded to the National Weather Service's River Forecast Center and is utilized in developing flooding outlooks. This information is also utilized by various other federal, state, and local agencies during and after flood events. During an event, the District is also active by issuing daily reports on what is happening at the various locations throughout the watershed. The information collected will also be useful in the development of the hydrologic model being put together in conjunction with this overall plan. The data will be used in analyzing future projects, including impoundments, ditches, land use controls, and water quality loading analysis.

  The District will continue to work to improve the network of staff gage readers, and to complete the development of rating curves for each site. The District will work

towards the establishment of two additional "flood warning" gages to be located at Pelan and Greenbush on the South Branch Two Rivers. These will be integral in flood forecasting for cities and other points along the River. In addition, 3 – 4 continuous data recording stations will be established within the watershed to provide additional data. The District will also begin to monitor summer low flows on the river to identify low range flows each year. All data collected under this program will be on file at the District office and will be entered into database, spreadsheet, and geographic information system software.

- **Snow Survey:** Each year in late winter and early spring the District collects snow depth and water equivalency information at 11 locations throughout the District. This information is collected in order to provide insight to the upcoming spring snowmelt runoff event and help predict flooding that may occur. The information is used locally and is also forwarded to the National Weather Service River Forecast Center.

- **Culvert Inventory**: Since 1998 the District has undertaken a culvert inventory of the entire watershed district. Each summer, crews from the Minnesota Conservation Corps have been utilized to inventory each and every culvert in designated areas. On average, four townships have been inventoried per year. It is a goal of the District to complete this undertaking within the next five years.

  Under this program, crews locate culverts and collect information on each one including location, size, type of construction, length, and flow line elevations relative to natural ground and road overtop. The information is kept in paper files and is also input into a geographic information system. The information gathered is extremely useful in analyzing hydrological information for each subwatershed and will help in various aspects of future water management activities.

- **Project Monitoring:** Any and all projects developed under the Red River Basin Flood Damage Reduction Agreement require that project specific monitoring be done. The TRWD will adhere to this agreement and monitoring requirements therein.

ii. Watershed & Hydrologic Studies

- **HEC-HMS:** As a part of this planning process, the District has hired an engineering firm to prepare a hydrologic model of the District. This computer program, known as HEC-HMS, will be calibrated using known information such as rainfall from actual rain gage records, observed stream flows from stream gauging information, land use, soils, and other data. This model will be used to predict stream flows at a number of predetermined points within each subwatershed for various rainfall events and intensities.

  This tool will be extremely useful to the Watershed District when analyzing the runoff characteristics of water that originates from snowmelt and rainfall events. The model will be used in flood forecasting, planning and locating sites for impoundments, studying subwatershed areas for the potential to store water in wetlands, analyzing a watershed for culvert sizing, water quality studies and time of

travel analysis, sediment loading analysis, analysis of how in place and proposed ditching affects the runoff, and many other applications.

i. Technical & Financial Assistance Programs

- **Farmstead Ring Dike Program:** Since 1997, the District has offered a cost share program to individuals residing within the District to assist with the construction of farmstead ring dikes intended to protect against repeated severe and persistent overland flooding. Under this program, 50% of the cost to construct a farmstead ring dike is paid for by funding provided by the Minnesota Legislature and administered by the DNR, 25% by the Red River Watershed Management Board, 12.5% by the Two Rivers Watershed District, and 12.5% by the local landowner. Under the program guidelines, the District provides all engineering for the dike, which includes preliminary survey, plan design, and construction inspection. The District also hires the contractors to do the dike work and seeding. Dike dimensions are specified by the DNR and each dike must be built according to these guidelines. This program will be continued as long as funding continues from the State of Minnesota and from the RRWMB.

- **Stream Maintenance:** The District on an annual basis contracts with the Northwest Sentencing to Service program to remove logjams and other debris from specified reaches of the Two Rivers. Using this program, STS crews remove several logjams within the District. This activity reduces the amount of free floating lumber in the river channel, which has a tendency to pile up against culverts and bridges, causing damage to public infrastructure. This activity also is conducive to maintaining a navigable waterway for small boat traffic, and also provides for better ag drainage.

- **Technical assistance** is available to local, state, and federal units of government, private organizations, other groups, and the general public regarding various aspects of water management. This assistance could be in the form of data and information relative to any programs of the District, professional assistance in the form of surveying, water quality monitoring, stream flow monitoring, flood control, or other disciplines. Assistance of this nature is available upon request.

D. Public Information & Education

- **Newsletter:** The District since 1998 has participated jointly in publishing a quarterly newsletter with the Kittson SWCD. The newsletter, *Northland Conservation News*, focuses on Watershed and SWCD programs and projects. The newsletter is mailed out to all farm operators, government agencies, farm related businesses, and others within the District.

- **Envirothon:** The District participates each year in the Envirothon, and outdoor, hands on environmental competition for teams of high school students. Teams of 5 students are required to visit 5 stations, each with a different theme. The themes are soils, wildlife, aquatics, forestry, and current events. At each station the students must answer 20 questions related to the station. Most of the questions are hands on. For instance, at wildlife a student may be asked to listen to a bird call and identify the species of bird, or at the aquatics station three stakes may be driven into the ground

and the student must identify which one is located on a wetland boundary. Winners at the local level go on to state competition and winners there advance to nationals.

- **River Watch:** The District provides technical and financial assistance to the Riverwatch program. This is a water quality monitoring program for high school students. River watch students are brought out to several monitoring locations and taught how to use water sampling equipment to take water samples and measure environmental indicators at each site. The program is viewed as a powerful learning tool as it provides real world hands on education.

- **Public Outreach:** Periodically throughout the year, the District tries to perform public outreach activities to provide information on programs, policies, and initiatives. News releases are submitted to the various radio, television, and print media. Also, the District has prepared a fact sheet regarding its *Rules* and permit procedures and sends this out to counties, cities, and townships each year.

E. Intergovernmental Coordination & Cooperation

- **Red River Basin Flood Damage Reduction Work Group & Mediation Process:**

The Mediation Process will continue over the course of the next 10 years. This is a process that was set up as a result of an Environmental Impact Statement that was done by the U.S. Army Corps of Engineers and the Minnesota DNR in the early 1990's, which was intended to assess the cumulative impact of flood control impoundments built by Watershed Districts within the Red River Basin. Disagreement over the outcome of the EIS led to a judge's decision that the USACE, DNR, and RRWMB enter into mediation to settle their differences.

A committee consisting of all possible "stakeholders" in the Red River Basin was put together, known as the Red River Basin Flood Damage Reduction Work Team. This work team was made up of representatives of various federal, local, and state agencies as well as environmental advocate organizations. A Mediation Agreement was written which is to be used to guide a possible flood control impoundment project through the permitting process. Each project will now address the problem, the proposed solution, and any possible alternatives. Each project will also now be assessed as to its flood control benefits, wildlife benefits, ecological benefits, etc. The District will strive implement - both in conjunction with other agencies and on its own - natural resource enhancement alternatives as well as flood damage reduction alternatives in any project that is under consideration. This will be accomplished through the project work team process.

Each Watershed District on the Minnesota side of the Red River has now formed its own "project work team" which addresses flood control projects and reports back to the overall Work Team once per year. The Two Rivers Watershed District assembled its Local Mediation Project Work Team and holds several meetings each year regarding flood control impoundments. This work team is made up of representatives of the Minnesota DNR, Board of Water & Soil Resources, Minnesota Pollution Control Agency, Kittson & Roseau County

Commissioner and staff, Roseau County SWCD, local citizens, U.S. Fish &Wildlife Service, Audubon Society, Two Rivers Watershed District, and The Nature Conservancy. Other interested parties are welcome to sit in on meetings and listen to discussion.

Projects introduced into this mediation process include the Ross #7 project, Twistal Swamp project, Skull Lake, and the Klondike project. Other projects looked at in the past by the Mediation Work Team include the Norway and Springbrook projects.

- **Red River Watershed Management Board:**

The RRWMB was created by an act of the Minnesota Legislature in 1976 to provide an organization with a basin-wide perspective concerning flooding. Historically, the activities of the RRWMB have centered on flood control. Previous efforts in dealing with the flooding problem within the Red River Basin consisted of single projects within a localized area, planned with primary regard to local benefits. The RRWMB actively promotes a basin-wide perspective for water management.

The RRWMB is currently made up of 8 of the individual watershed districts on the Minnesota side of the Red River. These include the Bois de Sioux, Wild Rice, Sand Hill, Red Lake, Middle-Snake-Tamarac, Roseau, Two, and Joe River Watershed Districts. These 8 Watershed Districts each pay a share into the RRWMB to fund flood control projects, basin planning, water quality studies, groundwater studies, data acquisition and educational programs. Each District has one representative and thus one vote on the RRWMB.

It is the intent of the Two Rivers Watershed District to maintain its status as a member in good standing with the RRWMB, and to support all programs and initiatives of the RRWMB.

VIII. Summary Statement of District Policy & Commitment

The Two Rivers Watershed District shall abide by the following general policies, as stated and carried forth from the 1970 Overall Plan:

1) It shall be the policy of the Watershed District to cooperate with and utilize all help available from any state or governmental subdivisions thereof; from any Federal agency; private or public corporation or person. When considered desirable, the manages of the Watershed District shall enter into a memorandum of understanding with said agencies and subdivisions of government.
2) The Managers of the District shall become acquainted with all existing water problems and programs and shall secure maximum assistance so as to reduce the assessments on local lands.
3) All projects which are to be paid by assessment upon benefited properties, shall be instituted only upon filing of a valid petition with the Managers.
4) The Managers shall not approve a petition for work unless the following facts are found to exist:
    i. That the proposed improvements are for the public interest and welfare as defined by the Minnesota Watershed Act, Minnesota Statute Chapter 103D.
    ii. That it is practical and in conformity with this Overall Plan.
    iii. That the total benefits are greater than the total estimated costs and damages.
    iv. That the proposed project is in compliance with the provisions and purposes of the Minnesota Watershed Act.
5) The Managers shall conscientiously ascertain the benefits to be derived from a proposed project. Assessments on individual property shall be based upon such benefits.
6) The Managers shall conserve and manage the supply of water in the District for the beneficial use of said water for domestic, industrial, agricultural, recreational, wildlife, and other public uses.
7) Before approving any project, the Managers shall carefully consider the effect of the contemplated project on other areas and other interests within the District. They shall not approve drainage projects unless they are satisfied that the proposed outlet and the waterway into which it discharges can satisfactorily handle the improved flows.

In addition to the above stated general policies, the District has assembled and attached as an appendix to this document a policy manual, which states in detail all of the policies of the Two Rivers Watershed District as they relate to various items.

It is the intent of the Two Rivers Watershed District to carry out its duties identified under Minnesota Statute, Chapter 103D. In doing so, the District will work with local, state and federal units of government as well as private organizations, individuals, and the public to the best of its ability.

The foregoing Overall Plan offers a description of the Watershed District, its several problems, and contains suggestions as to possible solutions. However, it must be remembered that the District cannot undertake the task of solving the problems alone. The individual landowners in the District can and must take responsibility and institute specific projects by proper petition under Minnesota law. It must also be recognized that water management beneficial to the landowner is dependent upon the voluntary cooperation of each individual

landowner within the District. In addition, other units of government and private organizations need to bring to the table their resources and expertise to help solve the problems.

The Board of Managers can and will to the best of their ability correlate, assist, and see that the various projects are carried out, as required by law, to proper completion after the desire for improved conditions has been expressed by the respective landowners, units of government, private organizations, or other interested persons or parties of the Watershed District.

The Two Rivers Watershed District desires to achieve a balance among the soil & water programs to fit its agricultural economy and environmental needs. It is the intention of the Board of Managers to extend to the local, state, and federal governments, all other political subdivisions of government, and agencies, and to all persons complete cooperation and understanding, and to accomplish as nearly as possible, in the manner provided by law, the purposes for which the District was created.

Appendices

Maps (water quality sites, streamflow sites, ring dikes, snow survey sites, etc.)

Resources Data

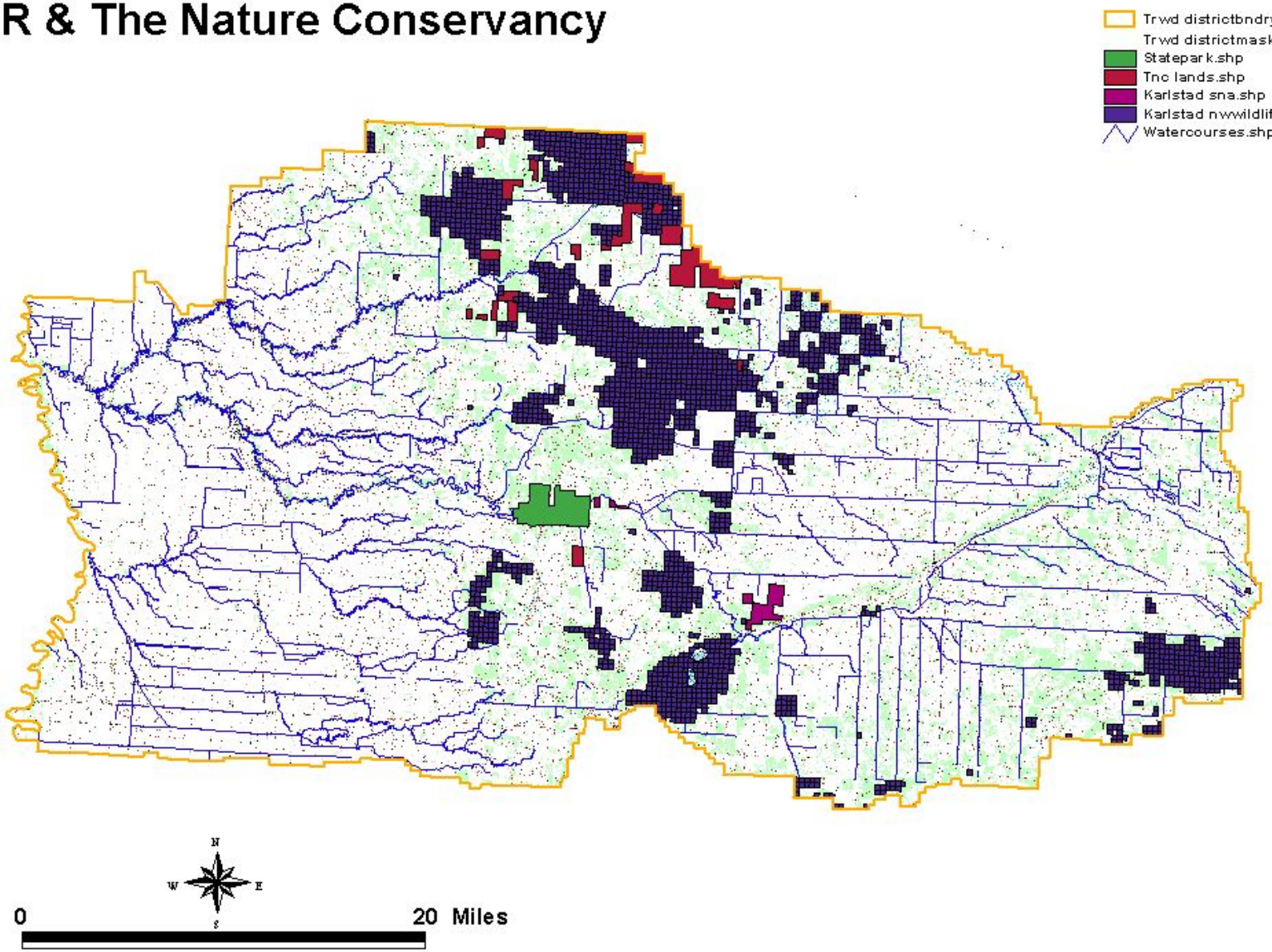
- **DNR Stream Survey**
- **Water Quality Monitoring Program (TRWD – Kittson SWCD)**

Rules of the Two Rivers Watershed District

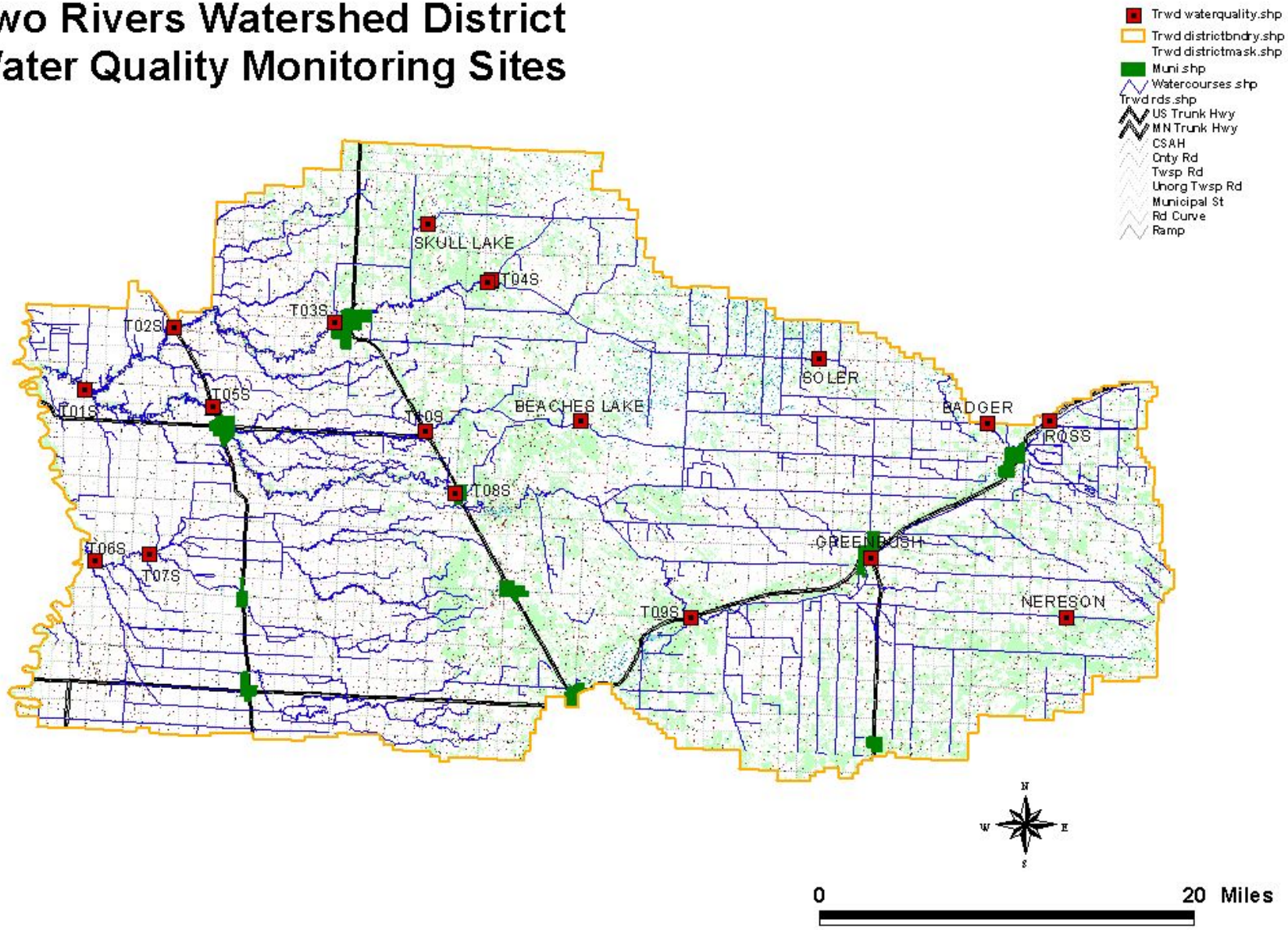
Appendix A

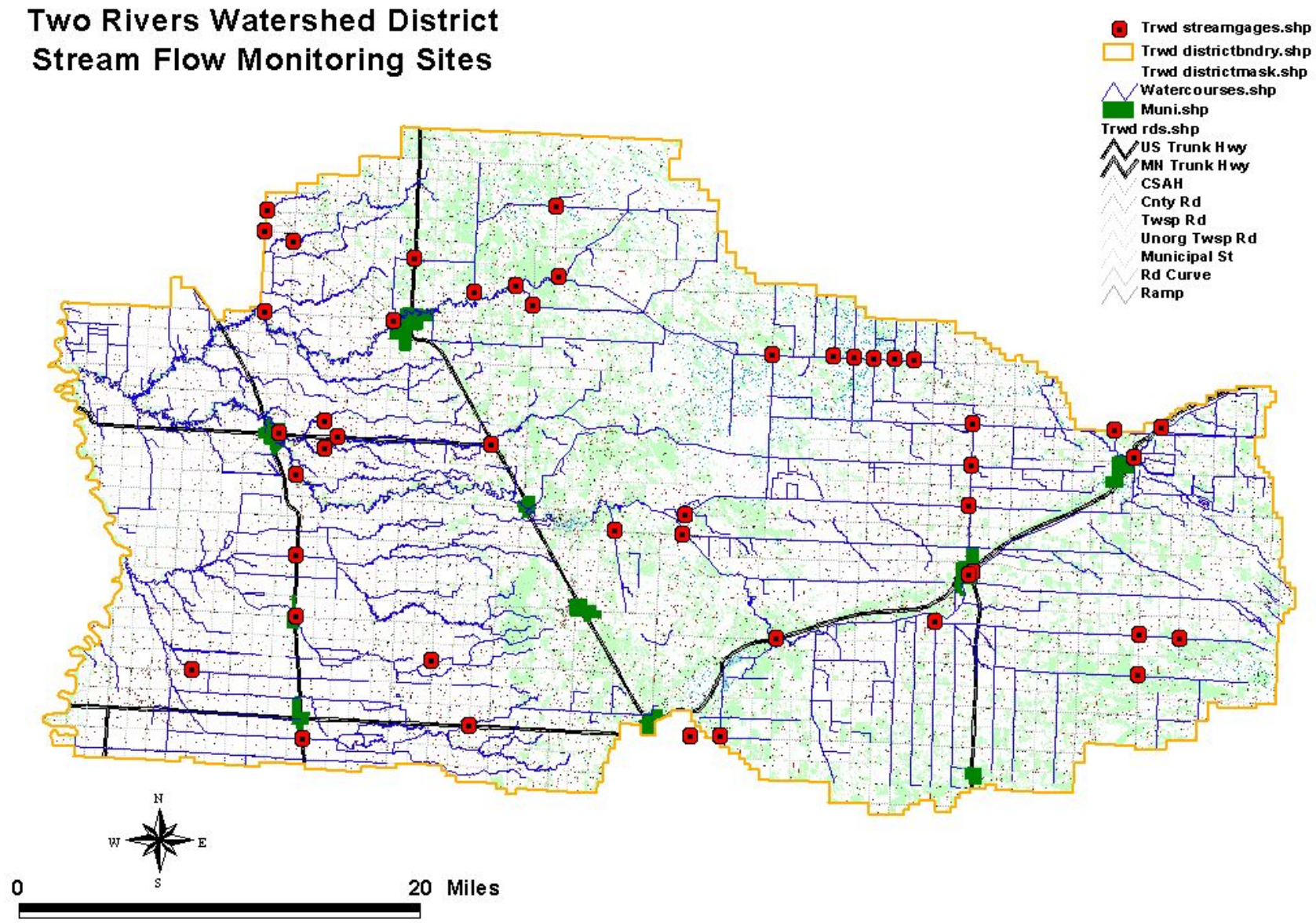
Maps

Public Accessible Lands
DNR & The Nature Conservancy

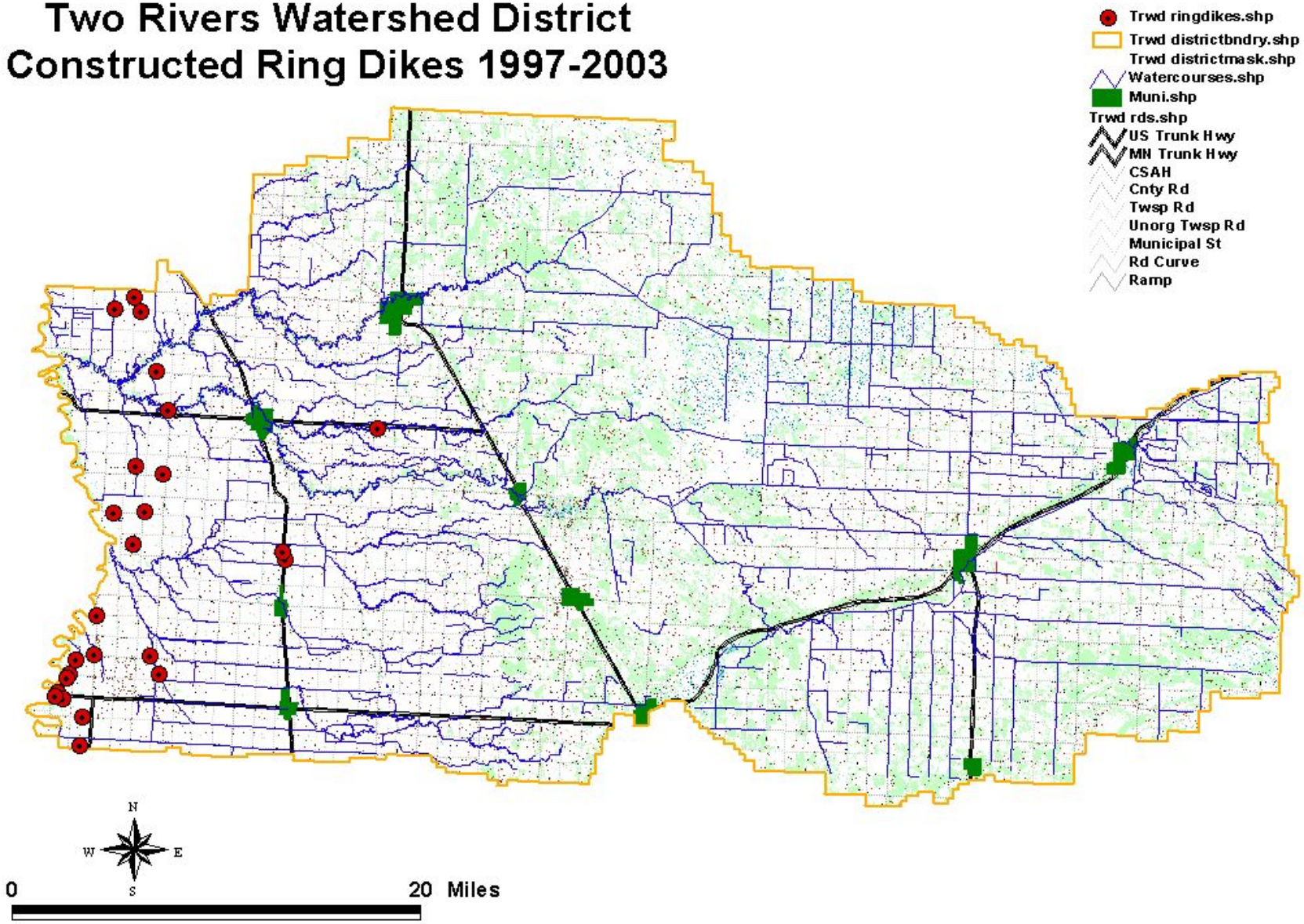


Two Rivers Watershed District
Water Quality Monitoring Sites




Two Rivers Watershed District
Stream Flow Monitoring Sites
Trwd streamgages.shp
Trwd districtbndry.shp
Trwd districtmask.shp
Watercourses.shp
Muni.shp
Trwd rds.shp
US Trunk Hwy
MN Trunk Hwy
CSAH
Cnty Rd
Twsp Rd
Unorg Twsp Rd
Municipal St
Rd Curve
Ramp
N
W
E
S
0
20 Miles

Two Rivers Watershed District
Constructed Ring Dikes 1997-2003



Jurisdiction of Legal Ditches