

ROSEAU RIVER WATERSHED DISTRICT

OVERALL PLAN

(Appendix 13)

Comprehensive Water Management Plan

Roseau River

A Comprehensive Water Management Plan

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Roseau River

A Comprehensive Water Management Plan

Section I: Introduction

1. Purpose:

This report presents a suggested comprehensive water management plan for the Roseau River. It was developed in response to the question of how to mitigate the devastating and disruptive flood damage that occurred during the June 2002 flood. The total proposal is costly, on the order of \$100 Million, but if the plan had been implemented prior to the 2002 flood, it would have saved more in damages in this one flood than the cost of this mitigation plan.

2. Plan Development Status:

The presented plan consists of many separate project features, all of which work together to provide the solution. The features of the plan are presented on the enclosed map and are discussed in some detail in the next section of this report.

The water problems in the Roseau River Basin have been discussed in previous overall planning meetings and a previous Flood Control Planning Committee. Some of the project features in this plan, as well as the goals, came out of those meetings with input from many individuals, including representatives of many agencies. Nevertheless, none of the project features can be considered to have had a full review by any of the responsible agencies or affected individuals.

The project features presented herein have been developed to a preliminary concept design status. This status is adequate for discussions and to provide planning cost estimates even though further design work is needed to refine the designs discussed in this report.

3. Flooding Background:

Upstream of the city, the basin drainage area is fan shaped with significant slopes such that any excess waters rapidly run off and produce flash type floods. Starting just a few miles upstream of Roseau, the slope flattens as it enters the glacial age lake plain. The city is actually located on the prehistoric flood delta formed where the river entered the ancient lake plain. Downstream of Roseau to the Canadian border is the flat lake plain lands which has poorly developed natural drainage.

Further amplifying the runoff problem is the fact that 45% of the lands upstream from Roseau are still wetlands which unfortunately are not of a pothole type. The existing types of upstream wetlands result in increased runoff during flood runoff events compared to farmed lands. Thus, even though 40% of the lands upstream are in public ownership and preserved in a mostly undeveloped status, these lands do contribute their share of excess waters during flood events.

Downstream of Roseau is the Roseau Lake basin which was drained in the early 1900s. The lake basin temporarily stores the flood waters and thus provides considerable attenuation of flood flow rates for the lands downstream. Unfortunately the original river channel downstream of Roseau Lake was able to handle only flows experienced on a yearly basis before flooding overland. The channel capacity was enlarged to approximately a 3 year capacity by the State of Minnesota in the early 1900s, but that is still inadequate for economic farming operations.

Before entering Canada, the river flows into a large area called the Big Swamp. Lands in the swamp slope to the south such that in prehistory times (before Minnesota enlarged the Roseau River channel), the majority of flood flows went south into the Two Rivers. Thus Canada was ill prepared for the increased flood flows that resulted from the early 1900s Roseau River enlargement. The Canadians did construct a floodway just across the border but will have legitimate concerns if a plan resulted in any future increase in peak flood flow rates. Meanwhile, given the Roseau River dredging, the Two Rivers hasn't been flooded as often and development in that river basin is now subject to flood damages when the excess flood water flows do go south, as in the 2002 flood. Thus an acceptable plan would not increase peak flood flows to either of these outlets, and ideally would serve to decrease those flow rates.

4. Planning Background:

Although USGS estimates the June 2002 flood was an extremely unlikely event (rarer than once every 500 years), the sad reality is that there is extensive property damage during a 100 year flood event and extensive farming losses during 10 year flood events in the Roseau River basin.

There exists a mediation agreement governing water management in the Red River Valley, of which the Roseau River is a part. That agreement suggests levels of protection for property from a 100 year flood event and prevention for farm losses from a 10 year flood event. This plan uses these levels of flood protection as the basis for the concept designs.

While those goals are for property damage prevention during a 100 year, not an event greater than the 500 year, flood event. The measures that will provide protection at 100 year flood levels will also drastically reduce damage during the extremely rare flood events.

The Roseau River Watershed District is currently updating it's Overall plan and expects to adopt the basic Flood Damage Reduction (FDR) goals of the mediation agreement. The mediation agreement also requires consideration of Natural Resource Enhancement (NRE) opportunities in the watershed. During the planning process the District expects to develop goals for the NRE opportunities.

The comprehensive plan presented herein tries to meet the Watershed's expected FDR and NRE goals.

5. Plan Implementation:

Under Minnesota law, the Roseau River Watershed District (RRWD) has the legal authorities necessary to implement any or all of the project features presented in this plan. Nevertheless, there will be significant difficulties bringing the plan to fruition. These can be categorized as Money, Permits, and Local Political Will.

1. Money:
 - a. The Roseau River undoubtedly has the least assessed valuation per dollar

of problems of any watershed in the Red River Valley, and perhaps the State. Thus it is impossible for the RRWD to consider completing the plan using local dollars.

- b. Although it is theoretically possible to get direct grants from both the Federal and State governments for project implementation, realistically this is very unlikely. The Federal dollars are preferably routed through the Federal Agencies (see next paragraph) while the State gives highest priority for its Flood Damage Reduction Grant Program dollars to assisting local governments with the match required for those Federal Projects.
- c. The Federal Agencies, in particular the Army Corps of Engineers (USA-COE) and the Natural Resources Conservation Service (USDA-NRCS), have the authority to develop and construct flood control projects in partnership with a local sponsor. These agencies, however, are limited to doing only projects which meet the federal definitions of an acceptable benefit to cost ratio where same is computed under the established Federal Rules. It is considered most likely that many of the project features presented in this plan will not meet those Federal requirements.

2. Permits:

- a. This plan is an attempt to provide a balanced water management plan which has significant NRE outcomes as well as the FDR outcomes.
- b. Even if this plan has been successful in meeting that balancing goal, each project feature will typically need many permits. Those agencies will face the unenviable and difficult task of evaluating the many obvious negative impacts of these major construction works and comparing them with the proposed beneficial NRE benefits, further complicated by the fact that they can only speculate on the probability of those NRE benefits being finally achieved. The net result is often an understandable desire on the permitting agencies' part to prefer the do nothing alternative.

3. Local Political Will:

- a. There is no way such large quantities of excess water can be managed without the taking of substantial land and many houses. The law provides that the owners will be financially compensated for loss of dollar value,

but as we all know, there often are intangibles attached to pieces of property that can not be mitigated with money.

- b. While the plan does try to address all problems, the plan does result in some people being better off than others. For example, some farm lands will now be adjacent to an adequate outlet while others lands will have to build a ditch to get advantage of the improved outlet. These local inequities may result in dissatisfaction which could undermine support for the plan.
- c. Finally, on a local level, there always is considerable opposition to any project which is in someone's backyard. For example, virtually all people will agree with the concept of holding water in impoundments but when specific sites are discussed, some real and many imagined reasons are presented as to why such a project shouldn't be built at a particular site.

6. Sequencing:

Lastly, even if money, permits, and politics does allow proceeding on implementing the plan, the question as to what order the project features must be planned and/or constructed needs discussion.

One proposed feature in the plan is a modification the Roseau River Wildlife Management Area (RRWMA). The proposed modification will assist in flood fighting efforts irrespective of the other features and could be done as soon as possible.

Another proposed feature is the Roseau River Restoration, this attempts to correct damage done almost a century ago and certainly could proceed when funds etc. are available.

Any upstream impoundment is also a net reduction in flooding and thus planning and construction for any feasible site could and should proceed as soon as possible.

The upstream impoundments will reduce the downstream peak flows and thus, to some extent, the size of the downstream features. Yet, until all the impoundments are built, there can be no guarantee that the number of acre-feet storage in the stated goal will be achieved. Therefore, early in the plan implementation process, an achievable goal for upstream storage must be determined. This will require some detailed evaluation of all

possible sites and perhaps even site specific meetings to determine if the particular sites are locally acceptable so as to establish a firmer goal on the water storage possible in the upstream areas.

There are a few features which are independent- or almost so- of other features that they can be constructed as soon as possible. For example, though upstream impoundments would somewhat reduce future 100 year flood heights, the inefficiencies associated with building Ring Dikes around rural homes slightly higher than ultimately necessary should be considered an acceptable approach.

The other Flood Damage Reduction features are significantly interdependent. The reason is that the implementation of just one feature, say the City of Roseau floodway, will increase expected downstream damages and, therefore, downstream interests will be strongly opposed unless the Roseau Lake, the Diversions, and the Big Swamp features are also constructed.

Roseau River
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Section II: Project Features

1. Impoundments Upstream from Roseau

Purpose:

Water storage upstream from Roseau in the headwaters would reduce the flood peaks at Roseau and also could keep their volume of water out of the Roseau Lakebed until that storage area has the capacity to take this water.

Design Goals:

While virtually everyone agrees with the statement that the water should be stored close to where it falls, the difficulty is in finding acceptable sites that are locally possible and which can be permitted. If 100,000 acre feet of storage were possible, then this feature alone would significantly reduce flood damages throughout the Roseau River Watershed. However, given the terrain and upstream land uses and ownership, a goal of 100,000 acre feet is not considered possible. An achievable goal might be 30,000 to 40,000 acre feet. A separate report accompanies this report containing preliminary information on some 15 possible water storage sites collectively having 50,000 acre feet of storage potential. Thus the goal of 30,000 to 40,000 acre feet of storage would represent construction of 60 to 70% of those, or comparable, sites.

Design Concept:

To insure that no water is released from the impoundments until the Roseau Lake level has started to fall, the impoundments should be designed to hold a minimum of 4 to 5 inches of gated storage for the runoff from their contributing drainage area. Also, these upstream pools should be designed- to the extent possible- for multiple uses, including low flow augmentation of the river and wildlife values, noting that these other uses significantly increase the sources available for funding.

Cost:

A Cost of about \$20 Million for 30,000 to 40,000 acre feet of flood water storage upstream of Roseau is estimated based on similar projects throughout the Red River

Valley.

Alternatives:

Alternate water storage sites are possible, though not identified at this time. But the alternative of no storage sites is not possible as the Roseau Lake and Big Swamp Features need the supplemental storage that will be provided by the upstream storage.

2. Diversion or Floodway for Roseau

Purpose:

This feature would carry the floodwaters through the City of Roseau without causing any damage during the 100 year design event.

Design Goals:

The City of Roseau incurs no damage up to a flow of about 4000 cubic feet of water per second (cfs). The goal should be to remove the City from the 100 year flood plain. While the current established 100 year flood flow rate for the City is 9,050 cfs, this estimate does not include the recent floods of 1996, 1997, and 2002. When the estimate is officially recomputed, the 100 year flow rate can be expected to increase. In this plan that will be balanced by the proposed upstream impoundments that could decrease that flow rate by up to 20 to 30%. Therefore, designing for the current 100 year flow rate of 9,050 to 10,000 cfs seems reasonable.

To minimize environmental impacts the floodway to the maximum extent possible should not disturb the low flows on the river.

Design Concept:

North of the city, the floodway would be a shallow 600 foot wide parallel channel to the river. The floodway would carry a portion of the water for all flows greater than a 2 year event. The floodway should be designed to handle 6,000 cfs with the inlet flows at about the 10 year flood level- the no damage in city flood level at the north end of the city. Total capacity at that elevation then is 4,000 cfs down the river channel plus the 6,000 cfs down the floodway. Such a floodway would have handled the flows during the recent extreme flood at a 2 foot higher elevation.

In the City, the upper part of the river channel will be enlarged such that the bottom of the enlarged section is normally dry and only carries flood waters. The depth (thus

the frequency of inundation) depends on the width of the bench. To make this cut as shallow as possible, significant widening is desired. For a depth of cut of 10 feet below the 10 year flood level, at a minimum, the channel enlargement should have a base width of 150 feet with 8 to 1 side slopes. The wider this is the better, allowing a shallower depth and a more stable channel.

The bridges in the City have the capacity to carry the 100 year flood flows within acceptable head losses but the velocities will become excessive. Also, the bridges do become restrictive in the large flows experienced in 2002. Therefore, the approach(s) to the bridges should be converted to bridge sections in order to carry flows underneath.

Cost:

If the cost of city utilities and structures relocation, as well as house purchases on one side of the river in the city are included for this through the city design, the estimated cost is \$30 Million which includes the bridge modifications as well as the extensive ditch work.

Alternatives:

The alternative of a floodway around the west side of the City is technically feasible and in the same cost range as the floodway proposed here if all the City's relocation costs are considered. The disadvantages of the west side floodway are that the Roseau Lake Feature becomes more complicated and expensive. Also the floodway through the city can be expected to benefit from relocations taking place because of the damage from the 2002 flood.

3. West Roseau Storm Drain

Purpose:

This feature will provide an outlet for the storm drains on the west side of Roseau. It will also carry the floodwaters that enter the City as overland flow from lands west of the city.

Design Goals:

To serve as an acceptable storm drain during flood times, the water elevation in the drain should have at least 3 feet of freeboard when 100 year flows are occurring.

Design Concept:

A 40 foot bottom width drain, about 10 to 12 feet deep, at the west side of the city with appropriate sized multiple box culverts under the roads and the railroad track will meet the design goal.

Cost:

The cost of land, ditch excavation, and 7 road crossings is estimated at \$ 3 Million

Alternatives:

The do nothing alternative leaves the west side of Roseau susceptible to overland flooding even if the river no longer floods.

4. Hay Creek/Norland Project

Purpose:

This feature is currently under study by the Corps of Engineers. Its primary purpose is to provide significant natural resource benefits by restoring wetlands and by creating a meandering stream along the alignment of existing Roseau CD #7. An incidental benefit is protecting downstream farmland from damage during the frequent flood events.

Design Goals:

The primary goals are the Natural Resource Enhancements. The incidental FDR goal is to protect the farmlands from 10 year events, in accordance with the mediation agreement.

Design Concept:

The concept is to construct an impoundment with 1,300 acre feet of water in a wildlife pool with an additional 9,000 acre feet of flood bounce. The meandering channel for 2 year flows will be constructed between 2 setback levees which will carry the 10 year flows without damaging the farmland. The details of the concept are presented elsewhere in a COE draft report about the project.

Cost:

The preliminary cost estimate is \$8.3 Million with significant funding assistance provided by COE, a Minnesota FDR Grant, and the Red River Watershed Management Board.

Alternatives:

The alternatives would be to do nothing leaving the downstream lands to frequently flood and forgoing the NRE benefits, to construct only the impoundment, or to construct only the meandered channel.

5. Other Impoundments

Purpose:

During flood events significant quantities of excess water flow down tributaries of the Roseau River that do not pass through Roseau. There needs to be an additional 10,000 acre feet of upstream flood water storage in the Hay Creek and Norland drainage areas to reduce flood damages in those areas. Also flood storage in the Lost River drainage is needed although it would be difficult to implement.. Finally, our Canadian friends need to implement flood water storage in their tributaries, the Sprague Creek and Pine Creek areas in Canada.

Design Goals:

Similar to the impoundments upstream of Roseau, to control waters in most damaging floods, they should store 4 to 5 inches of runoff from their tributary lands. Also, at every site possible, the dams should be multipurpose, including low flow augmentation and NRE benefits. The total US goal should be 15,000 acre feet of flood bounce storage.

Design Concept:

Provide gated storage for the flood runoff to allow the waters to be stored until Roseau Lake can handle the inflow.

Cost:

The 15,000 acre feet would be a cost of about \$ 8 Million.

Alternatives:

There really is no long range alternative. The floods in Roseau Lake and below are

of such significant volume that reducing that total volume of flood waters must be a priority.

6. Ring Dikes

Purpose:

Farm homesteads need to be protected for the 100 year event. In the farmland areas, the nominal flood protection goal for the farmlands is the 10 year event, thus an additional measure is necessary to protect the farmsteads.

Design Goals:

To provide farmsteads protection from a 100 year flood event. This is an ongoing program of the State of Minnesota, the Red River Watershed Management Board, and the Roseau River Watershed District.

Design Concept:

A dike around the farmstead with a top elevation above the 100 year flood elevation.

Cost:

The cost depends on the number of participants, perhaps \$500 Thousand.

Alternatives:

The do nothing alternative leaves many of the farm homesteads unprotected even if all other components of this plan are implemented.

7. Roseau Lake

Purpose:

The drained Roseau Lake provides significant flood water storage during flood events (almost 150,000 acre feet during the 2002 flood). The purpose of this feature is to improve the benefits from that storage while also restoring some NRE benefits in the lakebed.

Design Goals:

The is a huge feature with many components, each of which have design goals.

- a. Wildlife management pools, this is to restore some wildlife benefits to the lakebed.
- b. Low dikes, this is to allow frequent runoff events (less than 2 year) to pass through the lakebed area saving some 30,000 acre feet of storage for use during intermediate flood events while also protecting the wildlife management area from too frequent uncontrolled inundation.
- c. Farmlands, the low lying farmlands north of the main dike can not be protected for frequent flood events and should be purchased and utilized to provide natural resource benefits.
- d. Main dike, This is to keep the lake during high levels off farmland and homesteads to the south while also allowing the water outflow from the lake to be controlled by the 3 outlets.
- e. Outlets, the goal is to allow frequent runoff events to go down the river, in higher events, to split the flows such that by the 10 year event (3,500 cfs) the water goes down all 3 outlets with the river channel at it's no damage flow rate of 2,000 cfs. In less frequent events, the outlets need to allow the management of the lake storage such that water is transferred to the Big Swamp as necessary to keep the lake's rise to preproject levels but to then to trap those stored waters as needed to keep the Big Swamp from overflowing it's designed level.

Design Concept:

- a. The wildlife management pools will keep controlled levels of water in the bottom of the old lake bed. A concept design by MNDNR called for 9,000 acre feet of water to be kept in two separate pools. A source of water to replenish the pools during dry periods was proposed to be Pine Creek which will require modification of the Pine Creek Diversion Structure in Canada.
- b. The low dikes are proposed for an elevation of 1032.5 which will minimize construction work by utilizing the existing ditch spoil banks and natural levees through the lake area. Overflows would be installed at the 1032.5 elevation.
- c. Farmland conversions, the existing outlets from the purchased lands would have their outlets plugged such that they would be expected to revert to wet prairie.
- d. The main dike needs to be constructed with very flat slopes to allow use of the native soil materials along the alignment and to provide wind erosion protection for the dikes during flood events. The top of the dikes should be at the 1044 elevation to allow flooding to reach a 1039 emergency spillway elevation without fear of wave action overtopping the dike.

- e. Outlets, each of the 3 outlets will be designed to different criteria;
- 1) Roseau River Outlet, this outlet is to allow unrestricted flows up to the 2 year flow rates (1,500 cfs) then restrict the flows such that at the 10 year lake level (1035 elevation) the flow down the river is at the minimum damage level of 2,000 cfs. In larger events, controlled overflows will begin at 1035 elevation to manage the maximum lake level. In extreme events, when the lake reaches maximum level, that lake level will be maintained by limiting flows downstream to keep the outlet into Canada at its no damage capacity without exceeding the water storage capacity of the Big Swamp.
 - 2) South Diversion Control Structure, this structure will allow water to flow into the river whenever the river is lower in height than the water in the South Diversion. When the water in the lakebed is at 1031.5 elevation, water will begin to flow over a long weir such that at a lake elevation of 1032.5 the outlet is submerged and by elevation 1035, 1,000 cfs flows down the South Diversion. There will be a controlled overflow into the south diversion starting at elevation 1035
 - 3) North Diversion outlet, this will be similar to the south outlet except the flow at a lake elevation of 1035 will be 500 cfs. It will also have a controlled overflow starting at elevation 1035.

Cost:

The cost of dikes, structures, and land is estimated at about \$15 Million.

Alternatives:

No comprehensive plan can work unless the existing storage in the drained Roseau Lake is better managed.

8. Diversions

Purpose:

The Roseau River downstream from the Roseau Lake has limited capacity, even given the channel enlargement (State Ditch #51) done by the State of Minnesota in the early 1900s. The 2 new channels are to provide the needed additional flow capacity between the Lake and the Big Swamp.

Design Goals:

To provide a 10 year total flow capacity of 3,500 cfs thereby protecting farmlands from damage during 10 year events, the total capacity of the 2 diversions needs to be 1,500 cfs, (with the river at 2,000 cfs, total flow is thus 3,500 cfs) when the lake is at an elevation of 1035. These flows must be carried below the farm ground elevation to provide an outlet for local drainage through trapped culverts during the 10 year event. This is needed because of the long duration of the flows, the farmland along the channel would be damaged from local waters unless an outlet is maintained.

In the less frequent large floods, the channels will also provide additional flow capacity , though they will not function as outlets for the farm ditches since the water in the diversions would be higher than the farmlands.

Design Concept:

The South Diversion Channel will need a bottom width of 60 feet wide with a typical depth of 12 feet. At the lake dike, the elevation should be 1026. The crossings will be limited to county roads plus a crossing in the Big Swamp, this is to limit head loss while also limiting the cost of crossings.

The North Diversion Channel will need a bottom width of 40 feet and will be about 8 feet deep along much of its length.

Cost:

The cost of land, ditch excavation, and road crossings is estimated at \$ 10 Million

Alternatives:

To provide 10 year flood damage protection for the farmlands between Roseau Lake and the Big Swamp, the 10 year flows must be carried below the existing farmland. This requires additional channel capacity, either in the river or in new channels.

9. Roseau River Wildlife Management Area Modification

Purpose:

The Roseau River Wildlife Management Area was constructed 50 years ago with a primary purpose of creating multiple pools of open water in the Big swamp for the benefit of wildlife. A small measure of flood control was an incidental benefit. In

the 1980's, the pool outlets were redesigned to improve wildlife management capability and to increase flood control benefits. Experience in the past few floods has shown that the flood control benefits from the existing flood storage on this project could be improved if outlets were sized large enough to pass significant flood waters up to the time when the Roseau River outlet into Canada was full and thereby use the existing flood storage more optimally.

Design Goals:

To provide outlets sized to pass peak flood waters without using its flood storage until downstream river conditions require.

Design Concept:

Install large gated outlets.

Cost:

The cost for 2 outlets is estimated at \$500,000.

Alternatives:

The do nothing alternative leaves the management area providing flood benefits during frequent events but sub-optimally using flood water storage during major events.

The management area's dikes are substandard and ideally would be improved to reduce to chance of failure during a flood.

10. Roseau River Restoration

Purpose:

The Roseau River (a.k.a. State Ditch #51) is a dredged deepened channel from upstream of Roseau Lake down to the Canadian border. This feature is to restore some of the natural resource functions of the river by reopening the cut off oxbows and installing multiple low head dams to increase low flow river water levels and send low flows through the restored oxbows.

Design Goals:

Reopen the abandoned oxbows, force low flows through the oxbows, and also

develop structure (riffles and pools) in the dredged river bed.

Design Concept:

Remove the dredged spoil deposited in the abandoned oxbows and also the silt accumulation that resulted from that abandonment. Install a series of low head dams with rocked downstream slopes, one for each oxbow to force low flows around the oxbows, and 3 more along the length of the dredged channel in Roseau County up to Roseau Lake. The old plans indicate the channel was deepened about 2.5 feet so the dams should be about 4.5 feet in height.

Cost:

The cost for reopening the oxbows and constructing the series of low head dams is about \$1 Million.

Alternatives:

The river is a degraded resource which has been left in its degraded state for almost 100 years, therefore, continuing to do nothing is an obvious option.

11. Big Swamp

Purpose:

The Big Swamp currently bounces significantly during floods storing, at least temporarily, large quantities of flood waters. The purpose of this feature is to manage the storage of those flood waters and outlet them during all but the most extreme floods so that they do no damage downstream in Canada or in the Two Rivers system.

Design Goals:

Given that the land on the south side of the river slopes down to the Two Rivers system, the flood waters should be stored and preferably outletted into Canada at a rate below the 3,000 cfs flow rate which causes no damage to the Canadians.

Design Concept:

Dike a large portion of the Big swamp to elevation 1027 so water can be in controlled storage up to elevation 1024 thereby providing 125,000 acre feet of controlled storage. Construct the dike with flat side slopes to use local soil materials and reduce erosion. Install an outlet into the Roseau River that limits flow at elevation 1024 to

3,000 cfs. Install a long overflow spillway into the river at elevation 1024. Install a gate controlled outlet into the Two Rivers State Ditch #72 that can be used to drain water during a flood as SD #72 capacity allows with an overflow at elevation 1024, one half the length of the overflow into the river.

Cost:

The cost for the dike, 2 outlet structures and some private land is estimated at \$8 Million.

Alternatives:

The do nothing alternative would eliminate the chance of constructing the needed diversions as the outlet into Canada and also the one into the Two Rivers would receive excessive flows during major flood events.