SOUTH BRANCH
YELLOW MEDICINE RIVER
FECAL COLIFORM
TOTAL MAXIMUM DAILY LOAD REPORT

IMPLEMENTATION PLAN

Submitted by

YELLOW MEDICINE WATERSHED DISTRICT

MPCA APPROVED
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1.0 Problem Statement

The South Branch TMDL watershed represents a specific activity within a larger project addressing water quality improvements within the Yellow Medicine River Watershed. The larger project goals are to relate monitoring data to land use in a cause-effect manner. During the period of October 22, 1990 to May 17, 1999, 64 fecal coliform observations were conducted from a milestone site, YMS-10.1, South Branch of the Yellow Medicine River at CSAH-10 near the city of Minneota. Of these samples, 42 observations were greater than 200 organisms/100ml. The step 2 analysis shows there were 56 observations in this time period within the months that the fecal coliform standard was in effect. There were 5 months that had more than 5 observations per month (across all years), and for each of these 5 months, the geometric mean was greater that 200 organisms/100ml. This leads to a preliminary assessment of non-support, and a TMDL listing.

1.1 Target Watershed

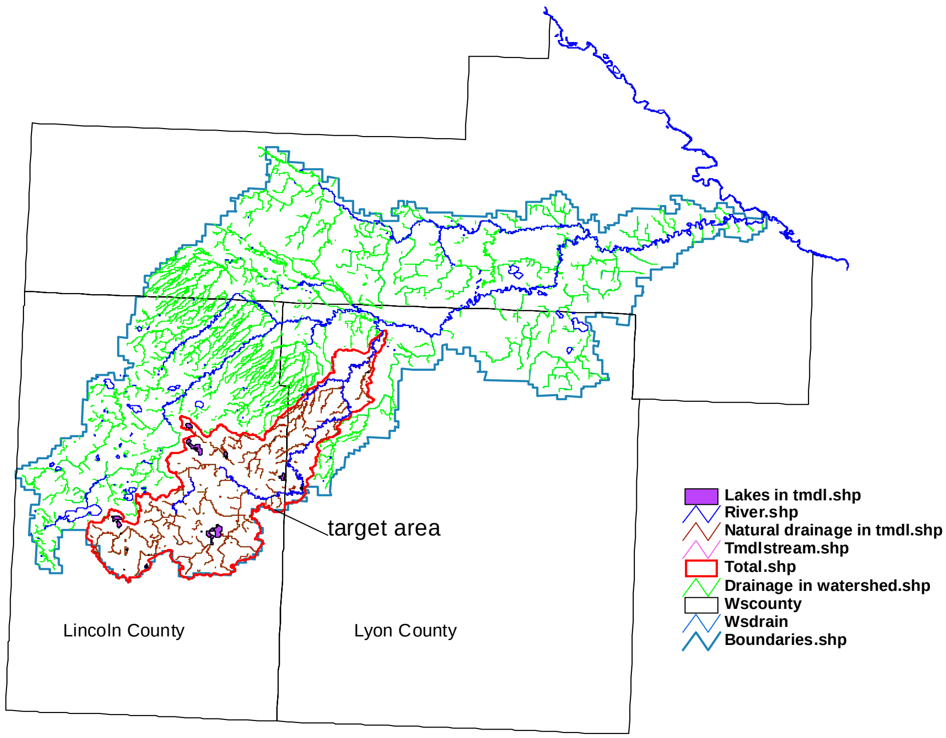
The project area is defined by the drainage area as shown in figure 1.1. The sub watershed is comprised of 57.2 square miles flowing mainly in a northeast direction down the Coteau de Prairies and out on the flood plain. The average slope of the watershed is 22.6 feet/mile.

LOCAL UNITS OF GOVERNMENT IN THE PROJECT AREA:

COUNTIES	TOWNSHIPS	CITIES
Lincoln	8	1
Lyon	4	1

The studies indicate the river is subject to extreme water quality deterioration processes in the recent past that related to rainfall storage loss and subsequent increasing stream velocities, changes in land use and intensive agriculture. Nutrient and suspended solids data suggest the river is receiving excessive loadings of nutrient and solids from this watershed. The state of the river is in very high profile within the surrounding communities and landowners due to the increasing downstream flooding. Crop loss due to flooding has particularly been the subject of growing debate.

Figure 1.1



The focus and primary intent of this project is to better characterize fecal levels, the probable sources, and estimate reductions required to meet the TMDL water quality goal. The scope of the project includes identifying and quantifying the point and non-point sources of fecal coliform, and linking these sources to the river concentrations. The project design attempts to:

- Assess the various sources of fecal coliform;
- Develop assumptions of the availability of each source;
- Develop assumptions on the delivery of each source to the river;
- Assess the central tendency and variability of the river's fecal coliform;

The data gathered during the diagnostic study enables the project managers and the steering committee to develop an information-based management plan to:

- Assess the magnitude of each pollution source;
- Design realistic control measures;
- Quantify the performance of the control measures implemented;
- Prognosticate the net effect on the river water quality and quantity.

1.2 Inventory of Fecal Coliform Sources

Table 1.1 summarizes the major potential sources of fecal coliform in the South Branch reach. The livestock records originate from the MPCA permitted facility database and the YMRWD feedlot survey[1]. In the winter of 2000, the YMRWD and SWCD personnel from Lyon and Lincoln Counties assisted with a level 2 feedlot survey.

The human sources were addressed largely by population census for urban and rural areas. The total population for the watershed is 2730, with an urban population of 1550 and a rural population of 1180. The urban populations are in the city of Minneota and the city of Arco. The septic coverage was provided by the Lincoln County Environmental Services[2], and also from the Lyon County Soil Water Conservation District[3]. The septic systems within the TMDL watershed were assumed to be 77% non-compliant[4]. The single point source, the Minneota municipal waste water treatment facility, provided discharge reports. The deer estimates of 2.6-9.4 per square mile were adapted from deer densities in the nearby Chippewa Watershed[5]. The high end of a reported range of deer densities, 2.6-9.4 deer per square mile, was selected and slightly inflated to 10 deer per square mile to account for other wildlife contributions of fecal coliform. The dog and cat populations were estimated from the population statistics. Urban and rural households were assumed to have 2.5 members on average, and 0.58 dogs and 0.73 cats per household[6].

Table 1.1 Inventory of Fecal Coliform Producers in the South Branch TMDL Watershed

Category	Sub-Category		Animal Units	Number
Livestock	The basin contains an estimated 93 livestock facilities ranging in size from 1 animal units to 733 animal units	Dairy	1757	
		Beef	4916	
		Swine	1737	
		Sheep	567	
		Chicken	31	
		Horse	45	
Human	Rural Population with Inadequate Wastewater Treatment*			909
	Rural Population with Adequate Wastewater Treatment			271
	Municipal Waterwater Treatment Facilities			1
Wildlife	Deer (average 10 per mile)			1218
	Other It was not possible to obtain estimates for other wildlife. This sub-category was estimated using an equivalency to deer in the basin.			
Pets	Dogs and Cats in Urban Areas**			812
	Dogs and Cats in Rural Areas***			618

* 77% non compliant
** 1550 people / 2.5 people/household, 0.58 dogs/household, .73 cats/household
*** 1180 people / 2.5 people/household, 0.58 dogs/household, .73 cats/household

[1] Yellow Medicine River Feed Lot Survey, 2000, Appendix 5
[2] Robert Olson, Lincoln County Environmental Services.
[3] Chris Winter, GIS Specialist Lyon County.
[4] Yellow Medicine River Watershed District ISTS survey, 2001.
[5] Bob Osborn, MNDNR Farmland Research Group, spring 2001.
[6] Minnesota Department of Animal Health

The values in Table 1.1 are expressed as "Animal Units" or "Number". Animal units represent the equivalent of a 1000 pound animal. The feedlot survey was tabulated as animal number. The animal numbers were converted to animal units by multiplying the animal numbers by the representative weights: Dairy 1400 lbs, Beef 1000 lbs, Swine 140 lbs, Sheep 100 lbs, Chicken 4 lbs, and Horse 1000 lbs[7]. The product was divided by 1000 lbs to get animal units (see appendix 2).

1.3 Assumptions and Current Load Contributions

In order to assess potential contributions of fecal coliform from different sources, a number of assumptions were made (Table 1.2). These assumptions translate livestock type and numbers into different stream loading situations such as overgrazed pasture, cattle in the streams, etc., and indicate how much of the total fecal coliform produced in the watershed is assessed to these sources. The assumptions are very gross and are intended to represent "average" conditions in the watershed. The assumptions were adopted from the Lower Mississippi River Fecal TMDL report[8], available information from sources such as the Generic Environmental Impact Statement on Animal Agriculture (e.g. Mulla ET. Al 2001), and professional judgment from MPCA and YMRWD staffs.

The assumptions in Table 1.2 are used to estimate daily fecal coliform availability by source, and are an attempt to account for all of the fecal material produced in the rural and urban areas of the watershed. The sources represent the major pathways to stream loading of fecal coliform. For example, 1% of dairy cow manure is on overgrazed pasture, 1% is in feedlots and stockpiles without controls, and 98% is split between surface and incorporated soil application. Well managed pastures, feedlots, and stockpiles

Table 1.2: Assumptions Used to Estimate the Amount of Daily Fecal Coliform Production Available for Potential Discharge into the Streams and Rivers of the South Branch TMDL Watershed.

Category	Source	Assumptions
Livestock	Overgrazed Pasture near Streams or Waterways	1% of Dairy, Beef, Sheep, and Horse Manure
	Feedlots of Stockpiles without Runoff Controls	1% of Dairy and Chicken manure, 5% of Beef and Swine Manure
	Surface Applied Manure	49% of Dairy Manure, 47% of Beef Manure, 47.5% of Swine Manure, 49.5% of Chicken Manure, 49.5% Horse and Sheep Manure
	Incorporated Manure	49% of Dairy Manure, 47% of Beef Manure, 47.5% of Swine Manure, 49.5% of Chicken Manure, 49.5% Horse and Sheep Manure
Human	Failing Septic Systems	100% of all Failing Septic Systems
	Municipal Wastewater Treatment Facilities	One facility discharging at a fecal coliform concentration of 200 organisms/100ml
Wildlife	Deer Other Wildlife	100% of all Deer in the Watershed The equivalent of all fecal matter produced by Deer in the Watershed
Pets	Improperly Managed Waste from Dogs and Cats	10% of waste produced by estimated number of dogs and cats in the basin

[7] ASAE D384.1 Feb, 2003 Manure Production and Characteristics
[8] Minnesota Pollution Control Agency, October 2002

with runoff controls are assumed to be negligible sources of fecal coliform. The majority of the fecal coliform available is associated with the land application of stored manure. The availability of fecal coliform from this source varies greatly with seasonal conditions and subsequent manure application cycles.

Table1.3 Estimated Deliveries for Each Available Source

Source	Estimated Delivery Potential	
	(Wet)	(Dry)
Overgrazed Pasture near Streams or Waterways	High (4%)	Low (1%)
Feedlots or Manure Stockpiles without Runoff Controls	High (4%)	
Surface Applied Manure	Low (0.5%)	
Incorporated Manure	Very Low (0.1%)	
Failing Septic Systems and Unsewered Communities	Very High (8%)	Very High (8%)
Municipal Wastewater Treatment Facilities	Contribution estimated directly on discharge reports	
Wildlife	High (4%)	Low (1%)
Pets	High (4%)	

Table 1.4 Contributions from Point and Non-Point Sources

Category	Source	Contribution Wet	Contribution Dry
Livestock	Overgrazed Pasture near Streams or Waterways	4%	32%
	Feedlots or Stockpiles without Runoff Controls	18%	
	Surface Applied Manure***	63%	
	Incorporated Manure	13%	
Human	Failing Septic Systems and Unsewered Communities	2%	66%
Wildlife	Deer	0.3%	3%
Pets	Dogs and Cats	0.4%	
Total		100.00%	100.00%

The contributions from point and non-point sources are summarized in Table 1.5. The table illustrates the series of calculations relating the “potential” inventory of sources to the “available sources” to the “deliveries” from each of the available sources in a stepwise fashion.

Table 1.5

CAUSE – EFFECT
Fecal Coliform Stream Loading Sequence:

Potential Sources → Availability of Sources → Delivery Fraction → Resulting Stream Concentration

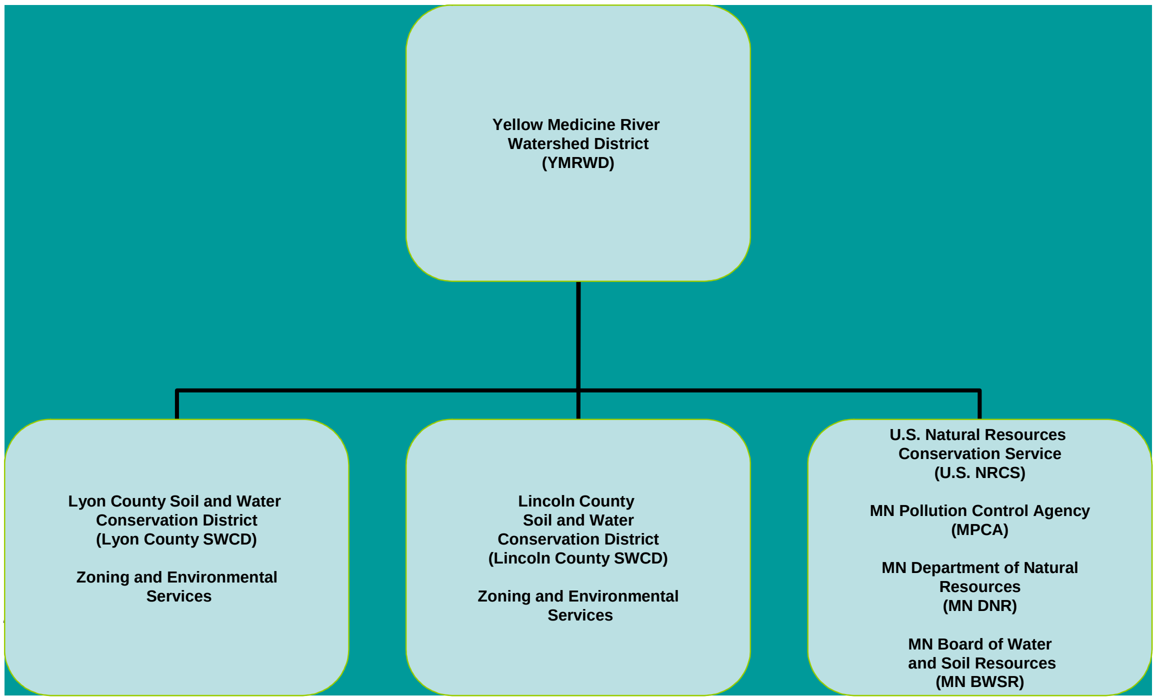
Tables 1.1 through 1.4 represent each of the four steps and are expressed as percent delivery from each of the available sources.

2.0 Building a Project Team and Public Support

The basic scope of the project is comprised of three components. The first is to access the magnitude and variability of the watershed loading quantitatively at the most cost effective resolution. The second is to assemble a technical committee involving the Yellow Medicine River Watershed District (YMRWD), the Lincoln County Soil and Water Conservation District, the Lyon County Soil and Water Conservation District, the Natural Resources Conservation Service (NRCS), the Minnesota Pollution Control Agency (MPCA), and local cities and townships. This committee guides the project flow by interpreting the available information and setting goals and direction. The third component is to create and utilize a one-stop, “state of the art” information processing mechanism in the form of a GIS system. The requirements of this system include, but are not limited to, compatibility within and outside of the user group, usable spatial and numeric information systems, and dynamic communication protocols linking the project information to committee members and the land owners. Figure 2.1 shows the basic organization of the agencies that comprise the technical committee.

2.1 Agency Roles and Responsibilities

Figure 2.1
Organizational Chart
South Branch Yellow Medicine River
Fecal Coliform Implementation Plan



The water quality impairment of excessive fecal coliform bacteria loading in the South Branch of the Yellow Medicine River is being addressed by the coordination of services by the organizations shown in Figure 2.1. In order to meet the required goal set forth by section 303d of the Clean Water Act of 200 organisms per 100 ml of water (180 organisms per 100 ml of water with the MOS) in the South Branch of the Yellow Medicine River, these organizations including but not limited to the Yellow Medicine River Watershed District, the Lyon and Lincoln County Soil and Water Conservation Districts, the Zoning and Environmental Services for both Lincoln and Lyon counties in this sub-watershed, the United States Natural Resources Conservation Service and the Minnesota Department of Natural Resources will coordinate their services in a technical committee for the implementation phase of the South Branch of the Yellow Medicine River (SBYMR) TMDL. The Yellow Medicine Watershed District (YMRWD) will act as the sponsors of the Implementation plan.

2.2 Integration with Existing Programs

In addition to the South Branch of the Yellow Medicine River Implementation Plan, there has been an implementation plan to reduce the loading of total phosphorous (TP), Total Suspended Solids (TSS), and Nitrate-Nitrite (NO2-NO3) in the greater Yellow Medicine River as a whole by 25%. This implementation plan has been in effect since 2001 and is called the Clean Water Partnership or CWP. Both the YMR implementation plan and the CWP implementation plan will be run simultaneously within the parameters of their respective goals.

2.3 Public Participation and Involvement

Public participation has been the hallmark of the South Branch TMDL from the beginning. Two public meetings have been conducted following the diagnostic phase of the TMDL. Invitations to the meeting were in the form of a brochure, which explained the TMDL process and was mailed to each resident within the TMDL watershed. Results of the monitoring and analysis were presented and questions and comments were received.

The feedlot survey was conducted using the Lincoln and Lyon SWCD staff. To complete the survey, several landowners were approached on a one-on-one basis to obtain the feedlot data. Throughout the current Phase II CWP implementation plan, landowners have been involved in planning and implementing nutrient control strategies. The YMRWD has also offered the services of their agronomist in determining optimized fertilizer and manure application rates based on soil fertility analysis and subsequent application plans.

Many local, state, and federal agencies have been involved in the public participation process including, but not limited to, the Lincoln and Lyon Soil and Water Conservation Districts, the Lincoln County Environmental Services, the Lincoln and Lyon County Boards, the MN Department of Natural Resources, the MN Board of Soil and Water Resources, the MN Pollution Control Agency, the US Natural Resources Conservation Service, the MN Fish and Wildlife Service, and the Yellow Medicine River Watershed District. These agencies, in cooperation with the local residents, landowners, and farm operators, have contributed to the understanding of the political, economic, and natural resource aspects of the TMDL and the ultimate implementation plan. The local residents, landowners, and farm operators will continue to be involved as committee members in the SBYMR implementation plan.

2.4 Education and Outreach

Local residents, landowners and farm operators will be apprised of meetings. Meeting locations and times will be mailed in brochure form. The meetings will outline progress made in the SBYMR implementation plan and will occur monthly. The YMRWD will participate in county farm fairs and conduct an annual water shed tour. In addition, the YMRWD will provide brochures and individual meetings with land owners on an on call basis. This will essentially be the hallmark of the program: regular public meetings and individual meetings at the office and on site. Project progress will be presented at local, state, and national conferences as well.

2.5 Communicating Lessons to Others in State and Beyond

The communication of strategies used in the TMDL and their effectiveness, as well as TMDL findings to date for SBYMR, have been conducted locally in monthly meetings at the very least and will continue in the future. It is not clear at this time what other methods will be used to educate the local citizens about current events in the implementation phase, but more measures to that end will be adopted if needed. In addition to local monthly meetings, other agencies both state and federal integral to the implementation plan, including: MN BWSR (MN Board of Water and Soil Resources); MN DNR (MN Department of Natural Resources); and the U.S.NRCS (U.S. Natural Resources Conservation Service) will hold educational conferences in concert or separately. The MPCA MN Pollution Control Agency will be integral to the implementation phase of the SBYMR naturally and will report their findings to the USEPA. Both the MPCA and the USEPA have websites that are used as educational tools to the public.

3.0 Set Goals and Identify Solutions

Section 303(d) of the Clean Water Act (CWA) provides authority for completing Total Maximum Daily Loads (TMDL's) to achieve state water quality standards and/or designated uses. A TMDL is a calculation of the maximum amount of pollutant that a water body can receive while still meeting water quality standards and/or designated uses. It is the sum of the loads of a single pollutant from all contributing point and non-point sources. In general, the TMDL is developed according to the following relationship:

$$TMDL = WLA + LA + MOS$$

Where:

TMDL	=	Total Maximum Daily Load
WLA	=	Waste Load Allocation (point source).
LA	=	Load Allocation (non-point source)
MOS	=	Margin of Safety (may be implicit and factored into conservative WLA or LA, or explicit).

3.1 Existing vs. Desired Uses of Waters of Concern

Applicable Water Quality Standards and Water Quality Numeric Targets

The single focus of this TMDL is on Fecal Coliform impairment. The current Fecal Coliform concentrations within this reach of the Yellow Medicine River poses an unacceptable health threat to human body contact recreation. The goal is to reduce the Fecal Coliform concentrations to levels that do not pose a health risk to swimming and wading and promote these recreational activities.

The river Fecal Coliform concentrations were characterized by calculating the geometric means of the samples gathered at 30 locations during the open water seasons of 1999 and 2001. The geometric means were calculated for each location for each month as well, and seasonal variations were also characterized by calculating the geometric means for the spring (April-May), the summer (June-August), and fall (September). Finally, geometric means were calculated for wet periods, defined by the samples collected during rainfall events, and dry periods defined as samples collected between rainfall events. The TMDL was based on the geometric mean of all the data collected, however.

The TMDL evaluation is a method of addressing and assessing the fecal coliform bacteria exceedences of the state standard. All waters of Minnesota are assigned classes, based on their suitability for the following beneficial uses:

a. Domestic consumption
b. Aquatic life and recreation

c. Industrial consumption
d. Agriculture and wildlife
e. Aesthetic enjoyment and navigation
f. Other uses
g. Limited resource value
h. The use classification assigned to the 303(d) South Branch impaired reach is Class 2B, 3B, 4A, 4B, 5 and 6 waters. The Minnesota Department of Natural Resources watershed and fisheries characteristics are shown in Table 3.1 below.

TABLE 3.1 WATERSHED AND FISHERY CHARACTERISTICS

MNDNR ID	Trib#M-55-146-42
AREA (ac)	36,582
RIVER LENGTH (mi)	37.9
DNR CLASSIFICATON	Agricultural; class 3 warm water feeder stream

The target Fecal Coliform concentration for this impaired reach was determined to be the water quality standard for class 1B, 2A, and 2C waters, or a monthly geometric means concentration of 200 organisms/100ml. A 10% margin of safety (MOS) was added as a part of a conservative goal effectively making the target concentration 180 organisms/100ml for the open water season April 1 – October 31.

3.2 Water Quality Goals

Allocation and Reductions Needed to Satisfy the TMDL

A "Bacteria Matrix" spreadsheet matrix approach[9] (Table 3.2) was used to simulate the existing loading contributions in two scenarios: 1) wet conditions; and 2) during spring, summer, and fall seasons. The contributions from each of seven sources are derived from Table 1.4. The "assumed shares" for each season and for each source contribution is calculated using the geometric mean fecal coliform concentration at all sites for spring (April-May), summer (June-August), and fall (September), as well as the average flows at site 1 for each season. The following combined 1999 and 2001 data sets were used in the calculations:

Month	Ave MGD	Geomean FC
April-May	257	75
June-Aug	54	364
Sept	7	85

[9] Spreadsheet Matrix Approach Memo from the MPCA to the EPA, 1999.

The total stream load is calculated as the product of flow and concentration (MGD*org/100ml). The contributions from each source are calculated as bacterial loads (organisms/day), and concentrations (organisms/100ml) by multiplying the total stream load by the percent shares.

Table 3.2: Source Contribution Matrix from Seasonal Loading Conditions for the South Branch TMDL Watershed

Bacteria TMDL process: South Branch TMDL Basin									
				Existing	Existing	Existing	Existing	Existing	Existing
	[assumed shares]			Loading	Concen.	Loading	Concen.	Loading	Concen.
	Spring	Summer	Fall	Spring	Spring	Summer	Summer	Fall	Fall
Sources:				(orgms/day)	(orgms/100mL)	(orgms/day)	(orgms/100mL)	(orgms/day)	(orgms/100mL)
Overgrazed Pasture	4%	4%	4%	2.84E+10	3	2.89E+10	14	9.30E+08	3
Feedlots/Stockpiles	18%	18%	18%	1.28E+11	13	1.30E+11	64	4.20E+09	15
Surface Applied Manure	63%	63%	63%	4.59E+11	47	4.69E+11	230	1.51E+10	54
Incorporated Manure	13%	13%	13%	9.16E+10	9	9.34E+10	46	3.00E+09	11
Failing Septic Systems	2%	2%	2%	1.45E+10	2	1.48E+10	7	4.77E+08	2
Wildlife**	0.3%	0.3%	0.3%	2.18E+09	0	2.22E+09	1	7.15E+07	0
Pets	0.4%	0.4%	0.4%	2.91E+09	0	2.97E+09	1	9.54E+07	0
	100.00%	100.00%	100.00%						
Total #s=				7.27E+11		7.41E+11		2.38E+10	
"Concentration"=	75	364	85	75	75	364	364	85	85
Flow(mgd)=				257		54		7	
WQ Goal =				180		180		180	
WQG #s=				1.74E+12		3.67E+11		5.05E+10	
** background; assume no reduction									
TMDL Standard	200								
Margin of Safety	20								

The source contributions are shown in blue, and the flow and fecal coliform concentrations are shown in green. The water quality goal of 180 organisms per 100 milliliters is shown in the lower left corner and is based on a 10% margin of safety[10].

The simulation indicates that the TMDL water quality goal of 180 organisms/100ml is satisfied in the spring and fall, but fails to meet the standard during the summer season. The model shows that the vast majority of the bacterial loading to the stream is from the manure application and feedlots. Urban, point, and wildlife bacterial loads are insignificant in comparison.

Table 3.3 illustrates a simulation showing the existing loading contributions during wet and dry conditions. The contributions from each of the seven sources are derived from Table 1.4. The wet and dry fecal coliform concentrations are calculated using the geometric mean fecal coliform concentration of all sites and all years. The "wet" fecal coliform concentration is the average of samples collected during storm events, and the "dry" concentration is the average of samples collected between storm events. The average flows (MGD, million gallons per day) are calculated for the same "wet" and "dry" conditions at site 1. The flows during wet conditions are nearly double the dry, but the concentrations are over eight times larger during wet conditions; the dry concentrations are about half the water quality goal of 180 org/100ml.

[10] See section 6.1 Method of Calculation Margin of Safety.

Table 3.3 Source Contribution Matrix from Wet and Dry Loading Conditions for the South Branch TMDL Watershed

Bacteria TMDL process: South Branch TMDL Basin						
	Wet	Dry	Existing Loading Wet	Existing Concen. Wet	Existing Loading Dry	Existing Concen. Dry
Sources:	[assumed shares]		(orgms/day)	(orgms/100mL)	(orgms/day)	(orgms/100mL)
Overgrazed Pasture	4%	32%	1.69E+11	31	9.82E+10	30
Feedlots/Stockpiles	18%	63%	7.64E+11	140	1.96E+11	60
Surface Applied Manure	63%	0%	2.74E+12	502	0.00E+00	0
Incorporated Manure	13%	0%	5.47E+11	100	0.00E+00	0
Failing Septic Systems	2%	66%	8.68E+10	16	2.03E+11	62
Wildlife**	0.3%	3%	1.30E+10	2	8.36E+09	3
Pets	0.4%	0.0%	1.74E+10	3	0.00E+00	0
	100%	100%				
Total #s=			4.34E+12		3.10E+11	
"Concentration"=	794	95	794	794	95	155
Flow(mgd)=			145		86	
WQ Goal =			180		180	
WQG #s=			9.84E+11		5.87E+11	
** background; assume no reduction						
TMDL Standard	200					
Margin of Safety	20					
Water Quality Goal	180					

Table 3.4 shows stream fecal coliform concentrations as a function of equivalent reductions from each source. The assumed reductions would be 78% inhibition of fecal coliform delivery to the stream from each source, and are shown as allocations (1-% reduction). The resulting "wet" stream concentration would be 176 organisms/100ml and would meet the water quality goal.

Table 3.4 Percent Reductions from Current Fecal Coliform Bacteria Load Necessary to Meet Total Maximum Daily Load Allocation for the South Branch Watershed; All Sources Reduced Equally

			All sources reduce equally				
	Wet	Dry	RS1 Wet	RS1 Wet	RS1 Dry	RS1 Dry	Reduction GOALS
Sources:	[assumed shares]		x	Concen.	x	Concen.	(1-x)
Overgrazed Pasture	4%	32%	22%	7	20%	6	78%
Feedlots/Stockpiles	18%	63%	22%	31	100%	60	78%
Surface Applied Manure	63%	0%	22%	110	20%	0	78%
Incorporated Manure	13%	0%	22%	22	100%	0	78%
Failing Septic Systems	2%	66%	22%	3	20%	12	78%
Wildlife**	0.3%	3%	100%	2	100%	3	0%
Pets	0.4%	0.0%	22%	1	100%	0	78%
	100%	100%					
			Conc	177		81	
			goal	180		180	
			WQG	200		200	

3.3 Fecal Coliform Source Reductions Needed

These spreadsheet models indicate that, based on 1999-2001 fecal coliform concentrations and average flow conditions for the South Branch TMDL watershed, the daily fecal coliform loads are **Summer: 7.41 x 10^{11}.** To meet water quality goals the allowable daily fecal coliform loads in the watershed are **Summer: 3.67 x 10^{11}.**

In terms of wet and dry conditions, as defined above, the fecal coliform loads are **Wet: 4.34 x 10^{12}.** To meet water quality goals the allowable daily fecal coliform loads in the watershed are **Wet: 9.84 x 10^{11}**.

From a seasonal point of view, a 51% reduction is required to bring the summer fecal concentrations to the water quality goal, and from a wet and dry condition point of view, a 78% reduction is required to meet the WQG during wet conditions. Therefore, the wet condition spreadsheet matrix represents a conservative approach allowing for an added margin of safety.

4.0 Implementation Management Measures

Overview
In this section ten management measures are described that will be employed during the implementation plan to reach the goal of 78% source reductions of fecal coliform bacteria. Each management measure includes an estimate of the time and additional resources needed to achieve this goal.

The following implementation strategies are referenced in the South Branch Fecal Coliform TMDL and are of two major types: 1) Those that are built upon the foundation of state rules and county-delegated programs (feedlots, manure management, ISTS, stormwater, wastewater, and biosolids) and, 2) Those that are strictly voluntary such as the promotion of buffers, rotational grazing, and conservation tillage. In the case of the voluntary implementation strategies, Yellow Medicine Watershed District will work with local resources for technical and financial assistance and will be based on collaboration between local landowners, the YMRWD staff, and agencies in the technical committee.

The YMRWD feels that the local residents need to know where we are now and where we hope to be in the future. We feel that they (the residents) need to know what can be accomplished with the knowledge that has been gathered, and can be used to prioritize and make effective decisions. These priorities will be based on the impact to the local environment, residents and local economy. Our intentions are to incorporate the knowledge and expertise of local agencies in pulling together to accomplish the objectives which are beneficial to everyone. Education of the local residents is considered to be the beginning step to make sure that everyone realizes the importance of their contribution to either the problem or the solution. To do so we have to present the public with the data which has been gathered to give them the complete picture of what is here now and what we hope will be the end result. With the knowledge that we have, the job of promoting water quality and quantity concepts will be an easier task.

Experience has taught us that residents are concerned for the environment not only for themselves but also for other residents and future generations. We are taking into consideration the financial burdens of the local residents but also the burdens of the overall cost to taxpayers. With the data gathered we are also going to incorporate all local, regional, state and federal agencies into the program. By utilizing existing programs, providing incentive money, and extending the time and benefits of these programs we will be able to realize greater improvements. By funding projects on the land we will be able to realize quicker results and reach the projected goals. In accomplishing this, the end result will be a unified effort benefiting the land owners, the residents who live on the land, and the residents who use the land and resources.

Approach

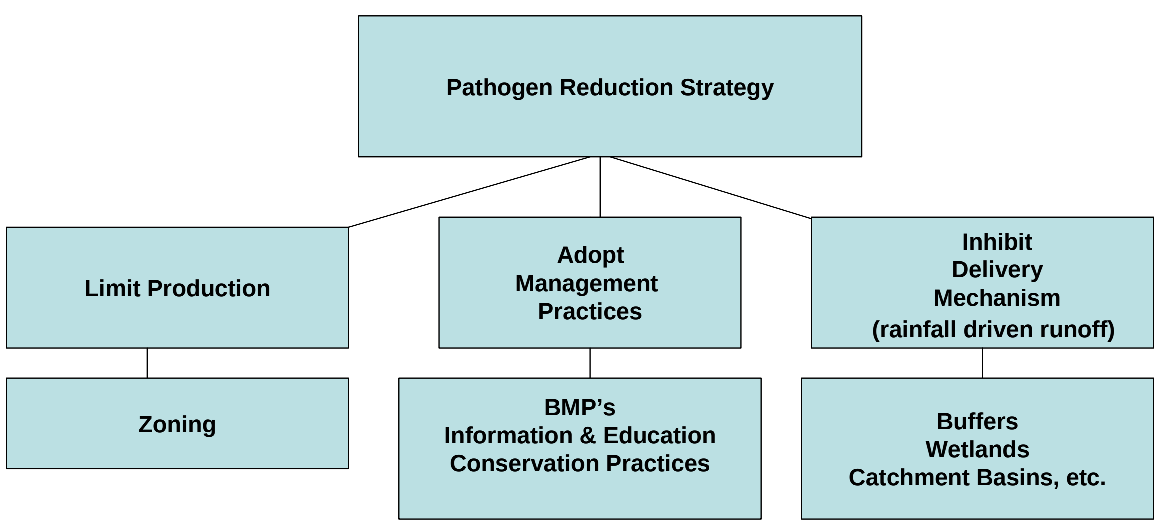
The goals of any water quality project should be based on practical considerations. Two important considerations are the potential for improvement for the specific watershed and how feasible the implementation is. An agricultural watershed is never going to be as pristine as a low population forest and realistic goals should reflect the constraints of the local economy and subsequent land use practices. The implementation controls have to be contiguous with the local culture, in that a certain degree of local “buy in” is necessary for the general success of the project.

The project staff, partners, and technical committee feel that the goals are realistic and obtainable, and that the initial success of the implementation plan is crucial to the long-term management of watershed water quality. The availability of programs, funding, local technical expertise and experience, and public acceptance are considered optimal with the project goals and strategies. Incentives were considered by the group to stimulate public interest in the plan and create the initial catalyst and sustained momentum for the project.

The basic approach to meeting the water quality goals is three fold: 1) limit and control the amount of production of Fecal Coliform and the location of the production facilities; 2) adopt effective management practices to properly handle fecal materials that are produced; and 3) provide barriers between the fecal loading sources and the streams. Local Zoning and planning will be the central tool to control the amount and location of production facilities and the management techniques to properly handle and control fecal material will be largely in the form of education and the implementation of regulatory criteria and BMP’s. The final barriers will be mostly in the form of buffers and catchments.

Figure 4.1

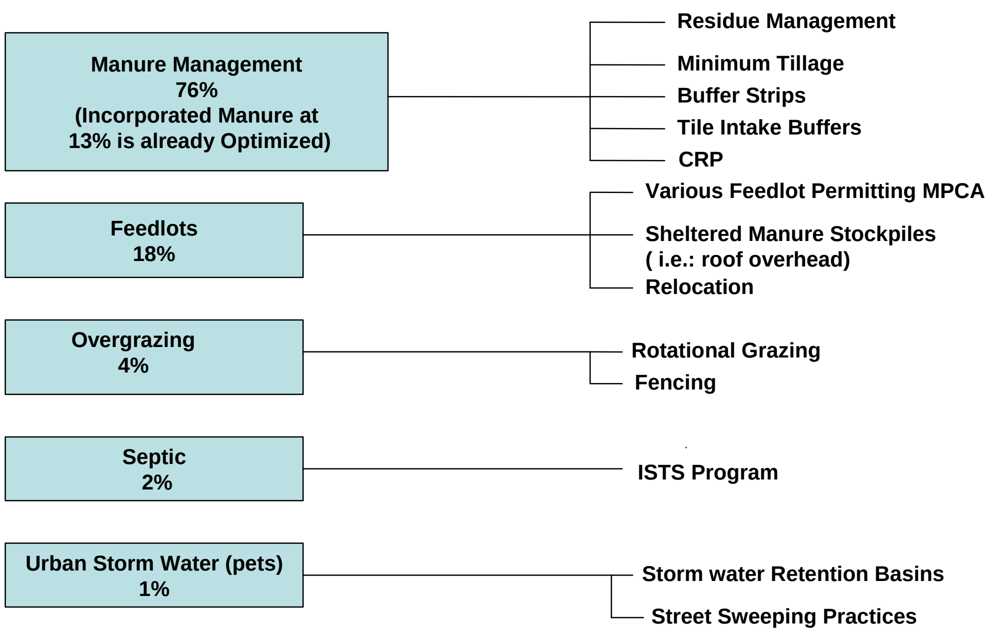
South Branch Yellow Medicine River Implementation Overview



The implementation strategies that will be employed for each of the contributing sources outlined in Table 1.2 are shown below in Figure 4.2. The schemata is intended as an outline of the initial strategy for implementation, and will undoubtedly be altered based on the performance data gathered as the implementation phase proceeds.

Figure 4.2

South Branch Yellow Medicine River Implementation Strategies

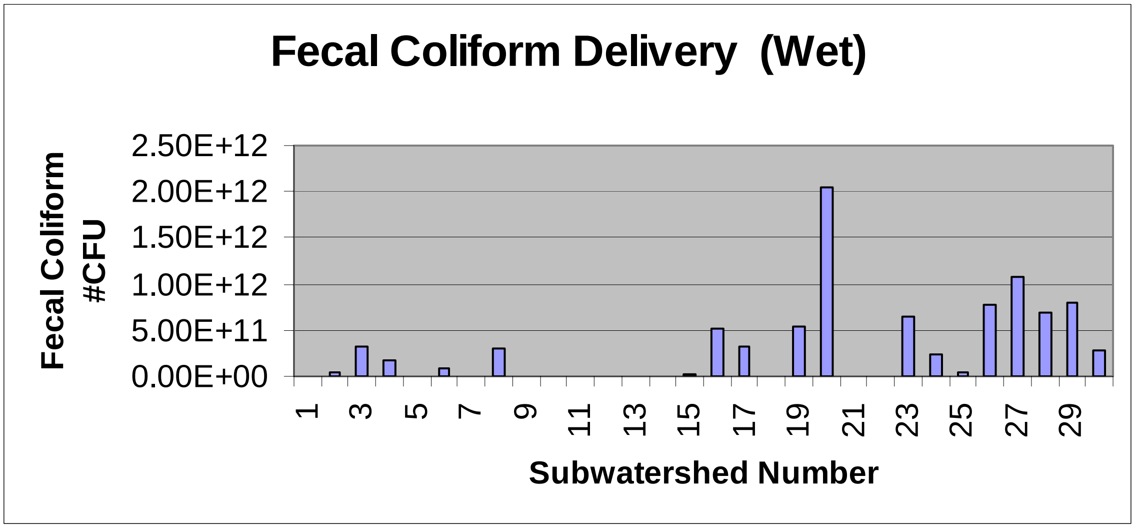


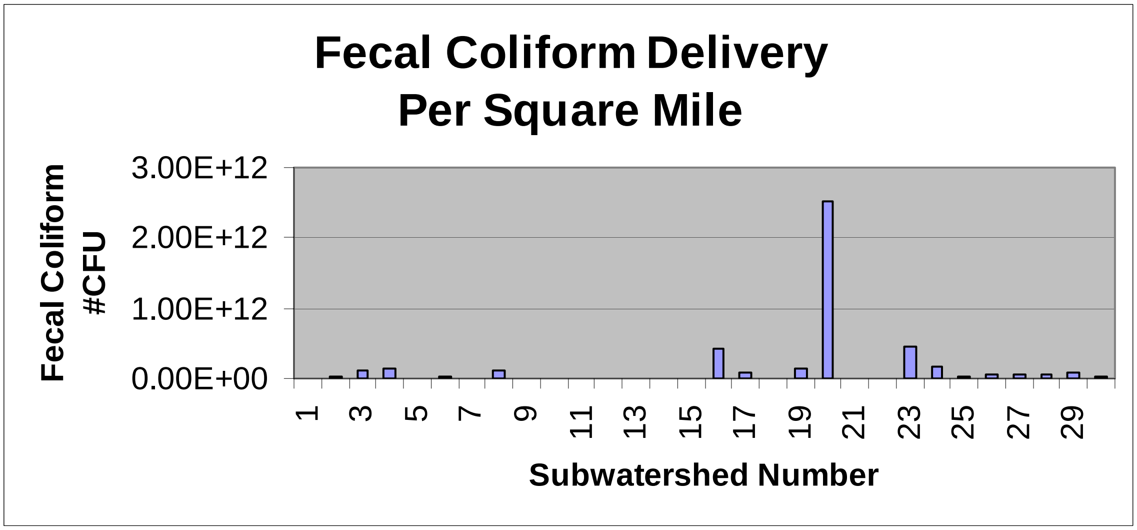
4.1 Priority Areas for All Management Measures

Implementation of all strategies will occur in prioritized succession. The initial focus will be based on the proximity of the loading sources to the river and tributaries and the relative magnitude of each source. Additional priorities include any known locations of grazing areas and portions of the river that cattle have access to, as well as known failing manure lagoons and septic systems. Other considerations include the relatively unknown performance of conservation practices on fecal coliform inhibition, either individually or in coordination with a combination of practices. Much is unknown in terms of the level of management techniques required to meet the fecal coliform water quality goals. For this reason, it would be effective to prioritize implementation on a sub watershed basis beginning with a sub watershed located on one of the headwaters of the river or tributaries. This would allow for the isolation of the sub watershed and subsequent implementation. Sampling analysis would reveal the performance of the conservation practices installed.

Figures 4.3 and 4.4 below illustrate the sub watershed fecal coliform loading based on the linkage analysis methodology outlined in Tables 1.1 – 1.4. The figures below show the total numbers of fecal coliform delivered per sub watershed and loading normalized as fecal coliform per unit area (CFU/mi^2). Sub watershed 20 is clearly the largest loading source in terms of magnitude and loading per unit area. Sub watershed 20 is also located at source of a tributary of the South Branch watershed, and will be a priority focus of the initial implementation.

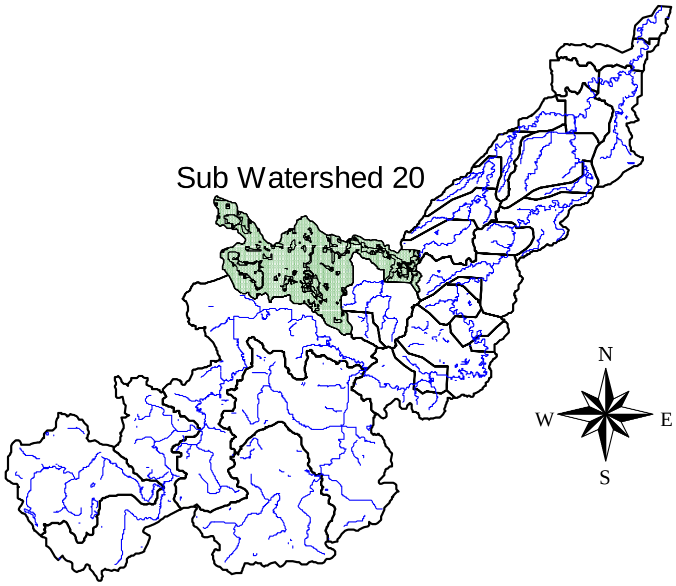
Figure 4.3 – 4.4 Priority Sub Watersheds





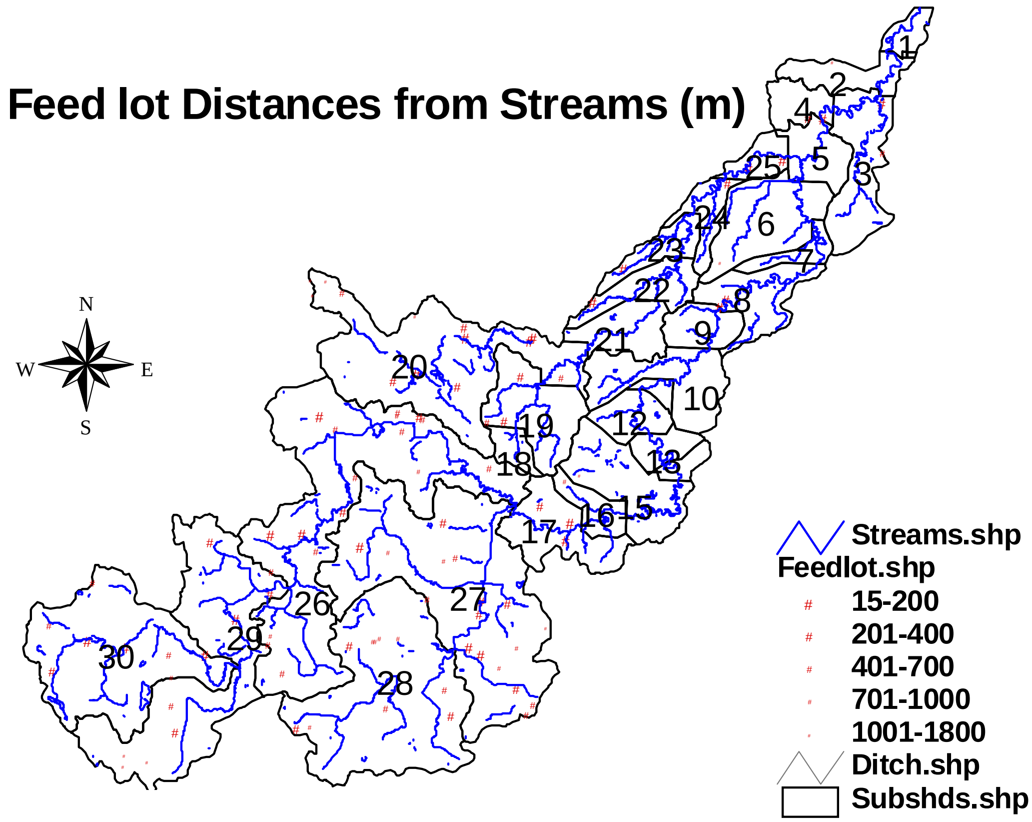
The implementation plan will focus on the feedlots and septic systems within 100 meters of the streams initially. Feedlot and septics more distant will be addressed in subsequent years in a progressive manner moving further from the streams. Similar sequences will be used for tillage and nutrient management as well as surface drain tiles. Intense grazing areas and portions of the stream with animal access will be located by observation and prioritized base on severity and number of animals. Stream buffers will be targeted at priority locations based on the severity of the pollution sources in a given stream reach.

Figure 4.5 Priority Sub Watershed 20



Intensive monitoring will follow each significant level of implementation to document the performance of the control measures put in place. Hopefully, with local acceptance by the landowners, sufficient Fecal Coliform control measures will be implemented throughout the South Branch TMDL watershed wide and especially within sub watershed 20 to determine the effectiveness of the control measures, and project the ultimate success of the plan within the 15 year time frame. Alternatively, if the control measures implemented prove ineffective or show limited performance, new or innovative measures for Fecal Coliform control will need to be evaluated and implemented to keep the plan on course with the water quality goals.

Figure 4.6 Feed Lot Distances from Streams



4.2 Description of Implementation Practices

4.2.1 Management Measures

Managed Rotational Grazing- Overgrazed pastures, allowing cattle unrestricted access to streams, and the reduction of pastureland are practices that contribute greatly to fecal coliform loading. Rotational grazing allows cropped pasture grasses to grow again and, as a result, reduces surface runoff and increases incorporation of water and nutrients into the soil.

Well-managed rotational grazing is both economically feasible and environmentally friendly. Rotational grazing as opposed to conventional grazing significantly reduces both sedimentation and fecal coliform concentrations in water downstream.

Rotational grazing is a somewhat unfamiliar farming practice than those normally employed in the South Branch watershed, and farmers will need education and technical assistance to implement this method. Components of a rotational grazing plan are as follows:

- Pasture Forage Plant Identification

- Fencing for Livestock
- Livestock Watering Systems
- Planning Rotational Grazing Systems
- Strategies for Maximizing Forage Production
- Pasture Monitoring
- Sensitive Areas Identification and Management

Riparian Buffers will be placed in priority areas which were deemed appropriate and/or existing buffers will be increased. Cattle and other livestock will be restricted from streams and fenced in wherever possible. Cattle and other livestock will have to be watered by other means if they are kept out of the streams by fences and the riparian buffers will have to be maintained by spraying to prevent interference with crops. Riparian buffers should reduce runoff proportional to their size and strategic placement. Riparian Buffers and Rotational Grazing have available funding through the NRCS Environmental Quality Incentives Program or EQIP. Additional funding may be needed to supplement EQIP grants in some targeted areas.

4.3 Feedlots or Manure Stockpiles without Runoff Controls

4.3.1 Management Measures

Feedlots are a significant source of fecal coliform bacterial loading during the wet season or summer. According to table 1.4, the estimated loading of fecal coliform during the summer months in the South Branch of the Yellow Medicine River for both point and non-point sources is 18 percent. According to the newly revised state feedlot rules through the Open Lot Agreement, feedlots of 300 animal units or less can come into compliance in two phases: 1) reduce feedlot runoff by 50 percent through the use of a standard set of water diversions and filters (roof gutters, clean water diversions, picket fences and grassed buffers), by October 2005; and 2) achieve full compliance with state feedlot rules by October 2010.

In order for farm operators to comply with these standards outlined in the Open Lot Agreement they will need both funding (cost share) and technical assistance. Both cost-share funding and technical assistance will be coordinated through the Yellow Medicine River Conservation District.

<u>Inspection and Enforcement</u>: Strategies of the implementation plan calls for determining priorities for feedlot inspection, assistance and enforcement. The following steps are appropriate to achieve reduced loadings of fecal coliform bacteria from feedlots:

- Identify priority areas.

- Prioritization of feedlots by proximity to the stream and secondly by magnitude of the loading source.

- Identify and coordinate funding sources for fixing feedlot pollution hazards in priority areas through watershed management.

- Perform a financial needs analysis in order to implement these management strategies, an analysis of financial need for the farmers who participate in the Open Lot Agreement must be done for both new participants and those that want to expand existing programs.

The feedlots that fall under the Open Lot Agreement are most likely contributing a significant portion of the feed lot contribution. The majority of feedlots fall into this category so the Open Lot Agreement will be the main program in which noncompliant feedlots will be addressed. The majority of feedlots in the category of 300-999 animal units or less are allowed to discharge limited pollution following rainfall events. The feedlots of the size 1000 animal units or greater are required to obtain permits for zero discharge through the National Pollution Discharge Elimination System (NPDES) program. These provisions are considered adequate to achieve a 78% reduction in fecal coliform bacteria loading from feedlots. Incentives will be used to place effective controls for critical feed lots that are currently in compliance, but are significant loading sources.

4.4 Manure Management

Land application of manure studies have shown that buffer strips, immediate incorporation and maintenance of surface residue have been demonstrated to reduce manure and pathogen runoff. The new state feedlot rules (Minn. R. ch. 7020) requires keeping records of manure application and management planning. These records will be used extensively to determine priorities for implementing controls. For any feedlots requiring a permit, the new feedlot rules require that manure management plans be developed. These include feedlots in the following categories:

- Feedlots with more than 300 animal units planning new construction or expansion;
- Feedlots where there is a pollution hazard not corrected by the Open Lot Agreement;
- The feedlot has been designated a CAFO or more than 1000 animal units or direct man-made conveyance to waters;
- Feedlots that have more than 300 animal units and is applying manure in sensitive areas, including: a) soil P levels exceeding 120/150 ppm Olsen/Bray, or half of those values within 300 feet of public waters; b) vulnerable drinking water supply management areas; or c) slopes exceeding 6 percent within 300 feet of waters.
- Feedlot has 300 to 1000 animal units and is not hiring a certified manure applicator.

Developing manure management plans for these feedlots should result in a significant portion of the total Fecal Coliform delivery to the streams within the South Branch TMDL watershed. Based on production inventories and soil application areas and methods, manure handling is considered the largest source contributor to stream Fecal Coliform concentrations. Fecal coliform loading reduction practices will be encouraged for manure management plans within the South Branch of the Yellow Medicine River project area and may be required by CAFO's. The MPCA is required to do annual inspections of all those with NPDES permits. Inspections of manure application records and manure management plans are included in MPCA inspections. Inspections for feedlots with 300 to 999 animal units, with interim permits or construction permits, fall under the responsibility of the respective counties of Lincoln and Lyon. To ensure the adoption of manure management plans by farmers, the YMRWD will seek funding for incentives and technical support.

Some of the following strategies may be used to accelerate the development and use of manure management plans in the South Branch YMR:

- Promote Buffer Strips within the South Branch for the Yellow Medicine River watershed using incentives.
- Lincoln and Lyon county and their SWCD's will participate in the project to increase the amount of land set aside for riparian buffers in permanent vegetation.
- Promote incorporation of manure in every application throughout the entire TMDL area with incentives.
- Define setback requirements for special areas and use incentives for local acceptance.
- Implement County specific requirements that go beyond state rules (Minnesota Rule chapter 7020.2225, subp.4-8)
- Institute an intensive information and education program.

Manure composting will be encouraged in the information and education program. There are several environmental advantages to composting manure. Advantages include: 1) the destruction of pathogens, 2) the conversion of manure to dry material (Manure is spread uniformly as a fertilizer and its nutrient content remains intact. It also reduces the risk of over-applying nutrients.), and, 3) When combined with the separation of liquids and solids, composting reduces the amount of storage needed. With education, technical support and financial assistance manure composting can significantly reduce manure runoff. This strategy can be cost effective with larger facilities where fixed costs can be spread over larger production in watersheds where fecal coli form impairment is high.

Conservation tillage is another cost-effective management practice that can significantly reduce fecal coliform bacterial loading in the SBYMR. A balance between immediate incorporation of fecal matter as fertilizer into the soil and the need for surface residue cover for erosion control must be weighed however. The University of Minnesota published a document entitled: "Tillage Best Management Practices for Water Quality

Protection in Southeastern Minnesota." This publication can be used in both promoting conservation tillage and determining the BMP in this implementation phase of the TMDL.

4.5 Septic System Management

4.5.1 Management Measures

Individual Sewage Treatment Systems or ISTS with proper drain fields provide nearly complete treatment of fecal coliform bacteria. Acceptable designs are described in Minn. R. ch.7080. Both Lincoln and Lyon counties in the SBYMR TMDL are responsible to enforce these rules that come into play with transfer of ownership of property and when new construction occurs. Failing and non-compliant septic systems are only 2% of the fecal coliform load to the SBYMR during wet conditions, but represent 66% of the load during the periods between storms. Implementation with incentives will be provided to address this source. Properly functioning ISTS and the Municipal Wastewater Treatment Facility provide nearly complete control of fecal coliform bacteria from these sources. Fecal coliform loading from these sources can be reduced in proportion to the faulty ISTS that are fixed.

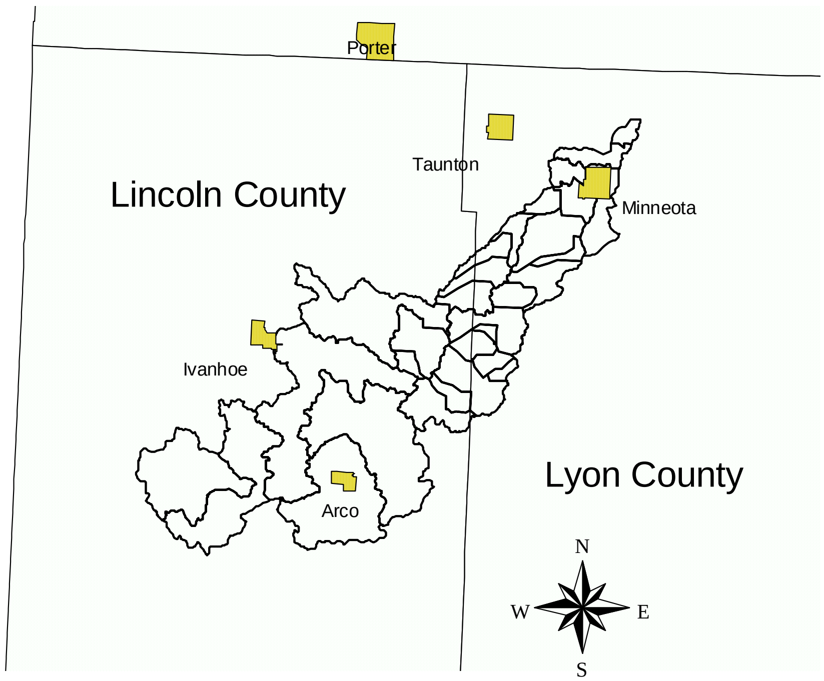
Critical areas for implementation of this strategy are given priority based on potential results in reducing fecal coliform loading and the potential for high delivery of pollutants. The priority in the SBYMR reach will be proximity to the streams. Additional priority will include systems that pose an imminent public health threat, and ISTS with a direct discharge to surface water where little or no treatment is provided. These include direct discharges to ditches and failing systems that discharge directly to surface water.

4.6 Urban Storm Water Runoff and Municipal Sewage Control

4.6.1 Management Measures

Urban storm discharges can be addressed by runoff detention (ponds), infiltration, and street sweeping to reduce urban runoff and resulting pollutants. Under the Clean Water Act Phase II Stormwater Program, communities in Lincoln and Lyon counties whose stormwater runoff empty into the South Branch of the Yellow Medicine River may be required to obtain a Municipal Separate Stormwater System (MS-4). There are only two municipal wastewater treatment facilities in the South Branch Yellow Medicine River TMDL, fecal coliform bacterial loadings are well controlled and negligible from this source; the counties in the SBYMR reach each have one city. Continued monitoring of these facilities will be conducted. However, priority in the implementation phase will be given to the rural areas of land surrounding the SBYMR.

Figure 4.6 Municipalities within the TMDL



4.7 Stream Buffer Initiative

This conservation practice is thought to be the best control in the TMDL implementation strategy. Stream buffers will be the last barrier to the stream when the limiting production and manure management techniques fail. High priority stream reaches will be targeted based on severity of the fecal coliform loading source and where fields that apply manure are near the water or have steep gradients to the river and tributary streams. Applications have been made to CREP and buffers have been put in place with the CWP Implementation phase; however, new applications will be made for financial assistance to the second phase of CREP or CREP II to increase existing buffers and/or create new buffers in these sensitive areas. The YMRWD will offer incentives in addition to CREP programs and negotiate perpetual agreements with a minimum distance of 200 feet width.

The South Branch TMDL linkage analysis has shown that only 0.32% of the total watershed fecal coliform production is necessary to drive all of the 30 monitoring sites to exceed the TMDL impairment level during wet periods. Current manure handing techniques are most likely incapable of containing 100% of all the manure production all of the time. For this reason, buffers are thought to be the most effective implementation tool to meet the water quality goal.

4.8 Implementation Monitoring and Evaluation

Evaluating the progress of the implementation activities will involve monitoring the river flows and fecal coliform concentrations, and tracking the implementation spatially through ArcView software. Flow weighted mean concentrations and annual loads will be calculated as a performance measure. An less intense monitoring schedule will be followed during the initial 4 years with the emphasis focus on implementation, A more intense monitoring protocol will be employed on the 5th year of implementation to determine the performance of the implementation progress especially in sub watershed 20. Miscellaneous sampling is added to sampling design to allow for site specific sampling to isolate specific implementation activities, or to respond to unusual data results. The monitoring locations, schedule, and costs for the 2006-2011 seasons are shown in Tables 4.1-4.5, below. The five year schedule will be repeated in 2012-2016 and in 2017-2021.

The project manager and the project technician will be responsible for the set up and maintenance of two hydrologic monitoring sites representing the upstream sub watersheds and outflow of the South Branch Yellow Medicine River near the city of Minneota.

The leadership of the implementation will be sponsored by the Yellow Medicine Watershed District Managers. They will have the responsibility to direct the staff consisting of project manager and project technician. This will be accomplished informally in daily interaction with the project elements and formally with monthly watershed district board meetings to keep current on progress. The YMRWD managers will also conduct quarterly meetings with the Technical Committee, which will consist of representatives from the two Soil and Water Conservation Districts, Water Planners, Natural Conservation Service, Board of Water and Soil Resources, Department of Natural Resources, and the Minnesota Pollution Control Agency. The Technical Committee will advise the Managers on technical matters and priorities concerning implementation and monitoring progress.

BMP Operation and Maintenance Plan:

The project has several levels of maintenance. The Basin levels will be maintained by the landowner because they are the secondary benefactors. Waterways will also be maintained the same way. Filter strips will have easements on them and will be randomly checked. Nutrient management will be an education element which we feel will expand if not from neighbor to neighbor then for the next generations. CREP will have the federal requirements for the life of the program. ISTS will be permanent as they will be installed according to specifications. Additional short and long term maintenance activities will be the responsibility of the YMRWD.

All implementation activities will be tracked through GIS mapping and GPS locating technologies. The performance of downstream water quality will be traced to specific implementation activities as the sampling resolution and modeling techniques will allow. A specific emphasis will be on sub watershed 20 and these cause-effect relationships and projected to the entire TMDL water shed in an effort to forecast the ultimate success of the project relative to the water quality goal.

QUALITY ASSURANCE: The Yellow Medicine River Watershed District and the technical committee will assure the quality of all management practices by adhering to all state and federal rules and guidelines for ISTS, feedlots, municipal wastewater treatment systems, manure management plans, storm water management plans, rotational grazing systems, livestock exclusion systems, and riparian buffer strips. The University of Minnesota has the guidelines for conservation tillage.

Inspection and enforcement of management measures put in place are important. The South Branch Yellow Medicine River Implementation will include measures to ensure that the environmental strategies put in place are effective in reducing fecal coliform bacterial loading in the South Branch of the Yellow Medicine River.

Table 4.1 Sampling Sites

Site Description and sampling series 2006-2011

Average: Samples/Round/Station

Station Description	Site #	Trib 100	Trib 101	Event 300
Site 1	1	1		1
Site 2	2		1	
Site 3	3		1	
Site 4	4		1	
Site 5	5	1		1
Site 6	6	1		1
Site 7	7		1	
Site 8	8		1	
Site 9	9		1	
Site 10	10		1	
Site 11	11		1	
Site 12	12		1	
Site 13	13		1	
Site 14	14		1	
Site 15	15		1	
Site 16	16		1	
Site 17	17		1	
Site 18	18		1	
Site 19	19		1	
Site 20	20	1		1
Site 21	21		1	
Site 22	22		1	
Site 23	23		1	
Site 24	24		1	
Site 25	25	1		1
Site 26	26	1		1
Site 27	27	1		1
Site 28	28		1	
Site 29	29		1	
Site 30	30			
Misc		1	1	1
Total Stations		8	23	8
Total Samples/Round		8	23	8

Trib 100: High Priority Sites
Trib 101: Low Priority Sites
Event 300: Storm Events

Table 4.2 2006-2010 Sampling Schedule

Sampling Schedule 2006-2010

Week Starting Monday	Trib 100	Trib 101	Event 300
		Sample Series	
Snow Melt	1	1	
			***note: try to collect 6 storm events**
Apr-7	1		
Apr-14			
Apr-21	1	1	
Apr-28			
May-5	1		
May-12			
May-19	1	1	
May-26			
Jun-2	1		
June-9			
Jun-16	1	1	
Jun-23			
Jun-30	1		
Jul-7			
Jul-14	1	1	
Jul-21			
Jul-28	1		
Aug-4			
Aug-11	1	1	
Aug-18			
Aug-25	1		
Sep-1			
Sep-8	1		
Sep-15			
Sep-22	1	1	
Sep-29			
Oct-06	1		
Oct-14			
Oct-21	1		
Oct-28			
Total Rounds	**16**	**7**	**6**

Table 4.3 2011 Sampling Schedule

Sampling Schedule 2011

Week Starting Monday	Trib 100	Trib 101	Event 300
			Sample Series
Snow Melt	1	1	
			*note: try to
Apr-1	1	1	collect 10 storm
Apr-7	1	1	events at all
Apr-14	1	1	stations
Apr-21	1	1	
Apr-28	1	1	
May-6	1	1	
May-13	1	1	
May-20	1	1	
May-27	1	1	
Jun-3	1	1	
June-10	1	1	
Jun-17	1	1	
Jun-24	1	1	
Jul-1	1	1	
Jul-7	1	1	
Jul-14	1	1	
Jul-21	1	1	
Jul-28	1	1	
Aug-5	1	1	
Aug-12	1	1	
Aug-19	1	1	
Aug-26	1	1	
Sep-2	1	1	
Sep-9	1	1	
Sep-16	1	1	
Sep-23	1	1	
Total Rounds	**27**	**27**	**10**

Table 4.4 2006-2010 Laboratory Costs

2006-2010 Sampling Seasons
Chemical Analyses and Costs by Sample Series

Sample series	Trib 100	Trib 101	Event 300	Unit Cost
stations	8	23	8	
samples/round	8	23	8	
rounds	16	7	6	
total samples	128	161	48	
Analyses				
total P				$17.60
soluble P				$17.60
no23-N				$12.00
nh34-N				$12.00
tkn				$17.60
conductivity				$3.47
alkalinity				$4.73
pH				$1.16
Turbidity				$10.50
TVS				$12.60
TSS				$12.00
sulfate				$10.50
iron				$10.50
manganese				$10.50
silica				$15.75
Chlorides				$6.93
Secchi Disk				$0.00
Temperature				$0.00
Dissolved Oxygen				$0.00
Chlorophyll A				$17.33
Phytoplankton				$26.25
Fecal Coliform	1	1	1	$15.00
cost/sample	$15.00	$15.00	$15.00	TOTAL
cost/series	$1,920	$2,415	$720	$5,055
percent of total	38.0	47.8	14.2	100.0

Table 4.5 2011 Laboratory Costs

2011 Sampling Season
Chemical Analyses and Costs by Sample Series

Sample series	Trib 100	Trib 101	Event 300	
stations	8	23	30	
samples/round	8	23	30	
rounds	27	27	10	
total samples	216	621	300	
Analyses				**Unit Cost**
total P				$17.60
soluble P				$17.60
no23-N				$12.00
nh34-N				$12.00
tkn				$17.60
conductivity				$3.47
alkalinity				$4.73
pH				$1.16
Turbidity				$10.50
TVS				$12.60
TSS				$12.00
sulfate				$10.50
iron				$10.50
manganese				$10.50
silica				$15.75
Chlorides				$6.93
Secchi Disk				$0.00
Temperature				$0.00
Dissolved Oxygen				$0.00
Chlorophyll A				$17.33
Phytoplankton				$26.25
Fecal Coliform	1	1	1	$15.00
cost/sample	$15.00	$15.00	$15.00	TOTAL
cost/series	$3,240	$9,315	$4,500	$17,055
percent of total	19.0	54.6	26.4	100.0

5 Year Total	**$37,275**

5.0 Budget

The incentives outlined in section 4.9 are shown in Table 5.1 below. Table 5.2 accounts for the stream lengths, cultivated acres, feedlot counts, and ISTS counts for the South Branch TMDL watershed on an individual sub watershed basis.

Table 5.1

Control Measure	YMRWD Incentive	Unit	FC removal
Feedlot Runoff Reduction	$10,000	Feedlot	90%
Stream Buffer	$200	Acre	50%
Replace Open intakes w/ Blind intakes	$500	Intake	50%
Minimum Tillage	$14	Acre	25%
Nutrient Management (incorporation)	$14	Acre	90%
ISTS Upgrades	$3,000	ISTS	90%
Conservation Reserve Program	$100	Acre	50%
Fencing	$1	Feet	100%
Rotational Grazing	$20	Acre	50%

Table 5.2

South Branch TMDL Implementation Plan Costs

Subshed	Area Acres	Stream & Ditch ft	Stream Buffer Cost	Cultivated Acres	Minimum Tillage Cost	Nutrient Mgmt Cost	Feedlot #	Feedlot Cost	ISTS #	ISTS Cost
1	500	5383	$9,886	493	$6,907	$6,907	0	$0	8	$24,000
2	1137	12233	$22,466	1080	$15,123	$15,123	1	$10,000	1	$3,000
3	2048	22031	$40,462	1925	$26,950	$26,950	2	$20,000	10	$30,000
4	838	9016	$16,557	771	$10,793	$10,793	2	$20,000	6	$18,000
5	1032	11104	$20,394	988	$13,829	$13,829	0	$0	6	$18,000
6	2616	28142	$51,683	2563	$35,889	$35,889	1	$10,000	6	$18,000
7	575	6189	$11,367	572	$8,014	$8,014	0	$0	4	$12,000
8	1746	18786	$34,501	1692	$23,689	$23,689	2	$20,000	10	$30,000
9	994	10699	$19,649	991	$13,881	$13,881	0	$0	3	$9,000
10	2334	25108	$46,111	2278	$31,888	$31,888	0	$0	6	$18,000
11	238	2562	$4,705	237	$3,324	$3,324	0	$0	1	$3,000
12	969	10426	$19,148	963	$13,486	$13,486	0	$0	2	$6,000
13	649	6978	$12,815	298	$4,177	$4,177	0	$0	2	$6,000
14	352	3784	$6,950	271	$3,792	$3,792	0	$0	2	$6,000
15	2476	26633	$48,914	2451	$34,312	$34,312	1	$10,000	4	$12,000
16	808	5922	$10,876	806	$11,286	$11,286	1	$10,000	2	$6,000
17	2097	6862	$12,602	2082	$29,147	$29,147	3	$30,000	10	$30,000
18	494	2067	$3,796	493	$6,896	$6,896	0	$0	1	$3,000
19	2338	9466	$17,385	2331	$32,637	$32,637	3	$30,000	5	$15,000
20	516	24062	$44,191	465	$6,506	$6,506	13	$130,000	20	$60,000
21	1358	4850	$8,907	1354	$18,956	$18,956	0	$0	2	$6,000
22	1252	9793	$17,985	1250	$17,494	$17,494	1	$10,000	7	$21,000
23	896	9212	$16,918	895	$12,524	$12,524	1	$10,000	2	$6,000
24	826	8099	$14,874	806	$11,282	$11,282	1	$10,000	7	$21,000
25	685	4560	$8,375	677	$9,479	$9,479	2	$20,000	3	$9,000
26	10723	40583	$74,533	10721	$150,089	$150,089	18	$180,000	29	$87,000
27	10010	34171	$62,757	10000	$139,994	$139,994	17	$170,000	23	$69,000
28	6896	24109	$44,277	6895	$96,532	$96,532	11	$110,000	20	$60,000
29	6277	17607	$32,336	6275	$87,856	$87,856	9	$90,000	20	$60,000
30	7944	17521	$32,178	7936	$111,110	$111,110	7	$70,000	13	$39,000
Totals	**71624**	**417958**	**$767,599**	**70560**	**$987,840**	**$987,840**	**96**	**$960,000**	**235**	**$705,000**

Total Cos $4,408,280

The stream lengths, land use areas, and septic and feed lot information was delineated using GIS mapping techniques. The extent of surface drain tiles, overgrazed pasture, and cattle access to the stream is unknown at this point and can only be estimated by experience at this point. The stream buffers are assumed to be 200 feet wide on each side of the stream totaling 400 ft^2 per ft of stream length.

As can be seen, the extent of the possible implementation of stream buffers, tillage and nutrient management practices, feedlot controls, and septic system upgrades is considerable. The extent of implementation required to meet the water quality goal of 180 CFU/100ml throughout the watershed is unknown at this point, and will not be determined until some significant portion of implementation has been installed and the performance has been measured by follow-up monitoring. The TMDL sampling has shown impairment of all of the 30 monitoring sites representing the 30 sub watersheds prompting a more comprehensive watershed wide approach. Additionally, the TMDL is based on concentrations of fecal coliform making our approach somewhat independent of flow volumes and mass loading considerations. This forces the implementation plan to focus on all streams and tributaries throughout the watershed.

Theoretical FC removals for each conservation practice is listed in Table 5.1 above. Little is known about the performance of these conservation practices in the inhibition of fecal coliform. For this reason, removals for each practice are reasonable assumptions based on the following considerations and are applied only to be used as an initial guide to implementation:

- 200 feet of buffer strip would inhibit the vast majority of particulate and associated phosphorus in cropland runoff. Fecal coliform is not a conservative substance, however, and are alive and may even multiply in low grassy areas[12]. For these reasons a more conservative 50% removal was used.

- Feed lot controls will be largely addressing containment of manure in sealed basins designed for proper storage and sheltering of stockpiles. If properly installed these controls should be very effective.

- ISTS upgrades following standard design should be very effective retaining fecal coliform. However, failing systems may have residual fecal coliform established in the soils and grasses near the outfall. For this reason, 90% inhibition is assumed.

- Minimum tillage is assumed to be only 25% effective based on the comparison with particulate phosphorus removals that would be expected.

- Nutrient management involves the incorporation of manure into the soil during application and is expected to reduce fecal coliform runoff by 90%. This is consistent with the TMDL linkage analysis assumptions.

[12] Center for Watershed Protection??

- Fencing is employed to restrict cattle from stream access and should be 100% effective.

- Rotational grazing is assumed to be 50% effective in Fecal Coliform control based on recent literature.

Budget

The annual and 15 year budget and associated assumptions are shown in detail below. There are 7 elements to budget: 1) Work plan Development; 2) Monitoring; 3) Watershed Assessment; 4) Information and Education; 5) Data Analysis; 6) Implementation of Control Measures; and 7) Administration. The costs are presented as annual costs with the exception of Element 5b that represents all 15 years of implementation.

Program element involves the planning and continuous review of the work plan. Tracking the implementation activities, monitoring results, costs, and the sentiment of the land owners and make adjustments to the work plan based on these factors. The monitoring element involves both hydrologic and water quality sampling programs. The Watershed assessment involves tracking the project progress using GIS and GPS technologies and will focus on the implementation activities and the agreements developed. The data analysis will involve reducing and summarizing the hydrological, water quality, and GIS data. This will include performance assessment of individual implementation activities, the effect of implementation on sub watershed 20, and the total TMDL watershed performance. Information and education will be an ongoing and important element in the implementation plan. Public meetings, farm fairs, watershed tours, and individual discussions with citizens and land owners. This element will be the driving force for local acceptance of the implementation plan.

The implementation of control measures involves the activities described in Table 5.1 and 5.2, and includes the labor required. The administration costs are described in element 7 and the total costs for the project are summarized on an annual and 15 year basis.

South Branch Yellow Medicine River TMDL Implementation

PROGRAM ELEMENT 1-Work Plan Development/Revisions

Cost Category	Unit Cost	Quantity	Total
Project Manager	$25	100	$2,500
Project Consultant	$50	20	$1,000
Supplies, office	500		$500
TOTAL PROGRAM ELEMENT 1			**$4,000.00**

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PROGRAM ELEMENT 2 Water Quality Monitoring

Task 2.1 - Watershed Monitoring

Cost Category	Unit Cost	Quantity	Total
a) Project Manager	$25	50	$1,250
Travel	$0.45	1500	$675
b) Technician	$18	250	$4,500
Travel	$0.45	3000	$1,350
c) Engineering Services	$50	20	$1,000
d) USGS River Monitoring	$75	50	$3,500
g) Additional Gaging Equipment	$14,950		$14,950

TOTAL TASK 2.1 Watershed Monitoring	**$27,225.00**

TOTAL TASK 2.2 - Laboratory Analysis (see Table 5)	**$7,455.00**

TOTAL PROGRAM ELEMENT 2	**$34,680.00**

Additional Equipment	Cost
Datalogging Setup	$2,500
Automated Sampler	$3,000
Current Meter	$5,000
Automated Raingage	$500
Pressure Transducers	$800
Solar Panel	$1,500
Batteries	$150
Bridge Crane & Miscellaneous	$1,500
Total	$14,950

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PROGRAM ELEMENT 3 Watershed Assessment

Cost Category	Unit Cost	Quantity	Total
Project Manager	$25	100	$2,500
Technician	$18	250	$4,500
GIS Processing	$75	100	$7,500
Technical Committee	$75	50	$3,750
Historical Records	$15	40	$600

TOTAL PROGRAM ELEMENT 3	**$18,850.00**

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PROGRAM ELEMENT 4 Data Analysis

Cost Category	Unit Cost	Quantity	Total
Project Manager	$25	160	$4,000
Supplies:			
Computer	$500	0	$500
Fax/Printer	$100		$100
Software	$900		$900
Data Storage equipment	$50		$50
Internet service & phone line	$300		$300
Lincoln Co. SWCD	$75	200	$0
Lyon Co. SWCD	$75	200	$0
Project Consultant	$50	200	$10,000

TOTAL PROGRAM ELEMENT 4	**$15,850.00**

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PROGRAM ELEMENT 5 Information and Education

Cost Category	Unit Cost	Quantity	Cash
Project Manager	$25	250	$6,250
Office Manager	$20	600	$12,000
Project Consultant	$50	32	$1,600
Office Supplies/Printing	$500	4	$2,000
Newsletters			
Fact Sheets			
Public Meetings	$43	480	$20,640
Open House			
Farm Fairs	$43	160	$6,880
County Fairs			
Watershed Tours	$43	200	$8,600

TOTAL PROGRAM ELEMENT 5	**$57,970.00**

Public Meetings	4 per yr	4	Tot hrs	480
Annual Farm Fairs	1/Co.	2	Tot hrs	160
Annual Watershed Tours		5	Tot hrs	200

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PROGRAM ELEMENT 6 Implementation

Task 6.1 Labor

Cost Category	Unit Cost	Quantity	Total
Project Manager	$25	75	$1,875
Travel	$0	120	$36
Technician	$18	200	$3,600
Travel			
Lincoln Co. SWCD	$50	40	$0
Yellow Medicine Co. SWCD	$50	40	$0
Lyon Co. SWCD	$50	40	$0
Engineering Services	$50	200	$10,000

TOTAL TASK 6.1	**$15,511**

Task 6.1 Control Measures

Cost Category	Total Cost	% implmt	Total
Feed lots	$960,000	50%	$480,000
Stream Buffers & CRP	$767,599	90%	$690,839
Draintiles (4/section)	$441	100%	$220,500
Minimum Tillage	$987,840	50%	$493,920
Nutrient Management	$987,840	90%	$889,056
ISTS Upgrades	$705,000	73%	$514,650
Rotational Grazing (acres)	46,412	90%	$928,240
Fencing (ft)	20,800	5%	$20,800

TOTAL TASK 6.2	**$4,238,006**

Grand Total	**$4,253,517**

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PROGRAM ELEMENT 7 Administration

Cost Category	Unit Cost	Quantity	Total
YMRWD Board	$25	200	$3,000
Project Manager	$25	250	$6,250
Office Manager	$20	250	$5,000

TOTAL PROGRAM ELEMENT 7	**$14,250**

YMRWD STEERING COMMITTEE

Meetings	Members	Total
20	5	100

Project Manager & Office Manager
5hrs/wk
250

PROJECT BUDGET SUMMARY

ANNUAL BUDGET	INKIND	CASH	TOTAL
Program Element 1: Workplan		$3,900	$3,900
Program Element 2: Monitoring		$34,580	$34,580
Program Element 3: Watershed Assessment		$18,850	$18,850
Program Element 4: Data Analysis		$15,850	$15,850
Program Element 5: Information & Education		$57,970	$57,970
Program Element 6: Implementation		$283,568	$283,568
Program Element 7: Administration		$14,250	$14,250
ANNUAL TOTAL	**$0**	**$428,968**	**$428,968**

15 YEAR BUDGET	INKIND	CASH	TOTAL
Program Element 1: Workplan		$58,500	$58,500
Program Element 2: Monitoring		$518,700	$518,700
Program Element 3: Watershed Assessment		$282,750	$282,750
Program Element 4: Data Analysis		$237,750	$237,750
Program Element 5: Information & Education		$869,550	$869,550
Program Element 6: Implementation		$4,253,517	$4,253,517
Program Element 7: Administration		$213,750	$213,750
15 YEAR TOTAL	**$0**	**$6,434,517**	**$6,434,517**

The expected performance of the implementation plan depends on the local acceptance and the performance of each control strategy. The plan addresses the largest sources with the most implementation strategies, manure management. Stream Buffers, drain tile intakes, tillage practices, and nutrient management are all intended to inhibit fecal coliform from entering the stream. Feed lot and septic system upgrades will be addressed by the current rules, and overgrazed pastures will be addressed by rotational grazing and fencing along the streams.

For feed lots there is assumed to be 50% of the feed lots that need some improvement and the improvements are expected to control 90% of the fecal coliform; the contribution from feed lots is 18%. 73% of the ISTS are in need of upgrades within the SBYMR; the contribution from ISTS is 2% during wet periods. The over grazing and stream access by cattle is about 4% of the contribution and will be addressed by implementing rotational grazing on 90% of the pastures and cattle access is expected to be about 5% of the stream lengths and will be addressed by fencing the cattle from the streams. The largest contributor, manure management will be addressed aggressively with stream buffers placed in 90% of the stream reaches, 100% of the surface inlet tiles converted to sub surface drains, 50% minimum tillage practices and 90% manure incorporation (nutrient management) of the available crop land.

Control Strategy	% Implemetation	FC removal	Source Contribution	
Feed lots	50%	90%	Feed lots	18%
Stream Buffers & CRP	90%	50%		
Draintiles (4/section)	100%	50%		
Minimum Tillage	50%	25%		
Nutrient Management	90%	90%	Manure	63%
ISTS Upgrades	73%	90%	ISTS	2%
Rotational Grazing (acres	90%	50%		
Fencing (ft)	5%	100%	Grazing	4%