4.0 Pollution Sources and Loads

4.1 Potential Causes of Water Quality Problems

In this section concerns identified by stakeholders in the watershed and through the watershed inventory will be linked to problems found through the watershed investigation. Additionally, potential causes for the problems identified will be expressed. Finally, potential sources will be identified. Table 4.1.1 shows the connection between those concerns the stakeholders have chosen to focus efforts on, problems found in the watershed, and the potential causes of those problems.

Table 4.1.1: Connection between Stakeholder Concerns, Problems, and Potential Causes

Concern(s)	Problem	Potential Cause(s)
- Livestock Access to open water - Stormwater runoff from livestock operations - Lakes in the area becoming more built-up - Septic system discharge - Tiled streams in ag. fields and un-buffered tiled inlets - Wetland Conservation	High levels of E. coli were discovered in areas streams after reviewing historic and current water quality data	- E. coli levels exceed the state standard - Area producers are unaware of the water quality threat of not having adequate manure storage and allowing livestock access to open water - There is a lack of education and outreach regarding septic management - There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding urban stormwater issues
- Livestock Access to open water - Stormwater runoff from livestock operations - Lakes in the area becoming more built-up - Septic system discharge - Tiled streams in ag. fields and un-buffered tiled inlets - Increase in impervious surfaces - Fertilizer used on urban lawns - Lack of no-till and cover crop practices - Wetland Conservation	Area streams have nutrient levels exceeding the target level set by this project	- Nitrogen levels exceed the target set by this project - Phosphorus levels exceed the target set by this project - There is a lack of education and outreach regarding septic maintenance - There has been little effort to address urban issues in the watershed - Area producers are unaware of the cumulative effects of best management practices - Livestock operators are unaware of the effects to water quality from “traditional” management techniques used in the watershed

Concern(s)	Problem	Potential Cause(s)
- Septic system discharge	Historic design and lack of maintenance of septic systems is an issue in the watershed	- There is a lack of education and outreach regarding septic system maintenance
- Livestock access to open water - Stormwater runoff from livestock operations - Lack of no-till and cover crop practices - Wetland conservation - Streambank erosion - Tiled Streams in Ag. fields and un-buffered tile inlets	Best management practices to limit nonpoint source pollution are underutilized in the watershed	- There is a lack of education and outreach regarding the benefits of best management practices - Area producers are unaware of the cumulative effects of best management practices
- Streambank Erosion - Wetland Conservation - Lack of no-till and cover crop practices - Tiled streams in ag. fields and un-buffered tile inlets - Livestock access to open water - Stormwater runoff from livestock operations - Increase in impervious surfaces - Fertilizer used on urban lawns - Lakes in the area becoming more built-up - Septic system discharge	Sections of the Fawn River and its tributaries are listed as impaired on the IN or MI 303(d) list for IBC	- There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding the benefits of best management practices - There is a lack of education and outreach regarding septic system maintenance - Area producers are unaware of the cumulative effects of best management practices - Livestock operators are unaware of the effects to water quality from “traditional” management techniques used in the watershed such as direct access to open water - Nutrient and *E. coli* levels exceed the targets set by this project - CQHEI scores were very low for several water quality sampling sites throughout the watershed - Lack of stream buffers/filter strips

Concern(s)	Problem	Potential Cause(s)
- Stream bank erosion - Wetland Conservation - Lakes in the area becoming more developed - Increase in impervious surfaces	Ten species in the watershed are on the Federal Endangered Species list	- Nitrates and phosphorus exceeded the target set by this project, thus lowering the quality of aquatic habitat - Lack of riparian buffer for adequate habitat - Land conversion / segmentation - CQHEI scores were very low for several water quality sampling sites throughout the watershed

4.2 Potential Sources Resulting in Water Quality Impairment

Now that stakeholder concerns have been linked to water quality problems and potential causes of those problems, and a thorough watershed inventory has been conducted, sources to the problems can be determined. Outlining the sources to the problems found in the watershed will help to narrow the land area of where to focus implementation efforts to have the greatest impact on improving water quality in the Fawn River Watershed. Table 4.2.1 lists the problems, potential cause(s), and potential source(s) of the problems.

Table 4.2.1: Problems, Causes, and Sources

Problem	Potential Cause(s)	Potential Source(s)
High levels of E. coli were discovered in areas streams after reviewing historic and current water quality data	- E. coli levels exceed the state standard - Area producers are unaware of the water quality threat of not having adequate manure storage and allowing livestock access to open water - There is a lack of education and outreach regarding septic management - There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding urban stormwater issues	- Pet waste in urban areas including built-up lakes and Fremont, Angola, Sturgis, Constantine, and Orland - It is estimated that greater than 25% of the households in the watershed are utilizing on-site waste disposal and up to 5% of those are failing - Many built-up lakes utilize on-site waste disposal (Snow Lake sub-watershed-3 lakes, Tamarack Lake sub-watershed-2 lakes, Himebaugh Drain sub-watershed-4 lakes, Clear Lake sub-watershed-3 lakes, Wegner Ditch sub-watershed-1 lake, Sherman Mill Creek sub-watershed-3 lakes) - Over 84% of the soils in the watershed are considered to be very limited for septic system placement and over 6% is considered somewhat limited for septic placement - There are four CFOs located in the watershed totaling 250,000 animals (Wegner Ditch, and Himebaugh Drain) which produces multiple tons of manure each year that may be land applied in an unsustainable manner, during wet weather, on frozen ground, or in close proximity to open water - Livestock access to open water (Lake James-1, Himebaugh Drain-1) - Pasture runoff issues (Clear Lake-2)

Problem	Potential Cause(s)	Potential Source(s)
Area streams have nutrient levels exceeding the target level set by this project	- Nitrogen levels exceed the target set by this project - Phosphorus levels exceed the target set by this project - There is a lack of education and outreach regarding septic maintenance - There has been little effort to address urban issues in the watershed - Area producers are unaware of the cumulative effects of best management practices - Livestock operators are unaware of the effects to water quality from "traditional" management techniques used in the watershed	- Lack of proper management measures on ag. land on PHEL (6.05% of soils) and HEL (20.17% of soils) - It is estimated that greater than 25% of the households in the watershed are utilizing on-site waste disposal and up to 5% of those are failing - Many built-up lakes utilize on-site waste disposal (Snow Lake-3, Tamarack Lake-2, Himebaugh Drain-4, Clear Lake-3, Wegner Ditch-1, Sherman Mill Creek-3) - Over 84% of the soils in the watershed are very limited for septic system placement and over 6% is considered somewhat limited for septic placement - Pasture runoff issues (Clear Lake) - Livestock with direct access to open water (Lake James, Himebaugh Drain) - 49% of the watershed is in cultivated crops which are fertilized to promote plant growth. Unsustainable farming techniques increase fertilizer runoff - 13% of the watershed is developed. Over fertilization of turf grass leads to excess fertilizer runoff - Over fertilization of turf grass at lake properties on the 32 built-up lakes in the watershed (Snow Lake, Lake James, Tamarack Lake, Himebaugh Drain, Clear Lake, Wegner Ditch, and Sherman Mill Drain sub-watersheds) - Excessive use of irrigation without irrigation management plans in place throughout the watershed - Only 8% of corn and 13% of bean fields also utilize cover crops which aids in nutrient uptake and prevents soil erosion - 56,796 lf of natural streams have been tiled in ag fields which, if not properly managed and buffered, allow for nutrients to leach through the tiles - 20% of corn fields in Steuben and 54% in LaGrange are conventionally tilled (4% and 24%, respectively for beans).

Problem	Potential Cause(s)	Potential Source(s)
Historic design and lack of maintenance of septic systems is an issue in the watershed	- There is a lack of education and outreach regarding septic system maintenance	- There is a lack of education and outreach regarding septic system maintenance - Over 84% of the soils in the watershed are considered to be very limited for septic system placement and over 6% is considered somewhat limited for septic placement - It is estimated that greater than 25% of the households in the watershed are utilizing on-site waste disposal and up to 5% of those are failing - Many built-up lakes utilize on-site waste disposal (Snow Lake-3, Tamarack Lake-2, Himebaugh Drain-4, Clear Lake-3, Wegner Ditch-1, Sherman Mill Creek-3)
Best management practices to limit nonpoint source pollution are underutilized in the watershed	- There is a lack of education and outreach regarding the benefits of best management practices - Area producers are unaware of the cumulative effects of best management practices	- There is a lack of education and outreach regarding the benefits of best management practices - Federal and local funding for the implementation of agricultural management measures have been cut significantly over the past decade including Farm Bill programs such as CREP, CRP and WRP, Counties have lowered funding to SWCDs, LARE, 319, and GLRI and GLC funding is not consistent - There is limited education and outreach regarding urban best management practices and stormwater control
Sections of the Fawn River and its tributaries are listed as impaired on the IN or MI 303(d) list for IBC, Mercury and PCBs in Fish Tissue	- There has been little effort to address urban issues in the watershed - There is a lack of education and outreach regarding the benefits of best management practices - There is a lack of education and outreach regarding septic system maintenance - Area producers are unaware of the cumulative effects of	- Lack of proper management measures on agriculture land on PHEL (6.05% of soils) and HEL (20.17% of soils) in the watershed - It is estimated that greater than 25% of the households in the watershed are utilizing on-site waste disposal and up to 5% of those are failing - Many built-up lakes utilize on-site waste disposal (Snow Lake-3, Tamarack Lake-2, Himebaugh Drain-4, Clear Lake-3, Wegner Ditch-1, Sherman Mill Creek-3)

Problem	Potential Cause(s)	Potential Source(s)
Sections of the Fawn River and its tributaries are listed as impaired on the IN or MI 303(d) list	best management practices - CQHEI scores were very low for several water quality sampling sites throughout the watershed - Livestock operators are unaware of the effects to water quality from "traditional" management techniques used in the watershed direct access to open water - Nutrient and E. coli levels exceed the targets set by this project	- Over 84% of the soils in the watershed are considered to very limited for septic system placement and over 6% is considered somewhat limited for septic placement - Pasture runoff issues (Clear Lake -2) - Livestock with direct access to open water (Lake James - 1 and Himebaugh Drain - 1) - 49% of the watershed is in cultivated crops which are fertilized to promote plant growth. Unsustainable farming techniques increase fertilizer runoff - 13% of the watershed is developed. Over fertilization of turf grass leads to excess fertilizer runoff - Over fertilization of turf grass and extensive use of seawalls at lake properties on the 32 built-up lakes in the watershed (Snow Lake, Lake James, Tamarack Lake, Himebaugh Drain, Clear Lake, Wegner Ditch, and Sherman Mill Drain sub-watersheds) - Excessive use of irrigation without irrigation management plans in place throughout the watershed - Only 8% of corn and 13% of bean fields utilize cover crops which aids in nutrient uptake and prevents soil erosion - 56,796 lf of natural streams have been tiled in ag fields which, if not properly managed and buffered, allow for nutrients to escape the fields through the tiles - There are four CFOs located in the watershed totaling 250,000 animals (Wegner Ditch, and Himebaugh Drain) which produces multiple tons of manure each year that may be land applied in an unsustainable manner, during wet weather, on frozen ground, or to close to open water - There is a lack of riparian buffer on 49,027 lf of stream within the ag. community and 2,176 lf in the urban areas

Problem	Potential Cause(s)	Potential Source(s)
Sections of the Fawn River and its tributaries are listed as impaired on the IN or MI 303(d) list		- 74% of the corn fields and 28% of the bean fields between Steuben and LaGrange counties utilize conventional tillage techniques
Ten species in the watershed on the Federal Endangered Species list	- Nitrates and phosphorus exceeded the target set by this project, thus lowering the quality of aquatic habitat - Lack of riparian buffer for adequate habitat - Land conversion / segmentation	- The watershed has lost a 39% of the presettlement wetlands equaling a habitat functional use loss of 44%. - The windshield survey revealed 51,203 lf of stream lacking a riparian buffer, most of which also exhibited slight to moderate streambank erosion - Less than 9% of the watershed is considered to be forested

4.3 Pollution Loads and Necessary Load Reductions

After close review of historic water quality data from the IDEM, Steuben County Lakes Council, MI DEQ, and current water quality data collected by the Fawn River Project as part of the development of this WMP, for consistency of parameters measured in each of the sub-watersheds, as well as quality assurance techniques and weather conditions, pollution loads and subsequent load reductions would be based on data collected by the FRP only, which was funded through the 319 grant used for this project. Current pollution loads were determined for each HUC12 sub-watershed, and when compared to the water quality targets set by the Fawn River steering committee and outlined in Section 3, provides detail on how much pollution loads will need to be reduced to meet the targets set for the project area.

Water quality samples were taken by the FRP from 54 sites; several sites in each of the nine HUC12 sub-watersheds. Adequate water quality samples were taken to provide a baseline look at water quality in each of the sub-watersheds. Current pollution loads and load reductions were analyzed for nitrate, total phosphorus, TSS and TDS only, as turbidity and *E.coli* loads cannot be accurately determined, and loads determined for the other parameters measured by the Initiative as part of this project would not be useful to this project. However, it is important to note that both turbidity and *E. coli* are a concern of the Fawn River steering committee.

Loads were determined by using the following equation; (cfs * (X * 0.001) * 984.2589781), where cfs equals the average flow of the stream measured in cubic feet per second, X equals

the average parameter measurement in mg/l, and 984.2589781 is the conversion factor used to make the outcome equal tons per year. Table 4.3.1 is a reminder of the target concentrations for each of the parameters of concern that were set by this project's steering committee. Table 4.3.2 through Table 4.3.5 show the current and target loads and load reductions needed for nitrate, total phosphorus, TDS, and TSS, respectively. Turbidity and E. coli, while loads cannot be determined, are important parameters to consider when evaluating the health of the watershed. Turbidity is an indicator of sediment, as well as other pollutants that can cause water to become murky and inhibit plant growth and effect aquatic habitat and *E. coli* is used as an indicator to determine the amount of fecal material making its way to open water. Therefore, Table 3.4.6 shows the average concentration of turbidity and *E. coli* for each sub-watershed as well as the percentage of target concentration exceedance per sub-watershed.

Table 4.3.1: Target Concentration for Parameters of Concern

Parameter of Concern	Target Concentration
Nitrate	< 1.5 mg/l
Total Phosphorus	< 0.08 mg/L (tributaries) and <0.3 mg/L (mainstem)
Total Dissolved Solids	< 750 mg/l
Total Suspended Solids	< 20 mg/l
Turbidity	< 10.4 NTU
E. coli	< 235 CFU/100ml

Table 4.3.2: Nitrate Pollution Load Reductions Needed to Meet Target Loads

Subwatershed		Mean Flow (ft^3/sec)	Nitrate (tons/year)		
HUC	Name		Current	Target	Reduction Needed
040500010801	Snow Lake	5.96	6.9	8.8	0
040500010803	Lake James	35.53	36.28	52.45	0
040500010802	Tamarack Lake	39.24	48.9	57.9	0
040500010804	Town of Orland	39.24	50.68	57.93	0
040500010805	Himebaugh Drain	10.76	23.14	15.89	7.25
040500010806	Clear Lake	123.78	208.64	182.75	25.89
040500010807	Wegner Ditch	156.91	429.12	231.66	197.46
040500010808	Sherman Mill Creek	111.51	329.51	164.63	164.87
040500010809	Fawn River Drain	247.02	454.3	364.69	89.6
		Total	**1587.47**	**1136.7**	**485.07**

Table 4.3.3: Phosphorus Pollution Load Reductions Needed to Meet Target Loads

Subwatershed		Mean Flow (ft^3/sec)	Total Phosphorus (tons/year)		
HUC	Name		Current	Target	Reduction Needed
040500010801	Snow Lake	5.96	1.4	0.5	0.9
040500010803	Lake James	35.53	5.59	2.79	2.79
040500010802	Tamarack Lake	39.24	7.3	3.09	4.21
040500010804	Town of Orland	39.24	7.52	3.09	4.43
040500010805	Himebaugh Drain	10.76	2.16	0.85	1.32
040500010806	Clear Lake	123.78	27.16	36.55	0
040500010807	Wegner Ditch	156.91	35.47	46.33	0
040500010808	Sherman Mill Creek	111.51	19.22	32.93	0
040500010809	Fawn River Drain	247.02	57.59	72.94	0
		Total	**163.41**	**199.07**	**13.65**

Table 4.3.4: Total Dissolved Solids Pollution Load Reductions Needed to Meet Target Loads

Subwatershed		Mean Flow (ft^3/sec)	Total Dissolved Solids (tons/year)		
HUC	Name		Current	Target	Reduction Needed
040500010801	Snow Lake	5.96	3282.14	4250	0
040500010803	Lake James	35.53	20371.17	26227.24	0
040500010802	Tamarack Lake	39.24	19866.94	28966.74	0
040500010804	Town of Orland	39.24	21911.73	28963.17	0
040500010805	Himebaugh Drain	10.76	6456.893	7946.292	0
040500010806	Clear Lake	123.78	65851.24	91377.07	0
040500010807	Wegner Ditch	156.91	94762.78	115830.1	0
040500010808	Sherman Mill Creek	111.51	49048.16	82317.37	0
040500010809	Fawn River Drain	247.02	134942.6	182346.1	0
		Total	**416493.653**	**568224.082**	**0**

Table 4.3.5: Total Suspended Solids Pollution Load Reductions Needed to Meet Target Loads

Subwatershed		Mean Flow (ft^3/sec)	Total Suspended Solids (tons/year)		
HUC	Name		Current	Target	Reduction Needed
040500010801	Snow Lake	5.96	47.2	117.3	0
040500010803	Lake James	35.53	151.54	699.39	0
040500010802	Tamarack Lake	39.24	242.3	772.45	0
040500010804	Town of Orland	39.24	170.58	772.35	0
040500010805	Himebaugh Drain	10.76	66.72	211.9	0
040500010806	Clear Lake	123.78	728.45	2436.63	0
040500010807	Wegner Ditch	156.91	874.24	3088.8	0
040500010808	Sherman Mill Creek	111.51	336.58	2195.13	0
040500010809	Fawn River Drain	247.02	1904.53	4862.56	0
		Total	**4522.14**	**15156.51**	**0**

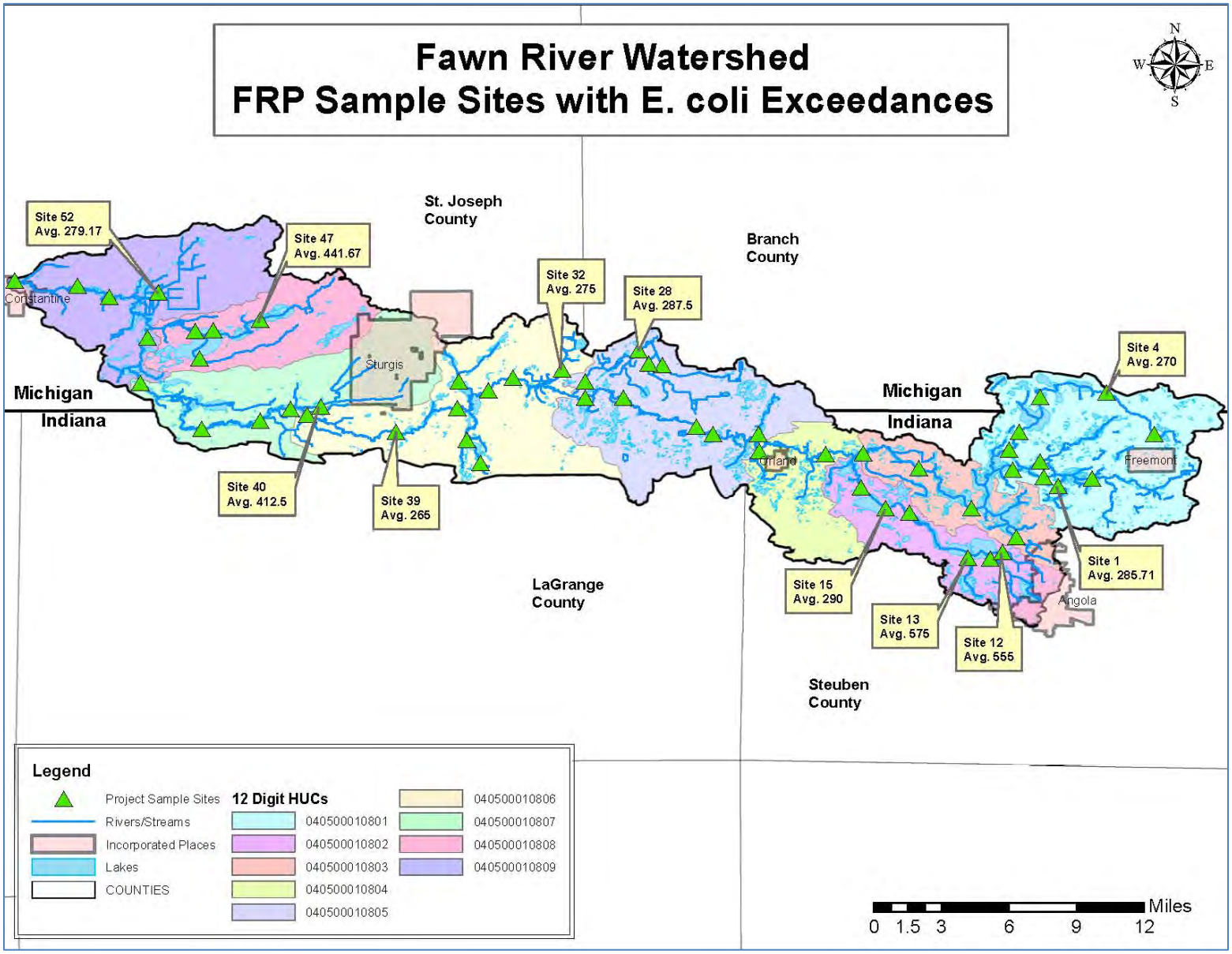
Table 3.4.6: E. coli and Turbidity Concentrations and Percent Exceedance per Sub-watershed

Sub-watershed	Parameter			
	E. coli		Turbidity	
	CFU	%	NTU	%
Snow Lake	257.02	22	2.4	4
Lake James	193.01	16	4.78	13
Tamarack Lake	499.3	44	3	3
Town of Orland	77.15	13	2	0
Himebaugh Drain	115.5	13	3.27	2
Clear Lake	146.35	19	2.58	1
Wegner Ditch	177.68	26	2.95	0
Sherman Mill Drain	168.89	17	1.18	0
Fawn River Drain	132.41	17	3.35	4

*The concentrations highlighted in pink either exceeded the target for that parameter or the percentage of exceedances was greater than 20%.

Examining the average *E. coli* levels for each sub-watershed does provide information about which sub-watersheds may have the most problem with *E. coli* contamination; however there are several Fawn River Project sample sites that also had average *E.coli* measurements that exceeded the state standard. The drainage area to those sample sites should be considered for the remediation of potential *E.coli* pollution sources. Figure 4.1 shows the location of the FRP sample sites, with the sites that had high *E.coli* measurements labeled with what the average *E. coli* measurements were for that site.

Figure 4.1: Fawn River Project Sample Sites with E.coli Exceedances



5.0 Critical Areas

Critical areas are defined by IDEM as those areas that have been identified through historical studies, land use information, and water quality data, in the project area as needing implementation efforts to improve current water quality or that will mitigate the impact of potential sources of NPS to protect water quality. This Section will identify the critical areas within the Fawn River Watershed and outline the reason why those areas are most important to focus implementation efforts.

5.1 Critical Areas to Focus Implementation Efforts.

Identifying critical areas and goals to address those critical areas will focus efforts in the watershed on the areas that will have the greatest impact on improving water quality in the Fawn River Watershed. Please note that if there are several areas that are considered critical for a particular practice or parameter, a "priority" may be assigned to those areas so that implementation efforts will be focused on the areas that will have the biggest impact on water quality first. Once all possible implementation efforts have been exhausted in Priority Area 1, efforts will be focused on Priority Area 2, and so on.

5.1.1 Pollutant Based Critical Areas

The Fawn River Watershed Steering Committee expressed concern regarding several problems, land uses and practices that can be observed throughout the watershed that may be contributing to the high nutrient and bacteria levels demonstrated by water quality data. These problems include runoff from livestock operations, increase in impervious surfaces, fertilizer used on urban lawns, increased development on built-up lakes, septic system discharge, lack of conservation tillage and cover crop practices, wetland conservation, streambank erosion and sedimentation. An additional issue was discovered during the windshield survey that may contribute to high nutrient levels; unbuffered tiled inlets and tiled ditches and streams through agriculture fields. Analysis of water quality data show that nitrate and phosphorus load reductions are needed throughout the project area. Additionally, there are several water quality sample sites spread throughout the watershed, except for in the Town of Orland and Lake James-Crooked Creek sub-watershed, whose *E. coli* averages exceed the state standard of 235 cfu/100ml.

The windshield survey conducted as part of this project revealed several areas of concern to help validate stakeholder concerns. It was also noted during the survey that many streams and ditches have been straightened and have lost their natural shelf and flood plain and much of the woody riparian area has been cleared, thus many area ditches and streams are lacking an adequate riparian buffer to reduce the pollutant loading to the stream. This practice does a great job to quickly move water away from farm fields; however it also increases stream flow causing bank erosion further downstream, increases water temperatures, and decreases aquatic and riparian habitat. In addition to those areas, 74% of the corn fields and 28% of the bean fields within Steuben and LaGrange counties utilize conventional tillage techniques, which allows for surface flow of sediment, fertilizers, and pesticides to discharge into open water.

The land cover of the Fawn River watershed is 13% urban due to the fact that Angola, Fremont, Orland, and Sturgis are all fully or mostly located within the watershed. Additionally, there are 37 built-up lakes within the watershed where heavy lawn fertilizer use is common practice. Sea walls are also common along the shorelines of the lakes, which allows for runoff from turf grass to run directly into the lakes, increases wave action which may contribute to more shoreline erosion, as well as stir up settled sediment carrying nutrients that then get released into open water.

There were only four livestock issues observed during the windshield survey which were located within the Lake James – Crooked Creek, Himebaugh Drain, and Clear Lake sub-watersheds. Therefore, it can be assumed that much of the high *E. coli* levels measured throughout the watershed are from leaking septic systems, wildlife, improperly applied manure as fertilizer, or pet waste runoff from urban lawns; however livestock are an obvious contributor of excessive nutrients and *E. coli* at the sample sites directly downstream of the four livestock issues that were observed in the project area.

For the reasons listed above, the FRP Steering Committee has decided to make certain sub-watersheds critical for implementation of BMPs to reduce nutrient loadings based on water quality data, necessary load reductions to meet water quality targets, and observations made during the windshield survey, as well as the likelihood that BMPs will be accepted by landowners within the sub-watershed. Table 5.1 lists each sub-watershed, the calculated load reduction for each, and the priority given to each sub-watershed for implementation efforts to mitigate the nutrient loads reaching open water. Priorities were determined based on the extent of the load reduction needed and the number of parameters that need to be addressed. Due to previous experience working with landowners within these subwatersheds by area conservation districts and NRCS offices, priorities were also based on the likelihood of being successful in implementation efforts in each sub-watershed. Each sub-watershed will be addressed differently, and implementation efforts for each sub-watershed will be discussed in Section 7.

Table 5.1: Implementation Prioritization for Nutrient Load Based Critical Areas

Sub-watershed	Load Reduction (Tons/year)		Implementation Priority
	Nitrates	TP	
Himebaugh Drain	7.25	1.32	1
Wegner Ditch	197.46	0	1
Sherman Mill Drain	164.87	0	1
Fawn River Drain	89.6	0	1
Tamarack Lake	0	4.21	2
Clear Lake	25.89	0	2
Town of Orland	0	4.43	2
Lake James	0	2.79	2
Snow Lake	0	0.9	3

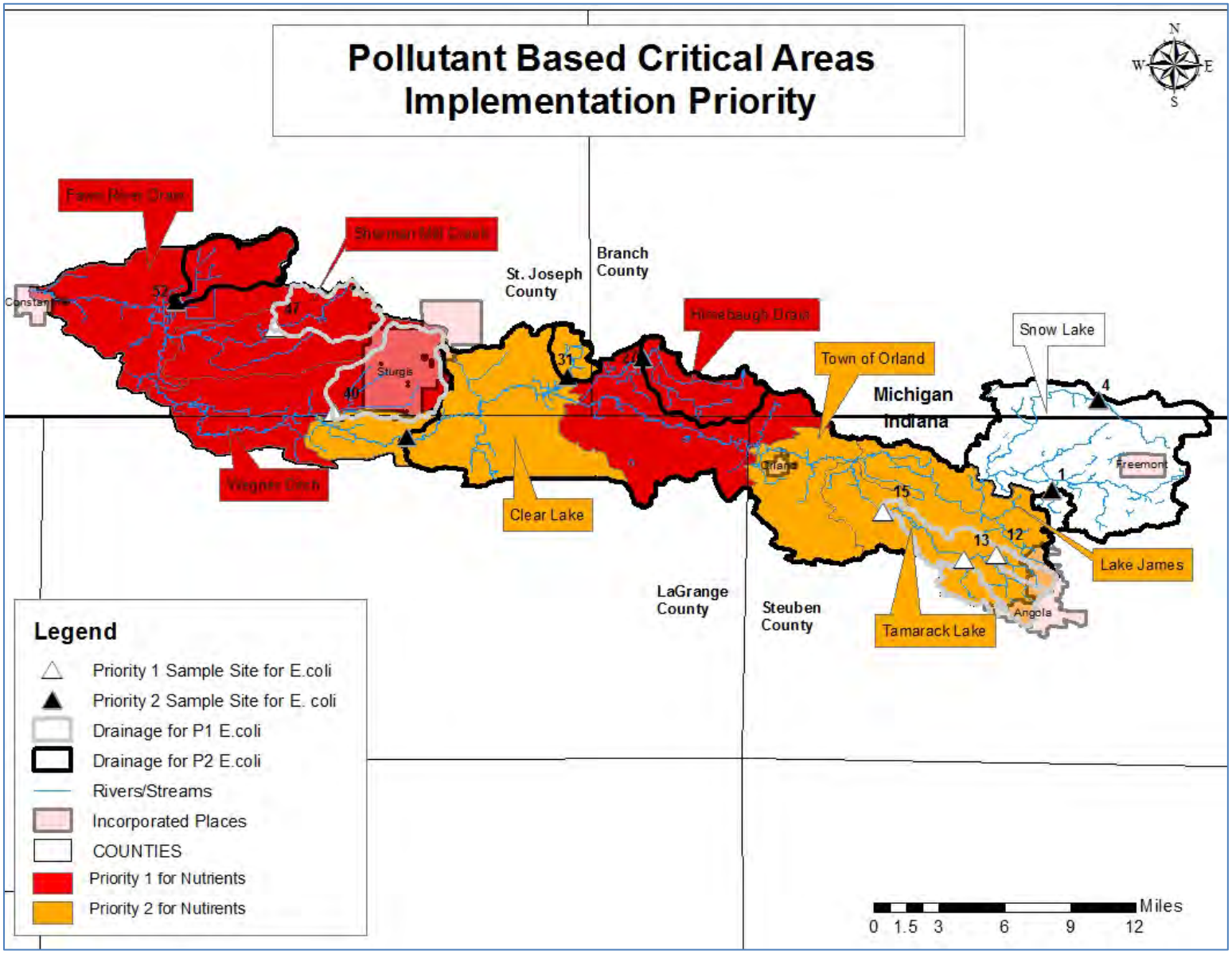
Critical areas for *E. coli* were determined based on those sub-watersheds that contained water quality samples sites whose average measurement was greater than the state standard of 235 cfu/100ml. The high *E. coli* measurements are likely due to leaking or failed septic systems, pet waste from urban lawns, or livestock. Table 5.2 lists the subwatersheds, as well as the sample site numbers within those sub-watersheds whose *E. coli* averages were greater than the state standard and whose drainage area is considered to be critical for education and outreach regarding septic system maintenance, pet waste disposal, and BMPs to lessen the impact of livestock operations and manure used as fertilizer. Priority of implementation efforts were determined based on the amount in which the sample averages exceeded the state standard and the likelihood of landowners to adopt various BMPs.

Table 5.2: Implementation Prioritization for E. coli Based Critical Areas

Sub-watershed	E. coli Averages Greater than Target by Site	Implementation Priority
Tamarack Lake	Site 12 - 555 cfu/100ml Site 13 - 575 cfu/100ml Site 15 - 290 cfu/100ml	1
Sherman Mill Drain	Site 47 - 441.67 cfu/100ml	1
Wegner Ditch	Site 40 - 412.5 cfu/100ml	1
Himebaugh Drain	Site 28 - 287.5 cfu/100ml	2
Snow Lake	Site 1 - 285.71 cfu/100ml Site 4 - 270 cfu/100ml	2
Fawn River Drain	Site 52 - 279.17 cfu/100ml	2
Clear Lake	Site 32 - 275 cfu/100ml Site 39 - 265 cfu/100ml	2
Town of Orland	0	
Lake James	0	

Figure 5.1, below, shows the location of critical sample sites for pollutants (nitrogen, phosphorus, and *E. coli*). Sub-watersheds in red are priority one for addressing nutrients, and those in orange are priority two. The USGS Stream Stats program is able to delineate drainage areas to a particular point for many states; however, it is not able to do so for points located in MI. Therefore, the following map has actual delineations for the drainage areas to the critical sample sites for *E. coli* in IN, and an approximate drainage area was drawn on the map for those critical sample sites for *E. coli* located in MI.

Figure 5.1: Implementation Priority for Pollutant Based Critical Areas



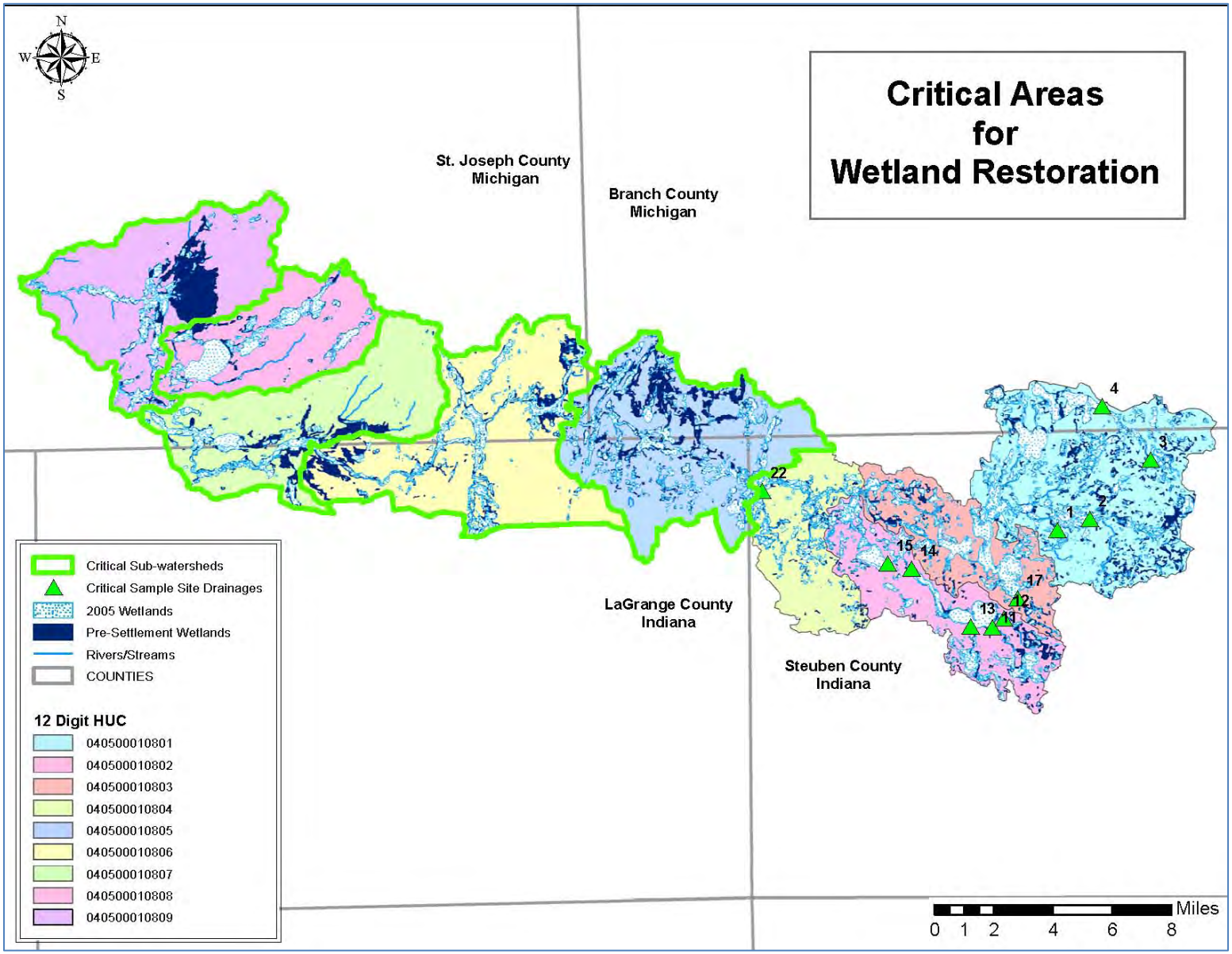
5.1.2 Wetland Based Critical Areas

Wetlands play an important role in the natural environment as they provide prime habitat for many species of flora and fauna, including eight of the ten endangered species listed in Section 2.7. Wetlands also act as sponges absorbing excess nutrients preventing its discharge into lakes and streams, as well as absorbing the impact of floodwaters which can prevent damage to homes and other structures. The wetland functional use study outlined in Section 2.4.3, and in each sub-watershed under Section 3.4, determined that the Fawn River Watershed has lost 40% of its floodwater control, 36% of its shoreline stabilization, 44% of its habitat, 36% of its combined water quality functional use, and 61% of its ability to retain harmful pathogens. Therefore, it is important to protect the remaining wetlands and restore wetlands that have disappeared since the last National Wetland Inventory was conducted in 1979. Protecting existing wetlands, especially in the more populated areas will help to mitigate any flooding issues as area lakes become more built-up and help to absorb nutrients and pathogens from leaking on-site waste disposal systems and fertilizer runoff. Restoring the wetlands present before settlement of the area will play an important role in improving water quality in the Fawn River Watershed's streams and lakes. Table 5.3 lists the sub-watersheds within the Fawn River Watershed and the percent of functional use loss since pre-settlement times for water quality and habitat in each sub-watershed. Note the last column in the Table shows the priority level given to each sub-watershed based on the functional use loss and the water quality data collected as part of this project. Figure 5.3 is a map depicting the 1979 NWI with the 2005 wetland inventory overlaid on top. The dark blue wetland areas visible in the map are critical for wetland restoration.

Table 5.3: Implementation Prioritization for Wetland Restoration Critical Areas

Sub-watershed	Wetland Functional Use Loss		Implementation Priority
	Water Quality	Habitat	
Clear Lake	47%	53%	1
Sherman Mill Creek	47%	61%	1
Fawn River Drain	59%	73%	1
Himebaugh Drain	42%	44%	1
Wegner Ditch	43%	43%	1
Town of Orland	32%	36%	2
Snow Lake	21%	28%	2
Lake James	29%	25%	2
Tamarack Lake	22%	21%	2

Figure 5.3: Critical Areas for Wetland Restoration



6.0 Goals, Management Measures, and Objectives

6.1 Goal Statements and Progress Indicators

The FRP steering committee used historic studies, land use, and water quality data, as well as current data, stakeholder input, problems found during the watershed investigation, and identified critical areas to determine overall goals for the watershed. The overarching goal of the project is to reduce pollutant loads and mitigate pollution sources so that water quality measurements will meet the project's target levels and/or state or federal water quality standards. However, to reach that principle goal of improving the quality of water in the Fawn River Watershed smaller, more attainable, goals were written. Each of the goal statements in the following Section is written to take small steps toward meeting the main goal of this project. It is also important to be able to measure the progress being made toward meeting each of the goals. Therefore, indicators were determined that will be used as a measurement tool and are listed in the following section as well.

6.1.1 Reduce Nitrogen Loading

The average historic nitrate levels measured in the Fawn River Watershed exceeded the target level in five of the nine sub-watersheds in the project area including Himebaugh Drain, Clear Lake, Wegner Ditch, Sherman mill Creek, and the Fawn River Drain sub-watersheds. The Nitrate loading calculations indicated that a combined 485.07 ton/year load reduction is needed in those sub-watershed mentioned above. To reach the target loading of 1136.7 tons/year or less, a 30.6% nitrate load reduction will need to be achieved. Much of the nitrate pollution may be coming from farm fields, urban fertilizer use, and leaking septic systems. Best management practices and an education and outreach program will need to be implemented in the critical areas identified for Nitrate loading to achieve the water quality goal for Nitrate.

<u>Goal Statement – Nitrate</u>

The goal of this project is for Nitrate levels in sampled water to be reduced by 15% within 5 years and 31% within 15 years.

<u>Indicator</u>

Water quality and administrative indicators will be used to show the progress toward meeting the goal for nitrogen levels in the Fawn River Watershed.

> <u>Water Quality Indicator</u>
>
> Nitrate will be measured at a minimum monthly throughout the year at the historic sample sites located within critical areas for nitrate. Sampling efforts will begin after three to five years of implementation. To determine if the milestones set for the nitrogen goal are being met, it would be expected to see that more water quality samples are meeting the target level for nitrate of 1.5 mg/L each year of sampling after three to five years of implementation.

Administrative Indicator

The load reductions as a result of best management practices that are installed in the watershed, as determined by the load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loadings of nitrate to reach the 30.6% reduction needed to meet the target load.

Administrative Indicator

The number of best management practices that can reduce nitrate levels that are installed in the watershed will be monitored. Annual goals for each of the various BMPs that can reduce nitrate levels are described in the Action register in Section 6.3.

6.1.2 Reduce Total Phosphorus Loading

The average historic total phosphorus levels measured in the Fawn River Watershed exceeded the target level in five of the nine sub-watersheds in the project area including Snow Lake, Lake James, Tamarack Lake, Town of Orland and Himebaugh Drain. The phosphorus loading calculations indicated that a combined 13.65 ton/year load reduction is needed in those sub-watersheds mentioned above. To reach the target loading of 72.94 tons/year or less, a 17.9% phosphorus load reduction will need to be achieved. Much of the phosphorus pollution may be coming from farm fields, urban fertilizer use, and leaking septic systems. Best management practices and an education and outreach program will need to be implemented in the critical areas identified for phosphorus loading to achieve the water quality goal for phosphorus.

Goal Statement – Total Phosphorus

The goal of this project is for phosphorus levels in sampled water to be reduced by 10% within 5 years and 18% within 15 years.

Indicator

Water quality and administrative indicators will be used to show the progress toward meeting the goal for total phosphorus levels in the Fawn River Watershed.

Water Quality Indicator

Phosphorus will be measured at a minimum monthly throughout the year at the historic sample sites located within critical areas for phosphorus. Sampling efforts will begin after three to five years of implementation. To determine if the milestones set for the phosphorus goal are being met, it would be expected to see that more water quality samples are meeting the target level for phsohphorus of 0.08 mg/L in tributaries and 0.3 mg/L in the mainstem of the Fawn River each year of sampling after three to five years of implementation.

Administrative Indicator

The load reductions as a result of best management practices that are installed in the watershed, as determined by the load reduction models, will be monitored to determine if the BMPs that are being installed are working adequately to reduce overall loading of total phosphorus to reach the 17.9% reduction necessary to meet the target load.

Administrative Indicator

The number of best management practices that can reduce total phosphorus levels (as described in Section 6.3) that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that can reduce phosphorus levels are described in the Action register in Section 6.3.

6.1.3 Reduce *E. coli* Loading

After analyzing both water quality data collected by this project and all historical water quality data, average *E. coli* levels exceeded the state standard of 235 CFU/100ml in three sub-watersheds located within the project area. Though, 11 of the 54 sample sites, in seven different sub-watersheds, including Tamarack Lake, Sherman Mill Drain, Wegner Ditch, Himebaugh Drain, Snow Lake, Fawn River Drain, and Clear Lake, exceeded the state standard. Excessive *E. coli* could be from wildlife, leaking failed or straight pipe on-site waste management, or animal operations located within the Fawn River Watershed.

Goal Statement – *E. coli*

The goal of this project is to have 30% of water quality samples meet the state standard of 235 CFU/100ml for *E. coli* within 5 years, and 50% of water quality samples meet the state standard within 15 years.

Indicator

Water quality and administrative indicators will be used to show the progress toward meeting the goal for *E. coli* levels in the Fawn River Watershed.

Water Quality Indicator

E. coli will be measured at a minimum monthly throughout the year at the historic sample sites located within critical areas for *E. coli*. Ideally weekly samples will be collected during the recreational season at the 11 sample sites where historically *E. coli* levels exceeded the state standard. Sampling efforts will begin after three to five years of implementation. To determine if the milestones set for the *E. coli* goal are being met, it would be expected to see that water quality samples are showing a decreasing trend in *E. coli* with more samples meeting the target level for *E. coli* of 235 CFU/100ml for a single sample each year of sampling after three to five years of implementation.

Administrative Indicator

The number of best management practices that can reduce *E. coli* levels that are installed in the watershed will be monitored. Annual milestones for each of the various BMPs that can reduce *E. coli* levels are described in the Action Register in Section 6.3.

6.1.4 Increase Wetland Acreage throughout the Watershed

The wetland functional use loss study that took place in 2005 revealed that the Fawn River Watershed has lost over 42% of its wetlands since pre-settlement times. With the loss in wetland acreage in the Fawn River Watershed also comes a functional use loss in excess of 35% for floodwater absorption, shoreline stabilization, water quality, and natural habitat. In a watershed dotted with lakes that are increasingly becoming built-up, and prime habitat for so many species of flora and fauna, including eight of the ten federally endangered species found within the project area, the protection and restoration of wetlands play a very important role in the health of the aquatic ecosystem in the Fawn River Watershed.

Goal Statement – Wetland Restoration and Protection

The goal of this project is to protect all existing wetlands immediately and increase the acreage of wetlands in the Fawn River Watershed by 500 acres within 5 years, and by 5,500 acres within 15 years.

Indicator

Administrative indicators will be used to show the progress toward meeting the goal for *E. coli* levels in the Fawn River Watershed.

Administrative Indicator

The acres of wetlands restored each year will be monitored. Annual milestones for wetland restoration are described in the Action Register in Section 6.3.

Administrative Indicator

The acres of wetlands that are protected will be monitored. It would be expected that no remaining wetlands in the Fawn River Watershed will be negatively altered or destroyed.

6.1.4 Reduce the Number of Faulty Septic Systems

Nearly 85% of the soils located within the Fawn River Watershed are considered to be very limited for the placement of septic systems, and another 6.8% of the soils are considered to be somewhat limited which means that significant alterations to the soil would need to be done in areas where a septic system is being installed to make it suitable. The rural community in the project area relies on on-site waste disposal systems, most of which were likely installed in soils that cannot support such a system. The majority of the urban and built-up areas are serviced by the Steuben Lakes Regional Sewer District (SLRSD) or municipal utilities; however not all homes located on populated lakes within the SLRSD's jurisdiction are currently serviced; there are still five populated areas in need of service from the SLRSD. There are also six other populated areas within the project area that are not currently serviced. High nitrate,

phosphorus, and *E. coli* levels found in the watershed may be a result of leaking and faulty septic systems.

Goal Statement – Septic Systems

It is the goal of this project to reduce the number of failing and leaking septic systems in the Fawn River Watershed by working with area decision makers on a comprehensive septic system ordinance and developing and promoting an education and outreach program regarding septic system maintenance.

Indicator

Water Quality, social and administrative indicators will be used to show the progress toward meeting the goal for reducing the impact on water quality from septic systems in the Fawn River Watershed.

Water Quality Indicator

Nitrate, phosphorus, and *E. coli* will be measured at a minimum monthly throughout the year at the historic sample sites located within critical areas for nutrients and *E. coli*. Ideally weekly samples for *E. coli* will be collected during the recreational season at the 11 sample sites where historically *E. coli* levels exceeded the state standard. Sampling efforts will begin after three to five years of implementation. To determine if the milestones set for the septic system goal are being met, it would be expected to see that water quality samples are showing an increasing trend in water quality with more samples meeting the target levels each year of sampling after three to five years of implementation.

Social Indicator

A pre and post indicator survey regarding septic system functionality and maintenance will be conducted at workshops to determine individuals knowledge regarding septic systems and the amount in which that knowledge increases as a result of the workshop. It would be expected that 80% of the attendants of the workshops would have a better understanding of septic systems after the workshop.

Administrative Indicator

The number of people who attend septic system maintenance workshops will be monitored. It is a goal to have 25% of targeted households, including those located in populated areas known to still be using septic systems for their waste disposal and rural homeowners, show representation at the septic system outreach events.

Administrative Indicator

The number of failing, leaking, or straight pipe septic systems reported to the local health departments will be monitored. It is expected that the education and outreach program will increase the number of reported septic issues to the health departments.

Administrative Indicator

The number of households that enlist septic system companies to provide regular maintenance and/or repair leaking, failed, and straight-piped septic systems will be monitored. It is expected that the education and outreach program will increase the number of households performing regular septic maintenance and repairing improperly functioning systems. The goal is that at least 30% more maintenance and repairs occur after 3 to 5 years of implementation of the education program.

Administrative Indicator

A comprehensive septic system ordinance is passed within each county of the project area within five years of implementation.

6.2 Management Practices to Address Critical Areas and Accomplish Goals

In order to address the concerns leading to the designation of the above mentioned critical areas, best management practices and conservation measures will need to be taken. The Fawn River Watershed Steering Committee considered the plethora of management practices and measures available to address the critical area concerns and determined that certain practices will have the greatest impact on the water quality in the critical areas and will be the focus of phase two of the FRW project. In the table below, several practices and measures are outlined, and the predicted load reduction is presented for each BMP. Load reduction estimates were determined using either the Region 5, or STEP-L and assumptions that were used to determine the load reductions in each of the models is outlined in the table as well. A few of the load reductions were determined using the Soil and Water Assessment Tool (SWAT) that has recently been recalibrated by Purdue University. The reductions that are presented from the SWAT model were calculated for the Upper St. Joseph River Watershed – Maumee River Basin and were used for the Fawn River project due to the fact that variables are very similar between the two watersheds, and it is believed that the SWAT model is more accurate than the other two available load reduction models. The following list is not all inclusive and other practices and management measures may be added to the list in the future.

Table 6.1: Management measures to Address Critical Areas and Project Goals

BMP or Management Measure	Critical Area to be Addressed by BMP	Reason for Being Critical	Assumptions Used	Estimated Load Reduction per BMP		
				Sediment	Total Phosphorus	Nitrogen
Agriculture, Urban, and Septic System Education Program	All Critical Sub-watersheds	Nutrients, E. coli, and Wetlands		N/A	N/A	N/A
Lake resident education and outreach on their impact to lake water quality		Nutrients, E. coli, and Wetlands		***	***	***
Annual Ag. And Urban Workshops/Field Days		Nutrients, E. coli, and Wetlands		N/A	N/A	N/A
Wetland (Restoration/Creation)	Clear Lake, Sherman Mill Creek, Fawn River Drain, Himebaugh Drain, Wegner Ditch, Town of Orland, Snow Lake, Lake James, Tamarack Lake	Wetland	100 acres contributing area/BMP	5.93 ton/yr	8 lbs/yr	48 lbs/yr

BMP or Management Measure	Critical Area to be Addressed by BMP	Reason for Being Critical	Assumptions Used	Estimated Load Reduction per BMP		
				Sediment	Total Phosphorus	Nitrogen
Nutrient / Pesticide Management	Himebaugh Drain, Wegner Ditch, Sherman Mill Drain, Fawn River Drain, Tamarack Lake, Clear Lake, Town of Orland, Lake James	Nutrient	Estimated 20% reduction of fertilizer and pesticides provided by Purdue University ona per acre basis	0.614 ton/yr	1.10 lbs/yr	6.67 lbs/yr
Cover Crops[1]		Nutrient	Planted a day after harvest. Cover crop killed and left as residue on field, one week prior to next crop planting	11 ton/yr	12lbs/yr	22 lbs/yr
Two-stage ditch[1]		Nutrient	1000 linear foot with a depth of 10'	80 ton/yr	80 lbs/yr	160 lbs/yr
Conservation Tillage/Mulch Till[3]		Nutrient	Presented on a per acre basis	0.77 ton/yr	.12 lbs/yr	2.37 lbs/yr
Conservation Tillage/No-Till[3]		Nutrient	Presented on a per acre basis	0.36 ton/yr	0.08 lbs/yr	1.13 lbs/yr
Soil Ammendments (Gypsum)[5,6]		Nutrient	Presented on a per acre basis	0.47 ton/yr	1.49 lbs/yr	***
Native Vegetation Planting (Switch Grass)[3]		Nutrient	Continuously grown, with one time planting. 75% is harvested and urea is applied annually at 122 kg/ha	2.68 ton/yr	4.65 lbs/yr	26.72 lbs/yr
Streambank Stabilization[1]		Nutrient	1000 linear feet of stabilization on both banks	160 ton/yr	160 lbs/yr	320 lbs/yr
Replace Seawalls with Natural Shoreline		Nutrient		***	***	***
Rain Barrels[2]		Nutrient	1 Acre contributing area to a 50 gallon rain barrell	0.2 ton/yr	0.15 lbs/yr	0.81 lbs/yr
Rain Gardens (Residential)[2]		Nutrient	1 acre of contributing area/BMP	0.18 ton/yr	0.1 lbs/yr	2 lbs/yr
Rain Gardens (Commercial)[2]		Nutrient	10 acres of contributing	4.63	6 lbs/yr	42 lbs/yr

BMP or Management Measure	Critical Area to be Addressed by BMP	Reason for Being Critical	Assumptions Used	Estimated Load Reduction per BMP		
				Sediment	Total Phosphorus	Nitrogen
	Himebaugh Drain, Wegner Ditch, Sherman Mill Drain, Fawn River Drain, Tamarack Lake, Clear Lake, Town of Orland, Lake James		area/BMP	ton/yr		
Curb Cuts (In combination with other LID practices)		Nutrient		***	***	***
Bioswale[2]		Nutrient	10 acres of contributing area/BMP	0.1 ton/yr	0.3 lbs/yr	0.6 lbs/yr
Infiltration Trench[2]		Nutrient	10 acres of contributing area/BMP	0.2 ton/yr	0.7 lbs/yr	4.0 lbs/yr
Pervious Pavement[2] (Commercial)		Nutrient	10 acres of contributing area/BMP	1.13 ton/y	4.35 lbs/yr	56.9 lbs/yr
Pervious Pavement[2] (Residential)		Nutrient	1 acre of contributing area/BMP	1.68	7.54	79.86
Encourage the Sale of Phosphorus Free Fertilizers at Local Retailers		Nutrient		N/A	N/A	N/A
Urban Fertilizer Education Program		Nutrient		N/A	N/A	N/A
Tree Planting[4]		Nutrient		N/A	N/A	N/A
Wildlife Exclusion at Stormwater Basins	All Critical Sub-watersheds	Nutrient and E. coli		***	***	***
Pet Waste Disposal Receptacle		Nutrient and E. coli		***	***	***
Native Vegetation Planting		Nutrient and E. coli		***	***	***
Extended Wet Detention[2]		Nutrient and E. coli	10 acres of contributing area/BMP	0.12 ton/yr	0.59 lbs/yr	5.56 lbs/yr
Riparian Buffers[1]		Nutrient and E. coli	LR model for streambank protection was used for 1000 linear feet on both banks of the stream	190 ton/yr	190 lbs/yr	320 lbs/yr
Filter Strip[2]		Nutrient and E. coli	1 acre of contributing area/BMP	2.10 ton/yr	3.42 ton/yr	11.63 lbs/yr

BMP or Management Measure	Critical Area to be Addressed by BMP	Reason for Being Critical	Assumptions Used	Estimated Load Reduction per BMP		
				Sediment	Total Phosphorus	Nitrogen
Repair/replace Leaking On-Site Waste Disposal Systems	All Critical Sub-watersheds	Nutrient and E. coli	4 people per household who use 60 gallons of water per day	248.2 lbs/yr	6.5 lbs/yr	55 lbs/yr
Drainage Water Management		Nutrient and E. coli		***	***	***
Blind Inlets		Nutrient and E. coli		***	***	***
Septic System Workshop		Nutrient and E. coli		N/A	N/A	N/A
Education Program Geared Toward Livestock Operators		Nutrient and E. coli		N/A	N/A	N/A
Limited Access Stream Crossing/Exclusion Fencing (along with Streambank Erosion Practices and/or Alternative Watering Facility)[2]		Nutrient and E. coli	30 head of dairy and/or beef cattle and 10 horses present on 50 acres of agriculture land	9.7 ton/yr	24.1 lbs/yr	194.2 lbs/yr
Rotational Grazing		Nutrient and E. coli		***	***	***
Manure Holding Facilities / Dry Stack Areas[1]		Nutrient and E. coli	40 head of dairy cows, 10 young heifers, and 10 horses and <24% paved/BMP	***	129 lbs/yr	1,426 lbs/yr
Comprehensive Nutrient Management		Nutrient and E. coli		***	***	***
Runoff Management System[1]		Nutrient and E. coli	40 head of dairy cows, 10 young heifers, and 10 horses and <24% paved/BMP	***	284 lbs/yr	***
Repair/replace Leaking On-Site Waste Disposal Systems[8]		Nutrient and E. coli	4 people per household who use 60 gallons of water per day	248.2 lbs/yr	6.5 lbs/yr	55 lbs/yr

BMP or Management Measure	Critical Area to be Addressed by BMP	Reason for Being Critical	Assumptions Used	Estimated Load Reduction per BMP		
				Sediment	Total Phosphorus	Nitrogen
Septic System Education and Outreach	All Critical Sub-watersheds	Nutrient and E. coli		N/A	N/A	N/A
Work With Local Planners to Establish Rules for Proper Septic System Usage/Placement/Inspection		Nutrient and E. coli		N/A	N/A	N/A

[1]Region 5 Load Reduction Model; [2]STEP-L Load Reduction Model; ***Too many variables, too new of a technology to estimate, or a model does not exist to estimate load reductions; [3]SWAT Load Reduction Model, [4]A medium sized tree is estimated to uptake 2380 gallons of water annually (Center for Urban Forest Research, Pacific Southwest Research Station, USDA Forest Service, Davis, California. July 2002); [5]TP loss estimated to be cut by 57% according to a study in the periodical Agricultural and Food Science, [6]DRP loss is estimated to be cut by 66% and sediment by 56% compared to controls fields reported in the National Soil Erosion Research Laboratory, [7]Extensive Green Roofs have the capacity to absorb 50% of rainfall, [8]Estimates found in the Onsite Wastewater Treatment Systems Manual, US EPA, 2002.

6.3 Action Register to Accomplish Goals

The goals set by the Fawn River Watershed Steering Committee are ambitious; therefore the steering committee determined objectives to help the project reach the goals set by the steering committee. Each objective has milestones to reach within a certain timeframe to determine the progress toward achieving each of the goals. The following tables are Action Registers which outline the management measures that will need to be implemented in order to reach the goals set for this project. The first Table is a general Action Register for the project as a whole, identifying specific tasks that need to be accomplished to implement the entire WMP including hiring personnel and acquiring funding, providing education and outreach, acquiring necessary partnerships, and developing and promoting a cost-share program. The following Tables are Action Registers for each critical area to address the pollutants or management measures that are causing the areas to be impaired. The critical area Action Registers outline the number of BMPs that will need to be installed within critical area to reach the necessary load reductions to meet target levels. Milestones are set for each of the BMPs stating how many, and/or what size of BMP will be installed to meet the goals set by this project. BMPs are not determined per sub-watershed as it is unknown where implementation will be successful, but rather the total number, or size, or BMP needed to reach the total load reduction necessary to meet the target load is presented.

6.3.1 General Action Register for Implement

The following table consists of general objectives necessary to implement the Fawn River Watershed Management Plan and reach all goals outlined in Section 6.1 on this WMP including reducing nutrient and E. coli loading, and protect and restore wetlands within the critical areas.

Table 6.1: General Action Register for Personnel and Funding

Hire Personnel and Acquire Necessary Funding					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Implement the Fawn River Watershed Management Plan	Fawn River Watershed Stakeholders	Within the First Two Years after WMP Approval then ongoing	Hire personnel to implement the WMP (6 months)	$50,000/ year	County SWCD and NRCS offices, Friends of the St. Joe River Assoc., IDEM, IN DNR, MDEQ and MI DNR, OEPA (P and TA)
			Secure Funding to Implement the WMP including any office overhead and salaries (6 months)	$1,000	
			Secure funding to promote education and outreach programs (6 months)	***	
			Secure Funding to Begin Water Quality Sampling Efforts (2 years)	***	

*** Cost included in salary.

Table 6.2: General Action Register for Education and Outreach

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop and Implement an Agriculture Education and Outreach Program	Fawn River Watershed Stakeholders Located within Critical Areas	Within the First 12 Months after WMP Approval then ongoing	Compile an ag. Education/Outreach Plan (6 months)	***	County Lakes Councils, SWCD, FSA, and NRCS offices (P, TA) Friends of the St. Joe River Assoc. (P, TA), The Nature Conservancy (P, TA)
			Develop and/or Disseminate an Ag. Education Brochure (8 months)	$4,000	
			Hold First Annual Ag. BMP Workshop/Field Day (12 months)	$1,500 / year	
			Meet with Amish Bishops to Get "buy-in" for Education Programs Within the Amish Community (6 months)	***	
Develop and Implement an Agriculture Education and Outreach Program Specific to Livestock Operators	Fawn River Watershed Livestock Operators	Within the First 12 Months after WMP Approval then ongoing	Compile a livestock education/outreach plan (6 months)	***	County Lakes Councils, SWCD, FSA, and NRCS offices (P, TA) Friends of the St. Joe River Assoc. (P, TA)
			Develop and/or disseminate a livestock education brochure (8 months)	$2,000	
			Hold first annual pasture walk (12 months)	$500 / year	
			Meet with Amish Bishops to Get "buy-in" for Education Programs Within the Amish Community (6 months)	***	
Develop and Implement an Urban Education and Outreach Program	Fawn River Watershed Stakeholders in Critical Areas (Sturgis, Angola)	Within the First 24 Months after WMP Approval then ongoing	Compile an urban education and outreach plan (12 months)	***	County Planning Commissions (P) Angola, Fremont, Sturgis, Administrators, MS4 coordinators and Decision
			Develop and/or disseminate an urban education brochure (12 months)	$4,000	

Provide Education and Outreach in Critical Areas					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
			Hold first Annual urban BMP Workshop (18 months)	$1,000 / year	Makers (P), County Lakes Councils and SWCDs (P, TA)
			Install a Demonstration Urban BMP that has not yet been utilized in that urban setting (18 months)	$2,000	
Develop and Implement a Septic System Educational Program	Fawn River Watershed Stakeholders who Utilize Septic Systems	Within the First 18 Months after WMP Approval then ongoing	Develop and/or Disseminate a Septic System Maintenance Brochure (18 months)	$4,000	County Health Departments and SWCDs (P,TA) Area Septic System Businesses (P, TA)
			Hold First Annual Septic System Workshop for homeowners (18 months)	$1,000/ year	
Develop and Implement a Wetland Educational Program	Fawn River Watershed Stakeholders	Within the First 12 Months after WMP Approval then ongoing	Compile a Wetland Education and Outreach Plan (6 months)	***	County SWCD and NRCS Offices (P, TA), IN DNR and MI DNR (P), The Nature Conservancy (P, TA), Friends of the St. Joe River Assoc. (P, TA), County Planning Offices (P)
			Develop and/or Disseminate a Brochure Discussing the Ecological and Environmental Services Offered by Wetlands (8 months)	$4,000	
			Hold First Annual Wetland Field Day to Promote Preservation and Construction of Wetlands. (12 months)	$500	

*** Cost included in salary.

Table 6.3: General Action Register for Partnerships

Partner with Key Organizations to Assist with WMP Implementation					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Partner with Organizations who are Providing Education/Outreach or cost assistance with Septic Issues	Fawn River Watershed Septic System Stakeholders	Within the First 18 Months after WMP Approval	Meet with County Health Departments Annually to Discuss Septic Issues (12 months)	***	County and State Health Departments and SWCDs (P,TA), EPA (TA), Local Septic System Businesses (P)
			Work with Local Septic System Businesses to offer discounts to stakeholders who sign up for regular septic maintenance including pump-outs and inspections. (12 months)	$500/ year	
Partner with Municipalities and other Organizations who are Providing Education and Outreach or Cost Assistance with Urban Stormwater Issues	Fawn River Watershed Urban Stormwater Stakeholders	Within the First 18 Months after WMP Approval	Make contact with City and County Planners / MS4 Coordinators (12 months)	***	County Planning Commissions and SWCDs (P) Angola, Fremont, and Sturgis Administrators, MS4 coordinators and Decision Makers (P)
			Meet with City and County Decision Makers Bi-annually (12 months)	***	
			Work with City and County Planners to Encourage Low Impact Design for New Developments (18 months)	***	
			Partner with organizations that currently provide urban education and outreach (12 months)	***	

Partner with Key Organizations to Assist with WMP Implementation					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Partner with County Lakes Councils	Fawn River Watershed Recreation Stakeholders	Within the First 12 Months after WMP approval then ongoing	Make contact with Lakes Councils and Lake Associations to discuss enforcing a phosphorus free fertilizer policy and replacement of seawalls with natural shorelines (6 months)	***	Steuben and LaGrange County Lake Councils (P), County SWCDs (P), All Private Lake Associations (P), IN DNR and MI DNR (P, TA)
			Meet with Organizations who have agreed to be partners bi-annually (12 months)	***	

*** Cost included in salary.

Table 6.4: General Action Register for Tracking Indicators

Milestones for Indicators of Reaching Goals (not covered elsewhere)					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Disseminate and Analyze Social Indicator Study for Septic Systems	Fawn River Watershed Stakehodlers who Utilize Septic Systems	Within 2 Years after WMP Approval	Social Indicator Study for Septic Systems Developed and Disseminated at Workshops (18 months)	$1,000	County SWCDs and Health Departments (P, TA)
			Social Indicator Study Analyzed (24 months)		
Water Quality Sampling	Fawn River Watershed Stakeholders	Within 5 Years after WMP Approval	Water Quality Sampling Begins at historic critical sites for Turbidity, TDS, TSS, Nitrate+Nitrite, TP, and *E. coli* at a minimum	$25,000/ year	County SWCDs (P), County Lakes Councils (P), Regional Sewer Districts and Cities of Angola and Sturgis (P)

Table 6.5: General Action Register for Cost-Share Program

Develop and Promote Cost-share Programs					
Objective	**Target Audience**	**Implementation Timeframe**	**Milestone**	**Estimated Cost**	**Partners (P) / Technical Assistance (TA)**
Develop, and Promote a Cost-share Program on BMPs to Reduce Pollutant Loadings	Fawn River Watershed Stakeholders	Within the First 18 Months after WMP Approval	Secure Funding to Implement the Cost-share Program (12 months)	***	County SWCD, FSA, and NRCS Offices (P) City and County Parks Departments (P) MS4 Coordinators and LTCP Implementers (P), The Nature Conservancy (P, TA), Purdue and Michigan State Extensions (P, TA), IDEM, IN DNR, MDEQ, MI DNR (P, TA)
			Program Developed for Agriculture Cost Share Opportunities (6 months)	***	
			Develop and disseminate an Ag. Cost-share Brochure (8 months)	$1,500 / year	
			Program Developed for Urban Cost Share Opportunities (12 months)	***	
			Develop and disseminate an Urban Cost-share Brochure (18 months)	$1,500/ year	
			Program Developed for Lake homeowner Cost Share Opportunities (8 months)	***	
			Develop and disseminate a Lake Cost-share Brochure (10 months)	$1,500/ year	
			Program Developed for Wetland Restoration Cost Share Opportunities (6 months)	***	
			Develop and disseminate a Wetland Cost-share Brochure (8 months)	$1,500/ year	

*** Cost included in salary.

6.3.2 Action Registers to Implement Cost-share Program in Each Sub-watershed

The following sub-sections include action registers for the implementation of a cost-share program in the critical areas outlined in Section 5 of this WMP. The Action Registers include information regarding the number of BMPs that will be installed annually, the total that will be installed over the next 15 years, the total cost of implementation over the 15 year period, as well as the total load reduction that will be achieved annually should all the BMPs be installed as outlined within the Action Register. It is important to note that the load reduction of each BMP often compounds year after year. For example, the annual load reduction from implementation of no-till will be greater in year three of no-till farming than it was during the initial year of implementation. Therefore, the overall load reduction may be greater than is projected from the models. Water quality testing after 3-5 years of implementation will aid in understanding what the actual load reduction is from BMP efforts. Additionally, not all the BMPs that will be implemented in the project area can be modeled in one of the available load reduction models, and therefore, not all BMPs listed in the following Action Registers will have load reductions associated with them.

Table 6.6: Implementation Action Register for Urban and Lake Residents

Nutrient and E. coli Critical Areas: Priority 1 - (Nutrients) Himebaugh Drain, Sherman mill Creek, Fawn River Drain (E. coli) Sample Sites 12, 13, 15, 40, 47; Priority 2 - (Nutrients) Lake James, Tamarack Lake, Clear Lake (E. coli) Sample Site 1, 4, 28, 32, 39, 52										
Objective	**Target Audience**	**Imple-mentation Timeframe**	**Action**	**Milestone**	**Quantity**		**Load Reduction**			**Estimated Total Cost**
					Annual	**Total**	**Sediment (tons/yr)**	**Phosphorus (lbs/yr)**	**Nitrogen (lbs/yr)**	
Implement Urban BMPs to Reduce Pollutant Loads in Critical Areas	Urban and Lake Home-owners	Within 15 Years of WMP Approval	Rain Barrels	Install 10 rain barrels/year	10	150	2	1.5	8.1	$7,500
			Rain Gardens (Residential)	Install 5 gardens/year	5	75	0.9	0.5	10	$15,000
			Rain Gardens (Commercial)	Install 2 garden/year	2	30	9.26	12	84	$30,000
			Curb Cuts (in combination with other LID practices)	1 project every 2 years	0.5	7	***	***	***	$55,000
			Bioswale	1 project every 2 years	0.5	7	0.05	0.15	0.3	$35,000

Nutrient and E. coli Critical Areas: Priority 1 - (Nutrients) Himebaugh Drain, Sherman mill Creek, Fawn River Drain (E. coli) Sample Sites 12, 13, 15, 40, 47; Priority 2 - (Nutrients) Lake James, Tamarack Lake, Clear Lake (E. coli) Sample Site 1, 4, 28, 32, 39, 52										
Objective	**Target Audience**	**Imple-mentation Timeframe**	**Action**	**Milestone**	**Quantity**		**Load Reduction**			**Estimated Total Cost**
					Annual	**Total**	**Sediment (tons/yr)**	**Phosphorus (lbs/yr)**	**Nitrogen (lbs/yr)**	
Implement Urban BMPs to Reduce Pollutant Loads in Critical Areas	Urban and Lake Home-owners	Within 15 Years of WMP Approval	Extended Wet Detention	1 project every 3 years	0.33	5	0.0396	0.1947	1.8348	$75,000
			Infiltration Trench	1 project every 3 years	0.33	5	0.066	0.231	1.32	$75,000
			Pervious Pavement (Residential)	Install 1 every 2 years	0.5	7	0.565	2.175	28.45	$55,000
			Pervious Pavement (Commercial)	Install 1 every 5 years	0.2	3	0.336	1.508	15.972	$30,000
			Native Vegetation Planting	Install 1 acre every 2 years	0.5	7	***	***	***	$35,000
			Pet Waste Disposal Receptacles	Install 2 in each urban park	2	20	***	***	***	$2,000
			Wildlife Exclusion at Stormwater Basins	Install 1 exclusion every 2 years	0.5	7	***	***	***	$35,000
			Encourage the sale of phosphorus free fertilizers at local retailers	Meet with all local retailers within 24 months of WMP approval						***

Nutrient and E. coli Critical Areas: Priority 1 - (Nutrients) Himebaugh Drain, Sherman mill Creek, Fawn River Drain (E. coli) Sample Sites 12, 13, 15, 40, 47; Priority 2 - (Nutrients) Lake James, Tamarack Lake, Clear Lake (E. coli) Sample Site 1, 4, 28, 32, 39, 52										
Objective	**Target Audience**	**Imple-mentation Timeframe**	**Action**	**Milestone**	**Quantity**		**Load Reduction**			**Estimated Total Cost**
					Annual	**Total**	**Sediment (tons/yr)**	**Phosphorus (lbs/yr)**	**Nitrogen (lbs/yr)**	
Implement Urban BMPs to Reduce Pollutant Loads in Critical Areas	Urban and Lake Home-owners	Within 15 Years of WMP Approval	Encourage Lake associations to institute a ban on the use of phosphorus fertilizers	Meet with all lake associations within 18 months of WMP approval						***
			Begin an urban tree planting program	Plant 10 trees annually	10	150				$15,000
			Replace sea walls with Natural Shoreline protection	Install 1 natural shoreline within 2 years and 1 annually thereafter	1	14				$100,000

Table 6.7: Implementation Action Register for Agriculture Producers

Nutrient and E. coli Critical Areas: Priority 1 - (Nutrients) Himebaugh Drain, Sherman mill Creek, Fawn River Drain (E. coli) Sample Sites 12, 13, 15, 40, 47; Priority 2 - (Nutrients) Lake James, Tamarack Lake, Clear Lake (E. coli) Sample Site 1, 4, 28, 32, 39, 52										
Objective	**Target Audience**	**Imple-mentation Timeframe**	**Action**	**Milestone**	**Quantity**		**Load Reduction**			**Estimated Total Cost**
					Annual	**Total**	**Sediment (tons/yr)**	**Phosphorus (lbs/yr)**	**Nitrogen (lbs/yr)**	
Implement Agricultural BMPs to Reduce Pollutant Loads	Agriculture Producers in Critical Areas	Within 15 Years of WMP Approval	Nutrient / Pesticide Management	1000 new acres annually	1000	15,000	614	1100	6670	$300,000
			Cover Crops	1500 new acres/yr	1500	22,500	16500	18000	33000	$700,000
			Two-stage Ditch	1 project every 2 years	1000 lf/ 2 years	7000 lf	80	80	160	$250,000
			Conservation Tillage	1000 acres annually	1000	15000	770	120	2370	$300,000
			Blind Inlets	2 annually	2	30				$30,000
			Drainage Water Management	2 annually	2	30				$60,000
			Soil amendments - Gypsum	500 new acres annually	500	7500	235	745	-	$300,000
			Native Vegetation Planting	200 new acres annually	200	3000	536	930	5344	$500,000
			Filter Strips	Install 2 annually with 150 acre contributing area	2 / 300 acres	30 / 4500 acres	63	102.6	348.9	$120,000

Nutrient and E. coli Critical Areas: Priority 1 - (Nutrients) Himebaugh Drain, Sherman mill Creek, Fawn River Drain (E. coli) Sample Sites 12, 13, 15, 40, 47; Priority 2 - (Nutrients) Lake James, Tamarack Lake, Clear Lake (E. coli) Sample Site 1, 4, 28, 32, 39, 52										
Objective	**Target Audience**	**Imple-mentation Timeframe**	**Action**	**Milestone**	**Quantity**		**Load Reduction**			**Estimated Total Cost**
					Annual	**Total**	**Sediment (tons/yr)**	**Phosphorus (lbs/yr)**	**Nitrogen (lbs/yr)**	
Implement Agricultural BMPs to Reduce Pollutant Loads	Agriculture Producers in Critical Areas	Within 15 Years of WMP Approval	Riparian Buffers	Install 1500 lf annually	1500	22,500	285	285	480	$400,000
			Streambank Stabilization	500 lf annually for 10 years	500	5000	80	80	160	$500,000
			Livestock Exclusion	2 annually until no access exists	2	2	19.4	48.2	388.4	$15,000
			Comp. Nutrient Management	2 annually	2	20				$60,000
			Runoff Management Systems	2 annually until no access exists	2	2				$15,000

Table 6.8: Implementation Action Register for Wetland Restoration

Wetland Restoration Critical Area: Priority 1 - Clear Lake, Sherman Mill Creek, Fawn River Drain, Himebaugh Drain, Wegner Ditch; Priority 2 - Town of Orland, Snow Lake, Lake James, Tamarack Lake										
Objective	**Target Audience**	**Imple-mentation Timeframe**	**Action**	**Milestone**	**Quantity**		**Load Reduction**			**Estimated Total Cost**
					Annual	**Total**	**Sediment (tons/yr)**	**Phosphorus (lbs/yr)**	**Nitrogen (lbs/yr)**	
Restore Pre-Settlement Wetlands	Stake-holders Located Within the Fawn River Watershed	Within 15 Years of WMP Approval	Wetland Restoration	Restore 100 acres of wetlands annually for 5 years, then 500 acres annually for 10 years	100	5,500	5.93	8	48	$1,000,000

7.0 Potential Annual Load Reductions after Implementation

Actions outlined in Section 6 were determined by taking a combination of aspects of watershed management including how likely it is that landowners will be willing to participate in a cost-share program to implement BMPs and the potential load reductions that would result from their implementation. Using the Spreadsheet Tool for Estimating Pollution Load (STEPL), the Region 5 load reduction model, which both can be found at http://it.tetratech-ffx.com/steplweb/, and the recalibrated SWAT model provided by Purdue University, potential load reductions were determined for nitrogen, phosphorus, and sediment on a per BMP basis.

The two load reduction models available for public use at this time do have some limitations in that not all BMPs can be modeled and as stated earlier in this WMP, estimates for *E. coli* cannot be determined accurately. Therefore, narrative assumptions for the benefit of certain BMPs and possible load reductions will be provided.

It is important to note that assumptions were made for the model inputs as exact acreage of implementation is dependent on the support for participation that is received by landowners in the critical areas as outlined in Section 5. The load reductions presented in this document are derived from a model and are best guess scenarios only, and only account for the BMPs which planned to be installed as part of this project, assuming that no BMPs were installed in the past, or are currently being used. It is understood throughout the conservation community that load reductions from BMPs have a cumulative effect and that the reductions in pollutant loads will increase exponentially as they are implemented year after year or in combination with other BMPs. Accurate load reductions will be determined when the water quality analysis is performed on historic sample sites in the Fawn River Watershed after three to five years of implementation. Table 7.1 shows the estimated load reduction after implementation of the Action Registers outlined in Section 6 for all critical areas. As can be seen in Table 7.1, according to estimated load reductions from various models the sediment, total phosphorus and nitrogen goals as outlined in Section 6.1 will not only be met, but likely exceeded by the end of the 15 year Fawn River Watershed Management Plan implementation.

Table 7.1: Estimated Load Reductions after Implementation

	Load Reduction			Estimated Total Cost
	Sediment (tons/yr)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)	
Estimated Total	19201.5466	21517.0587	49119.2768	$5,114,500
Necessary Annual Load Reduction	0	27300	970,140	
Annual Percent Reduction	-	78.82%	5.06%	
Estimated Load Reduction at Project End	288,023	322,756	736,789	
Percent Reduction at Project End	-	100.00%	75.95%	

8.0 Future Activities

After extensive research conducted over two and a half years in the Fawn River Watershed, the resulting Watershed Management Plan is full of valuable information regarding common land uses and practices, as well as historic and present day water quality issues found in each subwatershed located within the Fawn River watershed. However, this information is not common knowledge therefore; key findings in the WMP and the cost-share program will be introduced to the public through at least one annual public meeting held in Indiana and Michigan, within months of the final WMP approval by the IDEM, MDEQ, and US EPA. The meetings will be advertised through local media outlets including newspapers, Lake Associations, SWCD, NRCS, and FSA offices. Other means of advertisement will be pursued as well. Informing the Fawn River stakeholders on the extent of the water quality problems within the watershed will hopefully illicit concern as well as a willingness to change behaviors to have a positive impact on water quality.

Next steps in the Fawn River Watershed project is for the Steering Committee to develop a cost-share program that will include, at a minimum, those management measures outlined in the Action Register in Section 6.3 of this WMP, and the various incentive levels that will be used to encourage the adoption of those management measures. The Steering Committee will work closely with all Conservation Districts located within the project area, as well as the partners outlined in the Action Register to make sure their cost-share recommendations are realistic for the demographic of the area, and to utilize their help for promoting the program. A key component of the cost-share program's success is the education and outreach aspect of the Fawn River Watershed project. Field days and workshops regarding agricultural, lake and urban land uses and BMPs will be held annually, as part of this project, however, partnering with other organizations such as other county SWCD and NRCS offices, The Nature Conservancy, the IN and MI DNR, and smaller non-profit groups that focus on water quality and sustainable land uses, will prove to be integral in promoting practices to improve the health of the watershed.

It is anticipated and encouraged that this WMP be reviewed and utilized by other organizations within the Fawn River Watershed including the Friends of the St. Joe River Association, LaGrange and Steuben County Lake Associations, Steuben, LaGrange, and St. Joseph County SWCDs, The Nature Conservancy, County Drainage Boards, Surveyors and Engineers, City and County Planning Departments, and other organizations concerned about the water quality of the Fawn River Watershed. The Fawn River Watershed project's first priority will be to obtain funding to pursue the objectives outlined in the Action Register; however we hope to work with other organizations that plan to do the same. As the point of contact for this WMP, the LaGrange County SWCD will distribute the document to all stakeholder organizations (a distribution list is located at the end of this document), as well as have hard copies of the document available to borrow, or purchase at the SWCD office located at 910 S. Detroit St. LaGrange, IN.

A watershed is continually changing as land uses change, towns begin to expand, new businesses organize in the area, farmland is converted to other uses, or wetlands are drained or moved to accommodate development or farming. These changes in the Fawn River Watershed

particularly have continued to have an enormous impact on water quality and the aquatic habitat in area lakes, and in the river itself. As the watershed continues to change so must the actions taken to maintain and/or improve the integrity of the water quality. Therefore, the Fawn River Watershed Management Plan must remain a 'living document' and goals, objectives, and actions outlined in the WMP must be revisited by the LaGrange SWCD, or its partners, at a minimum, every ten years. However, as area stakeholders including residents, conservation organizations and planners, City and Town governments, or others working on the implementation of the Fawn River Watershed Management Plan observe land uses and/or water quality changing, the WMP must be revised to meet the area conservation needs and provide a refocus of efforts if necessary, at that time.

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