Section 3 – Identify Problems

Group Concerns

The results of the Watershed Inventory and stakeholder concern analysis in Section 2 indicate that the group concerns can be described in four general areas. Table 43 lists the concerns that the group will focus on and the problem associated with each group. Some concerns are listed in several problem groups as they cover a wide variety of issues.

Table 43: Concerns and Associated Problems	
Concern	**Problem Category**
-How to prioritize numerous watershed concerns for maximum improvement -Education and outreach of watershed issues -Changing public perception on stormwater as a bi-product -Stewardship quality/too few interested parties within watershed -Public concern over blue-green algae -Safety of using water for irrigation due to presence of blue-green algae	Public Participation/Education and Outreach
-Stormwater after rain event -Water clarity -Polluted runoff – nonpoint source pollution -Failing septic systems impact to water quality -Phosphorus -Brown water -Conflict between water quality and production agriculture -Nutrient management -Farming in Tipton County increase sediment and nutrients to watershed -Atrazine -Buffer areas -Residential fertilizer use -Livestock access to surface water within the watershed -Habitat degradation -Big Cicero habitat degradation -Public concern over blue-green algae -Skin irritation/toxin -Safety of using water for irrigation due to presence of blue-green algae	Stream & Reservoir Nutrient Levels
-Stormwater after rain event -Water clarity -Polluted runoff – nonpoint source pollution -Failing septic systems impact to water quality -*E. coli* in Little Cicero -Brown water -Buffer areas -Livestock access to surface water within the watershed -Habitat degradation -Big Cicero habitat degradation -Manure management	*E. coli* Levels

Table 43: Concerns and Associated Problems, cont.	
Concern	**Problem Category**
-Silt inputs from watershed into Morse Reservoir -Stormwater after rain event -Big Cicero erosion -Water clarity -Polluted runoff – nonpoint source pollution -Streambank deterioration caused by severe erosion -Brown water -Ditch maintenance -Buffer areas -Livestock access to surface water within the watershed -Water quality pre and post construction -Silt from construction sites -Runoff from construction sites -Erosion control at construction sites -Streambank erosion -Habitat degradation -Streambank stabilization -Big Cicero habitat degradation -Need for dredging	Erosion and Sedimentation within the Watershed & Reservoir

Problem Statements

Problem statements were developed during the planning process in an effort to link watershed concerns with existing and historical water quality data and the four major concern categories. Following each problem statement is a brief synopsis on how the data analyzed within the Watershed Inventory correlates with the identified problem.

It should be noted that there were originally six problem statements which separated the stream and reservoir issues (e.g. nutrients and sediment). In order to limit the amount of information that would be repeated from one problem statement to the next, the nutrient and sediment problem statements for streams and the reservoir were combined into one problem statement.

Public Participation/Education and Outreach

Stakeholders in the Morse Reservoir/Cicero Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.

The data analyzed during the Watershed Inventory does not directly correlate to the Public Participation/Education and Outreach problem statement. It is difficult to measure the impacts of the lack of knowledge on a specific pollutant of concern; however conversations at the public meeting and steering committee meetings validated the concern.

Stream & Reservoir Nutrient Levels

Agriculture and typical urban area practices (e.g. lawn care, pet waste disposal, erosion control during construction…etc.) within the watershed contributes a significant amount of pollutants, thereby contributing to the frequent exceedances of water quality targets and growth of algae within the reservoir.

IDEM water quality data and the CIWRP study both verified the exceedances of nutrient concentrations and directly correlate to the problem statement. According to the CIWRP data, all subwatersheds exceeded the Nitrate + Nitrite target of 1.6 mg/L by at least 69%, while in the IDEM data 6 subwatersheds (no data available for four subwatersheds) exceeded the target by at least 281%. Similarly, the phosphorus target of 0.076 mg/L was exceeded in all subwatersheds according to the CIWRP data by at least 97% and 6 subwatersheds exceeded the target by at least 28% in the IDEM data(no data available for three subwatersheds). Approximately 88% of the sampling points do drain to or from the reservoir. During the subwatershed analysis, the average of data points was used to determine the impairments of the subwatersheds relative to each other. Rather than reanalyzing the data, the reservoir and agricultural nutrient levels are assumed to be the same within the problem statements.

E. coli Levels

E. coli levels in the watershed regularly exceed the state standard, based on current and historical water quality data results, and often exceed safety standards for recreational use in streams.

IDEM water quality data and the CIWRP study both verified the exceedances of *E. coli* levels and directly correlate to the problem statement. According to the CIWRP data, all subwatersheds exceeded the *E. coli* target of 235 CFU/100mL by at least 569%, while in the IDEM data all subwatersheds exceeded the target by at least 40%.

Erosion and Sedimentation within the Watershed & Reservoir

Soil erosion and sedimentation within the watershed is degrading the water quality/quantity and limiting the aesthetics, wildlife habitat, and aquatic health of the streams and reservoir within the watershed.

IDEM water quality data and the CIWRP study both verified the exceedances of total suspended solids and directly correlate to the problem statement. According to the CIWRP data, seven subwatersheds exceeded the TSS target of 30 mg/L by at least 10% (no data available for one subwatershed), while in the IDEM data two subwatersheds exceeded the target by 55% (no data available for three subwatersheds).

Review of the Google and Bing aerials showed very distinctive areas at the confluences of Cicero Creek and Hinkle Creek where the reservoir is functioning as a sediment trap. Further analysis specific to sediment issues with in the reservoir (e.g. current and future bathymetric surveys, feasibility of BMPs immediately upstream of the reservoir to reduce sediment loads, sediment removal plans, TSS sampling etc.) should be completed as a part of implementing this plan and as a way to track the effectiveness of any BMP projects that focus on sediment reduction.

Section 4 – Identify Causes, Sources and Load Reductions

Potential Causes & Sources

A cause is an event, agent, or series of actions that produces an effect. In the context of a watershed management plan, the effect is the problem. Potential causes were identified for each problem statement based on the information summarized in the Watershed Inventory in Section 2. Where applicable, potential causes were related to specific pollutant parameters identified during the Watershed Inventory. A source is an activity, material or structure that results in nonpoint source pollution. Potential sources were identified for each problem statement based on the information analyzed in the Watershed Inventory in Section 2. Table 44 lists the potential causes and sources for each problem. For causes and sources that did not have IDEM, CIWRP or other agency collected data as backup, the information was obtained during the Steering Committee meetings, Public meetings or during the windshield survey.

Table 44: Potential Causes & Sources

Problem Statement	Potential Causes	Potential Sources
Stakeholders in the Morse Reservoir/Cicero Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.	-Lack of public awareness -Lack of unified approach -Lack of perceived benefits/ impacts -Lack of interest -Lack of time and commitment -Lack of media coverage/ educational material	- N/A, not applicable for administrative or social problems
Agriculture and typical urban area practices (e.g. lawn care, pet waste disposal, erosion control during construction…etc.) within the watershed contributes a significant amount of pollutants, thereby contributing to the frequent exceedances of water quality targets and growth of algae within the reservoir.	-Application of fertilizers that include Phosphorus -Over application of fertilizers for its specific use -Timing of application of fertilizers -Unsewered communities -Lack of septic maintenance -Undersized/old combined sewer systems -Improper disposal of yard waste -Lack of manure management -Lack of adequate buffers -Livestock access to ditches/streams -Improper disposal of pet/Canada goose waste -Municipal sludge management	-Residential lawns that drain directly to the reservoir with no or inadequate buffers -Conventionally tilled agricultural fields that drain directly to ditches/streams with no or inadequate buffers -Areas where live stock have direct access to streams -Areas with inadequate buffers -Communities with Combined Sewers and Overflows into ditches/streams -Communities with no sewer systems and direct discharges to ditches/streams

Table 44: Potential Causes & Sources, cont.		
Problem Statement	**Potential Causes**	**Potential Sources**
E. coli levels in the watershed regularly exceed the state standard, based on current and historical water quality data results, and often exceed safety standards for recreational use in streams.	-Illegal or improper septic systems -Inadequately functioning septic systems -Unsewered communities -Undersized/old combined sewer systems -Improper disposal of pet/Canada goose waste -Livestock access to ditches/streams -Lack of manure management -Lack of adequate buffers -Exceedances in NPDES permitted discharges	-Locations with improperly maintained septic systems -Communities with Combined Sewers and Overflows into ditches/streams -Communities with no sewer systems and direct discharges to ditches/streams -Areas with inadequate buffers -Locations where pet/Canada goose waste is disposed of directly into the reservoir -Confined Feeding Operations -Areas where live stock have direct access to streams -Areas with inadequate buffers -Locations of NPDES permitted facilities not in compliance
Soil erosion and sedimentation within the watershed is degrading the water quality/quantity and limiting the aesthetics, wildlife habitat, and aquatic health of the streams and reservoir within the watershed.	-Agricultural land/row crop production -Lack of temporary erosion control on construction sites -Lack of Rule 5 enforcement -Frequency of ditch maintenance -Lack of infiltration due to increased impervious areas -Streambank erosion -Livestock access to streams -Areas with inadequate stream buffers	-Conventionally tilled agricultural fields with no or inadequate buffers -Locations where on-going developments/construction sites have inadequate temporary erosion control measures -Locations where non-active construction sites have inadequate permanent erosion control measures -Ditches/streams that are frequently dredged/maintained

It should be noted that a non-active construction site is considered to be a site that has been hydrologically altered (e.g. trees have been cleared, topsoil/vegetation has been stripped) and the site is just bare ground with no permanent erosion control measures in place.

Pollutant Loading

Current Loading Calculation Methodology

Nitrate + Nitrite, Total Phosphorus, *E. coli* and Total Suspended Solids were identified as potential issues for several of the problem statements. In order to determine the extent of the current problem, current loads must be determined for comparison to target or known water quality targets.

There are several ways to estimate the current pollutant loads in a watershed, including nonpoint source modeling and actual sampling data. Both sources of information are available for the Morse Reservoir/Cicero Creek Watershed. With the extent of water quality data available from IDEM and CIWRP, it was determined that the most accurate estimate for pollutant loads would incorporate the available water quality data rather than the modeling results.

Two data sets, IDEM (1996-2009) and CIWRP (2003), sampled for Nitrate + Nitrite, Total Phosphorus, *E. coli* and TSS. Instead of averaging these two data sets together, the most recent data available for each subwatershed was used for the calculations. The IDEM data included sampling dating back to 1996, however, each subwatershed contained sampling locations as recent as 2006 therefore the most recent data for each parameter within the subwatershed was utilized for the loading calculation. The entire list of available IDEM data/reports obtained is included in the Available Data and Studies section of the WMP. The mean value of each parameter was then calculated on a subwatershed-wide scale. For the purposes of a watershed management plan, the pollutant loads need to be calculated in either pounds per year or tons per year. Since the water quality data was provided in units of mg/L and CFU/100mL, a flow rate was needed for the conversion. There is one USGS gaging station located within the Morse Reservoir/Cicero Creek Watershed. The station, number 03349510, is located on Cicero Creek at Arcadia. Average annual flow data is available for this station from 2004-2008. At the gage site, the drainage area is 131 square miles and the average annual flow is 171.3 cfs. This flow was scaled to each subwatershed. IDEMs load calculation tool was then used to estimate the loads based on the flow and concentration data.

Target Loads

The target loads were identified based on known water quality guidelines or standards for each pollutant. These standards typically reference a concentration, therefore as described above, IDEMs load calculation tool was used to estimate the target loads based on the flow and standard concentration data.

The single sample state standard in Indiana for *E. coli* is 235 CFU/100 mL.

Levels of Total Nitrate and Nitrite greater than 10 mg/L exceed the water quality target for Nitrate and Nitrite as described in the Indiana Administrative Code (IAC). However, for this analysis, a target of 1.6 mg/L was identified as the EPA nutrient criterion for this ecoregion.

Levels of Total Phosphorus greater than 0.3 mg/L exceed the IDEM statewide draft TMDL target, while levels above 0.076 mg/L exceed the EPA recommended water quality targets. For this analysis, EPA's recommended target was used as the target.

Levels of TSS greater than 30 mg/L exceed the IDEM statewide draft TMDL target.

Load Reductions

Once the current loads and the target loads of each pollutant were determined, the required load reduction to meet the targets was calculated. Tables 45-48 show the current, target and reduction loads of *E. coli*, Nitrate+Nitrite, Total Phosphorus and Total Suspended Solids within the watershed.

Table 45: *E. coli* Pollutant Loading

Subbasin	Flow Rate (cfs)	Current Loading		Target Loading		Reduction Needed
		Concentration (CFU/100mL)	Load (CFU/year)	Concentration (CFU/100mL)	Load (CFU/year)	Load (CFU/year)
Prairie Creek	30.9	822	2.3×10^{14}	235	6.5×10^{13}	1.6×10^{14} (71.4%)
Cox Ditch	27.0	638	1.5×10^{14}	235	5.7×10^{13}	9.7×10^{13} (63.2%)
Dixon Creek	22.5	329	6.6×10^{13}	235	4.7×10^{13}	1.9×10^{13} (28.6%)
Buck Creek	24.3	2464	5.3×10^{14}	235	5.1×10^{13}	4.8×10^{14} (90.5%)
Tobin Ditch	43.1	1046	4.0×10^{14}	235	9.0×10^{13}	3.1×10^{14} (77.5%)
Weasel Creek	28.0	2041	5.1×10^{14}	235	5.9×10^{13}	4.5×10^{14} (88.5%)
Teter Branch	27.2	2585	6.3×10^{14}	235	5.7×10^{13}	5.7×10^{14} (90.9%)
Little Cicero Creek	29.4	3934	1.0×10^{15}	235	6.2×10^{13}	9.7×10^{14} (94.0%)
Hinkle Creek	26.3	1919	4.5×10^{14}	235	5.5×10^{13}	4.0×10^{14} (87.8%)
Morse Reservoir/Cicero Creek	36.2	864	2.8×10^{14}	235	7.6×10^{13}	2.0×10^{14} (72.8%)

Table 46: Nitrate+Nitrite Pollutant Loading						
Subbasin	Flow Rate (cfs)	Current Loading		Target Loading		Reduction Needed
		Concentration (mg/L)	Load (lb/year)	Concentration (mg/L)	Load (lb/year)	Load (lb/year)
Prairie Creek	30.9	7.5	456000	1.6	97200	358800 (78.7%)
Cox Ditch	27.0	7.4	393200	1.6	85000	308200 (78.4%)
Dixon Creek	22.5	7.5	332000	1.6	70800	261200 (78.7%)
Buck Creek	24.3	7.1	339400	1.6	76600	262800 (77.5%)
Tobin Ditch	43.1	7.1	602000	1.6	135600	466400 (77.5%)
Weasel Creek	28.0	6.1	336000	1.6	88200	247800 (73.8%)
Teter Branch	27.2	4.4	235400	1.6	85600	149800 (63.6%)
Little Cicero Creek	29.4	6.2	358600	1.6	92600	266000 (74.2%)
Hinkle Creek	26.3	2.7	139800	1.6	82800	57000 (40.7%)
Morse Reservoir/Cicero Creek	36.2	6.1	436400	1.6	114000	322400 (73.8%)

Table 47: Total Phosphorus Pollutant Loading						
Subbasin	Flow Rate (cfs)	Current Loading		Target Loading		Reduction Needed
		Concentration (mg/L)	Load (lb/year)	Concentration (mg/L)	Load (lb/year)	Load (lb/year)
Prairie Creek	30.9	0.152	9200	0.076	4600	4600 (50.0%)
Cox Ditch	27.0	0.103	5400	0.076	4000	1400 (26.2%)
Dixon Creek	22.5	0.152	6800	0.076	3400	3400 (50.0%)
Buck Creek	24.3	0.172	8200	0.076	3600	4600 (55.8%)
Tobin Ditch	43.1	0.118	10000	0.076	6400	3600 (35.6%)
Weasel Creek	28.0	0.109	6000	0.076	4200	1800 (30.3%)
Teter Branch	27.2	0.204	11000	0.076	4000	7000 (62.7%)
Little Cicero Creek	29.4	0.186	10800	0.076	4400	6400 (59.1%)
Hinkle Creek	26.3	0.334	17200	0.076	4000	13200 (77.2%)
Morse Reservoir/Cicero Creek	36.2	0.074	5200	0.076	5400	N/A (0.0%)

Table 48: Total Suspended Solids Pollutant Loading						
Subbasin	Flow Rate (cfs)	Current Loading		Target Loading		Reduction Needed
		Concentration (mg/L)	Load (ton/year)	Concentration (mg/L)	Load (ton/year)	Load (ton/year)
Prairie Creek	30.9	40.1	1219.0	30.0	912.0	307 (25.2%)
Cox Ditch	27.0	27.7	735.8	30.0	796.9	N/A (0.0%)
Dixon Creek	22.5	40.1	887.6	30.0	664.0	223.6 (25.2%)
Buck Creek	24.3	60.0	1434.3	30.0	717.2	717.1 (50.0%)
Tobin Ditch	43.1	13.5	572.4	30.0	1272.0	N/A (0.0%)
Weasel Creek	28.0	27.9	768.5	30.0	826.4	N/A (0.0%)
Teter Branch	27.2	26.5	709.1	30.0	802.8	N/A (0.0%)
Little Cicero Creek	29.4	32.9	951.6	30.0	867.7	83.9 (8.8%)
Hinkle Creek	26.3	32.9	851.2	30.0	776.2	75.0 (8.8%)
Morse Reservoir/Cicero Creek	36.2	9.6	341.9	30.0	1068.4	N/A (0.0%)

Section 5 – Set Goals and Identify Critical Areas

Goal Statements

Based on the identified concerns and possible sources, goal statements were developed for each problem statement. Implementation of policies and programs to meet these goal statements will improve watershed management in the Morse Reservoir/Cicero Creek Watershed. The goal statements indicate the ultimate goal for a specific project. In some cases this goal may not be attainable in the short term; therefore there is also a list of long term objectives included with each goal. Short term implies efforts will begin implementation in the years 0-5 and long term implies years 6-20. Timeframes for the objectives listed under each problem statement is provided in Section 7 – Action Register and Schedule in the Task Column. The goal statements themselves are typically the overall long term goal. It should be noted that some objectives may relate to several goal statements, they are listed in each applicable category.

Public Participation/Education and Outreach

Problem Statement: Stakeholders in the Morse Reservoir/Cicero Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.

Goal Statement: Develop and implement an education and outreach program within the watershed by 2031 (20 years).

Short Term Objectives:

- Effectively share and communicate past, current and future activities within the watershed
- Educate stakeholders within the watershed on the function of a watershed and their impacts to water quality
- Educate homeowners in urban communities about the use of fertilizers
- Coordinate efforts with the UWRWA, local MS4s, high schools, FFA/4-H groups, and any other education and outreach efforts being conducted within the watershed
- Work with Indiana Wildlife Federation on efforts to educate on and reduce the use of fertilizers containing phosphorus
- Educate stakeholders using septic systems about the importance of septic system maintenance

Long Term Objectives:

- Continue viable and effective short term objectives
- Educate agricultural stakeholders about the use of Atrazine and its impacts to water quality
- Utilize examples or pilot programs/demonstration projects for educational purposes
- Review education and outreach program within the watershed and continue development and implementation of the program

Stream & Reservoir Nutrient Levels

Problem Statement: Agriculture and typical urban area practices (e.g. lawn care, pet waste disposal, erosion control during construction…etc.) within the watershed contributes a significant amount of pollutants, thereby contributing to the frequent exceedances of water quality targets and growth of algae within the reservoir.

Goal Statement: Reduce the nutrient loads so that there are no exceedances of EPAs suggested targets for Nitrate + Nitrite of 1.6 mg/L and Total Phosphorus of 0.076mg/L by 2031 (20 years).

Short Term Objectives:

- Educate the agricultural stakeholders on the importance of reduced application of fertilizers and the urban/residential stakeholders on use of low phosphorus or no phosphorus fertilizers
- Educate local, regional, and state officials on the need for regulations for urban areas (specifically for phosphorus)
- Partner with NRCS, SWCDs, MS4s, Indiana State Department of Agriculture and County Boards to promote and implement cost share and/or education programs
- Promote and implement agricultural BMPs that will reduce nutrient levels in the watershed (e.g. alternative watering systems, buffer/filter strips, exclusionary fencing, conservational tillage, reforestation, stream restoration, wetland restoration, etc.)
- Promote and implement urban BMPs that will reduce nutrient levels in the watershed (e.g. filtration basins, pervious pavement, bioretention practices, etc.)

Long Term Objectives:

- Continue viable and effective short term objectives
- Educate and work with point discharges (CFOS, NPDES permitted facilities) to reduce their nutrient loads
- Establish a monitoring program or group to collect samples

E. coli Levels

Problem Statement: *E. coli* levels in the watershed regularly exceed the state standard, based on current and historical water quality data results, and often exceed safety standards for recreational use in streams.

Goal Statement: Reduce *E. coli* concentrations to meet the state standard of 235 CFU/100mL by 2031 (20 years).

Short Term Objectives:

- Educate stakeholders using septic systems about the importance of septic system maintenance
- Encourage urban/residential stakeholders to properly dispose pet and/or Canada goose waste
- Partner with NRCS, SWCDs, MS4s, Indiana Department of Agriculture and County Boards to promote and implement cost share and/or education programs
- Promote and implement agricultural BMPs that will reduce *E.coli* levels in the watershed (e.g. alternative watering systems, buffer/filter strips, exclusionary fencing, wetland restoration, etc.)

- Educate the public and stakeholders on the benefits of manure management practices

Long Term Objectives:
- Continue viable and effective short term goals
- Educate and work with point dischargers to reduce the amount of *E. coli* runoff from point sources, package plants, CFOs and CSOs
- Establish a monitoring program or group to collect samples

Proper disposal of pet and wildlife waste was a significant concern of the Steering Committee as it relates to waste which occurs on residential lawns around the reservoir. Wildlife waste was specifically referenced to the Canada goose waste being disposed of directly in the reservoir. Therefore an education program would encourage the proper disposal of this waste.

Erosion and Sedimentation within the Watershed & Reservoir

Problem Statement: Soil erosion and sedimentation within the watershed is degrading the water quality/quantity and limiting the aesthetics, wildlife habitat, and aquatic health of the streams and reservoir within the watershed.

Goal Statement: Reduce sediment loads to meet the IDEM statewide draft TMDL target of 30 mg/L for TSS by 2031 (20 years).

Short Term Objectives:
- Research cost effective ways to measure sediment change within the reservoir
- Research/evaluate the need and effectiveness of a sediment removal program
- Partner with NRCS, SWCDs, MS4s and County Boards to promote and implement cost share and/or education programs in order to reduce erosion from agricultural lands
- Promote and implement agricultural BMPs that will reduce TSS levels in the watershed (e.g. alternative watering systems, buffer/filter strips, exclusionary fencing, grassed waterways, naturalized stream buffers, conservational tillage, reforestation, stream restoration, wetland restoration, etc.)
- Promote and implement urban BMPs that will reduce nutrient levels in the watershed (e.g. filtration basins, infiltration trenches, naturalized detention basins, pervious pavement, rain barrels, rain gardens, bioretention practices, etc.)

Long Term Objectives:
- Continue viable and effective short term objectives
- Measure sediment change within the reservoir
- Encourage enforcement of erosion control practices associated with the issuance of Rule 5 construction permits
- Establish a monitoring program or group to collect samples

Monitoring the change in the sediment levels within the reservoir can be handled in a variety of ways. For example, one option could be to focus on the reservoir confluence with Hinkle Creek, as it is one of the areas that has an obvious sediment problem, and coordinate with land owners in that subwatershed to implement sediment reducing BMPs. Based on the

Streambank Erosion Critical Areas exhibit, there are at least 3 waterway crossing locations with greater than 3 feet of eroded streambanks in the Hinkle Creek subwatershed. Therefore, stream restoration or buffer/filter strip projects would be great in aiding in the reduction of sediment in this subwatershed and ultimately to the reservoir. Typically, a sediment removal plan can not be implemented unless the source has been identified and resolved. The ultimate decision on how to proceed with monitoring the sediment levels in the reservoir should be made by the Steering Committee as they are implementing the WMP.

It is difficult to put a cost to something without knowing the exact scope of the sediment removal project. However, in general, dredging costs vary greatly depending on the need for dewatering, access, disposal site location, and the type of dredging. Industry standards would suggest that hydraulic dredging can cost anywhere from $10-$20 per cubic yard and $12 to $35 per cubic yard for mechanical dredging. If there is a known project with a scope, it would be best to get bids from multiple contracts that specialize in this type of work.

Indicators

Indicators are measurable parameters or criteria which can used to determine the progress being made toward achieving a goal. Indicators were developed for each goal and objective. Some indicators may be appropriate for several categories and are listed for each applicable goal. As the watershed management plan is being implemented, it is anticipated that additional indicators will be identified; therefore this list is not intended to be comprehensive. Table 49 lists the indicators and the goals to which they are linked. An Education/Outreach Menu was developed by the UWRWA and V3 and is included in Appendix M. This menu includes various media for education and outreach. Since it is unknown at this time the preferred methods of outreach, several indicators refer to this menu in addition to specific outreach tools.

Table 49: Goals and Indicators	
Goal	**Indicators**
Develop and implement an education and outreach program within the watershed	-Number of updates to website -Number of newspaper/newsletter articles or other media communications -Number of brochures/educational materials distributed or field days organized -Number of programs and ideas utilized from the Education/Outreach Menu
Reduce the nutrient loads so that there are no exceedances of EPAs suggested targets for Nitrate + Nitrite of 1.6 mg/L and Total Phosphorus of 0.076mg/L.	-Observed Nitrate + Nitrite and Total Phosphorus concentrations -Number or stream miles of improved/created buffer zones and associated load reductions -Number of agricultural fields utilizing cover crops, conservation tillage, or other BMPs and associated load reductions -Number of urban BMPs installed (e.g. pond shoreline plantings, rain gardens) and associated load reductions -Nutrient loadings from point dischargers
Reduce *E. coli* concentrations to meet the state standard of 235 CFU/100mL	-Observed *E. coli* concentrations -Number or stream miles of stabilized streambanks and associated load reductions -Number of direct animal access points eliminated and associated load reductions -Number or stream miles of improved/created buffer zones and associated load reductions -*E. coli* loadings from point dischargers
Reduce sediment loads to meet the IDEM statewide draft TMDL target of 30 mg/L for TSS.	-Number of agricultural fields utilizing conservation tillage, cover crops or other BMPs and associated load reductions -Number or stream miles of improved/created buffer zones and associated load reductions -Number of inspections and/or enforcement actions on construction sites with Rule 5 permits -Number or stream miles of stabilized streambanks and associated load reductions -Number of direct animal access points eliminated and associated load reductions -Change in sediment amount in reservoir

Critical Areas

Critical areas are defined as areas where project implementation can remediate current water quality impairments or reduce the impact of future water quality impairments. The critical areas within the Morse Reservoir/Cicero Creek watershed were identified based on the Watershed Inventory, the identified problems and the goals of the Watershed Management Plan. Critical areas were split into two categories: Subwatershed Priority Areas and Specific Source Critical areas.

High Priority Subwatersheds

The Subwatershed Critical Areas were chosen based on the Watershed Inventory Rankings. Based on the Watershed Inventory, the lowest/worst ranked subwatersheds are the most impaired based on all of the available data. Projects within these subwatersheds would provide the greatest water quality benefit. The top four ranked subwatersheds were identified as the High Priority Subwatersheds.

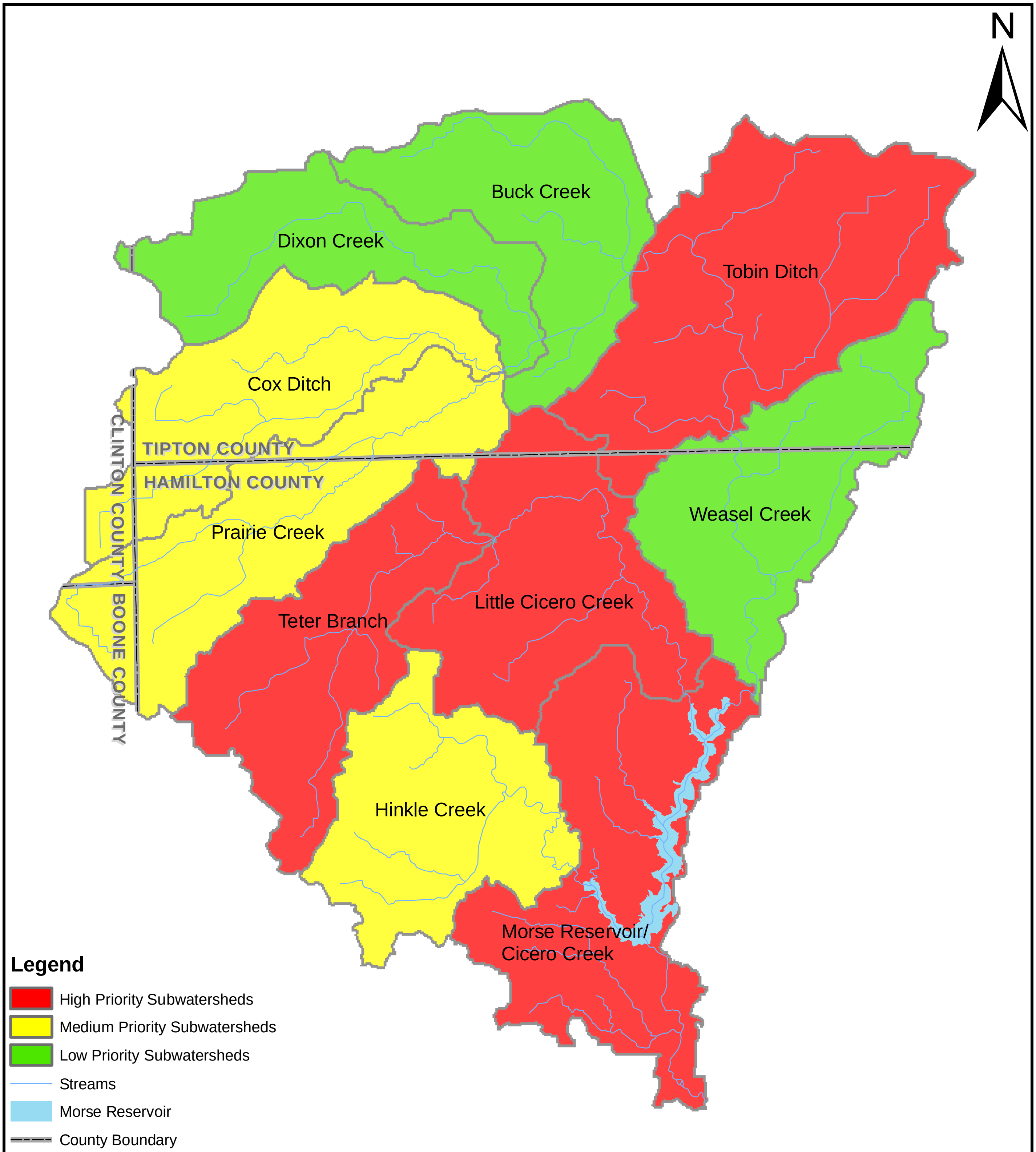
Since the watershed management plan is a living document, the intent is not to limit projects to only the High Priority Areas as these may become less critical as the plan is implemented. In an effort to prioritize work, the remaining six subwatersheds were also categorized as medium priority or low priority. The intent of this ranking is that if all projects are implemented in the High Priority Areas, then a medium subwatershed should be evaluated for project implementation. Exhibit 27 shows the priority subwatershed areas and the ranking of the remaining subwatersheds.

Little Cicero Creek Subwatershed

As discussed in the Watershed Inventory in Section 2, the Little Cicero Creek Subwatershed shows the highest level of current water quality impairment and the highest level of land use and industrial impairments based on the available data. The Little Cicero Creek Subwatershed exceeded the State standard for *E. coli* and water quality targets for Nitrate + Nitrite, Phosphorus and TSS according to the CIWRP study and the IDEM data and needs reductions of 94%, 74.2%, 59.1% and 8.8% respectively to meet the target loads set for the subwatershed.

Little Cicero Creek also contained the poorest macroinvertebrate ratings per V3's sampling analysis. During the windshield survey, 3 of the 10 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 30), 3 sites showed areas with no stream buffers (see Exhibit 29), 6 locations had in-stream debris, conventional tillage practices were seen in 9 of the 15 locations (see Exhibit 31) and 3 locations had the possibility of direct animal access (see Exhibit 28). Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Little Cicero Creek Subwatershed is a High Priority Subwatershed Area for Best Management Practice implementation.

As this subwatershed is 89% agricultural with no significant urban areas, the BMPs suggested in Table 51 for the Little Cicero Creek subwatershed are agricultural/rural focused and are beneficial in reducing pollutant loadings for more than one impairment.



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www.v3co.com

TITLE: Subwatershed Priority Areas	PROJECT: Morse Reservoir/Cicero Creek Watershed Management Plan		
BASE LAYER: HUC-12 Watershed Boundaries	PROJECT NO. 09005	EXHIBIT: 27	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance, P.O. Box 2065, Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 15000'

The windshield survey information showed that there at least 3 locations within the subwatershed where animals could access streams. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for *E. coli* in this subwatershed is 94% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in *E. coli* for area tributary to the fencing based on Table 50 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen.

Similarly, the windshield survey results showed that the subwatershed has at least 3 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 16 miles of major stream corridor (Little Cicero Creek, Bennett Ditch and Taylor Creek) which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips, reforestation along streams and stream restoration within the subwatershed as a best management practice for reducing, Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 89% agricultural land with at least 9 locations from the windshield survey showing conventional tillage practices, promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce TSS and Nitrate+Nitrite loadings. Based on the information obtained from the Hamilton County SWCD, approximately 49% of corn fields in the County operate using conventional tillage practices. Nutrient/Waste Management plans would also be a beneficial BMP for reduction of all pollutants.

Approximately 39.7% of the subwatershed is mapped as having hydric soils. These areas would be conducive for wetland restoration, which has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

Based on this information, BMP implementation projects are very feasible within the Little Cicero Creek subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Tobin Ditch Subwatershed

The Tobin Ditch Subwatershed shows a moderate level of current water quality impairment (ranked sixth) and a high level of land use and industrial impairments (ranked third) based on the available data. The Tobin Ditch Subwatershed exceeded the State standard for *E. coli* and water quality targets for Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the State standard for *E. coli* and water quality targets for Nitrate + Nitrite and Phosphorus in the IDEM data. Reductions of 77.5%, 77.5%, and 35.6% are needed for *E. coli*, Nitrate + Nitrite, and Phosphorus respectively to meet the target loads set for the subwatershed. The current loading of TSS within this subwatershed meets the target, therefore no reduction is necessary.

During the windshield survey, 3 of the 15 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 30), 6 sites showed areas with no or inadequate stream buffers (see Exhibit 29), 2 locations had in-stream debris and conventional tillage practices were seen in 2 of the locations (see Exhibit 31) within the Tobin Ditch subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Tobin Ditch Subwatershed is a High Priority Subwatershed for Best Management Practice implementation.

The Tobin Ditch subwatershed is approximately 87% agricultural with urban areas concentrated in the western portion of the subwatershed associated with Tipton, a small area in the northeastern portion associated with the town of Hobbs, and a small area in the southern portion associated with the Town of Atlanta. Therefore, the BMPs suggested in Table 51 for this subwatershed are agricultural/rural and urban focused and are beneficial in reducing pollutant loadings for more than one impairment.

The subwatershed is critical for *E. coli.* The City of Tipton Municipal Sewer Treatment Plant has an outfall permit for eight locations within the Tobin Ditch subwatershed. Similarly, the Town of Atlanta Municipal Sewer Treatment Plant has a permit for one outfall within the subwatershed. Based on the obtained information, there were six *E.coli*, five N and one TSS exceedances reported for these outfalls. There are also three active CFOs located within the subwatershed. All of these could be potential sources for elevated *E. coli* levels. More specifically, combined sewer overflows at the outfall locations and improperly maintained waste management plans contribute pollutants into the ditches/streams. Even though there are no Urban BMPs that show a benefit for reducing *E. coli*, the potential for wetland restoration within the subwatershed is feasible due to 57.9% of the subwatershed being mapped with hydric soils. Wetland restoration has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

Although the windshield survey did not show any locations where animals could access streams, the subwatershed is 87% agricultural with three active CFOs and the subwatershed is critical for *E. coli* indicating that there may be animal access locations that were not observed during the survey. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for *E. coli* in this subwatershed is 77.5% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in *E. coli* for area tributary to the fencing based on Table 50 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen.

The windshield survey results showed that the subwatershed has at least 9 sites with inadequate stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 28 miles of major stream corridor (Cicero Creek, Buscher Ditch, Doversberger Ditch, Bacon Prairie Creek, Stone Hinds Ditch, Schlater Ditch, Goff Ditch, Richman Ditch and Tobin Ditch) which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips, reforestation along streams and stream restoration within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 87% agricultural land with at least 2 locations from the windshield survey showing conventional tillage practices, promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce TSS and Nitrate+Nitrite loadings. Based tillage information from Tipton County for 1996-2007, approximately 43% of cultivated fields in the County operate using conventional tillage practices. Nutrient/Waste Management plans would also be a beneficial BMP for reduction of all pollutants.

Approximately 57.9% of the subwatershed is mapped as having hydric soils. These areas would be conducive for wetland restoration, which has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

The Tobin Ditch Subwatershed includes a portion of the City of Tipton, Town of Hobbs and Town of Atlanta. Urban runoff is often a significant source of nonpoint source pollution within a watershed. The implementation of BMPs such as bioretention practices, filtration basins, and pervious pavement within urban areas has the potential to significantly reduce the pollutant loadings within the watershed. For example, the load reduction needed for Nitrate+Nitrite in this subwatershed is 77.5% in order to meet the target loads. Installation of pervious pavement has the potential to reduce Nitrate+Nitrite loads tributary to the pavement by 85% based on Table 50 Best Management Practice Load Reduction Summary in Section 6. Therefore, this practice propagated throughout the watershed has the potential to significantly reduce nonpoint source pollution loadings.

Based on this information, BMP implementation projects are very feasible within the Tobin Ditch subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Teter Branch Subwatershed

The Teter Branch Subwatershed shows a high level of current water quality impairment (ranked third) and a moderate level of land use and industrial impairments (ranked sixth) based on the available data. The Teter Branch Subwatershed exceeded the State standard for *E. coli* and the water quality targets for Nitrate + Nitrite and Phosphorus in the CIWRP study and exceeded the State standards for *E. coli* in the IDEM data (Nitrate + Nitrite, Phosphorus, and TSS information was not available from the IDEM data). Reductions of 90.9%, 63.6% and 62.7% are needed for *E. coli*, Nitrate + Nitrite, and Phosphorus respectively to meet the target loads set for the subwatershed. The current loading of TSS within this subwatershed meets the target, therefore no reduction is necessary.

During the windshield survey, 5 of the 9 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 30), 5 sites showed areas with no or inadequate stream buffers (see Exhibit 29), 3 locations had in-stream debris and conventional tillage practices were seen in 3 of the locations (see Exhibit 31) within the Teter Branch subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Teter Branch Subwatershed is a High Priority Subwatershed for Best Management Practice implementation.

The Teter Branch subwatershed is approximately 88% agricultural with urban areas concentrated in the southwestern portion of the subwatershed associated with Sheridan. Therefore, the BMPs suggested in Table 51 for this subwatershed are agricultural/rural and urban focused and are beneficial in reducing pollutant loadings for more than one impairment.

The windshield survey information showed that there at least 3 locations within the subwatershed where animals could access streams. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for Phosphorus in this subwatershed is 62.7% in order to meet the target loads. Implementation of the stream restoration alone provides a 75% reduction in Phosphorus based on Table 50 Best Management Practice Load Reduction Summary in Section 6. Stream restoration also provides 75% removal of TSS and 75% of Nitrogen.

The windshield survey results also showed that the subwatershed has at least 10 sites with inadequate stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 17 miles of major stream corridor (Little Cicero Creek, Ross Ditch, Teter Branch, Jay Ditch and Symons Ditch) which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips, reforestation along streams and stream restoration within the subwatershed as a best management practice for reducing Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 88% agricultural land with at least 3 locations from the windshield survey showing conventional tillage practices, promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce Nitrate+Nitrite loadings. Based on the information obtained from the Hamilton County SWCD, approximately 49% of corn fields in the County operate using conventional tillage practices. Nutrient/Waste Management plans would also be a beneficial BMP for reduction of all pollutants.

Approximately 41.2% of the subwatershed is mapped as having hydric soils. These areas would be conducive for wetland restoration, which has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

The Teter Branch Subwatershed includes a portion of the Town of Sheridan. Urban runoff is often a significant source of nonpoint source pollution within a watershed. The implementation of BMPs such as bioretention practices, filtration basins, naturalized detention basins and pervious pavement within urban areas has the potential to significantly reduce the pollutant loadings within the watershed. For example, the load reduction needed for Nitrate+Nitrite in this subwatershed is 63.6% in order to meet the target loads. Installation of bioretention has the potential to reduce Nitrate+Nitrite loads tributary to the pavement by 65% based on Table 50 Best Management Practice Load Reduction Summary in Section 6. Therefore, this practice propagated throughout the watershed has the potential to significantly reduce nonpoint source pollution loadings.

Based on this information, BMP implementation projects are very feasible within the Teter Branch subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Morse Reservoir/Cicero Creek Subwatershed

The Morse Reservoir/Cicero Creek Subwatershed shows a moderate level of current water quality impairment (ranked seventh) and a high level of land use and industrial impairments (ranked second) based on the available data. The Morse Reservoir/Cicero Creek Subwatershed exceeded the targets of *E. coli* and Nitrate + Nitrite in the IDEM data (no CIWRP data was available for this subwatershed). Reductions of 72.8% and 73.8% are needed for *E. coli* and Nitrate + Nitrite, respectively to meet the target loads set for the subwatershed. The current loading of Phosphorus and TSS within this subwatershed meet the target, therefore no reduction is necessary. It should be noted that the majority of the sampling stations within this subwatershed are located downstream of the reservoir.

During the windshield survey, 7 of the 12 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 30), 10 sites showed areas with no or inadequate stream buffers (see Exhibit 29), 10 locations had in-stream debris and conventional tillage practices were seen in 5 of the locations (see Exhibit 31) within the Morse Reservoir/Cicero Creek subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Morse Reservoir/Cicero Creek Subwatershed is a High Priority Subwatershed for Best Management Practice implementation.

The Morse Reservoir/Cicero Creek subwatershed is approximately 54% agricultural with urban areas concentrated along the eastern edge of the subwatershed associated with Cicero and Noblesville. Therefore, the BMPs suggested in Table 51 for this subwatershed are agricultural/rural and urban focused and are beneficial in reducing pollutant loadings for more than one impairment.

The subwatershed is critical for *E. coli.* The Town of Cicero has one permitted outfall location. There was one *E.coli* and 10 TSS exceedances reported for this outfall based on the information obtained from IDEM. Similarly, the City of Noblesville has a Long Term Control plan for combined sewer overflows (there are no known locations within this subwatershed). There are also one active and one voided CFO located within the subwatershed. All of these could be potential sources for elevated *E. coli* levels. More specifically, combined sewer overflows at the outfall locations and improperly maintained waste management plans contribute pollutants into the ditches/streams. Even though there are no Urban BMPs that show a benefit for reducing *E. coli*, the potential for wetland restoration within the subwatershed is feasible due to 27.1% of the subwatershed being mapped with hydric soils. Wetland restoration has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

Although the windshield survey did not show any locations within the subwatershed where animals could access streams, the subwatershed is 54% agricultural lands and is critical for *E. coli* indicating that there may be animal access locations that were not observed during the survey. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for *E. coli* in this subwatershed is 72.8% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in *E. coli* for area tributary to the fencing based on Table 50 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen.

The windshield survey results showed that the subwatershed has at least 8 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 35 miles of major stream corridor (Cicero Creek, West Fork, East Fork, Sly Run, Hinkle Creek, Bear Slide Creek and Little Cicero Creek) which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips, reforestation along streams and stream restoration within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 54% agricultural land with at least 5 locations from the windshield survey showing conventional tillage practices, promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce Nitrate+Nitrite loadings. Based on the information obtained from the Hamilton County SWCD, approximately 49% of corn fields in the County operate using conventional tillage practices. Nutrient/Waste Management plans would also be a beneficial BMP for reduction of all pollutants.

The Morse Reservoir/Cicero Creek Subwatershed includes portions of the Town of Cicero and the City of Noblesville. Urban runoff is often a significant source of nonpoint source pollution within a watershed. The implementation of BMPs such as bioretention practices, filtration basins, naturalized detention basins, naturalized stream buffers, rain barrels/rain gardens and pervious pavement within urban areas has the potential to significantly reduce the pollutant loadings within the watershed. For example, the load reduction needed for Nitrate+Nitrite in this subwatershed is 73.8% in order to meet the target loads. Installation of pervious pavement has the potential to reduce Nitrate+Nitrite loads tributary to the pavement by 85% based on Table 50 Best Management Practice Load Reduction Summary in Section 6. Therefore, this practice propagated throughout the watershed has the potential to significantly reduce nonpoint source pollution loadings.

Based on this information and the fact that Morse Reservoir is a part of the drinking water supply system for the Indianapolis Water Company's White River Water Treatment Facility, BMP implementation projects are very feasible within the Morse Reservoir/Cicero Creek subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Medium Priority Subwatersheds

The Cox Ditch, Prairie Creek and Hinkle Creek Subwatersheds are all considered Medium Priority areas.

Cox Ditch

The Cox Ditch Subwatershed shows a moderate level of current water quality impairment (ranked fourth) and a moderate level of land use and industrial impairments (ranked seventh) based on the available data. The Cox Ditch subwatershed exceeded the State standard for *E. coli* and the water quality targets for Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the State standards for *E. coli* and the water quality targets for Nitrate + Nitrite and Phosphorus in the IDEM data. Reductions of 63.2%, 78.4% and 26.2% are needed for *E. coli*, Nitrate + Nitrite, and Phosphorus respectively to meet the target loads set for the subwatershed.

During the windshield survey, 1 of the 9 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 30), 5 sites showed areas with no or inadequate stream buffers (see Exhibit 29), 1 location had in-stream debris within the Cox Ditch subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Cox Ditch Subwatershed is a Medium Priority Subwatershed for Best Management Practice implementation.

The Cox Ditch subwatershed is approximately 93% agricultural. Therefore, the BMPs suggested in Table 51 for this subwatershed are agricultural/rural focused and are beneficial in reducing pollutant loadings for more than one impairment.

The windshield survey information showed that there is at least 1 location within the subwatershed where animals could access streams. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for *E. coli* in this subwatershed is 63.2% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in *E. coli* for area tributary to the fencing based on Table 50 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen.

The windshield survey results also showed that the subwatershed has at least 6 sites with inadequate stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 20 miles of major stream corridor (Cicero Creek, Cox Ditch, Christy Ditch, Leander Boyle Ditch, Matthews Ditch and Kigin Ditch) which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips, reforestation along streams and stream restoration within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

Even though the windshield survey did not show any locations practicing conventional tillage, the subwatershed is 93% agricultural land. Promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce Nitrate+Nitrite loadings. Based tillage information from Tipton County for 1996-2007, approximately 43% of cultivated fields in the County operates using conventional tillage practices. Nutrient/Waste Management plans would also be a beneficial BMP for reduction of all pollutants.

Approximately 55.0% of the subwatershed is mapped as having hydric soils. These areas would be conducive for wetland restoration, which has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

Based on this information, BMP implementation projects are very feasible within the Cox Ditch subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Prairie Creek

The Prairie Creek Subwatershed shows a low level of current water quality impairment (ranked eighth) and a moderate level of land use and industrial impairments (ranked fourth). The Prairie Creek subwatershed exceeded the State standard for *E. coli* and the water quality targets for Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the State standards for *E. coli* in the IDEM data (Nitrate + Nitrite, Phosphorus, and TSS information was not available from the IDEM data). Reductions of 71.4%, 78.7%, 50.0% and 25.2% are needed for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS respectively to meet the target loads set for the subwatershed.

During the windshield survey, 1 of the 10 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 30), 6 sites showed areas with no or inadequate stream buffers (see Exhibit 29), and conventional tillage practices were seen in 3 of the locations (see Exhibit 31) within the Prairie Creek subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Prairie Creek Subwatershed is a Medium Priority Subwatershed for Best Management Practice implementation.

The Prairie Creek subwatershed is approximately 92% agricultural. Therefore, the BMPs suggested in Table 51 for this subwatershed are agricultural/rural focused and are beneficial in reducing pollutant loadings for more than one impairment.

The windshield survey information showed that there is at least 1 location within the subwatershed where animals could access streams. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for *E. coli* in this subwatershed is 71.4% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in *E. coli* for area tributary to the fencing based on Table 50 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen.

The windshield survey results also showed that the subwatershed has at least 7 sites with inadequate stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 19 miles of major stream corridor (Prairie Creek, Endicott Ditch, Pearce Ditch and McKinzie Ditch) which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips, reforestation along streams and stream restoration within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 92% agricultural land with at least 3 locations from the windshield survey showing conventional tillage practices, promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce Nitrate+Nitrite loadings. Based on the information obtained from the Hamilton County SWCD, approximately 49% of corn fields in the County operate using conventional tillage practices. Nutrient/Waste Management plans would also be a beneficial BMP for reduction of all pollutants.

Approximately 54.4% of the subwatershed is mapped as having hydric soils. These areas would be conducive for wetland restoration, which has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

Based on this information, BMP implementation projects are very feasible within the Prairie Creek subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Hinkle Creek

The Hinkle Creek Subwatershed shows a high level of current water quality impairment (ranked second) and a low level of land use and industrial impairments (ranked tenth). The Hinkle Creek subwatershed exceeded the State standard for *E. coli* and the water quality targets for Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the State standards for *E. coli* and the water quality targets for Nitrate + Nitrite and Phosphorus in the IDEM data. Reductions of 87.8%, 40.7%, 77.2% and 8.8% are needed for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS respectively to meet the target loads set for the subwatershed.

During the windshield survey, 3 of the 9 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 30), 9 sites showed areas with no or inadequate stream buffers (see Exhibit 29), and 10 locations had in-stream debris within the Hinkle Creek subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Hinkle Creek Subwatershed is a Medium Priority Subwatershed for Best Management Practice implementation.

The Hinkle Creek subwatershed is approximately 81% agricultural. Therefore, the BMPs suggested in Table 51 for this subwatershed are agricultural/rural focused and are beneficial in reducing pollutant loadings for more than one impairment.

The windshield survey information showed that there is are at least 3 locations within the subwatershed where animals could access streams. Implementation of alternative watering systems as well as exclusionary fencing and eliminating the potential for animals to have direct access to the streams will reduce pollutant loadings within the subwatershed. For example, the load reduction needed for *E. coli* in this subwatershed is 87.8% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in *E. coli* for area tributary to the fencing based on Table 50 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen.

The windshield survey results also showed that the subwatershed has at least 9 sites with inadequate stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 18 miles of major stream corridor (Hinkle Creek, Jones Ditch, Lindley Ditch and Baker Ditch) which doesn't include the minor tributaries or other regulated drains within the subwatershed. Therefore, there is great potential for implementation of buffer/filter strips, reforestation along streams and stream restoration within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

Even though the windshield survey did not show any locations practicing conventional tillage, the subwatershed is 81% agricultural land. Promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce Nitrate+Nitrite loadings. Based on the information obtained from the Hamilton County SWCD, approximately 49% of corn fields in the County operate using conventional tillage practices. Nutrient/Waste Management plans would also be a beneficial BMP for reduction of all pollutants.

Approximately 31.7% of the subwatershed is mapped as having hydric soils. These areas would be conducive for wetland restoration, which has the potential to reduce pollutant loads by 80% for sediment and *E. coli*, 55% for phosphorus and 45% for nitrogen.

Based on this information, BMP implementation projects are very feasible within the Hinkle Creek subwatershed. However, specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind.

Lower Priority Subwatersheds

The Buck Creek, Dixon Creek and Weasel Creek Subwatersheds are all considered Low Priority areas.

The Buck Creek Subwatershed shows a moderate level of current water quality impairment (ranked fifth) and a low potential for future water quality impairment (ranked ninth). The Dixon Creek Subwatershed shows a moderate level of current water quality impairment (ranked seventh) and a low potential for future water quality impairment (ranked eighth). And the Weasel Creek Subwatershed shows a low level of current water quality impairment (ranked eighth) and a moderate potential for future water quality impairment (ranked fifth).

Specific Source Critical Areas

Sources that would reduce loading of several pollutants of concern or address several identified problems at once if modified or eliminated were designated Specific Source Critical Areas. The specific source critical areas are found throughout the watershed and not confined to a specific subwatershed. These critical areas can and do overlap the Subwatershed Critical Areas. However, problem areas in the lowest ranking subwatersheds cannot be addressed until the high and medium priority areas have been addressed. The locations of the Specific Source Critical Areas were identified during the Windshield Survey, completed as part of the Watershed Inventory. The windshield survey only covered a finite number of locations within the watershed, so instances and locations of these sources may not be specifically identified, but are still considered critical areas.

Livestock Access
All areas in the watershed where livestock have direct access to the stream are identified as being critical.

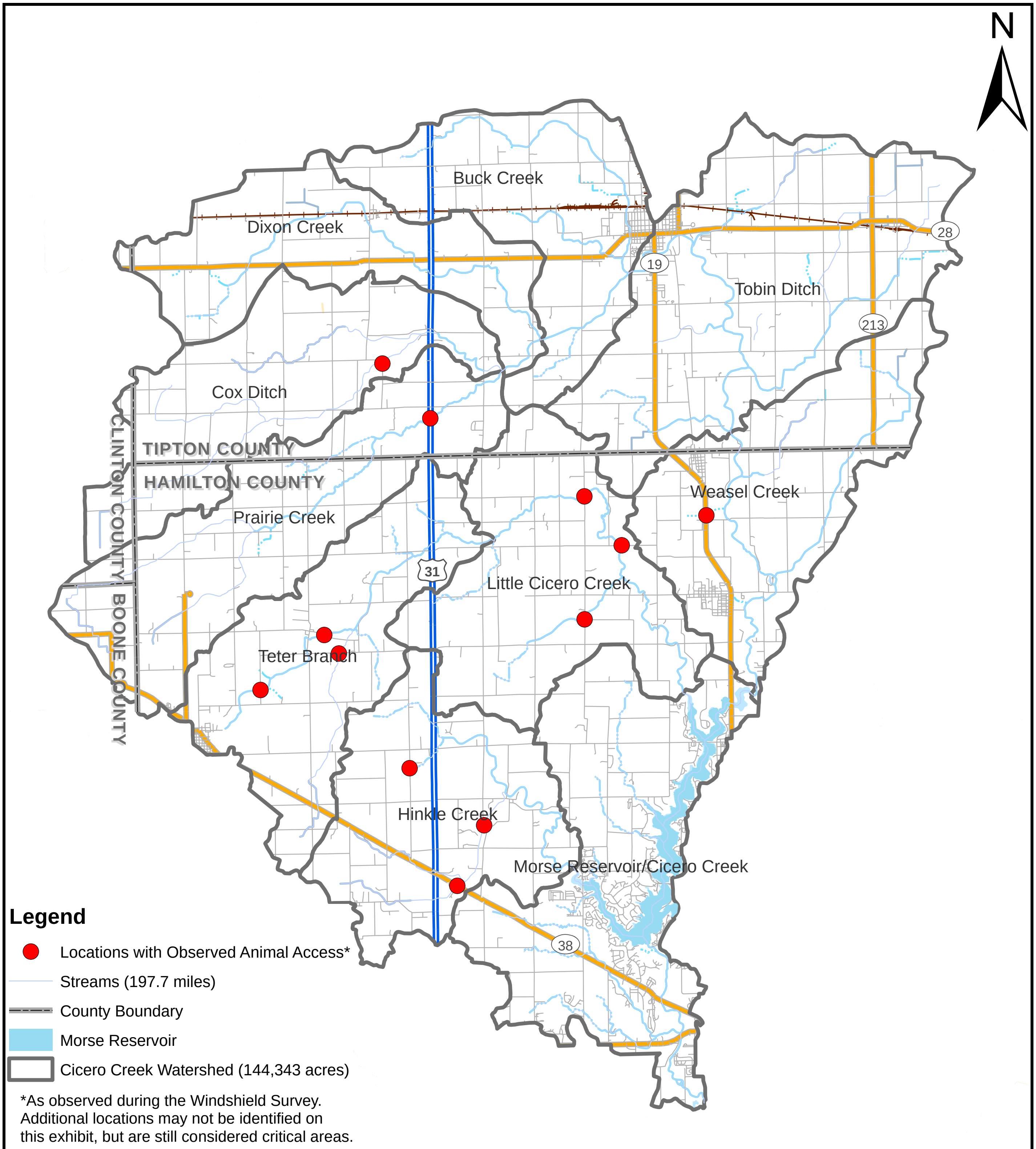
Animal access within the stream can inhibit wildlife and aquatic habitat, increase flooding risks, and introduce additional pollutants. Animal waste is a large source of *E. coli* and when animals have access to the stream, *E. coli* is directly introduced to the stream. As livestock walk down the streambanks, existing vegetation can be dislodged enabling streambank erosion, thus introducing sediment and nutrients to the water. Exhibit 28 shows the locations where direct animal access was identified during the windshield survey. As stated previously, the windshield survey only covered a finite number of locations within the watershed, so all instances and locations of direct animal access may not be specifically identified, but are still considered critical areas.

Absent or Insufficient Stream Buffers
All areas where stream buffers are absent or insufficient are identified as being critical.

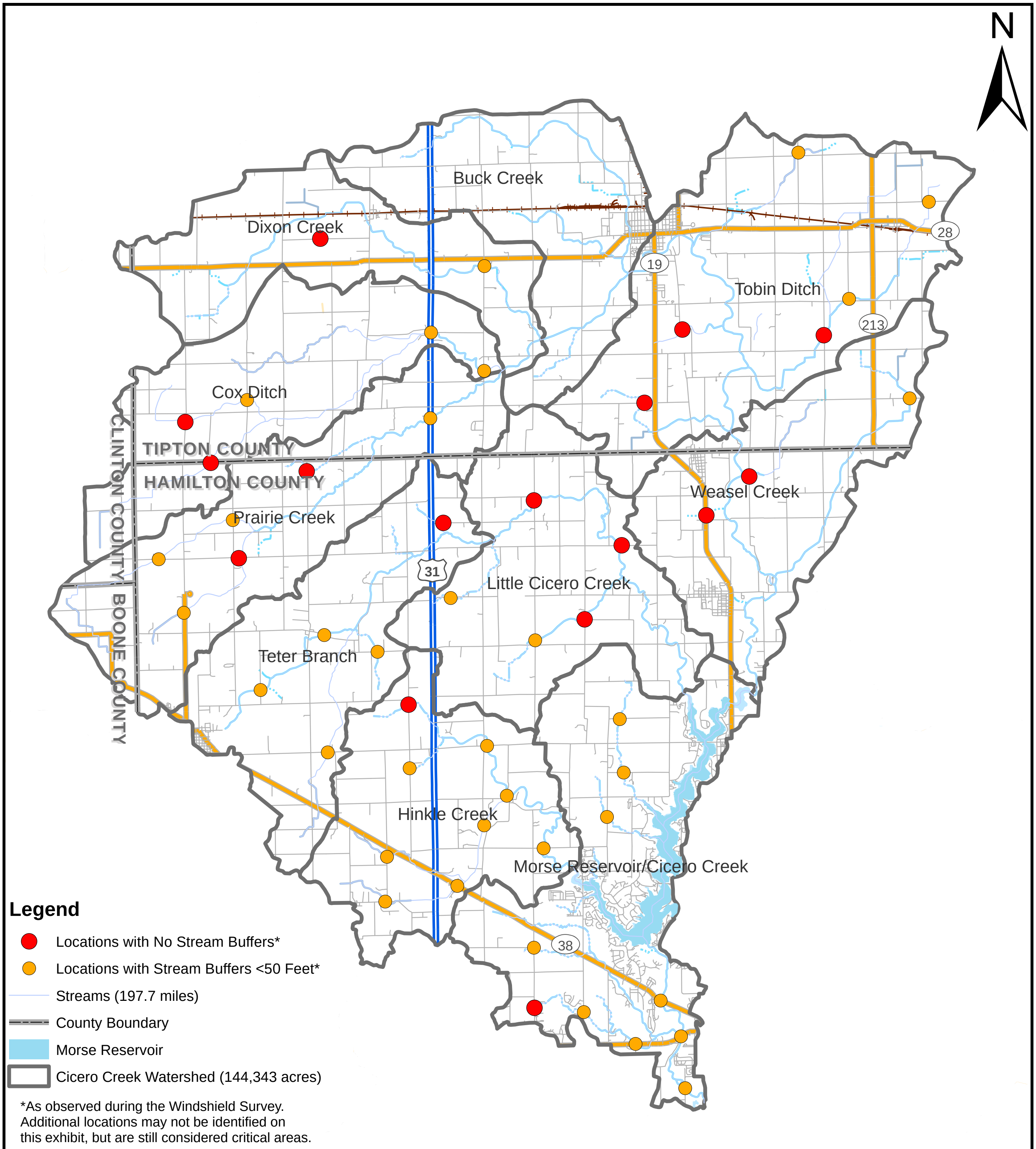
Stream buffers are areas of either planted or natural vegetation between a surface water body the surrounding land. Runoff from the surrounding land may carry sediment and organic matter, and plant nutrients and pesticides that are either bound to the sediment or dissolved in the water. The buffers provide water quality protection by reducing the amount of pollutants in the runoff before it enters the water body. Filter strips can also provide localized erosion protection and habitat for wildlife. Exhibit 29 shows the locations where absent or insufficient stream buffers were identified during the windshield survey. Buffers were identified as absent if they were less than ten feet in width. Insufficient stream buffers were identified as buffers with more than 10 feet but less than 50 feet of grass or treed area. As stated previously, the windshield survey only covered a finite number of locations within the watershed, so instances and locations of absent or insufficient buffers may not be specifically identified throughout the watershed, but are still considered critical areas.

Excessive Streambank Erosion
All areas where excessive streambank erosion is occurring are identified as being critical.

Accelerated erosion can contribute high sediment loads to receiving streams, which is a concern due both to the impacts of the sediment itself, and of the contaminants that often bind with, or otherwise reside in the sediment. The sediment itself can smother aquatic habitat and therefore negatively affect the aquatic flora and fauna. Sediment can also transport nutrients, especially phosphorus that tends to adhere to sediment particles causing excess algal growth leading to large swings in DO. Exhibit 30 shows the locations where excessive streambank erosion was identified during the windshield survey. Identification of streambank erosion was broken up into the following categories: absent, stabilized (rip-rap,



V3 Companies 7325 Janes Avenue Woodridge, IL 60517 630.724.9200 phone 630.724.9202 fax www.v3co.com	TITLE: **Livestock Access Critical Area Exhibit**	PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**		
	BASE LAYER: HUC-12 Watershed Boundaries	PROJECT NO. 09005	EXHIBIT: 28	SHEET: 1 OF: 1
	CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 15000'



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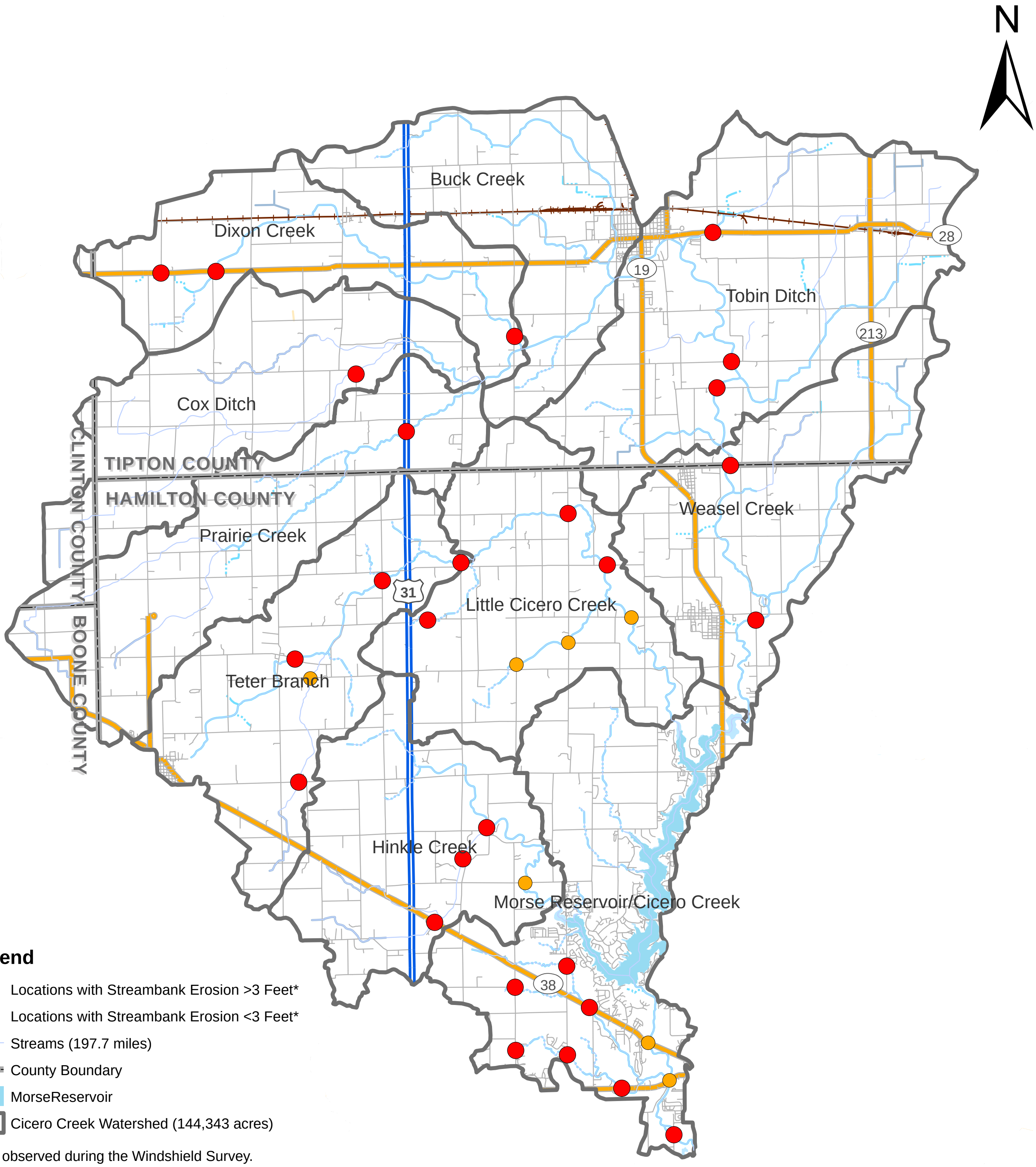
TITLE: **Stream Buffers Critical Area Exhibit**	PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**		
BASE LAYER: HUC-12 Watershed Boundaries	PROJECT NO. 09005	EXHIBIT: 29	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 15000'



Legend

- Locations with Streambank Erosion >3 Feet*
- Locations with Streambank Erosion <3 Feet*
- Streams (197.7 miles)
- County Boundary
- MorseReservoir
- Cicero Creek Watershed (144,343 acres)

*As observed during the Windshield Survey. Additional locations may not be identified on this exhibit, but are still considered critical areas.

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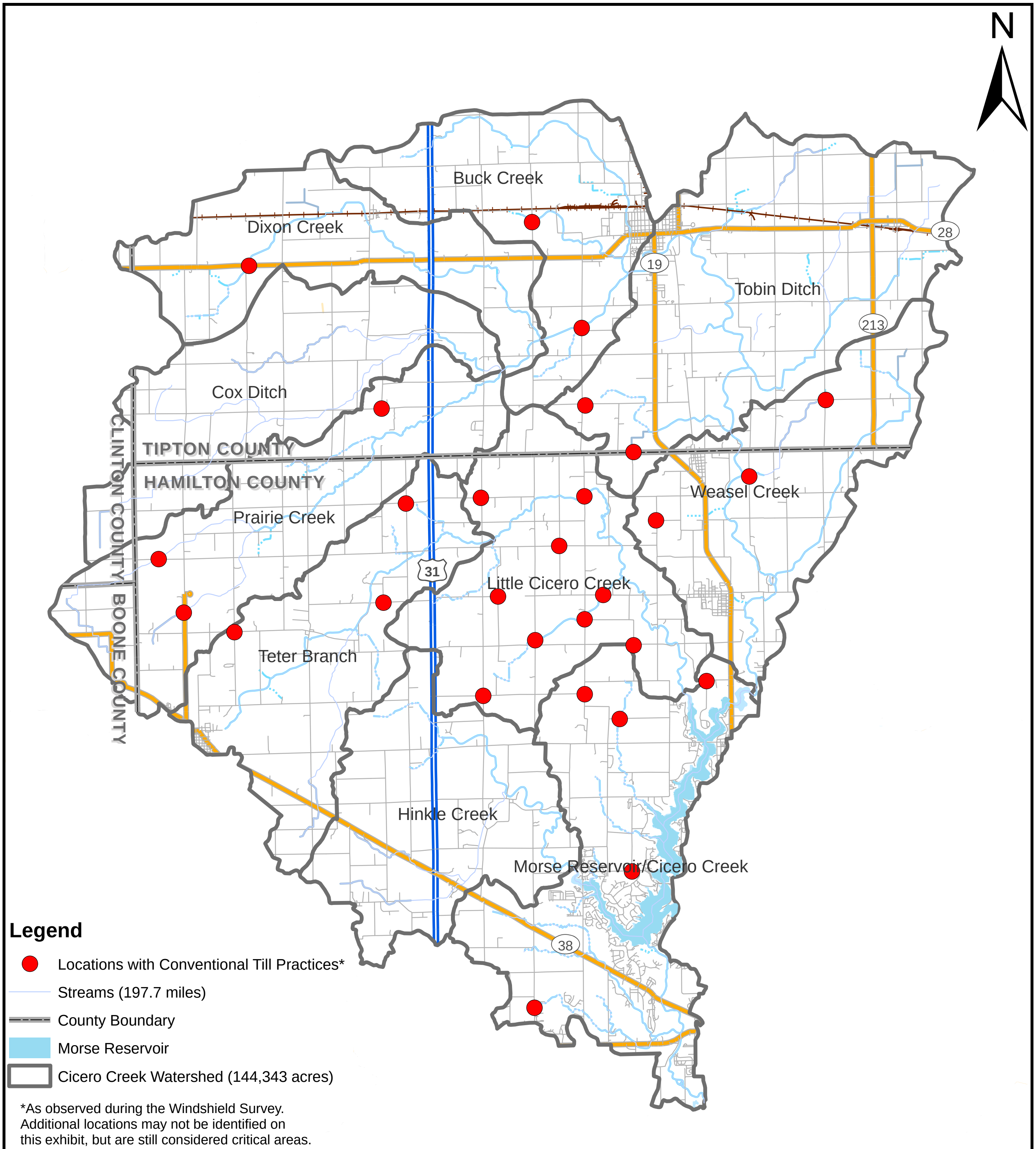
www.v3co.com

TITLE: **Streambank Erosion Critical Area Exhibit**	PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**		
BASE LAYER: HUC-12 Watershed Boundaries	PROJECT NO. 09005	EXHIBIT: 30	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 15000'



V3 Companies
7325 Janes Avenue
Woodridge, IL 60517
630.724.9200 phone
630.724.9202 fax
www.v3co.com

TITLE: **Conventional Till Critical Area Exhibit**

PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**

BASE LAYER: HUC-12 Watershed Boundaries

CLIENT: Upper White River Watershed Alliance
P.O. Box 2065
Indianapolis, Indiana 46206

PROJECT NO.	EXHIBIT:	SHEET: 1 OF: 1
09005	31	
QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 15000'

coir log, etc.), present > 3 feet tall and present < 3 feet tall. Excessive streambank erosion are those areas with greater than 3 feet tall of erosion. As stated previously, the windshield survey only covered a finite number of locations within the watershed, so instances and locations of excessive streambank erosion may not be specifically identified, but are still considered critical areas.

Agricultural Areas Practicing Conventional Till

All agricultural areas where conventional till is practiced are identified as being critical. Conventionally tilled fields can all contribute NPS pollution to the watershed. Fields within a closer proximity to open ditches or streams may contribute more NPS pollution. Targeting all conventionally tilled fields will reduce the pollutant loading. Direct work with land owners will be required as the next step toward implementation to gain a number of fields that will convert to conservation tillage practices within a subwatershed.

Conservation till and no till practices reduce the amount of runoff leaving a field. Crop residue protects the soil surface and allows water to infiltrate. As the amount of runoff is reduced and the velocities of runoff leaving the agricultural area are reduced, the amount of sediment, nutrients and pesticides carried in the runoff are reduced. Conventional till does not retain any crop residue and therefore contributes a large amount of sediment, nutrients and pesticides with an increased runoff rate. Exhibit 31 shows the locations where conventional till was identified during the windshield survey. As stated previously, the windshield survey only covered a finite number of locations within the watershed, so instances and locations of conventional till may not be specifically identified, but are still considered critical areas.

Section 6 – Choose Measures/BMPs to Apply

BMPs

The watershed restoration and management techniques described in this section, when applied to the Morse Reservoir/Cicero Creek Watershed, can help achieve the watershed goals and objectives to decrease the concentrations of sediment and nutrient loads as identified in this WMP. The Steering Committee was provided a draft list of BMPs based on the impairments within the watershed and the measures that would improve the water quality within the watershed. Comments were received to add measures that some stakeholders had experience either implementing or educating landowners within the watershed. The selected measures and BMPs for improvement are categorized as Agricultural/Rural and Urban BMPs as well as Preventative Measures. While not all of the BMPs are being recommended at this point in the plan preparation, these BMPs may become important to have incorporated into the plan as the plan is updated and for future implementation opportunities. The Preventative Measures section is provided as potential recommendations for education and outreach focused implementation. The following BMP summaries are typical BMPs and are provided as a reference and generally describe each measure and its design components, it is not meant to be all inclusive list but only a guide.

To choose an appropriate BMP, it is essential to determine in advance the objectives to be met by the BMP and to calculate the cost and related effectiveness of alternative BMPs. Once a BMP has been selected, expertise is needed to insure that the BMP is properly installed, monitored, and maintained over time.

Agricultural/Rural BMPs

Agricultural/Rural BMPs are implemented on agricultural lands for the purpose of protecting water resources, protecting aquatic wildlife habitat, and protecting the land resource from degradation. These practices control the delivery of nonpoint source pollutants to receiving water resources by first minimizing the pollutants available.

Agricultural/Rural BMPs include:

- Alternative Watering System
- Buffer/Filter Strips
- Cover Crops
- Grassed Waterways
- Infiltration Trenches
- No-Till/Reduced Till (Conservation Tillage)
- Nutrient/Waste Management
- Rotational Grazing/Exclusionary Fencing
- Two Stage Ditches
- Stream Restoration
- Wetland Restoration
- Reforestation

Alternative Watering System

Alternative watering systems (e.g. nose pumps or gravity flow systems) protect surface water by eliminating livestock's direct access to the stream. Providing an alternative watering source for livestock reduces soil erosion and sedimentation and improves surface water quality by reducing *E. coli* concentrations and nutrient loading. Alternative watering systems help to provide additional bank stabilization and assist in the preservation of riparian buffers through a reduction in compaction.

Buffer/Filter Strips

Creating and maintaining buffers along stream and river channels and lakeshores increases open space and can reduce some of the water quality and habitat degradation effects associated with increased imperviousness and runoff in the watershed. Buffers provide hydrologic, recreational, and aesthetic benefits as well as water quality functions, and wildlife habitat. TSS, phosphorus, and nitrogen are at least partly removed from water passing through a naturally vegetated buffer. *E. coli* concentrations are also reduced with buffers. The percentage of pollutants removed depends on the pollutant load, the type of vegetation, the amount of runoff, and the character of the buffer area. The most effective buffer width can vary along the length of a channel. Adjacent land uses, topography, runoff velocity, and soil and vegetation types are all factors used to determine the optimum buffer width. Buffers need to be a minimum of 30 feet wide to be eligible for most USDA programs. The greater the width of the buffer, the pollutant removal efficiency will be greater. Education is important in teaching farmers what options they have for funding. Several state and federal programs exist to provide incentives for maintaining riparian buffers. The Wetlands Reserve Program (WRP) makes funding available for the purchase and restoration of wetlands and riparian buffer connections between wetlands.

A filter strip is an area of permanent herbaceous vegetation situated between environmentally sensitive areas and cropland, grazing land, or otherwise disturbed land. Filter strips reduce TSS, particulate organic matter, sediment adsorbed contaminants, and dissolved contaminant loadings in runoff to improve water quality. Filter strips also restore or maintain sheet flow in support of a riparian forest buffer, and restore, create, and enhance herbaceous habitat for wildlife and beneficial insects.

Filter strips should be permanently designated plantings to treat runoff and should not be part of the adjacent cropland's rotation. Overland flow entering the filter strip should be primarily sheet flow. If there is concentrated flow, it should be dispersed so that it creates sheet flow. Filter strips cannot be installed on unstable channel banks that are eroding due to undercutting of the toe bank. Permanent herbaceous vegetation should consist of a single species or a mixture of grasses, legumes and/or other forbs (an herbaceous plant other than a grass) adapted to the soil, climate, and farm chemicals used in adjacent cropland. Filter strips must be properly maintained so that they function properly.

Filter strips should be located to reduce runoff and increase infiltration and groundwater recharge throughout the watershed. Filter strips should also be strategically placed to intercept contaminants, thereby enhancing the water quality in the watershed. Filter strip sizes should be adjusted to accommodate planting, harvesting, and maintenance equipment.

Filter strip widths greater than that needed to achieve a 30 minute flow-through time at ½-inch depth will not likely improve the effectiveness of the strip in addressing water quality concerns created by TSS, particulate organics, and sediment adsorbed contaminants. Like buffers; filter strips decrease TSS and nutrient loading, reduce *E. coli* concentrations, and increase open space. Education will help to teach farmers where these practices should be applied and sources of possible funding. Implementation of filter strips is part of the Conservation Reserve Program and assistance may be provided to eligible projects.

Cover Crops

Cover crops can be legumes or grasses, including cereals, planted or volunteered vegetation established prior to or following a harvested crop primarily for seasonal soil protection and nutrient recovery. Cover crops protect soil from erosion decreasing sediment concentrations in the creek and recover/recycle phosphorus in the root zone. They are grown seasonally.

Cover crops are established during the non-crop period, usually after the crop is harvested, but can be interseeded into a crop before harvest by aerial application or cultivation. Cover crops reduce phosphorus transport by reducing soil erosion and runoff. Both wind and water erosion move soil particles that have phosphorus attached. Sediment that reaches water bodies may release phosphorus into the water. The cover crop vegetation recovers plant-available phosphorus in the soil and recycles it through the plant biomass for succeeding crops. The soil tilth also benefits from the increase of organic material added to the surface. Growing vegetation promotes infiltration, and roots enhance percolation of water supplied to the soil. This reduces surface runoff. Runoff water can wash soluble phosphorus from the surface soil and crop residue and carry it off the field.

Grassed Waterways

Grassed waterways are natural or constructed channels established for transport of concentrated flow at safe velocities using adequate channel dimensions and proper vegetation. They are generally broad and shallow by design to move surface water across farmland without causing soil erosion. Grassed waterways are used as outlets to prevent rill and gully formation. The vegetative cover slows the water flow, minimizing channel surface erosion. When properly constructed, grassed waterways can safely transport large water flows downslope. These waterways can also be used as outlets for water released from contoured and terraced systems and from diverted channels. This BMP can reduce sediment concentrations of nearby waterbodies and pollutants in runoff. The vegetation improves the soil aeration and water quality due to its nutrient removal through plant uptake and absorption by soil. The waterways can also provide wildlife corridors and allows more land to be natural areas.

Infiltration Trenches

Infiltration trenches are excavated trenches backfilled with a coarse stone aggregate and biologically active organic matter. Infiltration trenches allow temporary storage of runoff in the void space between the aggregate and help surface runoff infiltrate into the surrounding soil. Phosphorus from agricultural areas is primarily from animal manure either directly washing into streams and rivers or washing off from farm fields. Soil infiltration trenches can be especially beneficial as concrete feed-lots, barns, confined livestock areas, CFOs, and other agricultural areas can carry excess food and waste materials towards the adjacent stream through stormwater runoff. Installing soil infiltration trenches where runoff is concentrated will maximize the benefit of contaminant removal.

No-till/Reduced Till Conservation Practices

This practice manages the amount, orientation, and distribution of crop and other plant residues on the soil surface year-round, while growing crops planted in narrow slots or tilled, residue free strips previously untilled by full-width inversion implements. The purpose of this conservation practice is to reduce sheet and rill erosion thereby promoting improved water quality by reducing sediment and nutrient loading in the waterways. Additional benefits of this practice are to reduce wind erosion, to maintain or improve soil organic matter content and tilth, to conserve soil moisture, to manage snow, to increase plant available moisture or reduce plant damage from freezing or desiccation, and to provide food and escape cover for wildlife. This technique includes tillage and planting methods commonly referred to as no-till, zero till, slot plant, row till, direct seeding, or strip till.

Residue management is when loose residues are left on the field, and then uniformly distributed on the soil surface to minimize variability in planting depth, seed germination, and emergence of subsequently planted crops. When combines or similar machines are used for harvesting, they are equipped with spreaders capable of distributing residue over at least 80% of the working width. No-till or strip till may be practiced continuously throughout the crop sequence, or may be managed as part of a system which includes other tillage and planting methods such as mulch till. Production of adequate amounts of crop residues is necessary for the proper functioning of this conservation practice and can be enhanced by selection of high residue producing crops and crop varieties in the rotation, use of cover crops, and adjustment of plant populations and row spacings.

Maintaining a continuous no-till system will maximize the improvement of soil organic matter content. Also, when no-till is practiced continuously, soil reconsolidation provides additional resistance to sheet and rill erosion. The effectiveness of stubble to trap snow or reduce plant damage from freezing or desiccation increases with stubble height. Variable height stubble patterns may be created to further increase snow storage.

Nutrient/Waste Management

Nutrient management is the management of the amount, source, placement, form, and timing of the application of plant nutrients and soil amendments to minimize the transport of applied nutrients into surface water or groundwater. Nutrient management seeks to supply adequate nutrients for optimum crop yield and quantity, while also helping to sustain the physical, biological, and chemical properties of the soil.

Nutrient management plans are generally developed with assistance from NRCS. A nutrient budget for nitrogen, phosphorus, and potassium is developed considering all potential sources of nutrients including, but not limited to, animal manure, commercial fertilizer, crop residue, and legume credits. Realistic yields are based on soil productivity information, potential yield, or historical yield data based on a 5-year average. Nutrient management plans specify the form, source, amount, timing, and method of application of nutrients on each field in order to achieve realistic production levels while minimizing transport of nutrients to surface and/or groundwater.

Animal waste is a major source of pollution to waterbodies. To protect the health of aquatic ecosystems and meet water quality targets, manure must be safely managed. Good management of manure keeps livestock healthy, returns nutrients to the soil, improves pastures and gardens, and protects the environment, specifically water quality. Poor manure management may lead to sick livestock, unsanitary and unhealthy conditions for humans and other organisms, and increased insect and parasite populations. Proper management of animal waste can be done by implementing BMPs, through safe storage, by application as a fertilizer, and through composting. Proper manure management can effectively reduce *E. coli* concentrations, nutrient levels and sedimentation. Manure management can also be addressed in education and outreach to encourage farmers to participate in this BMP.

Rotational Grazing and Exclusionary Fencing

Intensive grazing management is the division of pastures into multiple cells that receive a short but intensive grazing period followed by a period of recovery of the vegetative cover. Pasture management practices that include the use of rotational grazing systems are beneficial for water and soil quality. Systems that include the riparian area as a separate pasture are beneficial because livestock access to these areas is controlled to limit the impact on the riparian plant communities.

The impacts of livestock grazing within riparian areas include manure and urine deposited directly into or near surface waters where leaching and runoff can transport nutrients and pathogens into the water. Unmanaged grazing may accelerate erosion and sedimentation into surface water, change stream flow, and destroy aquatic habitats. Improper grazing can reduce the capacity of riparian areas to filter contaminates, shade aquatic habitats, and stabilize stream banks.

A livestock exclusion system is a system of permanent fencing (board, barbed, etc) installed to exclude livestock from streams and areas, not intended for grazing. This will reduce erosion, sediment, and nutrient loading, and improve the quality of surface water. Education and outreach programs focusing on rotational grazing and exclusionary fencing are important in the success of this BMP.

Two Stage Ditches

Water, when confined to a channel such as a stream or ditch, has the potential to cause great destruction. If there is too much water moving through an undersized area of land, then there is nowhere for it to go but to rush out of its barriers. Bank erosion, scouring, and flooding are good indicators that there is problem with how the water is drained from the soil. Researchers have been working on a type of in-stream restoration called the two-stage ditch that has proven to help solve these problems.

The design of a two-stage ditch incorporates a floodplain zone, called benches, into the ditch by removing the ditch banks roughly 2-3 feet about the bottom for a width of about 10 feet on each side. This allows the water to have more area to spread out on and decreases the velocity of the water. This not only improves the water quality, but also improves the biological conditions of the ditches where this is located.

The benefits of a two-stage ditch over the typical agricultural ditch include both improved drainage function and ecological function. The two-stage design improves ditch stability by reducing water flow and the need for maintenance, saving both labor and money. It also has the potential to create and maintain better habitat conditions. Better habitats for both terrestrial and marine species are a great plus when it comes to the two-stage ditch design. The transportation of sediment and nutrients is decreased considerably because the design allows the sorting of sediment, with finer silt depositing on the benches and courser material forming the bed.

Stream Restoration

Stream restoration techniques are used to improve stream conditions so they more closely mimic natural conditions. For urban stream reaches, restoration to natural conditions may not be possible or feasible. For instance, physical constraints due to adjacent development may limit the ability to re-meander a stream. In addition, the natural stream conditions may not be able to accommodate the increased volume of flow from the developed watershed.

Even in cases where restoring the stream to its natural condition is not possible, the stream can still be naturalized and improved by reestablishing riparian buffers, performing stream channel maintenance, stabilizing streambanks using bioengineering techniques, and, where appropriate, by removing manmade dams and installing pool/riffle complexes. Stream restoration projects may be one component of floodplain restoration projects, and can be supplemented with trails and interpretive signs, providing recreational and educational benefits to the community.

Wetland Restoration

Because agriculture and urbanization have destroyed or degraded many of the remaining wetlands in the Morse Reservoir/Cicero Creek, wetland enhancement projects are necessary to improve the diversity and function of these degraded wetlands. The term enhancement refers to improving the functions and values of an existing wetland. Converted wetland/field sites (or sites that were formerly wetlands but have now been converted to other uses) can also be restored to provide many of their former wetland benefits. Wetland restoration is the process of establishing a wetland on a site that is not currently a wetland, but once was prior to conversion. Restoring wetlands can address many of the concerns of the Morse Reservoir/Cicero Creek Stakeholders. Wetlands have the ability to reduce *E. coli* concentrations, nutrient loading, TSS concentrations, and flood damage. Wetlands can be used to teach landowners about their importance with respect to plants and animals and also increases the amount of open space in the watershed.

Wetland functional values vary substantially from wetland to wetland; they receive special consideration because of the many roles they play. Because of the wetland protection laws currently in place, the greatest impact on wetlands from future development in the Morse Reservoir/Cicero Creek will likely be a shift in the types of wetlands. Often in mitigation projects, various types of marshes, wet prairies, and other wetlands are filled and replaced elsewhere, usually with existing open water wetlands. This replacement may lead to a shift in the values served by the wetland communities due to a lack of diversity of wetland types. The wetland restorations that are proposed in the Morse Reservoir/Cicero Creek should include a variety of different wetland types to increase the diversity of wetlands in the watershed. The restoration of wetlands can decrease flood damage by providing new stormwater storage areas, will improve water quality by treating stormwater runoff, and will create new plant and wildlife habitat. In addition to these values, wetlands can be part of regional greenways or trail networks. They can be constructed with trails to allow the public to explore them more easily, and they can be used to educate the public through signs, organized tours, and other techniques. Wetland restorations are an exceptional way to meet multiple objectives within a single project.

Reforestation

Reforestation is the restocking of existing forests and woodlands which have been depleted. Reforestation can be used to improve the quality of human life by soaking up pollution and dust from the air and rebuild natural habitats and ecosystems.

Urban BMPs

For the past two decades the rate of land development across the country has been more than two times greater than the rate of population growth. The increased impervious surface associated with this development will increase stormwater volume and degrade water quality, which will harm the overall watershed.

The best way to mitigate stormwater impacts from new developments is to use Urban BMPs to treat, store, and infiltrate runoff onsite before it can affect water bodies downstream. Innovative site designs that reduce imperviousness and smaller-scale low impact development practices dispersed throughout a site are excellent ways to achieve the goals of reducing flows and improving water quality.

The Urban BMPs include:

- Bioretention Practices
- Filtration Basin
- Naturalized Detention Basin
- Naturalized Stream Buffer
- Pervious Pavement
- Rain Barrels/Gardens
- Infiltration Trench
- Stream Restoration

Bioretention Practices

Bioretention practices (including bioinfiltration or biofiltration) are primarily used to filter runoff stored in shallow depressions by utilizing plant uptake and soil permeability. This practice utilizes combinations of flow regulation structures, a pretreatment grass channel or other filter strip, a sand bed, a pea gravel overflow treatment drain, a shallow ponding area, a surface organic mulch layer, a planting soil bed, plant material, a gravel underdrain system, and an overflow system to promote infiltration. Bioinfilitration systems such as swales are used to treat stormwater runoff from small sites such as driveways, parking lots, and roadways. They provide a place for stormwater to settle and infiltrate into the ground. Biofiltration swales are a relatively low cost means of treating stormwater runoff for small sites typifying much of the urban environment, such as parking, roadways, driveways, and similar impervious features. They provide areas for stormwater to slow down and pollutants to be filtered out. Careful attention to location and alignment of swales can lend a pleasing aesthetic quality to sites containing them.

In general, bioretention practices are highly applicable to residential uses in community open space or private lots. The bioretention system is very appropriate for treatment of parking lot runoff, roadways where sufficient space accommodates off-line implementation, and pervious areas such as golf courses. This BMP is not recommended for highly urbanized settings where impervious surfaces comprise 95% or more of the area due to high flow events and limited storage potential. This BMP can address most of the WMP goals including; reducing concentration of sediments and nutrients. Bioretention practices can also decrease flooding by storing stormwater and increase open space.

Filtration Basin

Filtration basins provide pollutant removal (including TSS, nutrients, and *E. coli*) and reduce volume of stormwater released from the basin. These basins utilize sand filters or engineered soils to filter stormwater runoff through a sand or engineered soil layer within an underdrain system that conveys the treated runoff to a detention facility or to the ultimate point of discharge. The filtration system consists of an inlet structure, sedimentation chamber, sand/engineered soil layer, underdrain piping, and liner to protect against infiltration.

Naturalized Detention Basins

Naturalized wet-bottom detention basins are used to temporarily store runoff and release it at a reduced rate. Naturalized wet-bottom detention basins are better than traditional detention basins because they encourage water infiltration, and thereby recharge groundwater tables. Native wetland and prairie vegetation also help to improve water quality by trapping sediment and other pollutants found in runoff, and are aesthetically pleasing. Naturalized wet-bottom detention basins can be designed as either shallow marsh systems with little or no open water or as open water ponds with a wetland fringe and prairie side slopes.

Naturalized Stream Buffer

Creating and maintaining buffers along stream and river channels and lakeshores increases open space and can reduce some of the water quality and habitat degradation effects associated with increased imperviousness and runoff in the watershed. Buffers provide hydrologic, recreational, and aesthetic benefits as well as water quality functions, and wildlife habitat. Sediment, phosphorus, and nitrogen are at least partly removed from water passing through a naturally vegetated buffer. The percentage of pollutants removed depends on the pollutant load, the type of vegetation, the amount of runoff, and the character of the buffer area. The most effective buffer width can vary along the length of a channel. Adjacent land uses, topography, runoff velocity, and soil and vegetation types are all factors used to determine the optimum buffer width. Buffers need to be a minimum of 30 feet wide to be eligible for most USDA programs. Other specific requirements for regulated drains should be determined during the feasibility stages of utilizing this practice.

Pervious Pavement
Pervious pavement has the approximate strength characteristics of traditional pavement but allows rainfall and runoff to percolate through it. This decreases sediment concentrations and flood damage in the watershed by slowing the water from entering the streams. The key to the design of these pavements is the elimination of most of the fine aggregate found in conventional paving materials. Pervious pavement options include porous asphalt and pervious concrete. Porous asphalt has coarse aggregate held together in the asphalt with sufficient interconnected voids to yield high permeability. Pervious concrete, in contrast, is a discontinuous mixture of Portland cement, coarse aggregate, admixtures, and water that also yields interconnected voids for the passage of air and water. Underlying the pervious pavement is a filter layer, a stone reservoir, and filter fabric. Stored runoff gradually drains out of the stone reservoir into the subsoil.

Modular pavement consists of individual blocks made of pervious material such as sand, gravel, or sod interspersed with strong structural material such as concrete. The blocks are typically placed on a sand or gravel base and designed to provide a load-bearing surface that is adequate to support personal vehicles, while allowing infiltration of surface water into the underlying soils. They usually are used in low-volume traffic areas such as overflow parking lots and lightly used access roads. An alternative to pervious and modular pavement for parking areas is a geotextile material installed as a framework to provide structural strength. Filled with sand and sodded, it provides a completely grassed parking area.

Rain Barrels/Gardens
A rain barrel is a container that collects and stores rainwater from your rooftop (via your home's disconnected downspouts) for later use on your lawn, garden, or other outdoor uses. Rainwater stored in rain barrels can be useful for watering landscapes, gardens, lawns, and trees. Rain is a naturally soft water and devoid of minerals, chlorine, fluoride, and other chemicals. In addition, rain barrels help to reduce peak volume and velocity of stormwater runoff to streams and storm sewer systems.

Rain gardens are small-scale bioretention systems that be can be used as landscape features and small-scale stormwater management systems for single-family homes, townhouse units, and some small commercial development. These units not only provide a landscape feature for the site and reduce the need for irrigation, but can also be used to provide stormwater depression storage and treatment near the point of generation. These systems can be integrated into the stormwater management system since the components can be optimized to maximize depression storage, pretreatment of the stormwater runoff, promote evapotranspiration, and facilitate groundwater recharge. The combination of these benefits can result in decreased flooding due to a decrease in the peak flow and total volume of runoff generated by a storm event. In addition, these features can be designed to provide a significant improvement in the quality of the stormwater runoff. These units can also be integrated into the design of parking lots and other large paved areas, in which case they are referred to as bioretention areas.

Infiltration Trenches
Infiltration trenches are excavated trenches backfilled with a coarse stone aggregate and biologically active organic matter. Infiltration trenches allow temporary storage of runoff in the void space between the aggregate and help surface runoff infiltrate into the surrounding

soil. Infiltration trenches remove fine sediment and the pollutants associated with them. Soil infiltration trenches can be effective at reducing sediment concentrations and nutrient loading. Soluble pollutants can be effectively removed if detention time is maximized. The degree to which soluble pollutants are removed is dependent primarily on holding time, the degree of bacterial activity, and chemical bonding with the soil. The efficiency of the trench to remove pollutants can be increased by increasing the surface area of the trench bottom. Infiltration trenches can provide full control of peak discharges for small sites. They provide groundwater recharge and may augment base stream flow.

Stream Restoration

Stream restoration techniques are used to improve stream conditions so they more closely mimic natural conditions. For urban stream reaches, restoration to natural conditions may not be possible or feasible. For instance, physical constraints due to adjacent development may limit the ability to re-meander a stream. In addition, the natural stream conditions may not be able to accommodate the increased volume of flow from the developed watershed.

Even in cases where restoring the stream to its natural condition is not possible, the stream can still be naturalized and improved by reestablishing riparian buffers, performing stream channel maintenance, stabilizing streambanks using bioengineering techniques, and, where appropriate, by removing manmade dams and installing pool/riffle complexes. Stream restoration projects may be one component of floodplain restoration projects, and can be supplemented with trails and interpretive signs, providing recreational and educational benefits to the community.

Preventative Measures

Conservation Design Developments

The goal of conservation design development is to protect open space and natural resources for people and wildlife, while at the same time allowing development to continue. Conservation design developments designate half or more of the buildable land area as undivided permanent open space. They are density neutral, allowing the same density as in conventional developments, but that density is realized on smaller areas of land by clustering buildings and infrastructure. In addition to clustering, conservation design developments incorporate natural riparian buffers and setbacks for streams, wetlands, other waterbodies, and adjacent agricultural.

The first and most important step in designing a conservation development is to identify the most essential lands to preserve in conservation areas. This will require coordination with local officials and the community as this practice is commonly added into ordinances and future planning efforts. Natural features including streams, wetlands, lakes, steep slopes, mature woodlands, native prairie, and meadow (as well as significant historical and cultural features) are included in conservation areas. Clustering is a method for preserving these areas. Clustered developments allow for increased densities on less sensitive portions of a site, while preserving the remainder of the site in open space for conservation and recreational uses (such as trails, soccer or ball fields).

Clustering can be achieved in a planned unit development (PUD) or planned residential development (PRD). PUDs contain a mix of zoning classifications that may include commercial, residential, and light industrial uses, all of which are blended together. Well-designed PUDs usually locate residences and offices within walking distance of each other to reduce traffic. Planned residential developments (PRDs) apply similar concepts to residential developments.

Greenways and Trails

Greenways can provide a large number of functions and benefits to nature and the public. For plants and animals, greenways provide habitat, a buffer from development, and a corridor for migration. Greenways located along streams include riparian buffers that protect water quality by filtering sediments and nutrients from surface runoff and stabilizing streambanks. By buffering the stream from adjacent developed land use, riparian greenways offset some of the impacts associated with increased impervious surface in a watershed. Maintaining a good riparian buffer can mitigate the negative impacts of approximately 5% additional impervious surface in the watershed.

Greenways also provide long, linear corridors with options for recreational trails. Trails along the river provide watershed stakeholders with an opportunity to exercise and enjoy the outdoors. Trails allow users to see and access the river, thereby connecting people to their river and the overall watershed. Trails can also be used to connect natural areas, cultural and historic sites and communities, and serve as a safe transportation corridor between work, school, and shopping destinations.

Techniques for establishing greenways and trails involve the development of a plan that proposes general locations for greenways and trails. In the case of trails, the plan also identifies who the users will be and provides direction on trail standards. Plans can be developed at the community and/or county level, as well as regionally, statewide, and in a few cases, at the national level. Public and stakeholder input are crucial for developing successful greenway and trail plans.

Several techniques can be used for establishing greenways and trails. Greenways can remain in private ownership, they can be purchased, or easements can be acquired for public use. If the lands remain in private ownership, greenway standards can be developed, adopted, and implemented at the local level through land use planning and regulation. Development rights for the greenway can be purchased from private landowners where regulations are unpopular or not feasible.

If the greenways will include trails for public use, the land for trails is usually purchased and held by a public agency such as a forest preserve district or local park system. In some cases, easements will be purchased rather than purchasing the land itself. Usually longer trail systems are built in segments, and completing connections between communities depends heavily on the level of public interest in those communities.

In new developing areas, the local planning authority can require trails. Either the developer or the community can build the trails. In some cases, the developer will voluntarily plan and build a trail connection through the development and use this as a marketing tool to future homebuyers. In other cases, the local planning authority may require the developer to donate an easement for the trail. To install trails through already developed areas, land can be purchased by a community agency with a combination of local, state, and federal funds.

Impediments to land purchase can significantly slow up trail connections in already established areas.

Protected Ownership

There are several options for land transfer ranging from donation to fee simple land purchase. Donations can be solicited and encouraged through incentive programs. Unfortunately, while preferred by money-strapped conservation programs, land donations are often not adequate to protect high priority sites. A second option is outright purchase (or fee simple land purchase). Outright purchase is frequently the least complicated and most permanent protection technique, but is also the most costly. A conservation easement is a less expensive technique than outright purchase that does not require the transfer of land ownership but rather a transfer of use rights. Conservation easements might be attractive to property owners who do not want to sell their land at the present time, but would support perpetual protection from further development. Conservation easements can be donated or purchased.

Protecting Open Space and Natural Areas

Several techniques can be used for protecting natural areas and open space in both public and private ownership. The first step in the process is to identify and prioritize properties for protection. The highest priority natural areas should be permanently protected by the ownership or under the management of public agencies or private organizations dedicated to land conservation. Other open space can be protected using conservation design development techniques, and is more likely to be managed by homeowner associations.

Septic Tank Maintenance and Repair

Septic, or on-site waste disposal systems, are the primary means of sanitary flow treatment in the unincorporated parts of the Morse Reservoir/Cicero Creek Watershed. Because of the prohibitive cost of providing centralized sewer systems to many areas, septic tank systems will remain the primary means of treatment into the future. Annual maintenance of septic systems is crucial for their operation, particularly the annual removal of accumulated sludge. The cost of replacing failed septic tanks is about $5,000-$15,000 per unit based on industry standards.

Property owners are responsible for their septic systems under the regulation of the County Health Department. When septic systems fail, untreated sanitary flows are discharged into open watercourses that pollute the water and pose a potential public health risk. Septic systems discharging to the ground surface are a risk to public health directly through body contact or contamination of drinking water sources, provide conditions favorable to insect vectors such as flies and mosquitoes, and contribute significant amounts of nitrogen and phosphorus to the watershed. Therefore, it is imperative for homeowners not to ignore septic failures. If plumbing fixtures back up or will not drain, the system is failing. Funding for this practice is limited.

Threatened and Endangered (T&E) Species Protection

Threatened and endangered species are those plant and animal species whose survival is in peril. Both the federal government and the state of Indiana maintain lists of species that meet threatened or endangered criteria within their respective jurisdictions. Threatened species are those that are likely to become endangered in the foreseeable future. Federally endangered species are those that are in danger of extinction throughout all or a significant portion of their range. A state-endangered species is any species that is in danger of extinction as a breeding species in Indiana.

Considerations in protecting endangered species include making sure there is sufficient habitat available - food, water, and “living sites” (For animals, this means areas for making nests and dens and evading predators. For plants, it refers to availability of preferred substrate and other desirable growing conditions.); providing corridors for those species that need to move between sites; and protecting species from impacts due to urbanization.

Several techniques can be used to protect T&E species. One technique is to acquire sites where T&E species occur. Purchase and protection of the site where the species is located (with adequate surrounding buffer) may be sufficient to protect that population. In some instances it is not feasible or possible to buy the needed land. Where the site and buffer area is not available for purchase, where an animal’s range is too large of an area (or migrates between sites), or where changes in hydrology or pollution from outside the site affect the species, other techniques must be used to protect the T&E species.

Developing a resource conservation or management plan for the species and habitat of concern is the next step. Resource plans consider the need for buffer areas and habitat corridors, and consider watershed impacts from hydrology changes or pollutant loadings. The conservation plan will include recommendations for management specific to the species and its habitat, whether located on private or public lands. The conservation plan will guide both the property owner and the local unit of government that plans and permits adjacent land uses and how to manage habitat to sustain the species.

Wetland Enhancement and Protection

Wetlands provide a multitude of benefits and functions. Wetlands improve water quality by removing suspended sediment and dissolved nutrients from runoff. They control the rate of runoff discharged from the watershed and reduce flooding by storing rainfall during storm events. Wetlands also provide habitat for plants and animals including many of those that are threatened and endangered.

Because agriculture and urbanization have destroyed or degraded many of the remaining wetlands in the Morse Reservoir/Cicero Creek Watershed, wetland enhancement projects are necessary to improve the diversity and function of these degraded wetlands. The term enhancement refers to improving the functions and values of an existing wetland. Converted wetland/field sites (or sites that were formerly wetlands but have now been converted to other uses) can also be restored to provide many of their former wetland benefits. Wetland restoration is the process of establishing a wetland on a site that is not currently a wetland, but once was prior to conversion. Wetlands have the ability to reduce nutrient loading, sediment concentrations, and flood damage. Wetlands can be used to teach landowners about their importance with respect to plants and animals and also increases the amount of open space in the watershed.

Best Management Practices Load Reductions

Load reduction calculations were estimated for nitrogen, phosphorus and sediment based on the potential BMPs to be implemented within the Morse Reservoir/Cicero Creek Watershed. The percent reductions for each BMP were based on the review of EPA's Stormwater Menu of BMPs, EPAs National Management Measures to Control Nonpoint Source Pollution from Agriculture, The Nature Conservancy of Indiana, The Center for Watershed Protection and STEPL. The reductions for the Buffer/Filter strips were obtained from STEPL and the rest of the load reductions were obtained from the studies and information mentioned above.

The BMPs listed are typical BMPS and are provided as a reference, it is not meant to be all inclusive list but only a guide. The reductions only apply to the drainage area that is directly tributary to the BMP implemented. Meaning, a BMP is only effective for the drainage area tributary to it and not the areas of the entire subwatershed. Therefore, when trying to evaluate BMPs and their effectiveness for pollutant removal, the tributary drainage area needs to be evaluated as well.

The actual efficiency of each BMP is based on several variables making it difficult to accurately determine the number required to equal the reduction goals (e.g. the location in the watershed, tributary area, soils, etc), therefore specific locations and types of BMPs should be carefully planned out in coordination with the landowners and applicable local, state and federal agencies and with the load reduction needs of the subwatershed in mind. Table 50 shows the expected load reductions and associated costs for each BMP.

The reductions shown in Table 50 are based on the tributary drainage area to the BMP. For example, if you have a tributary drainage area that is 1 acre and you install a buffer/filter strip that is 5 acres, you will reduce the loads for that 1 acre tributary drainage area by 65%, 75% and 70% for TSS, P and N respectively. And the approximate cost for the buffer/filter strip will be $25,000 to $50,000 (5 acres * $5,000/acre and $10,000/acre).

Table 50: Best Management Practice Load Reduction Summary					
Agricultural/Rural Best Management Practices					
	Estimated Load Reductions				
BMP/Measure	**Sediment**	**Phosphorus**	**Nitrogen**	***E. coli***	**Cost**
Alternative Watering System	80%	78%	75%	N/A	$5,000/EA
Buffer/Filter Strips	65%	75%	70%	N/A	$5,000-$10,000/AC
Cover Crops	40%	45%	40%	N/A	$100/AC
Exclusionary Fencing	70%	60%	65%	90%	$50/Ft
Grassed Waterways	80%	30%	40%	N/A	$5,000-$10,000/AC
Nutrient/Waste Management	60%	90%	80%	85%	$5 - $30/AC
Infiltration Trench	100%	45%	45%	N/A	$10,000-$20,000/AC
No-Till/Reduced Till (Conventional Tillage)	75%	45%	55%	N/A	$20/AC
Reforestation	80%	42%	68%	N/A	$750/AC
Rotational Grazing	40%	20%	20%	N/A	N/A
Stream Restoration	75%	75%	75%	N/A	$100-$250/Ft
Two-Stage Ditches	38%	33%	17%	N/A	$15-$20/Ft
Wetland Restoration	80%	55%	45%	80%	$5,000-$10,000/AC
Urban Best Management Practices					
	Estimated Load Reductions				
BMP/Measure	**Sediment**	**Phosphorus**	**Nitrogen**	***E. coli***	**Cost**
Bioretention Practices	40%	80%	65%	N/A	$10,000-$20,000/AC
Filtration Basin	75%	65%	60%	N/A	$10,000-$20,000/AC
Naturalized Detention Basin	80%	55%	35%	N/A	$10,000-$20,000/AC
Naturalized Stream Buffer	75%	45%	40%	N/A	$10,000-$20,000/AC
Pervious Pavement	95%	85%	85%	N/A	$2 - $7/Sq. Ft
Rain Barrels	N/A	N/A	N/A	N/A	$75-$300/Each
Rain Garden	80%	20%	20%	N/A	$10,000-$20,000/AC
Stream Restoration	75%	75%	75%	N/A	$100-$250/Ft
Infiltration Trench	100%	45%	45%	N/A	$10,000-$20,000/AC

Subwatershed Best Management Practice Selection

Table 51 is a breakdown of the selected best management practices for each subwatershed based on the characteristics of the subwatershed that are degrading its water quality. The BMPs listed are typical BMPS and are provided as a reference, it is not meant to be all inclusive list but only a guide. The "Reason for being Critical" column was created based on the subwatershed specific analysis of the land use within the subwatershed, water quality data (IDEM, CIWRP and V3), and the findings of the windshield survey. The water quality parameters that require reduction loads equal to or greater than 50% based on Tables 45-48 were considered to be critical for that subwatershed. Similarly, the windshield survey parameters that ranked 1, 2, or 3 were considered to be critical for that subwatershed.

The "Suggested BMP" column was then created only including the BMPs that would provide better than a 50% reduction based on the information provided in Table 50 for its associated critical impairment. Certain BMPs are suggested for more than one impairment (e.g. Buffer/Filter Strips are suggested for *E.coli*, Nitrate+Nitrite, Total Phosphorus, TSS, Lack of Stream Buffers and Streambank Erosion). The table was created in this way so not to limit the possible projects if a specific impairment is to be targeted for implementation for a specific funding source.

Table 51: BMP Selection		
Critical Area	**Reason for being Critical**	**Suggested BMP**
High Priority Subwatersheds		
Little Cicero Creek	*E. coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Nitrate+Nitrite	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
		Reforestation
		Stream Restoration
	Total Phosphorus	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Stream Restoration
		Wetland Restoration
	Livestock Access	Alternative Watering System
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Stream Restoration
	Conventional Tillage Practices	Education and Outreach
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
	In-stream Debris	Education and Outreach
	Lack of Stream Buffers	Education and Outreach
		Buffer/Filter Strips
		Stream Restoration
	Streambank Erosion	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Stream Restoration
		Wetland Restoration

Table 51: BMP Selection, cont.		
Critical Area	**Reason for being Critical**	**Suggested BMP**
High Priority Subwatersheds		
Tobin Ditch	*E. coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Nitrate+Nitrite	Alternative Watering System
		Bioretention Practices
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Filtration Basin
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
		Pervious Pavement
		Reforestation
		Stream Restoration
	Lack of Stream Buffers	Education and Outreach
		Buffer/Filter Strips
		Stream Restoration
	Livestock Access	Alternative Watering System
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Stream Restoration

Table 51: BMP Selection, cont.		
Critical Area	**Reason for being Critical**	**Suggested BMP**
High Priority Subwatersheds		
Teter Branch	Total Phosphorus	Alternative Watering System
		Bioretention Practices
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Filtration Basin
		Naturalized Detention Basin
		Nutrient/Waste Management
		Pervious Pavement
		Reforestation
		Stream Restoration
		Wetland Restoration
	Nitrate+Nitrite	Alternative Watering System
		Bioretention Practices
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Filtration Basin
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
		Pervious Pavement
		Reforestation
		Stream Restoration
	E. coli	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Livestock Access	Alternative Watering System
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Stream Restoration
	Conventional Tillage Practices	Education and Outreach
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
	In-stream Debris	Education and Outreach
	Streambank Erosion	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Stream Restoration
		Wetland Restoration

Table 51: BMP Selection, cont.		
Critical Area	**Reason for being Critical**	**Suggested BMP**
High Priority Subwatersheds		
Morse Reservoir/Cicero Creek	*E. coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Nitrate+Nitrite	Alternative Watering System
		Bioretention Practices
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Filtration Basin
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
		Pervious Pavement
		Reforestation
		Stream Restoration
	Algae	Alternative Watering System
		Bioretention Practices
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Filtration Basin
		Naturalized Detention Basin
		Nutrient/Waste Management
		Pervious Pavement
		Wetland Restoration
	Streambank Erosion	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Naturalized Stream Buffer
		Rain Barrel/Rain Garden
		Stream Restoration
		Wetland Restoration
	In-stream Debris	Education and Outreach
	Conventional Tillage Practices	Education and Outreach
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
	Livestock Access	Alternative Watering System
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Stream Restoration

Table 51: BMP Selection, cont.		
Critical Area	**Reason for being Critical**	**Suggested BMP**
Medium Priority Subwatersheds		
Cox Ditch Prairie Creek Hinkle Creek	Nitrate+Nitrite	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
		Reforestation
		Stream Restoration
	E. coli	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Total Phosphorus	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Reforestation
		Stream Restoration
		Wetland Restoration
	Livestock Access	Alternative Watering System
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Stream Restoration
	Conventional Tillage Practices	Education and Outreach
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
	Lack of Stream Buffers	Education and Outreach
		Buffer/Filter Strips
		Stream Restoration

Table 51: BMP Selection, cont.		
Critical Area	**Reason for being Critical**	**Suggested BMP**
	Low Priority Subwatersheds	
Weasel Creek Buck Creek Dixon Creek	*E. coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	Nitrate+Nitrite	Alternative Watering System
		Bioretention Practices
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Filtration Basin
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
		Pervious Pavement
		Reforestation
		Stream Restoration
	TSS	Alternative Watering Systems
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Filtration Basin
		Grassed Waterways
		Nutrient/Waste Management
		Infiltration Trench
		Naturalized Detention Basin
		Naturalized Stream Buffer
		No-Till/Reduced Till (Conservation Tillage
		Pervious Pavement
		Rain Barrel/Rain Garden
		Reforestation
		Stream Restoration
		Wetland Restoration
	Total Phosphorus	Alternative Watering System
		Bioretention Practices
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Filtration Basin
		Naturalized Detention Basin
		Nutrient/Waste Management
		Pervious Pavement
		Stream Restoration
		Wetland Restoration

<table>
<tr><th colspan="3">Table 51: BMP Selection, cont.</th></tr>
<tr><th>Critical Area</th><th>Reason for being Critical</th><th>Suggested BMP</th></tr>
<tr><th colspan="3">Low Priority Subwatersheds</th></tr>
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Buck Creek
Dixon Creek</td><td rowspan="5">Livestock Access</td><td>Alternative Watering System</td></tr>
<tr><td>Education and Outreach</td></tr>
<tr><td>Exclusionary Fencing</td></tr>
<tr><td>Nutrient/Waste Management</td></tr>
<tr><td>Stream Restoration</td></tr>
<tr><td rowspan="3">Conventional Tillage Practices</td><td>Education and Outreach</td></tr>
<tr><td>Nutrient/Waste Management</td></tr>
<tr><td>No-till/Reduced Till (Conservation Tillage)</td></tr>
<tr><th colspan="3">Specific Source Critical Areas</th></tr>
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<tr><td>Education and Outreach</td></tr>
<tr><td>Exclusionary Fencing</td></tr>
<tr><td>Nutrient/Waste Management</td></tr>
<tr><td>Stream Restoration</td></tr>
<tr><td colspan="2" rowspan="3">Absent or Insufficient Stream Buffers</td><td>Education and Outreach</td></tr>
<tr><td>Buffer/Filter Strips</td></tr>
<tr><td>Stream Restoration</td></tr>
<tr><td colspan="2" rowspan="8">Excessive Streambank Erosion</td><td>Alternative Watering System</td></tr>
<tr><td>Buffer/Filter Strips</td></tr>
<tr><td>Education and Outreach</td></tr>
<tr><td>Exclusionary Fencing</td></tr>
<tr><td>Naturalized Stream Buffer</td></tr>
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<tr><td>Wetland Restoration</td></tr>
<tr><td colspan="2" rowspan="3">Agricultural Areas Practicing Conventional Tillage</td><td>Education and Outreach</td></tr>
<tr><td>Nutrient/Waste Management</td></tr>
<tr><td>No-till/Reduced Till (Conservation Tillage)</td></tr>
</table>

Incentives/Cost Share Opportunities

There are a number of incentive programs to implement BMP projects. Fund sources for wetland protection and restoration, as well as technical assistance, are available from programs at the local, regional, state, and federal levels of government including USEPA Section 319 grants.

U.S. Army Corps of Engineers (USACE) Continuing Authorities Program

At the Federal level, the USACE Continuing Authorities Program (CAP) from Section 206 of the 1996 Water Resources Development Act targets wetland restoration. This section, also known as the "Aquatic Ecosystem Restoration" program gives the USACE the authority to carry out aquatic ecosystem restoration and protection if the projects will improve the quality of the environment, are in the public interest, and are cost effective. The objective of section 206 is to restore degraded ecosystem structure, function, and dynamic processes to a less degraded and more natural condition. The local sponsors of aquatic ecosystem restoration projects are required to contribute 35% towards the total project cost.

U.S Environmental Protection Agency (USEPA) Section 319 Grants

Section 319 of the Clean Water Act provides funding for projects that work to reduce nonpoint source water pollution. IDEM administers funds from the Section 319 program which are used to create watershed management plans, demonstrate new technology, provide education and outreach on pollution prevention, conduct assessments, develop and implement Total Maximum Daily Loads (TMDLs), provide cost share dollars for BMP implementation and provide technical assistance. Organizations that are eligible for funding include nonprofit organizations, universities, and local, State or Federal government agencies. An in-kind or cash match of the total project cost must be provided.

Lake and River Enhancement (LARE) Program

LARE grants are available on a competitive basis for several actions that can address the ecology and management of public lakes, rivers and their watersheds. All grants require a local cost share. The goal of the Division of Fish and Wildlife's Lake and River Enhancement Section is to protect and enhance aquatic habitat for fish and wildlife, to insure the continued viability of Indiana's publicly accessible lakes and streams for multiple uses, including recreational opportunities. This is accomplished through measures that reduce non-point sediment and nutrient pollution of surface waters to a level that meets or surpasses state water quality targets. Funding for the LARE program is provided by an annual fee charged to boat owners. LARE grants are available for preliminary lake studies, engineering feasibility studies of pollution control measures, design engineering of control measures, and performance appraisals of a constructed pollution measure. The projects listed above are considered "traditional" projects and the deadline to submit applications is January 15th. Approved projects are awarded grant money in the month of July. Additionally, LARE sets aside one-third of its annual funds for sediment removal or exotic species control. Land treatment cost share dollars for agricultural practices require the involvement of the County SWCDs as the grant sponsor.

Farm Service Agency (FSA) Programs

Indiana Farm Service Agency (FSA) supports farmers through a variety of Credit and Commodity Programs designed to stabilize and enhance rural landscape. The FSA administers and manages farm commodity, credit, disaster and loan programs, and conservation as laid out by Congress through a network of federal, state and county offices. Programs are designed to improve economic stability of the agricultural industry and to help farmers adjust production to meet demand. Economically, the desired result of these programs is a steady price range for agricultural commodities for both farmers and consumers.

Conservation Reserve Program (CRP)
The CRP is a voluntary program encouraging landowners for long-term conservation of soils, water, and wildlife resources. CRP is the US Department of Agriculture's single largest environmental improvement program and is administered through the Farm Service Agency (FSA) with 10 to 15 year contracts. The goal of the CRP program (and CREP - Conservation Reserve Enhancement Program) is to give incentives to landowners who take frequently flooded and environmentally sensitive land out of crop production and plant specific types of vegetation. Participants earn annual rental payments and sign-up incentives. This program offers up to 90% cost share. Rental payments are boosted by 20% for projects such as installation of riparian buffers and filter strips. Windbreaks, contour buffer strips, and shallow water areas are additional funded practices. The WHIP program is available for private landowners to make improvements for wildlife on their property. This program offers up to 75% cost share. This grant program is competitive and funding depends on the project's ranking compared to others in the state.

Conservation Stewardship Program (CSP)
The Conservation Stewardship Program (CSP) is a voluntary program that encourages agricultural producers to improve conservation systems by improving, maintaining, and managing existing conservation activities and undertaking additional conservation activities. The Natural Resources Conservation Service administers this program and provides financial and technical assistance to eligible producers. CSP is available on Tribal and private agricultural lands and non-industrial private forestland (NIPF) on a continuous application basis.

CSP offers financial assistance to eligible participants through two possible types of payments:

- Annual payment for installing and adopting additional activities; and improving, maintaining, and managing existing activities.
- Supplemental payment for the adoption of resource-conserving crop rotations.

Environmental Quality Incentives Program (EQIP)
EQIP is accommodating to grass-roots conservation and is another voluntary USDA conservation program for farmers faced with threats to soil, water, and related natural resources. Typically EQIP monies will fund 75% of land improvements and installation of conservation practices such as grade stabilization structures, grassed waterways, and filter strips adjacent to water resources (including wetlands). The goal of WRP is to restore and protect degraded wetlands such as farmed wetlands. WRP provides technical and financial assistance to eligible landowners to restore, enhance and protect wetlands. At least 70% of each project area will be restored to natural site conditions to the extent practicable. WRP has three options available: permanent easements, 30-year easements and restoration agreements. The NRCS will reimburse the landowners for easements on the property plus a

portion of the restoration costs based on the type of easement agreed to by the landowner. EQIP and WRP are only applicable to agricultural lands.

Wetlands Reserve Program (WRP)
The WRP is the Nation's premier wetlands restoration program. It is a voluntary program that offers landowners the means and the opportunity to protect, restore, and enhance wetlands on their property. The USDA NRCS manages the program as well as provides technical and financial support to help landowners participate in WRP. Program objectives include: purchasing conservation easements from, or entering into cost-share agreements with willing owners of eligible land, helping eligible landowners, protect, restore, and enhance the original hydrology, native vegetation, and natural topography of eligible lands, restoring and protecting the functions and values of wetlands in the agricultural landscape, helping to achieve the national goal of no net loss of wetlands, and improving the general environment of the country.

The emphasis of the WRP program is to protect, restore and enhance the functions and values of wetland ecosystems to attain: 1) first and foremost, habitat for migratory birds and wetland dependent wildlife, including threatened and endangered species; 2) protection and improvement of water quality; 3) lessen water flows due to flooding; 4) recharge of ground water; 5) protection and enhancement of open space and aesthetic quality; 6) protection of native flora and fauna contributing to the Nation's natural heritage; and 7) contribute to educational and scholarship.

Wildlife Habitat Incentive Program (WHIP)
The Wildlife Habitat Incentive Program (WHIP) is a voluntary program for people who want to develop and improve wildlife habitat primarily on private land. Through WHIP USDA's Natural Resources Conservation Service provides both technical assistance and up to 75 percent cost-share assistance to establish and improve fish and wildlife habitat. WHIP agreements between NRCS and the participant generally last from 5 to 10 years from the date the agreement is signed.

In order to provide direction to the State and local levels for implementing WHIP to achieve its objective, NRCS has established the following national priorities:

- Promote the restoration of declining or important native fish and wildlife habitats.
- Protect, restore, develop or enhance fish and wildlife habitat to benefit at-risk species
- Reduce the impacts of invasive species on fish and wildlife habitats; and
- Protect, restore, develop or enhance declining or important aquatic wildlife species' habitats

WHIP has proven to be a highly effective and widely accepted program across the country. By targeting wildlife habitat projects on all lands and aquatic areas, WHIP provides assistance to conservation minded landowners that are unable to meet the specific eligibility requirements of other USDA conservation programs.

Conservation Reserve Enhancement Program (CREP)
CREP is a federal-state natural resources conservation program that addresses agricultural-related environmental concerns at the state and national level. CREP participants receive

financial incentives to voluntarily enroll in CRP in contracts of 14 to 15 years. Participants remove cropland from agricultural production and convert the land to native grasses, trees and other vegetation. The Indiana CREP is a partnership between USDA and the state of Indiana. The program targets the enrollment of 7,000 acres of land in the Pigeon-Highland, Tippecanoe, and Upper White River watersheds where sediments, nutrients, pesticides and herbicides run off from agricultural land.

The program will improve water quality by creating buffers and wetlands that will reduce agricultural runoff into the targeted watersheds. Installing buffer practices and wetlands will enhance habitat for wildlife, including State and Federally-listed threatened and endangered species. The program will also reduce nonpoint source nutrient losses. The goals of the Indiana CREP are to: 1) enroll 7,000 acres of eligible cropland and marginal pastureland, including frequently flooded lands, into CREP to establish buffer practices and wetlands, 2) protect at least 2,000 linear miles of watercourses by installing buffer practices, 3) reduce by 15 percent the amount of sediment, nutrients and agricultural chemicals entering watercourses within the targeted watersheds, 4) enroll 30 percent of farmed riparian acreage in the watersheds in accordance with statutory and regulatory rules, 5) enroll 8 percent of eligible acres in voluntary state ten-year contract extensions with local Soil and Water Conservation Districts in the Tippecanoe watershed; and 6) enroll 10 percent of eligible acres in voluntary state permanent easements in the Tippecanoe and Upper White River watersheds.

Landowners may enroll any amount of eligible cropland in the federal program and voluntary state 14-15 year contract extensions. State permanent easements allow producers to offer non-cropped acreage when they enroll cropland. Installation of conservation practices must be completed within 12 months of the federal CREP contract effective date. Once enrolled in the CREP program the land cannot be developed (i.e. no permanent structures or roads may be built). Existing abandoned structures and roads may remain if approved by DNR. Landowners must follow the Conservation Plan of Operation and land cannot go back into row crops or agricultural uses. The landowners retain the right to recreational use of their property providing it does not negatively impact the practices or cover established. The state CREP contract is attached to the land deed; thus, a producer who purchases land enrolled in an active state CREP contract is required to participate in the program or refund state money paid to date and incur other penalties.

Section 7 – Action Register and Schedule

Action Register

The success of a watershed management plan can be measured by how readily it is used by its intended audience and how well it is implemented. The Morse Reservoir/Cicero Creek WMP is very ambitious and continued implementation of the plan will require an even greater degree of cooperation and coordination among partners and funding for projects.

The action register is a tool used to easily identify each objective, milestone, estimated cost, and possible partners for easier implementation of the plan. The action register is divided based on the previously identified problem and goal categories. The problem and goal statements are also repeated in these sections for quick reference. It should be noted that some objectives may relate to several problem/goal statements, they are listed in each applicable category.

Public Participation/Education and Outreach

Problem Statement: Stakeholders in the Morse Reservoir/Cicero Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.

Goal Statement: Develop and implement an education and outreach program within the watershed by 2031 (20 years).

Table 52: Public Participation/Education and Outreach Action Register

	Objective	Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Short Term Objectives (0-5 Years)	Effectively share and communicate past, current and future activities within the watershed	All stakeholders and landowners within the watershed	-Update MWA website on a monthly basis -Link UWRWA Morse page to efforts on MWA website within 6 months	$400/month (Estimated $100/hour for 4 hours a month)	PP – UWRWA TA – UWRWA, Consultant
	Educate stakeholders within the watershed on the function of a watershed and their impacts to water quality	All stakeholders and landowners within the watershed	-Compile a list of publications willing to feature watershed articles and complete within 6 months -Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 1 year	$750 - $8,600 (Estimated $100/hour for 6 hours to compile list and $150 - $8,000 for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR, Consultant
	Educate homeowners in urban communities about the use of fertilizers	Homeowners in urban areas	-Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 1 year	$150 - $8,000 (for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR, Consultant
	Coordinate efforts with the UWRWA, local MS4s and any other education and outreach efforts being conducted within the watershed	Other groups/ organizations with similar watershed goals	-Identify all Education & Outreach focused organizations and/or committees within the watershed and complete within 6 months -Attend at least one meeting for each organization/committee within the first 3 years -Evaluate the value of the meetings attended for further attendance /coordination	$1,000 - $2,600) (Estimated $100/hour for 6 hours to compile list and 2 hours per meeting for 2-10 meetings)	PP – N/A TA – N/A

Table 52: Public Participation/Education and Outreach Action Register, cont.					
Objective		Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Short Term , cont.	Work with Indiana Wildlife Federation on efforts to educate on and reduce the use of fertilizers containing phosphorus	Indiana Wildlife Federation	-Identify MWA liaison to coordinate with IWF within first 6 months -Attend at least 1 meeting within 1 year	$200 (Estimated $100/hour for 2 hours)	PP – N/A TA – N/A
	Educate stakeholders using septic systems about the importance of septic system maintenance	Stakeholders and landowners with septic systems	-Choose the most effective outlet from the Education/Outreach Menu within 2 years -Complete chosen Education/Outreach mechanism within 5 years	$150 - $4,000 (for direct cost of chosen outlet)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR, Consultant
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
	Educate agricultural stakeholders about the use of Atrazine and its impacts to water quality	Agricultural landowners and operators	-Choose the most effective outlet from the Education/Outreach Menu -Complete chosen Education/Outreach mechanism	$150 - $4,000 (for direct cost of chosen outlet)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR, Consultant
	Utilize examples or pilot programs/demonstration projects within the watershed for educational purposes	All stakeholders and landowners within the watershed	-Identify existing projects/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, MS4s, SWCDs, County Surveyor's TA – UWRWA, MS4s, SWCDs, County Surveyor's, Consultant
	Review education and outreach program within the watershed and continue development and implementation of the program	N/A	-Review tasks and effectiveness at MWA/Sub-Committee Meetings	N/A	PP – N/A TA – N/A

Stream & Reservoir Nutrient Levels

Problem Statement: Agriculture and typical urban area practices (e.g. lawn care, pet waste disposal, erosion control during construction…etc.) within the watershed contributes a significant amount of pollutants, thereby contributing to the frequent exceedances of water quality targets and growth of algae within the reservoir.

Goal Statement: Reduce the nutrient loads so that there are no exceedances of EPAs suggested targets for Nitrate + Nitrite of 1.6 mg/L and Total Phosphorus of 0.076mg/L by 2031 (20 years).

Table 53: Stream & Reservoir Nutrient Levels Action Register

	Objective	Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Short Term Objectives (0-5 Years)	Educate the agricultural stakeholders on the importance of reduced application of fertilizers and urban/residential stakeholders on the use of low phosphorus or no phosphorus fertilizers	Agricultural /Residential landowners	-Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 1 year	$150 - $8,000 (for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR, Consultant
	Educate local, regional, and state officials on the need for regulations for urban areas (specifically for phosphorus)	Local, regional and state officials	-Identify MWA liaison within 1 year -Coordinate with IWF & ILMWG on on-going efforts at the state level within 3 years -Identify avenues to communicate concerns to officials on local and regional level within 3 years	$600 - $1,200 (Estimated $100/hour for 6 to 12 hours of time)	PP – UWRWA, NRCS, SWCDs TA – N/A
	Partner with NRCS, SWCDs, MS4s, ISDA and County Boards to promote and implement cost share and/or education programs	Other groups/ organizations with similar watershed goals	-Identify all local, state and/or federal programs focused on nutrient management within 1 year -Identify eligible project and complete within 5 years	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – IDEM, UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – IDEM, UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Promote and implement agricultural BMPs	Agricultural landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Promote and implement urban BMPs	Urban/Residen tial landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant

Table 53: Stream & Reservoir Nutrient Levels Action Register, cont.					
Objective		**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
	Educate and work with point discharges (CFOS, NPDES permitted facilities) to reduce their nutrient loads	NPDES Permittees	-Identify all currently permitted point dischargers -Research possible regulation changes -Coordinate/educate each point discharger to determine best practices	$800/Permittee (Estimated $100/hour for 8 hours of time)	PP – IDEM TA – IDEM
	Establish a monitoring program or group to collect samples	Other groups/ organizations with similar watershed goals	-Identify any monitoring efforts currently being done within the watershed by other groups -If lack of sufficient data exists from current monitoring efforts, develop program guidelines and begin sampling efforts	$600 (Estimated $100/ hour for 6 hours of identification time) $2,800/ collection event (Estimated $100/ hour for 8 hours of collection time and $200 per sample for analysis of ten samples)	PP – IDEM, Hoosier Riverwatch TA – IDEM. Hoosier Riverwatch

E. coli Levels

Problem Statement: *E. coli* levels in the watershed regularly exceed the state standard, based on current and historical water quality data results, and often exceed safety standards for recreational use in streams.

Goal Statement: Reduce *E. coli* concentrations to meet the state standard of 235 CFU/100mL by 2031 (20 years).

Table 54: *E. coli* Levels Action Register

	Objective	Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Short Term Objectives (0-5 Years)	Educate stakeholders using septic systems about the importance of septic system maintenance	Stakeholders and landowners with septic systems	-Choose the most effective outlet from the Education/Outreach Menu within 2 years -Complete chosen Education/Outreach mechanism within 5 years	$150 - $4,000 (for direct cost of chosen outlet)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, Veolia, IDEM, DNR, Consultant
Short Term Objectives (0-5 Years)	Encourage proper disposal of pet and/or Canada goose waste	Pet and open space owners	-Create a list of potential BMPs for implementation -Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2	$750 - $8,600 (Estimated $100/hour for 6 hours of identification time and $150 - $8,000 for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, County Surveyor's, Veolia TA – UWRWA, MS4s, County Surveyor's, Veolia, Consultant
Short Term Objectives (0-5 Years)	Partner with NRCS, SWCDs, MS4s and County Boards to promote and implement cost share and/or education programs	Other groups/ organizations with similar watershed goals	-Identify all local, state and/or federal programs focused on *E. coli* within 1 year -Identify eligible project and complete within 5 years	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – IDEM, UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – IDEM, UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
Short Term Objectives (0-5 Years)	Promote and implement agricultural BMPs	Agricultural landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
Short Term Objectives (0-5 Years)	Educate the public and stakeholders on the benefits of manure management practices	Agricultural landowners	-Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 5 years	$150 - $8,000 (for direct cost of chosen outlets per year)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant

Table 54: *E. coli* Levels Action Register, cont.					
Objective		**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
	Educate and work with point dischargers to reduce the amount of *E. coli* runoff from point sources, package plants, CFOs and CSOs	NPDES Permittees	-Identify all currently permitted point dischargers -Research possible regulation changes -Coordinate/educate each point discharger to determine best practices	$800/Permittee (Estimated $100/hour for 8 hours of time)	PP – IDEM TA – IDEM
	Establish a monitoring program or group to collect samples	Other groups/ organizations with similar watershed goals	-Identify any monitoring efforts currently being done within the watershed by other groups -If lack of sufficient data exists from current monitoring efforts, develop program guidelines and begin sampling efforts	$600 (Estimated $100/ hour for 6 hours of identification time) $2,800/ collection event (Estimated $100/ hour for 8 hours of collection time and $200 per sample for analysis of ten samples)	PP – IDEM, Hoosier Riverwatch TA – IDEM. Hoosier Riverwatch

Erosion and Sedimentation within the Watershed & Reservoir

Problem Statement: Soil erosion and sedimentation within the watershed is degrading the water quality/quantity and limiting the aesthetics, wildlife habitat, and aquatic health of the streams and reservoir within the watershed.

Goal Statement: Reduce sediment loads to meet the IDEM statewide draft TMDL target of 30 mg/L for TSS by 2031 (20 years).

Table 55: Erosion and Sedimentation Action Register

Objective		Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Short Term Objectives (0-5 Years)	Research cost effective ways to measure sediment changes within the reservoir	Other groups/ organizations with similar watershed goals	-Monitor long term changes based on measured sediment change within 5 years	Varies based on amount of sediment removed	PP – IDEM, IDNR TA – IDEM, IDNR
	Research/evaluate the need and effectiveness of a sediment removal program	Other groups/ organizations with similar watershed goals	-Monitor long term changes based on measured sediment change within 5 years	Varies based on amount of sediment removed	PP – IDEM, IDNR TA – IDEM, IDNR
	Partner with NRCS, SWCDs, MS4s and County to promote and implement cost share and/or education programs in order to reduce erosion from agricultural lands	Other groups/ organizations with similar watershed goals	-Identify all local, state and/or federal programs focused on erosion and sediment control within 1 year -Identify eligible project and complete within 5 years	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – IDEM, UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – IDEM, UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Promote and implement agricultural BMPs	Agricultural landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Promote and implement urban BMPs	Urban/Residen tial landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant

Table 55: Erosion and Sedimentation Action Register, cont.					
Objective		Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
	Measure sediment change within the reservoir	Other groups/ organizations with similar watershed goals	-Identify procedures to monitor changes in the amount of sediment within the reservoir -Monitor changes every year	\$600 (Estimated \$100/ hour for 6 hours of identification time) \$400/year (Estimated \$100/ hour for 4 hours of monitoring time per year	PP – IDEM, DNR TA – IDEM, DNR
	Encourage enforcement of erosion control practices associated with the issuance of Rule 5 construction permits	Local MS4s and SWCDs	-Identify enforcement officers -Educate public on how to identify potential violators utilizing most effective Education/Outreach outlet -Establish reporting mechanism with enforcement officers	\$750 - \$4,600 (Estimated \$100/hour for 6 hours of identification time and \$150 - \$4,000 for direct cost of chosen outlet) Cost of reporting mechanism will vary	PP – MS4s, SWCDs TA – MS4s, SWCDs, Consultant
	Establish a monitoring program or group to collect samples	Other groups/ organizations with similar watershed goals	-Identify any monitoring efforts currently being done within the watershed by other groups -If lack of sufficient data exists from current monitoring efforts, develop program guidelines and begin sampling efforts	\$600 (Estimated \$100/ hour for 6 hours of identification time) \$2,800/ collection event (Estimated \$100/ hour for 8 hours of collection time and \$200 per sample for analysis of ten samples)	PP – IDEM, Hoosier Riverwatch TA – IDEM. Hoosier Riverwatch

Section 8 – Tracking Effectiveness

Evaluating Plan Performance

This Management Plan is meant to be a flexible tool to achieve water quality improvements within the Morse Reservoir/Cicero Creek Watershed. The WMP will be evaluated by assessing the progress made on each of the six goals. The evaluation and adaptation of the plan will be the responsibility of the Steering Committee.

The plan should be evaluated every five years to assess the progress made as well as to revise the plan, if appropriate, based on the progress achieved. The plan will also have a comprehensive review every 15 years. Amendments and changes may be made more frequently as laws change or new information becomes available that will assist in providing a better outlook for the Watershed. As goals are accomplished and additional information is gathered, efforts may need to be shifted to watershed issues of higher priority.

Tracking Strategy

In addition to the official 5 year evaluation and update, the Steering Committee will have a key role in evaluating implementation progress on an annual basis. The Steering Committee will review the status of actions recommended in the Action Register at least once per year and then identify the top priority concerns and actions for the following years focus. The Steering Committee should identify how it will implement the plan (subcommittees, reporting structure, meeting schedule, etc.).

In order to evaluate the implementation progress, a task completion log (Table 56) was completed for all milestones identified in the Action Register. An indicator tracking log (Table 57) was also created to evaluate the overall impact of implementation of the WMP. The indicators based on records maintained by the Steering Committee and in coordination with the partners identified within the Action Register.

Other opportunities for evaluating the status of plan implementation include the completion of quarterly project reports or Steering Committee meeting minutes. Since this plan is a flexible tool, the provided logs are suggestions on ways to evaluate progress; however changes/modifications are anticipated based on usability and changes in priority throughout the implementation of the WMP.

It was assumed that implementation would begin in March 2011. Dates were assigned to each milestone timeframe based on the implementation start date.

Table 56: Task Completion Log		
Task	**Start Date**	**Completion Date**
Monthly (Beginning March 2011)		
Update MWA website on a monthly basis		
6 months (Completed September 2011)		
Link UWRWA Morse page to efforts on MWA website		
Compile a list of publications willing to feature watershed articles		
Identify all Education and Outreach focused organizations/ committees within the watershed		
Identify MWA liaison to coordinate with IWF		
1 year (Completed February 2012)		
Complete 2 Education/Outreach menu items focused on the use of fertilizers and low/no phosphorus products (both urban and agricultural)		
Identify all local, state and/or federal programs focused on nutrient management, erosion control and *E. coli* reduction		
Identify MWA liaison to coordinate with local, regional and state officials for phosphorus regulations		
Complete 2 Education/Outreach Menu items focused on stakeholders and their impact to the watershed		
Attend at least one meeting focused on coordinating efforts with IWF		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		
2 years (Completed February 2013)		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		
3 years (Completed February 2014)		
Coordinate with IWF and ILMWG on on-going efforts at the state level		
Identify avenues to communicate phosphorus regulation concerns to officials on local level		
Attend at least one meeting for each educational and outreach organization and evaluate the required efforts for coordination		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		

Table 56: Task Completion Log, cont.		
Task	**Start Date**	**Completion Date**
5 years (Completed February 2016)		
Identify eligible projects for cost share opportunities in nutrient management/erosion control and *E. coli* reduction and complete at least 1 in each category		
Research long term changes based on measured sediment change within the reservoir		
Complete Education/Outreach Menu items focused on stakeholders with septic systems about the importance of septic maintenance		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		
Complete 2 Education/Outreach Menu items focused on manure management practices		
6-20 years (March 2016 – December 2030)		
Choose and complete Education/Outreach Menu items focused on agriculture stakeholders about the use of Atrazine and its impacts to water quality		
Identify and complete pilot programs/demonstration projects		
Identify procedures to monitor changes in the amount of sediment within the reservoir		
Review tasks and effectiveness at MWA/Sub Committee Meetings		
Identify all currently permitted point dischargers		
Monitor changes in sediment within the reservoir		
Research possible regulation changes for point dischargers		
Coordinate/educate point dischargers to determine best practices		
Identify erosion control enforcement officers within the watershed		
Educate public on how to identify potential erosion control violators		
Establish reporting mechanism for stream/reservoir nutrient and erosion and sediment control violations		
Identify any monitoring efforts currently being conducted within the watershed by other groups		
If lack of sufficient data exists from current monitoring efforts, develop program guidelines and begin sampling efforts		
Identify procedures to monitor changes in the amount of sediment within the reservoir		

Table 57: Indicator Tracking Log														
Year of Implementation	# of updates to website	# of programs/ideas utilized from Education/Outreach Menu	Change in sediment amount within reservoir	# of agricultural fields that have stopped using Atrazine	# of point dischargers reducing their pollutant loadings	# of observed Nitrate + Nitrite/ Phosphorus loadings above WQ target	# of observed *E. coli* loadings above WQ target	# of stream miles of improved/created buffer zones	# of stream miles of stabilized streambanks	# of miles of exclusionary fencing installed	# of agricultural fields utilizing cover crops, conservation tillage, or other BMPs	# of urban BMPs installed	# of inspections/enforcement actions on Rule 5 permit holders	# of demonstration projects installed
1														
2														
3														
4														
5														
6-10														
11-15														
16-20														

Section 9 – Appendices

Appendix A – Acronyms and Abbreviations

Appendix B – References

Appendix C – Stakeholder Groups and Related Organizations

Appendix D – Steering Committee Meeting Agendas, Sign-In Sheets and Minutes

Appendix E – Public Meeting Agendas and Sign-In Sheets

Appendix F – IDEM Data

Appendix G – CIWRP Data

Appendix H – Macroinvertebrate Data

Appendix I – Windshield Survey Data

Appendix J – NPDES/CFO Compliance

Appendix K – Reservoir Shoreline Investigation

Appendix L – Nonpoint Source Modeling

Appendix M – Education and Outreach Menu

Appendix N – Reservoir Aerial Images

Appendix O - Highly Erodible Land Documentation