VFC Index - Watershed (Plan)

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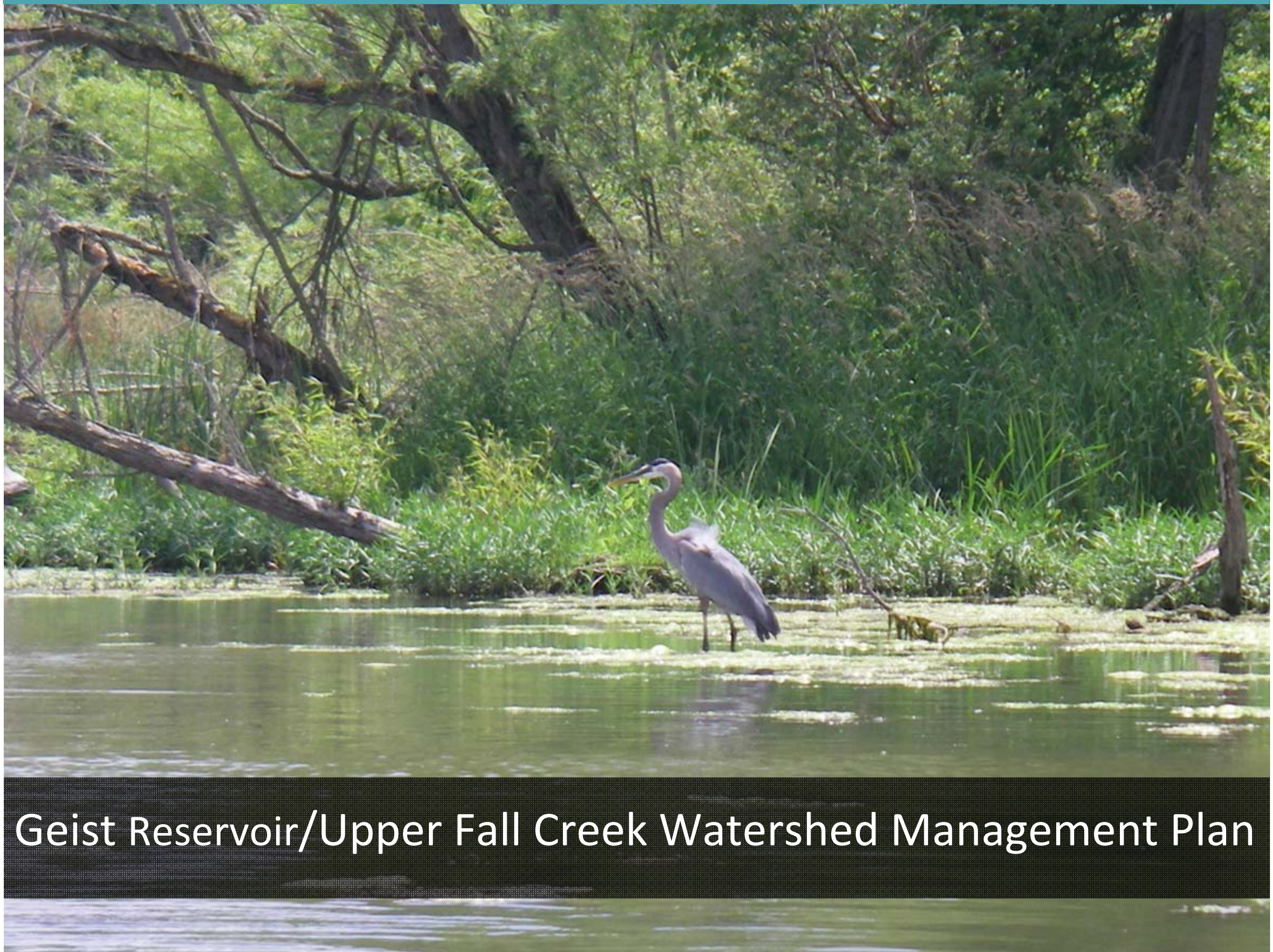
Project Manager: none



Geist Reservoir/Upper Fall Creek Watershed Management Plan

Delaware, Hamilton, Hancock, Henry, Madison and Marion Counties, Indiana

Prepared by:
V3 COMPANIES

Prepared for:
UPPER WHITE RIVER WATERSHED ALLIANCE

GEIST WATERSHED ALLIANCE

UWRWA
Upper White River Watershed Alliance

GEIST
WATER QUALITY
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February 2011

Executive Summary

The Upper White River Watershed Alliance and the Geist Watershed Alliance has received funding from the Department of Natural Resources, Division of Fish and Wildlife Lake and River Enhancement Program for a Watershed Management Plan (WMP) for the Geist Reservoir and the Upper Fall Creek Watershed. The Geist Reservoir/Upper Fall Creek Watershed is located in Central Indiana, northeast of Indianapolis. Upper Fall Creek has its origins in northwest Henry County and flows southwest through Madison, Hamilton, and Marion Counties. The watershed also encompasses portions of Delaware and Hancock Counties. The Geist Reservoir/Upper Fall Creek Watershed consists of approximately 140,194 acres of mixed land use of which approximately 1,900 acres is Geist Reservoir.

Following the drought and subsequent toxic blue-green algal bloom during the summer of 2007, a number of concerned residents came together and began seeking solutions to prevent Geist Reservoir's problems from escalating; they formed the Geist Watershed Alliance (GWA). The Geist Watershed Alliance is a non-profit organization focused on the improvement and protection of Geist Reservoir's water quality. Its membership consists of many types of stakeholders seeking to ensure that the reservoir will remain a healthy recreational and drinking water resource within the Central Indiana region. As a means for achieving the goals GWA, the Alliance is operating in partnership with the Upper White River Watershed Alliance (UWRWA), and in alignment with local and state agencies/organizations goals in the development of this Watershed Management Plan. A Steering Committee of stakeholders within the watershed was organized to work with GWA and UWRWA to develop and implement the Watershed Management Plan.

The Geist Reservoir/Upper Fall Creek Watershed Management Plan (WMP) is intended as a guide for the protection and enhancement of the environment and quality of the Watershed while balancing the different uses and demands of the community on this natural resource. The plan will address items such as:

- education and outreach;
- increasing preservation, restoration and protection of this vital system;
- increasing cooperation, coordination and collaboration among all stakeholders in the Watershed; and
- maintaining a solid organization to look after the welfare of this important natural resource.

The WMP follows the Indiana Department of Environmental Management (IDEM) requirements for watershed management plans, including sections on: watershed inventory, identifying problems and causes, identifying sources and calculating loads, setting goals and identifying critical areas, choosing measures and BMPs to apply, creating an action register and schedule, and tracking effectiveness.

Watershed Inventory

The watershed inventory is a comprehensive inventory that quantifies, describes, and summarizes all available watershed data. This inventory is used to determine the current conditions of the watershed and identify the link between the stakeholder concerns and those watershed conditions. Part one of the watershed inventory focuses on the data at a watershed-wide scale and includes broad topics not easily summarized at the subwatershed scale. Part two of the watershed inventory provides detailed water quality data gathered at the subwatershed scale. And part three of the watershed inventory summarizes and explains the relationships of the data gathered in parts one and two.

Identify Problems and Causes

Problem statements were developed during the planning process in an effort to link watershed concerns with existing and historical water quality data. Six major concern categories were identified during this process.

1. Stakeholders in the Geist Reservoir/Upper Fall Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.
2. Nutrient concentrations within all subwatersheds frequently exceed water quality standards thereby aiding the growth of algae within the reservoir.
3. Soil erosion and sedimentation within the watershed is degrading the water quality and limiting the aesthetics, wildlife habitat, and aquatic health of the streams and reservoir within the watershed.
4. There is a lack of funding for the implementation of Best Management Practices within urban areas.
5. Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.
6. *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.

Watershed Goals

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 Geist Reservoir/Upper Fall Creek Watershed. The goal statements indicate the ultimate goal for a specific project. In some cases this goal may not be obtainable in the short term; therefore there a list of short term and long term objectives were included with each goal.

1. Develop and implement an education and outreach program within the watershed.
2. Reduce *E. Coli* concentrations to meet the state standard of 235 CFU/100mL.
3. 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.
4. Reduce sediment loads to meet the IDEM statewide draft TMDL target of 30 mg/L for TSS.
5. Reduce and control the growth of exotic plants within the reservoir.
6. Identify and utilize existing BMP funding sources and encourage the development and enhancement of additional and non-traditional funding sources.

Watershed 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 Geist Reservoir/Upper Fall 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 Critical Areas and Specific Source Critical areas.

High Priority Subwatersheds
Thorpe Creek
Honey Creek
Flatfork Creek
Sly Fork

Medium Priority Subwatersheds
Deer Creek
Prairie Creek
Headwaters Lick Creek

Low Priority Subwatersheds
McFadden Ditch
Foster Branch

Specific Source Critical Areas
Livestock Access
Absent or Insufficient Stream Buffers
Excessive Streambank Erosion
Agricultural Areas Practicing Conventional Till

Best Management Practices

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. BMPs identified for implementation within the Geist Reservoir/Upper Fall Creek Watershed were divided into two categories: Agricultural/Rural and Urban, with cost estimates and pollutant removal rates provided for each BMP.

Action Register and Schedule

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 Geist Reservoir/Upper Fall Creek WMP is very ambitious and continued implementation of the plan will require and 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.

Acknowledgements

The Geist Reservoir/Upper Fall Creek Watershed Management Plan was made possible with funding from the Indiana Department of Natural Resources – Division of Fish and Wildlife – Lake and River Enhancement Program with cost share funds provided by the Upper White River Watershed Alliance and the Geist Watershed Alliance. DNR staff that provided information in preparation of this plan include: Gwen White, Angela Sturdevant, Greg Biberdorf, Rod Edgell, and Doug Nusbaum. Upper White River Watershed Alliance assistance was provided by Dr. Lenore Tedesco, Jill Hoffmann and Kelly Levengood. Scott Rodgers with the Geist Watershed Alliance was also involved in the preparation of the Watershed Management Plan.

Additional Geist Reservoir/Upper Fall Creek Watershed stakeholders who participated in the study by attending meetings, providing input for the creation of the plan, etc., included: Kevin Kenyon, Ball State Facilities; Kent Duckwall, Geist Marina; Cindy Newkirk, Hancock County Soil and Water Conservation District; Shaena Reinhart, Hamilton County Soil and Water Conservation District; Kent Ward and Bob Thompson; Hamilton County Surveyor's Office; Kellie Harding, Henry County Soil and Water Conservation District; Richard Byers, Henry County Surveyor; Bonny Elifritz and Ernest Johnson, Indiana Department of Environmental Management; Angela Cowan, Indiana University Purdue University Indianapolis – Center for Earth and Environmental Science; Marija Watson, Indiana Wildlife Federation; Stephen Schmidt, Madison County Soil and Water Conservation District; Patrick Manship, Madison County Surveyor; Glenn Lange and Ron Lauster, Marion County Soil and Water Conservation District; Sharon Ferguson, Shorewalk Condo Association Dredging Committee; Bowden Quinn, Sierra Club; Jason Armour, Town of Fishers; Tim McClintick and Doug McGee, Town of Pendleton; Paul Whitmore, Veolia Water Indianapolis, LLC; Crist Blassaras and Judy DeLury, White River Watchers; Jo Biggers, Stephanie Box, Glenn Brown, William Ellingson, Dear Farr, Sarah Kempfer, Jhani Laupus, Matthew Newell, Nina Sidibe, Janice Snell, Wendy Thanisch, Victor Wakley, Watershed Residents. Authors of this report include Jessica Spurlock, Carrie Pintar, and Greg Wolterstorff, V3.

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Section 1 – Watershed Community Initiative

Intentions of the Watershed Management Plan

The Upper White River Watershed Alliance and the Geist Lake Coalition/Geist Watershed Alliance has received funding from the Department of Natural Resources, Division of Fish and Wildlife Lake and River Enhancement Program for a Watershed Management Plan (WMP) for the Geist Reservoir and the Upper Fall Creek Watershed in Delaware, Hamilton, Hancock, Henry, Madison and Marion Counties, Indiana.

The Geist Reservoir/Upper Fall Creek Watershed Management Plan (WMP) is intended as a guide for the protection and enhancement of the environment and quality of the watershed while balancing the different uses and demands of the community on this natural resource. The plan will address items such as:

- education and outreach;
- increasing preservation, restoration and protection of this vital system;
- increasing cooperation, coordination and collaboration among all stakeholders in the watershed; and
- maintaining a solid organization to look after the welfare of this important natural resource.

The WMP follows the Indiana Department of Environmental Management (IDEM) requirements for watershed management plans, including sections on: Watershed Inventory, Problems and Causes, Sources and Loads, Setting Goals and Identifying Critical Areas, Action Register and Schedule, and Tracking Effectiveness.

Public input is essential for the sustainability and success of the watershed improvement effort. Stakeholder and public input was sought and included during all aspects of the planning process. This local input was essential for developing a plan that would have broad appeal throughout the watershed and garner continued support. A steering committee and three sub-committees were developed to address the diverse needs in the watershed.

The Geist/Upper Fall Creek WMP is intended to be comprehensive; identifying problem areas and suggesting improvement measures for both water quality and quantity concerns. The watershed is large and diverse, and thus has a variety of issues and concerns that need to be addressed. To address some of these issues, the Steering Committee will work with local stakeholder groups to pursue Best Management Practices (BMPs) that will result in the improvement of water quality within the watershed. Because of the size of the task at hand, this plan will also be used as a platform upon which to pursue additional grants and other funding for implementation of the many different improvement measures recommended in the plan.

Community Involvement

Geist Lake Coalition/Geist Watershed Alliance

The Geist Lake Coalition was established in 2000 and evolved from a property owners association Lake Committee. Following the drought and subsequent toxic blue-green algal bloom during the summer of 2007, a number of concerned residents came together and began seeking solutions to prevent Geist Reservoir's problems from escalating; they formed the Geist Watershed Alliance (GWA).

The Geist Watershed Alliance is a non-profit organization focused on the improvement and protection of Geist Reservoir's water quality. Its membership consists of many types of stakeholders seeking to ensure that the reservoir will remain a healthy recreational and drinking water resource within the Central Indiana region.

As a means for achieving the goals of public awareness and improved water quality, the Alliance is operating in partnership with the Upper White River Watershed Alliance, and in alignment with other community watershed groups in the development of this Watershed Management Plan. To help achieve their objectives three sub-committees have been formed to spearhead and guide the activities necessary. These sub-committees include:

1. Education and Outreach/Awareness and Communications Sub-Committee
2. Fund Raising Sub-Committee
3. Product/Services Sub-Committee

Upper White River Watershed Alliance

The Upper White River Watershed Alliance (UWRWA) was formed in 1999 through a local municipal initiative. Not long thereafter, a substantial fish kill occurred as a result of a pollution incident along the White River near Anderson, Indiana. Public and municipal concern regarding overall water quality in the river continued to rise. Current urban development pressures, concern for the quality of area water supplies, and other use impairments drive the Alliance's activities.

The Geist Reservoir and Upper Fall Creek Watersheds lie within the Upper White River watershed boundary, and therefore the information within this WMP is important to incorporate into the ongoing work for the Upper White River. The watershed coordinators and other members of the UWRWA have participated in the Geist/Upper Fall Creek Steering Committee and helped facilitate communication between each group. The website for the Geist/Upper Fall Creek Steering Committee is hosted by the UWRWA so that communication at a single point could occur. The improvements recommended by this WMP and implemented within the Geist/Upper Fall Creek watershed will ultimately provide benefit to the Upper White River. Additionally, these communities have very similar demographics and a coordinated education and outreach program between the Upper White and Geist/Upper Fall Creek will help get a broader message to the people that live within these watersheds.

Steering Committee

Mission/Vision Statement

As part of the watershed planning process, the Steering Committee developed a mission statement in order to clearly define the groups' goals and objectives. The mission statement was referenced during the development of this watershed management plan and is included below.

The Geist Watershed Alliance mission is to create ecological awareness, unite private citizens, public groups, and government agencies and promote outreach and stewardship in a collaborative effort to protect water quality, achieve environmental standards, and maintain all beneficial uses of the Geist Reservoir and its watershed.

The Upper White River Watershed Alliance's vision is to become the principal regional watershed leader by creating resources, education programs and partnerships, that promote, protect, and enhance the biological, chemical, and physical integrity of the White River ecosystem.

The stakeholders of the Geist Reservoir/Upper Fall Creek Watershed have many important partners in conservation including:

- Geist Watershed Alliance (GWA),
- Upper White River Watershed Alliance (UWRWA),
- Indiana University Purdue University Indianapolis (IUPUI) – Center for Earth and Environmental Science (CEES),
- Indiana Department of Natural Resources (IDNR) ,
- Indiana Department of Environmental Management (IDEM),
- Indiana Wildlife Federation (IWF),
- White River Watchers,
- Sierra Club,
- Veolia Water Indianapolis, LLC,
- Hamilton County Soil and Water Conservation District,
- Hancock County Soil and Water Conservation District,
- Henry County Soil and Water Conservation District,
- Madison County Soil and Water Conservation District,
- Marion County Soil and Water Conservation District,
- Hamilton County Surveyor,
- Madison County Surveyor,
- Town of Fishers, and
- Town of Pendleton

All County SWCD representatives and Surveyor's were invited to the initial Steering Committee meetings. Not all counties chose to participate in the plan process. A task item for further coordination with Ag stakeholders in the watershed is included in the Public Participation/Education and Outreach goal. A complete list of stakeholder groups and related organizations is available in Appendix C of this document.

A representative from each of the stakeholder groups listed above, along with individual residents, comprises the Geist Reservoir/Upper Fall Creek Watershed Steering Committee. The steering committee's purpose is to review the concerns from the public meetings, guide the development of the management plan, and provide additional data as requested. They meet on a monthly or bi-monthly basis to accomplish these goals. The Steering Committee meeting agendas, sign-in sheets and minutes are available in Appendix D.

Steering Committee Planning Process

As stated previously, public input is essential for the sustainability and success of the watershed improvement effort. A steering committee was formed to review the concerns from the public meetings and guide the development of the management plan.

Plan Development

The steering committee was directly involved in all aspects of the development of the plan, including input at public meetings, steering committee meetings, and completion of the windshield surveys. The following steps were used in the development of the plan for the Geist Reservoir/Upper Fall Creek Watershed.

- Outreach to stakeholders
- Develop watershed management partnership with relevant stakeholders
- Identify and collect existing studies and other watershed data
- Solicit public input on watershed problems and opportunities
- Summarize existing watershed data
- Formulate project goals and objectives for watershed plan
- Collect new data where needed
- Complete assessment of watershed conditions
- Identify best management practices and policies appropriate for the watershed
- Develop an action plan recommending watershed improvement projects and policies
- Identify potential funding sources for watershed improvements
- Obtain public official and general public input from review of draft watershed plan
- Develop implementation schedule and complete final watershed management plan

Public Meetings

A Public Meeting was held on May 21, 2009 at Geist Elementary School to address the concerns of stakeholders in the Geist Reservoir/Upper Fall Creek Watershed. Twenty-six people were in attendance which included members of the steering committee, industrial and commercial businesses representatives, governmental entities, and home owners along Geist Reservoir.

A second Public Meeting was held on January 20, 2010 at the Pendleton Community Public Library to address the concerns of stakeholders in the Geist Reservoir/Upper Fall Creek Watershed. Ten people were in attendance which included members of the steering committee and representatives from governmental agencies. It should be noted that there were no land owners/stake holders in attendance at this meeting and therefore stake holder input was not provided.

At the public meeting, stakeholders were informed of the purpose of a Watershed Management Plan, informed on the planning process, updated on the Steering Committee progress, and given the opportunity to evaluate the priority resource concerns for the Geist Reservoir/Upper Fall Creek Watershed.

The priority resource concerns that were identified during the public meetings are listed below. Specific concerns were taken from the stakeholders and later listed in categories to aid understanding of the issues. The information will be used to prioritize watershed issues and aid in the planning and implementation process. Once stakeholders finished identifying issues and concerns they were given the opportunity to rank their top three issues. A value of 3 represented their highest priority issue. Ranking is provided in parenthesis in the format of: (total value / number of votes).

Water Pollution/Water Quality Issues:

- Quality of drinking water (3/1)
- Organic debris entering waterways
- Quality of surface water runoff

Development/Urban Issues:

- Erosion control and enforcement – Rule 5 (5/3)
- Sediment from storm drains (4/2)
- Encourage and improve public perception of native landscaping (4/2)
- Maintenance of culverts and roadways (1/1)
- Changing actions/perceptions towards fertilizer use
- Dredging in the reservoir

Wildlife/Habitat Issues:

- Enhance wildlife habitat and recreational uses of reservoir (1/1)

Watershed Education and Outreach:

- Encourage public participation (16/7)
- Outreach that is solution based (6/3)
- Education to the public (5/2)
- Education to the recreational users at marinas

Aquatic Plant Issues:

- Exotic species control – Eurasian Watermilfoil (3/2)
- Public concern over blue – green algae

Administrative Issues:

- Legislative action on phosphorus ban (21/9)
- Lack of funding sources for urban areas (16/7)
- Recognition of problems at State level (4/4)
- Lack of phosphorus regulations

The Public Meeting agendas and sign-in sheets are available in Appendix E.

During the development of the Watershed Management Plan, concerns that were not identified during the Public Meetings were added based on input from the Steering Committee and/or watershed data analyzed. These additional concerns are listed below:

- Lack of agricultural stakeholders
- Lack of sufficient buffers
- Streambank erosion
- Lack of conservation tillage
- Livestock access to streams

Section 2 – Watershed Inventory

The Watershed Inventory is a comprehensive inventory that quantifies, describes, and summarizes all available watershed data. This inventory will be used to determine the current conditions of the watershed and identify the link between the stakeholder concerns and those watershed conditions.

Part One of the Watershed Inventory focuses on the data at a watershed-wide scale and includes broad topics not easily summarized at the subwatershed scale. Part Two of the Watershed Inventory provides detailed water quality data gathered at the subwatershed scale. And Part Three of the Watershed Inventory summarizes and explains the relationships of the data gathered in parts one and two.

Part One of the Watershed Inventory

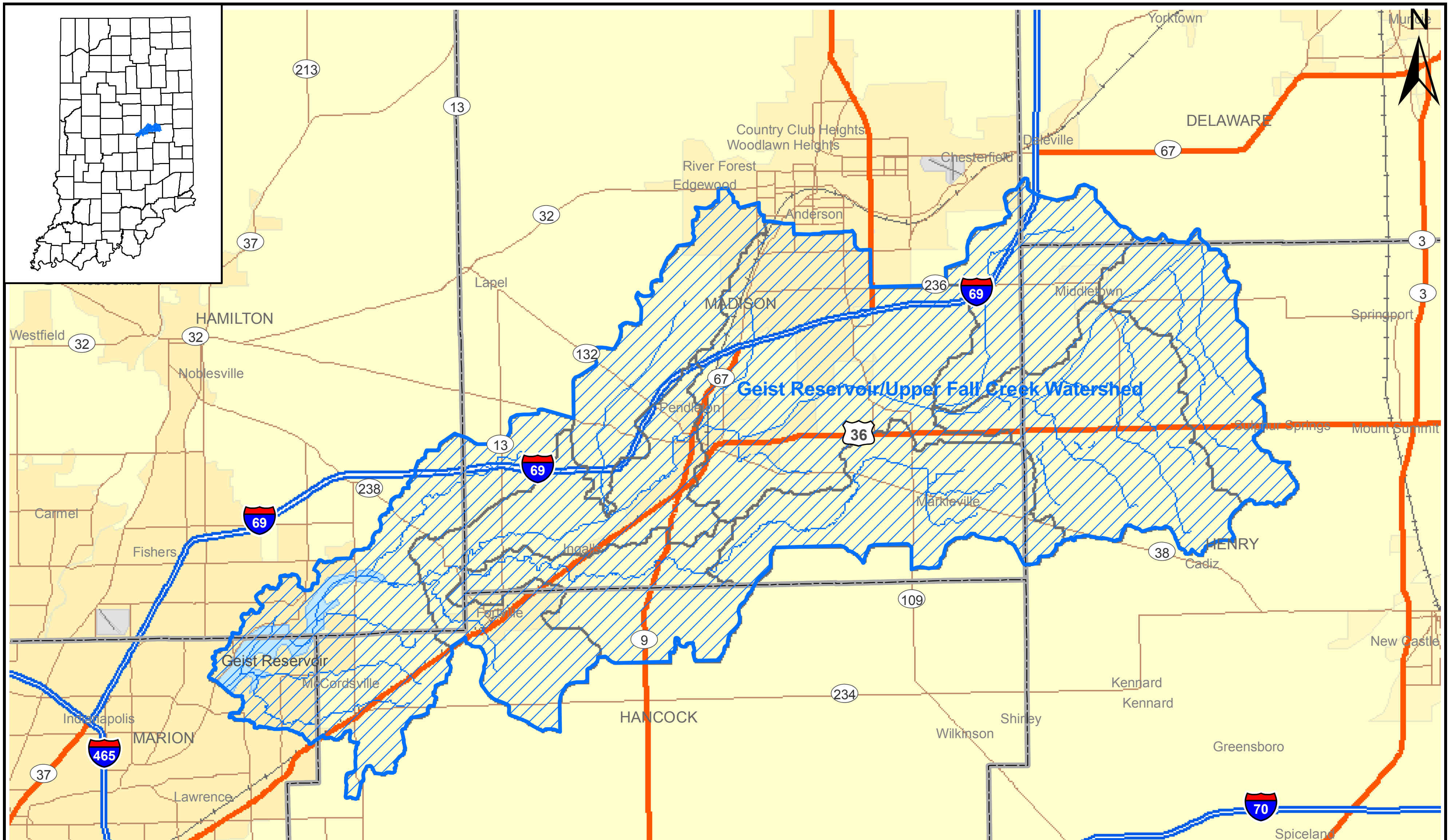
Relevant Relationships

A healthy watershed is essential for a healthy environment and economy. The watersheds we live in provide us with drinking water, jobs, recreation, food and shelter. Watersheds are a unique, dynamic complex combination of natural resources; air, water, soil, plants and animals. Each characteristic of a watershed plays a role in the overall health of a watershed. How these characteristics interact with each other can not only negatively impact certain characteristics within the watershed but can also impact the watershed itself.

For example, sandy soils allow the ground to soak up water faster. This reduces surface runoff, but can affect ground water. Clay soils, on the other hand, are tighter and do not allow as much water infiltration. This can lead to more runoff and soil erosion. Similarly, wetlands utilize nutrients and tie up sediment to help improve water quality. Wetlands also act as natural sponges to absorb peak flows of water and reduce flooding. Many fish and wildlife species rely on wetlands for rearing their young, and for food and shelter. The combination of population centers and septic tank unsuitable soils may be a source of an *E.coli* problem. These are some of the ways that watershed characteristics are related to each other.

Location, Characteristics and Size

Upper Fall Creek (HUC 0512020108) has its origins in northwest Henry County and flows southwest through Madison, Hamilton, and Marion Counties (Exhibit 1). The watershed also encompasses portions of Delaware and Hancock Counties. The Geist Reservoir/Upper Fall Creek Watershed consists of approximately 140,194 acres of mixed land use of which approximately 1,900 acres is Geist Reservoir. The distribution of watershed area within each county is shown in Table 1.



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7325 Janes Avenue
Woodridge, IL 60517
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TITLE:	**Location Exhibit**
BASE LAYER:	StreetMap USA
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206

PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**		
PROJECT NO.: 09006	EXHIBIT: 1	SHEET: 1 OF: 1
QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 20,000'

Table 1: Counties Within the Watershed		
County	**Acres**	**Percentage**
Delaware	2,489	1.8%
Hamilton	10,584	7.5%
Hancock	17,907	12.8%
Henry	31,919	22.8%
Madison	73,349	52.3%
Marion	3,946	2.8%
Total	140,194	100%

Approximately 140.5 linear miles of cumulative waterways are contained in the Geist Reservoir/Upper Fall Creek Watershed. Some of the cities and towns located in the watershed include: Middletown, Anderson, Markleville, Pendleton, Ingalls, Fortville, McCordsville, Lawrence, Fishers, and Indianapolis.

Geology/Topography

The bedrock geology of Indiana formed primarily during the Paleozoic Era. The principal bedrock formations in the Geist Reservoir/Upper Fall Creek Watershed are associated mainly with rocks of Silurian and Devonian age, and consist mainly of limestone and dolomites with some shale or argillaceous zones, whereas the Silurian material consists of limestone, dolomite, and much more argillaceous material than in the Devonian age rock.

The topography of Upper Fall Creek, which lies in the Tipton Till Plain physiographic unit, consists of a flat to slightly rolling plain. Streams tend to have very low gradients, and lie only a few feet below the general land surface. Extensive alteration of the drainage system has occurred via ditching and the installation of drainage tiles. This has resulted in excellent land for agricultural production. Some rolling and hummocky areas may be present and are related to glacial activity. The gradient throughout the watershed ranges from an elevation of 1090 feet at the eastern edge of the watershed in Henry County to an elevation of 785 feet at the spillway of Geist Reservoir in Marion County, or a change of 305 feet.

Hydrology

Climate

The Geist Reservoir/Upper Fall Creek Watershed is within a humid continental climate region. The humid continental climate is marked by variable weather patterns and a large seasonal variance. Summers are often warm and humid with frequent thunderstorms and winters can be very cold with frequent snowfall and persistent snow cover.

The National Oceanic and Atmospheric Administration, National Climatic Data Center publishes the normals of average monthly and annual maximum, minimum, and mean temperature, monthly and annual total precipitation (inches), and heating and cooling degree days (base 65 degrees F) for individual locations throughout the United States, Puerto Rico, Virgin Islands, and Pacific Islands.

The monthly precipitation and temperature normals were obtained for Indiana for the time period of 1971 – 2000. Out of the 113 climate stations within Indiana, none fall within the Geist Reservoir/Upper Fall Creek Watershed, however one is located immediately downstream of the watershed. Table 2 summarizes the temperature and precipitation data for the Oaklandon Geist Reservoir station.

Table 2: NOAA Monthly Normals for Oaklandon Geist Reservoir, 1971- 2000		
Month	**Average Temperature (^oF)**	**Average Precipitation (in.)**
January	25.3	2.42
February	29.4	2.42
March	39.5	3.28
April	50.4	3.92
May	61.3	4.86
June	70.3	4.15
July	74.2	4.49
August	72.1	4.06
September	65.3	3.32
October	53.4	3.02
November	42.0	3.77
December	30.5	3.14

Geist Reservoir

Construction of Geist Reservoir was completed in 1944. The primary purpose of the reservoir was to provide a consistent source of water supply to the Indianapolis Water Company's Fall Creek Water Treatment Facility. In the early 1980's real estate development began around the reservoir, resulting in development along most of its 35 miles of shoreline. The reservoir has a maximum depth of approximately 48 feet, a storage capacity of 6.9 billion gallons, and a surface area of approximately 1,900 acres. In addition to water supply, Geist Reservoir is currently widely used for recreation purposes including swimming, boating, and fishing (Exhibit 1).

Geist Reservoir is characterized as a shallow turbid water body and has an average depth of 11 feet. Geist Reservoir is elongated with many branches representing the tributaries of the former stream or river. Geist Reservoir is a popular recreational lake due to its size and fishing opportunities. The majority of Geist Reservoir's shoreline is developed with a concrete, sheet pile seawall, or rock wall utilized for shoreline protection. Geist Reservoir is a man made water body, as it was formed by an impoundment of Fall Creek, and as such has upland soils that are not typically found as lake bottom substrates which also impacts the ability of aquatic vegetation to establish.

Geist Reservoir is rated as mesotrophic by IDEM. Mesotrophic lakes are lakes with an intermediate level of productivity, greater than oligotrophic lakes, but less than eutrophic lakes. These lakes are commonly clear water lakes and ponds with beds of submerged aquatic plants and medium levels of nutrients.

Based on information provided in previous studies (US EPA) for Geist Reservoir, the volume within the reservoir is completely replaced by the input volume (surface water, groundwater, direct precipitation, etc.) every 58 days. Therefore, meaning the hydraulic retention time for the direct tributary area to the watershed is 58 days. Based on the size of the reservoir and tributary area, this is somewhat of a short retention time which ultimately suggests that the reservoir will respond in a short time after implementation of upstream BMPs for pollutant reduction.

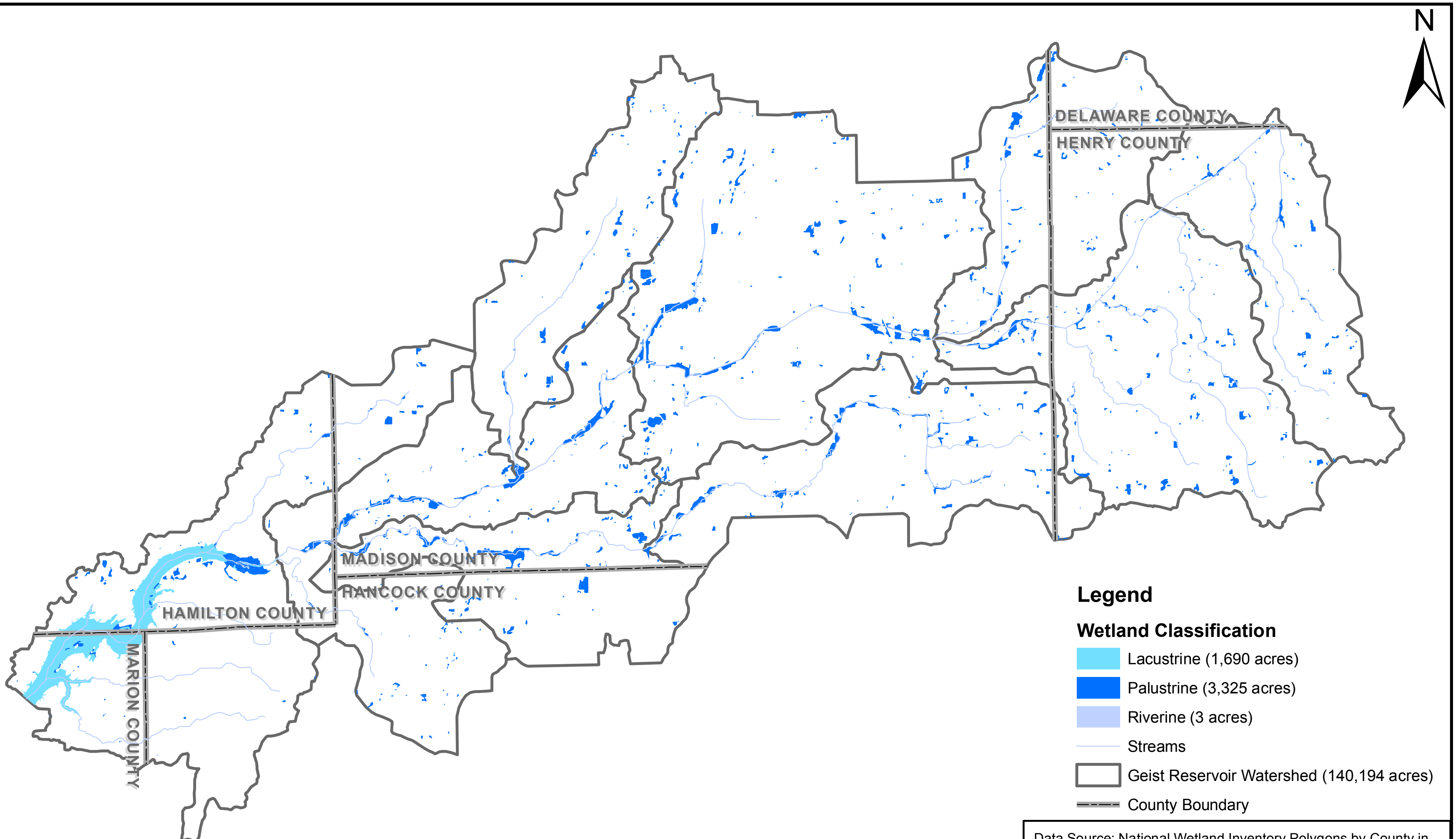
Wetlands

Wetlands are a valuable resource not only for the habitat they create but for the water detention/retention and filtration they provide within a watershed. Wetland classifications are based on attributes which can be measured and when combined, help to define the nature of a specific wetland and distinguish it from others. According to the National Wetland Inventory, the three wetland classifications within the Geist Reservoir/Upper Fall Creek Watershed include lacustrine, palustrine, and riverine. There are 5,018 acres (3.6% of the watershed) of wetlands scattered throughout the watershed. Among the three wetland classifications, 1,690 acres are considered lacustrine, 3,325 acres are palustrine, and 3 acres are riverine (Exhibit 2).

As defined by the U.S Fish and Wildlife Service, lacustrine wetlands are associated with lakes and are characterized by a lack of trees and a dominance of emergent and submersed aquatic vegetation. Lacustrine wetlands typically extend from the shoreline to depths of 6.5 feet or until emergent vegetation no longer persists. Lacustrine wetlands are important in removing sediment and nutrients as well as providing habitat for fish and macroinvertebrates which are a vital food source within a lake ecosystem. The Lacustrine System includes wetlands and deepwater habitats with all of the following characteristics: (1) situated in a topographic depression or a dammed river channel; (2) lacking trees, shrubs, persistent emergents, emergent mosses or lichens with greater than 30% areal coverage; and (3) total area exceeds 20 acres. Similar wetland and deepwater habitats totaling less than 20 acres are also included in the Lacustrine System if an active wave-formed or bedrock shoreline feature makes up all or part of the boundary, or if the water depth in the deepest part of the basin exceeds 6.6 feet at low water.

Palustrine wetlands are related to marshes, swamps and bogs. Palustrine habitats are wetlands dominated by trees, shrubs, persistent emergents, and emergent mosses or lichens. Palustrine habitats have structural features that provide feeding, breeding, nesting, over wintering and migration habitat for wildlife in addition to their natural filtration properties. Riverine wetlands occur in floodplains and riparian corridors in association with stream channels. Riverine wetlands are directly affected by streamflow including overbank and backwater conditions. Riverine wetlands are very important in sediment retention as well as pollutant removal.

Wetlands provide numerous valuable functions that are necessary for the health of a watershed. They play a critical role in protecting and moderating water quality. Water quality is improved through a combination of filtering and stabilizing processes. Wetland vegetation adjacent to waterways helps to stabilize slopes and prevent mass wasting, thus reducing the sediment load within the river system. An unprotected streambank can easily erode, which results in an increase of sediment and nutrients entering the water. Additionally, wetland vegetation removes pollutants through the natural filtration that occurs, or by absorption and assimilation. This effective treatment of nutrients and physical stabilization leads to an increase in overall water quality to downstream reaches.



Data Source: National Wetland Inventory Polygons by County in Indiana (US Fish and Wildlife Service, publication date 20030128)

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TITLE:	**National Wetland Inventory Map**
BASE LAYER:	National Wetland Inventory
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206
PROJECT:	**Geist Reservoir/Upper Fall Creek Watershed Management Plan**
PROJECT NO.:	09006
EXHIBIT:	2
SHEET:	1 OF: 1
QUADRANGLE:	N/A
DATE:	09/30/10
SCALE:	1" = 16,000'

In addition, wetlands have the ability to increase storm water detention capacity, increase storm water attenuation, and moderate low flows. These benefits help to reduce flooding and reduce erosion. Wetlands also facilitate groundwater recharge by allowing water to seep slowly into the ground, thus replenishing underlying aquifers. This groundwater recharge is also valuable to wildlife during the summer months when precipitation is low and the base flow of the river draws on the surrounding groundwater table.

Although wetlands occupy a small percentage of the surrounding landscape, these areas typically contain large percentages of wildlife and produce more flora and fauna per acre than any other ecosystem. As a result of this high diversity, wetlands provide many recreational opportunities, such as fishing, hunting, boating, hiking and bird watching. Many of these recreational activities are available in the wetland areas within the Geist Reservoir/Upper Fall Creek Watershed. However, wetlands within this watershed have experienced degradation as a result of urbanization and development. Development projects that have wetlands present or adjacent to the property are applying for and receiving Section 404 of the Clean Water Act permits to fill and develop wetlands. This practice reduces the amount of wetland acreage in the watershed.

Isolated and adjacent wetlands are regulated through IDEM and the Army Corps of Engineers (ACOE), respectively. Although wetlands are typically avoided during the development phase, permits have been given to fill wetlands that cannot be avoided. Some isolated wetlands are being converted to detention/retention basins in new residential developments. Some development and agency permits require on-site mitigation, which includes the creation of wetlands and natural areas on the same piece of land where wetland impacts occur. Some development projects that impact wetlands are allowed to mitigate for wetland impacts at an approved off-site wetland mitigation bank facility. In this case, the wetland impacts are offset through the purchase of wetland mitigation credits at an approved wetland mitigation bank. For Indiana Department of Transportation (INDOT) projects, in general the Federal and State requirement is to mitigate for impacts to wetlands associated with roadway improvements within the same watershed. Stream enhancement and stream mitigation are some of the options that INDOT utilizes to offset wetland/stream impacts.

Threatened or Endangered Species

The Indiana Department of Natural Resources (IDNR) Division of Nature Preserves was contacted to provide any Indiana Natural Heritage Data or related records for all listed threatened, endangered (T&E) or rare species documented within the Geist Reservoir/Upper Fall Creek Watershed. Their response indicated that the watershed is home to a number of Species of Special Concern to Indiana, a number of State Endangered Species, and a number of Federally Endangered Species (Table 3).

Table 3: Threatened or Endangered Species			
Type	**Common Name**	**State Status**	**Federal Status**
Bird	Loggerhead Shrike	Endangered	
	Least Bittern	Endangered	
	Red-shouldered Hawk	Species of Special Concern	
	Osprey	Endangered	
	Black-crowned Night Heron	Endangered	
	King Rail	Endangered	
	Cerulean Warbler	Endangered	
	Upland Sandpiper	Endangered	
Mammal	American Badger	Species of Special Concern	
	Bobcat	Species of Special Concern	
	Least Weasel	Species of Special Concern	
Mollusk	Clubshell	Endangered	Endangered
	Wavyrayed Lampmussel	Species of Special Concern	
	Little Spectaclecase	Species of Special Concern	
	Kidneyshell	Species of Special Concern	
	Purple Lilliput	Species of Special Concern	
Vascular Plant	Cucumber Magnolia	Endangered	
	Goose-foot Corn-salad	Endangered	
	Butternut	Watch List	
	Bog Bluegrass	Watch List	
High Quality Natural Community	Mesic Upland Forest Fort Benjamin Harrison State Park	Significant	
	Central Till Plain Flatwoods Stout Woods Nature Preserve	Significant	

The Indiana Natural Heritage Data Center maintains the most comprehensive and up-to-date information about federal and state endangered, threatened, and rare species, high quality natural communities, and significant natural areas in Indiana. Requests for this information is assessed a fee based on the time needed to complete the request. This information is required by most regulatory agencies prior to issuing development permits.

Nuisance Wildlife and Exotic Invasive Species

According to IDNR, many wild animals in Indiana have become displaced as the result of urban growth and removal of their habitat. While some species may move to other areas where natural habitat exists, some species actually thrive in urban settings. Species such as raccoons, opossums, Canada geese and even red foxes are becoming more common in urban areas and are frequently seen by people. However, these animals can also cause problems when they use a person's attic for shelter, destroy shingles and soffits, utilize lawns as homes, and eat their garbage.

Canada geese are a particular problem within the watershed, specifically for the reservoir. As stated by the DNR, many people enjoy seeing Canada geese, but problems can occur when too many geese concentrate in one area. Typically, developers and landowners unknowingly cause the problem by creating ideal goose habitat. Geese are grazers and feed extensively on fresh, short, green grass. Add a permanent body of water adjacent to their feeding area and you have the created the perfect environment for geese to set up residence, multiply and concentrate. Geese, including their young, also have a strong tendency to return to the same area year after year. Once geese start nesting in a particular place, the stage is already set for more geese in successive years. The problem is further exacerbated when well-intentioned people purposefully feed geese. Artificial feeding of geese tends to concentrate larger numbers of geese in areas that under normal conditions would only support a few geese. Artificial feeding can also disrupt normal migration patterns and hold geese in areas longer than what would be normal. With an abundant source of artificial food available, geese can devote more time to locating nesting sites and mating. Artificial feeding can also concentrate geese on adjacent properties where their presence may not be welcomed, resulting in neighbor/neighborhood conflicts.

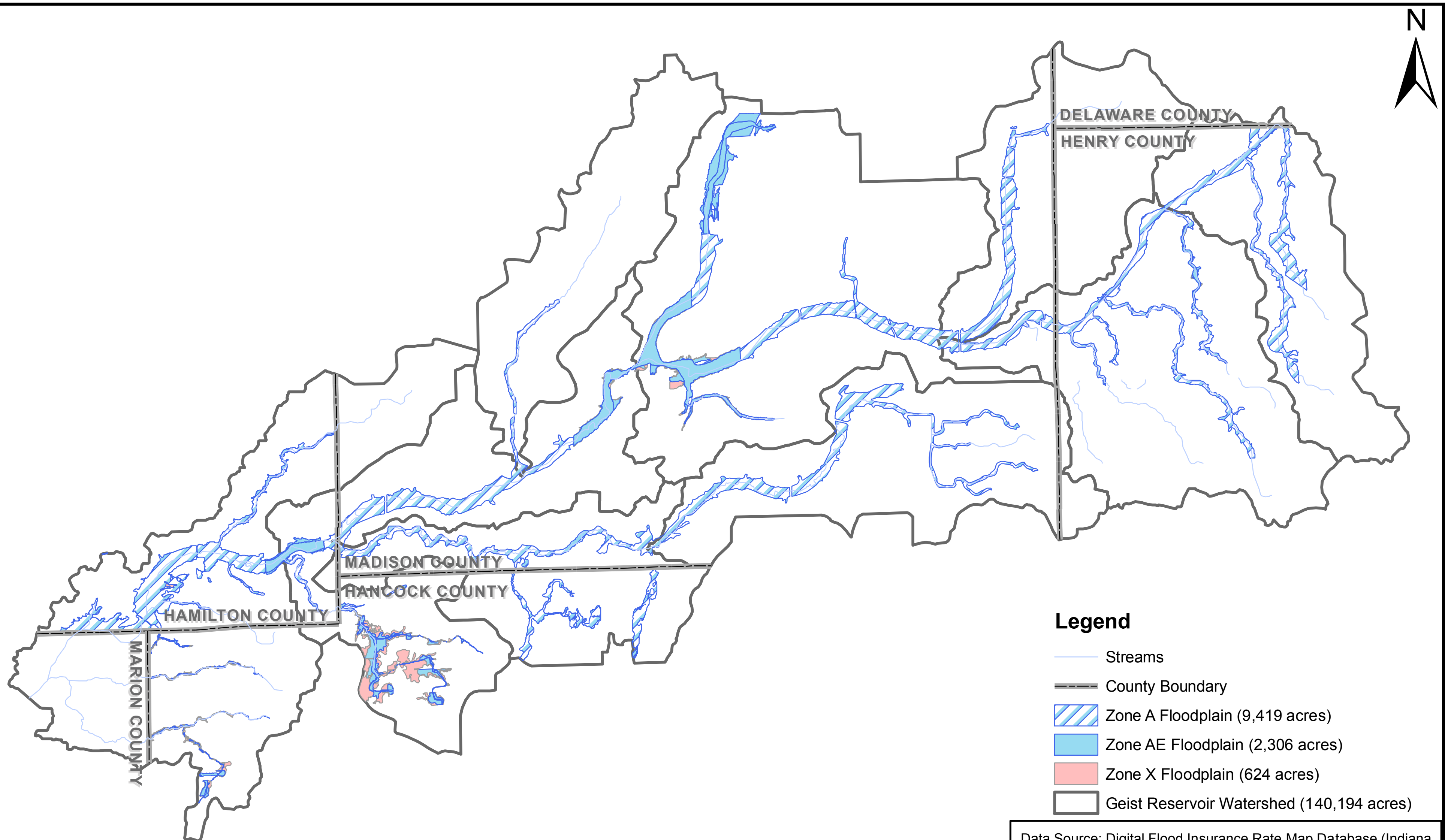
Congregating geese can cause a number of problems. Damage to landscaping can be significant and expensive to repair or replace, while large amounts of excrement can render swimming areas, parks, golf courses, lawns, docks, and patios unfit for human use. Since they are active grazers, they are particularly attracted to lawns and ponds located near apartment complexes, houses, office areas and golf courses. Geese can rapidly denude lawns, turning them into barren, dirt areas. Most of the problems in metropolitan areas occur from March through June during the nesting season. Breeding pairs begin nesting in late February and March. Egg-laying begins soon after nest construction is complete.

Based on information obtained from the DNR website, the Indiana Legislature created an Invasive Species Task Force in October 2007 to study the economic and environmental impacts of invasive species in Indiana and provide findings and recommendations on strategies for prevention, early detection, control and management of invasive species to minimize these impacts. Based on the Aquatic Vegetation Management Plan completed by V3 as a part of this project, Blue-Green Algae and Eurasian Watermilfoil have been reported in the Geist Reservoir. Zebra mussels were also report in the reservoir early spring of 2010.

Invasive plant species are a threat to natural areas. They displace native plants, eliminate food and cover for wildlife, and threaten rare plant and animal species. Many agencies and organizations have joined together to form the Invasive Plant Species Assessment Working Group (IPSAWG) to assess which plant species threaten natural areas in Indiana and develop recommendations regarding the use of that specific plant species. The IPSAWG's goal is that all partner agencies and organizations would utilize the species assessment when recommending or selling plants.

Regulatory Floodplain

Flooding is one of the most common hazards in the United States. Floods can occur on a local level, or can affect entire river basins. The Federal Emergency Management Agency (FEMA) has developed Flood Insurance Rate Maps (FIRMs) for many parts of the country in order for individuals and governments to assess the risk of flooding in specific areas. These maps also indicate what insurance rates property owners may need to pay to develop property in these areas. The current FIRM panels for the Geist Reservoir/Upper Fall Creek Watershed are shown on Exhibit 3. It should be noted that Indiana is in the midst of revising the floodplain maps on a county wide basis through the FEMA Map Modernization program. The floodplain maps will need to be reevaluated during the feasibility phases of implementation projects.



Data Source: Digital Flood Insurance Rate Map Database (Indiana Department of Natural Resources, publication date 20040528)

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TITLE: **FEMA Floodplain Map**	PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**			
BASE LAYER: FEMA Floodplain	PROJECT NO.: 09006	EXHIBIT: 3	SHEET: 1 OF: 1	
CLIENT: Upper White River Watershed Alliance, P.O. Box 2065, Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'	

There are three flood hazard areas identified within the watershed. Zone A, which is defined as an area inundated by 100-year flooding for which no base flood elevation (BFE) has been established comprises 9,419 acres (6.7% of the watershed). In this zone there is a 1% chance of annual flooding, and a 26% chance that the area will be inundated at sometime during the life of a 30-year mortgage. Zone AE, which is defined as an area inundated by 100-year flooding for which a BFE has been determined, comprises 2,306 acres (1.6% of the watershed). Chance of flooding in Zone AE is the same as in Zone A. However, Zone A floodplain boundaries are based off of approximate methods, and Zone AE floodplain boundaries are based off of detailed hydrologic and hydraulic analyses, establishing BFEs and making the delineation more accurate. Zone X, which is defined as an area that is either determined to be outside the 100-year floodplain but within the 500-year floodplain (0.2% chance of annual flooding) or have a 1% chance of sheet flow flooding where the average depths are less then 1 foot, comprises only 624 acres (0.4% of the watershed). These areas are considered to have a moderate or minimal risk of flooding, and the purchase of flood insurance is available but not required.

The rainfall data used to create these maps is based on Bulletin 71 rainfall depths. Bulletin 71 is a study that relied primarily on data from 275 daily reporting stations of the National Weather Service cooperative network, which had records exceeding 50 years. Based on USGS information, Central Indiana has experienced two 500-year floods in the last 18 years. Teams of USGS hydrographers have traveled to 40 streamflow-gaging stations to keep station instruments operating and to verify streamflow data needed for National Weather Service (NWS) flood forecasts. USGS personnel have worked closely with Federal, state, and local agencies during the flood to provide flood information for emergency managers, the media, and the public.

Identifying the location of floodplain areas within the Geist Reservoir/Upper Fall Creek Watershed allows for targeted areas for floodplain management and/or restoration. Floodplain management is the operation of a community program of corrective and preventative measures for reducing flood damage. These measures take a variety of forms and generally include requirements for zoning, and special-purpose floodplain ordinances.

Developments within flood prone areas are regulated by local, state and federal agencies. Depending on the floodplain boundaries depicted on the FEMA FIRM for the area proposed to be developed, floodplain designation (Zone A, AE, etc.), if there is floodway present and how much tributary drainage area (less or more than one square mile) there is to the proposed site, permits from the local municipality, County, IDNR-Division of Water, and FEMA would be required.

In addition to stormwater runoff, flooding can negatively affect water quality as large volumes of water transport contaminants into water bodies and also overload storm and wastewater systems. Nonpoint source (NPS) pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. NPS pollution is caused by rainfall or snowmelt moving over and through the ground and ultimately increases during periods of flooding. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, and streams.

Regulated Drains

Regulated drains consist of creeks, ditches, tiles (underground pipe systems), and other structures intended to move run-off water. Regulated drains are under the jurisdiction of the local county drainage board and/or the County Surveyor's office. Regulated drains are common throughout the watershed and are mainly tiles and open ditches. Regulated drain locations were obtained from Hamilton, Hancock, and Madison Counties and are shown on Exhibit 4.

Regulated drains are typically maintained by the County Surveyors office. This maintenance includes dredging with large construction equipment, removal of debris, and management of vegetation both within the regulated drains and within the riparian zone associated with the drains. Based on the unpredictable maintenance schedule of regulated drains within the watershed, it is difficult to assign a priority rating to these areas for potential improvement of wildlife habitat, water quality improvement measures, and erosion control measures within the Geist Reservoir/Upper Fall Creek Watershed. However, the selected BMPs and Action Registers include measures and implementation projects that include regulated drains. Coordination with the County Surveyors Office will be necessary during the implementation project evaluation phase.

BMPs within regulated drains in the watershed should be evaluated prior to implementation. If regulated drains are considered for BMP measures (i.e. two-stage ditches, stabilization, etc), the Steering Committee should coordinate with the local County Surveyor's offices of Delaware, Hamilton, Hancock, Henry, Madison, and Marion Counties.

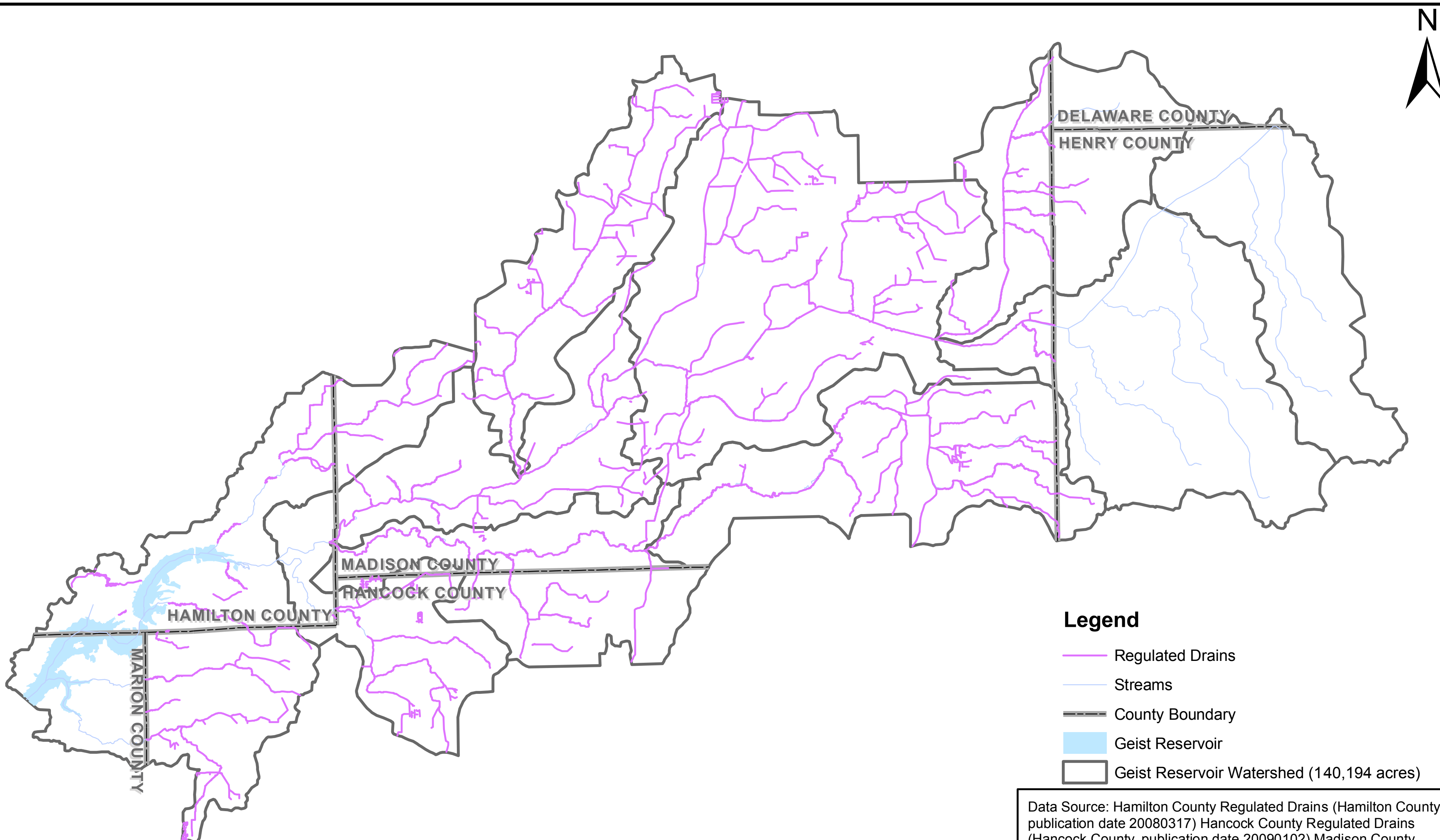
Wellhead Protection Areas

The IDEM Ground Water Section administers the Wellhead Protection Program, which is a strategy to protect ground water drinking supplies from pollution. The Safe Drinking Water Act and the Indiana Wellhead Protection Rule (327 IAC 8.4-1) mandates a wellhead program for all Community Public Water Systems. The Wellhead Protection Programs consists of two phases. Phase I involves the delineation of a Wellhead Protection Area (WHPA), identifying potential sources of contamination, and creating management and contingency plans for the WHPA. Phase II involves the implementation of the plan created in Phase I, and communities are required to report to IDEM how they have protected ground water resources.

Information pertaining to wellhead protection and its delineations/restrictions will be important during the implementation phases of the plan. Approved Wellhead Protection Areas are no longer available on-line due to recent legislation classifying this type of information as Confidential.

Soil Characteristics

There are many different soil types throughout Indiana based on their unique characteristics. Many counties arrange these soil types by like characteristics into groups, or major soil associations. A soil association is a geographic area consisting of landscapes on which soils are formed. Soil associations are groups of soil types that generally share one or more common characteristics; such as parent material or drainage capability. These soil associations provide general characteristics for the specific soil association, and can be used for conceptual locations of best management practices. Information pertaining to the clay



Data Source: Hamilton County Regulated Drains (Hamilton County, publication date 20080317) Hancock County Regulated Drains (Hancock County, publication date 20090102) Madison County Regulated Drains (Madison County, publication date 20090825)

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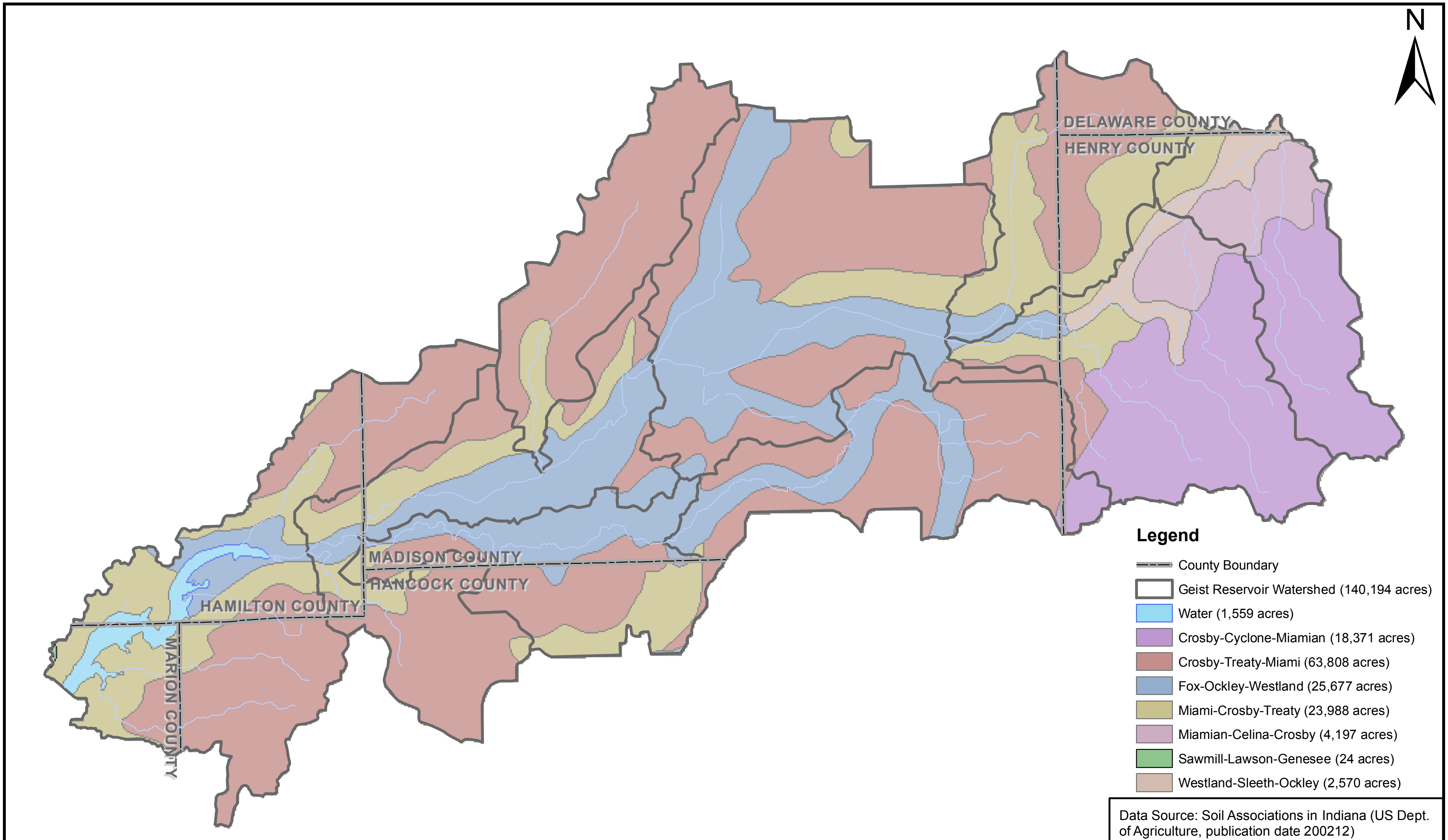
TITLE:	**Regulated Drain Map**
BASE LAYER:	Regulated Drains
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206
PROJECT:	**Geist Reservoir/Upper Fall Creek Watershed Management Plan**
PROJECT NO.:	09006
EXHIBIT:	4
SHEET:	1 OF: 1
QUADRANGLE:	N/A
DATE:	09/30/10
SCALE:	1" = 16,000'



Data Source: Soil Associations in Indiana (US Dept. of Agriculture, publication date 200212)

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TITLE:	**Soil Associations Map**
BASE LAYER:	State Soil Geographic Data Base
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206
PROJECT:	**Geist Reservoir/Upper Fall Creek Watershed Management Plan**
PROJECT NO.:	09006
EXHIBIT:	5
SHEET:	1 OF: 1
QUADRANGLE:	N/A
DATE:	09/30/10
SCALE:	1" = 16,000'

content, permeability and even groundwater characteristics are helpful when identifying locations that are feasible for infiltration practices or other best management practices to improve the water quality within the watershed. It should be noted that soil tests in these specific areas should be performed for more project specific detailed information. The major soil associations in the Geist Reservoir/Upper Fall Creek Watershed are shown in Exhibit 5. Table 4 includes the major characteristics of the four soil associations that make up the majority (94%) of the watershed.

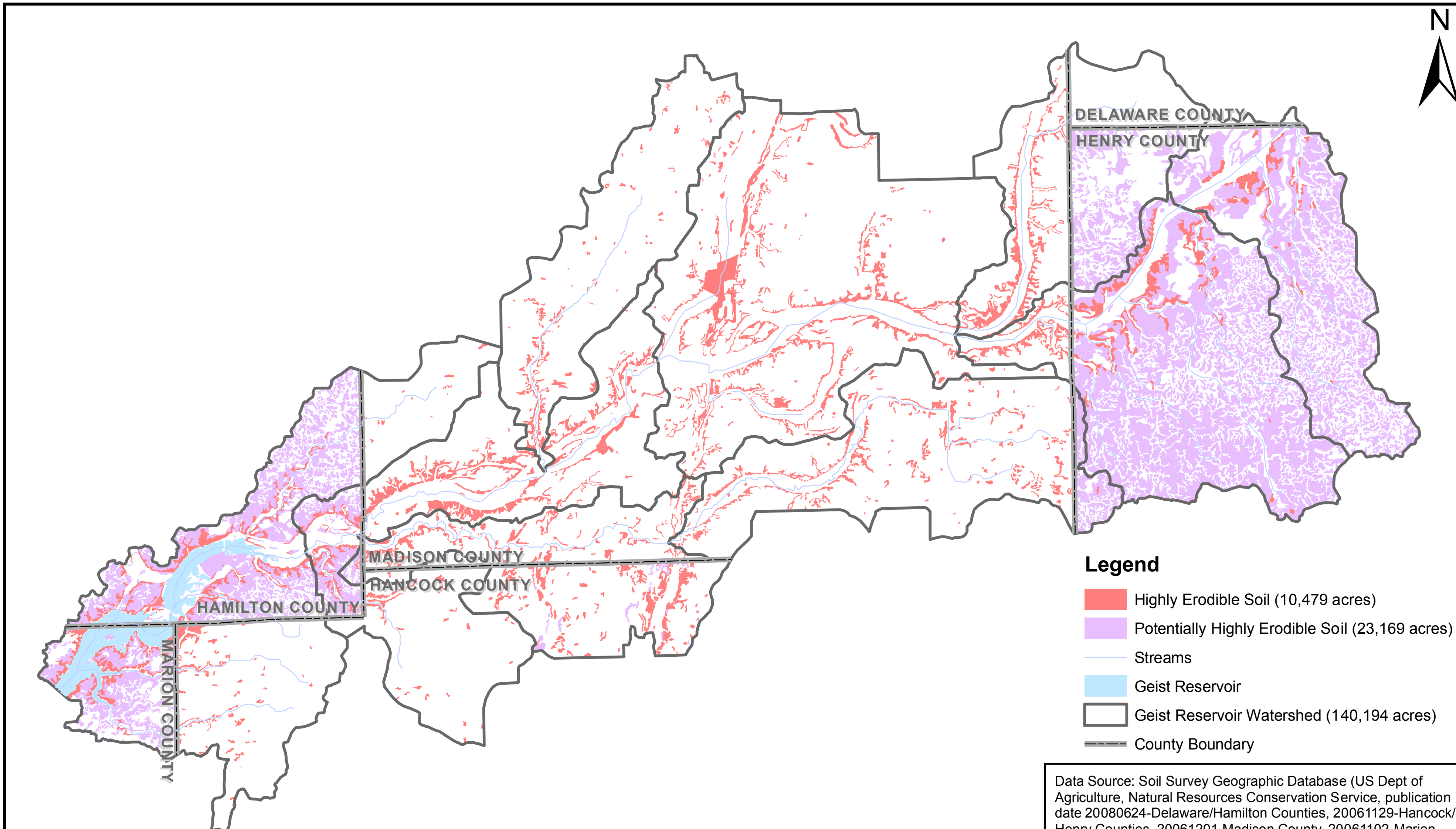
Table 4: Soil Associations		
Name	**Characteristics**	**Acres**
Crosby-Treaty-Miami	Deep, somewhat poorly to poorly drained soils	63,808
Fox-Ockley-Westland	Deep, well drained soils	25,677
Miami-Crosby-Treaty	Deep, moderately well drained to somewhat poorly drained soils	23,988
Crosby-Cyclone-Miamian	Deep, somewhat poorly to poorly drained soils	18,371

The data source for the Soil Association Map is from the Department of Agriculture Soil Associations in Indiana GIS shapefile with a published date of December 2002. Based on this data and the time it was obtained, the water area is a total of 1,559 acres which includes the reservoir. This could be due to the fluctuation of the draw down period of the reservoir.

Highly Erodible Land

Erosion is a natural process within stream ecosystems; however excessive erosion negatively impacts the health of the watershed. Erosion throughout the watershed increases sedimentation of the streambeds which impacts the quality of habitat for fish and other organisms. As water flows over land and enters the stream it carries pollutants and other nutrients that are attached to the sediment. Sediment suspended in the water blocks light needed by plants for photosynthesis and clogs respiratory surfaces of aquatic organisms. Therefore, erosion also impacts water quality as it increases nutrients and decreases water clarity. Highly erodible land (HEL) and potentially highly erodible soils in the Geist Reservoir/Upper Fall Creek Watershed are mapped in Exhibit 6. The data used to create Exhibit 6 is from the USDA-SCS Indiana Technical Guide Section II-C and was collected from the NRCS website for Delaware, Hamilton, Hancock, Henry, Madison, and Marion Counties. A total of approximately 10,479 acres or 7.5% of the watershed is considered highly erodible and 23,169 acres or 16.5% of the watershed is considered potentially highly erodible. It should be noted that the areas of potentially highly erodible soils appear to be significantly greater in Hamilton, Henry, and Marion Counties when compared to Delaware, Hancock, and Madison Counties. This discrepancy can be attributed to the difference in the classification of soils between the counties. For example, Miami soil (MMB2) in Hamilton County is considered potentially highly erodible however the same soil in Madison County is considered not highly erodible. Appendix M contains the USDA-SCS Indiana Technical Guide Section II-C documentation obtained for this analysis.

Highly erodible soils are especially susceptible to the erosional forces of wind and water. Wind erosion is common in flat areas where vegetation is sparse or where soil is loose, dry, and finely granulated. Wind erosion damages land and natural vegetation by removing productive top soil from one place and depositing it in another.



Data Source: Soil Survey Geographic Database (US Dept of Agriculture, Natural Resources Conservation Service, publication date 20080624-Delaware/Hamilton Counties, 20061129-Hancock/Henry Counties, 20061201 Madison County, 20061102-Marion County) USDA-SCS Indiana Technical Guide Section II-11/87

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TITLE:	**Highly Erodible Lands Map**
BASE LAYER:	NRCS Soil Survey
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206
PROJECT:	**Geist Reservoir/Upper Fall Creek Watershed Management Plan**
PROJECT NO.:	09006
EXHIBIT:	6
SHEET:	1 OF: 1
QUADRANGLE:	N/A
DATE:	09/30/10
SCALE:	1" = 16,000'

In areas with highly erodible soils special care must be taken to insure that land use practices do not result in severe wind or water erosion. Although natural erosion cannot be prevented, the effects of runoff can be moderated so that it does not diminish the health of the watershed. There are no specific requirements for developments within highly erodible soils. However IDEMs Rule 5 regulates stormwater discharges during construction where temporary best management practices are required until construction activities are completed and the site has been stabilized as to not impact receiving waters with sediment.

Hydric Soils

Soils that remain saturated or inundated with water for a sufficient length of time become hydric through a series of chemical, physical, and biological processes. Once a soil takes on hydric characteristics, it retains those characteristics even after the soil is drained. Approximately 46,779 acres or 33.4% of the soils in the Geist Reservoir/Upper Fall Creek Watershed are considered hydric (Exhibit 7).

The three essential characteristics of wetlands are hydrophytic vegetation, hydric soils, and wetland hydrology. Criteria for each of the characteristics must be met for areas to be identified as wetlands. Undrained hydric soils that have natural vegetation should support a dominant population of ecological wetland plant species. Hydric soils that have been converted to other uses should be capable of being restored to wetlands. However, a large majority of the soils in the watershed have been drained for either agricultural production or urban development. Removing the subsurface drainage systems would allow for restoration of these wetland areas.

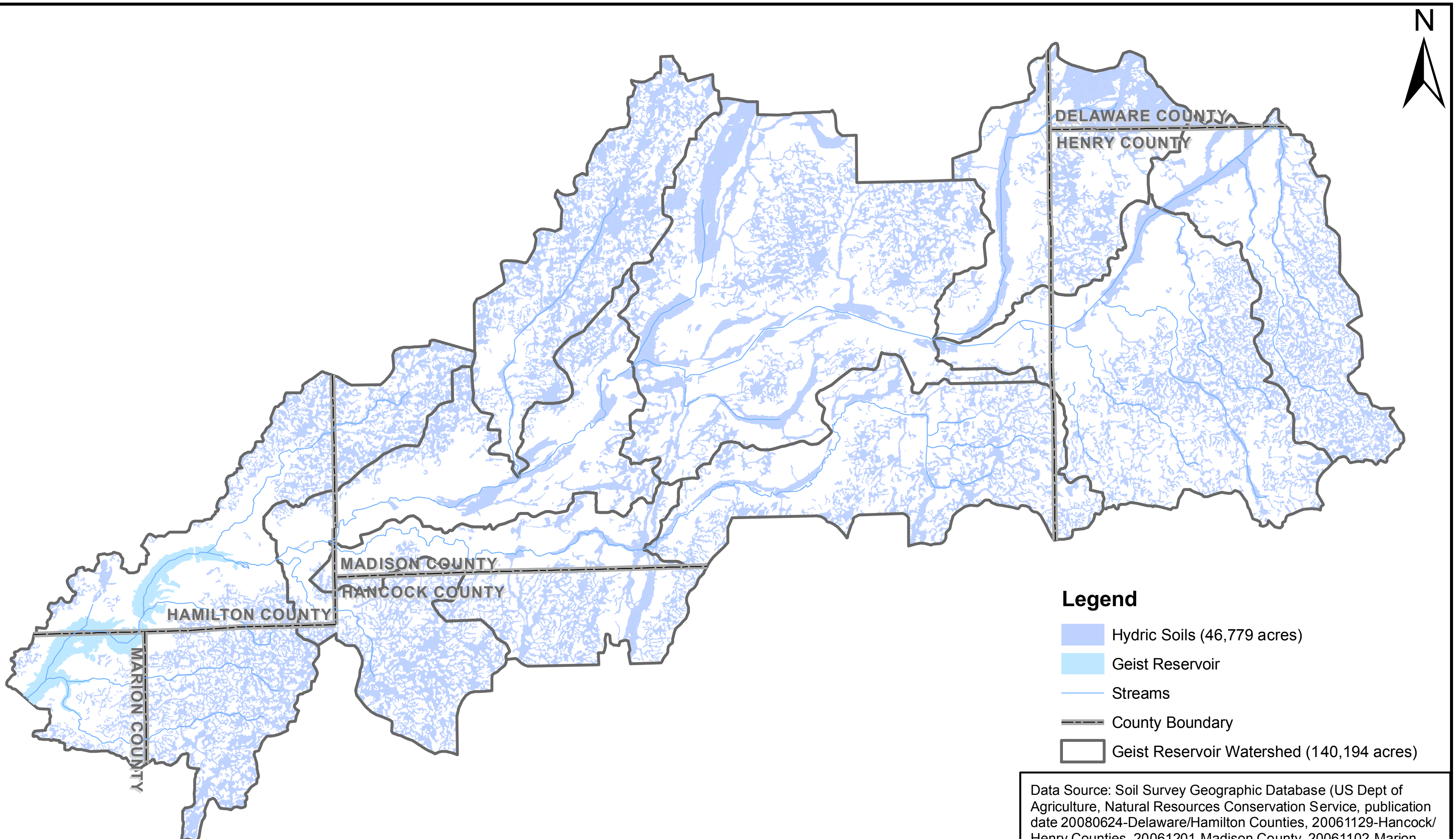
Septic Tank Suitability

In rural areas, households often depend on septic tank absorption fields. These waste treatment systems require soil characteristics and geology that allow gradual seepage of wastewater into the surrounding soils. Seasonal high water tables, shallow compact till and coarse soils present limitations for septic systems. While system design (i.e. perimeter drains, mound systems or pressure distribution) can often overcome these limitations sometimes the soil characteristics prove to be unsuitable for any type of traditional septic system. Heavy clay soils require larger (and therefore more expensive) absorption fields; while sandier, well-drained soils are often suitable for smaller, more affordable gravity-flow trench systems.

The septic disposal system is considered failing when the system exhibits one or more of the following:

1. The system refuses to accept sewage at the rate of design application thereby interfering with the normal use of plumbing fixtures
2. Effluent discharge exceeds the absorptive capacity of the soil, resulting in ponding, seepage, or other discharge of the effluent to the ground surface or to surface waters
3. Effluent is discharged from the system causing contamination of a potable water supply, ground water, or surface water.

Prior to 1990, residential homes on 10 acres or more of land -- and at least 1,000 feet from a neighboring residence -- did not have to comply with any septic system regulations. A new septic code in 1990 fixed this loophole but many of these homes still do not have



Legend

- Hydric Soils (46,779 acres)
- Geist Reservoir
- Streams
- County Boundary
- Geist Reservoir Watershed (140,194 acres)

Data Source: Soil Survey Geographic Database (US Dept of Agriculture, Natural Resources Conservation Service, publication date 20080624-Delaware/Hamilton Counties, 20061129-Hancock/ Henry Counties, 20061201-Madison County, 20061102-Marion County) National Hydric Soils List by State-February 2010

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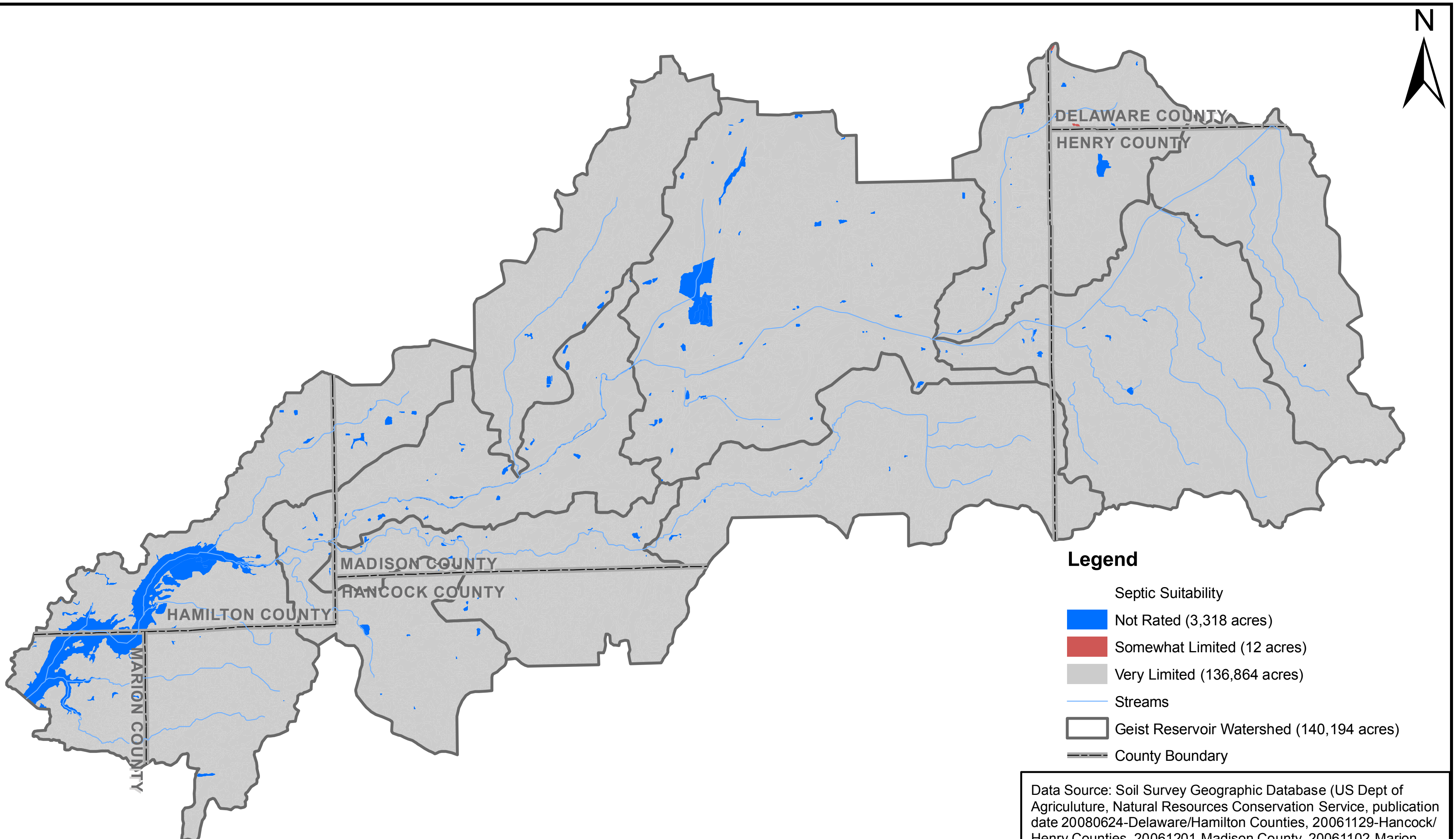
TITLE:	**Hydric Soils Map**
BASE LAYER:	NRCS Soil Survey
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206
PROJECT:	**Geist Reservoir/Upper Fall Creek Watershed Management Plan**
PROJECT NO.:	09006
EXHIBIT:	7
SHEET:	1 OF: 1
QUADRANGLE:	N/A
DATE:	09/30/10
SCALE:	1" = 16,000'



Legend

Septic Suitability

- Not Rated (3,318 acres)
- Somewhat Limited (12 acres)
- Very Limited (136,864 acres)
- Streams
- Geist Reservoir Watershed (140,194 acres)
- County Boundary

Data Source: Soil Survey Geographic Database (US Dept of Agriculuture, Natural Resources Conservation Service, publication date 20080624-Delaware/Hamilton Counties, 20061129-Hancock/Henry Counties, 20061201-Madison County, 20061102-Marion County) Soil Reports Tabular Data for Sewage Disposal

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TITLE: **Septic Suitability Map**	PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**			
BASE LAYER: NRCS Soil Survey	PROJECT NO.: 09006	EXHIBIT: 8	SHEET: 1 OF: 1	
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'	

functioning septic systems. The septic effluent from many of these older homes discharges into field tiles and eventually flows to open ditches. Unfortunately, the high cost of septic repair (typically from $5,000 to $15,000) has been an impediment to modernization.

Individual septic sites must be evaluated on a case-by-case basis to determine septic system suitability. Systems for new construction cannot be placed in the 100-year flood plain and systems for existing homes must be above the 100-year flood elevation.

Exhibit 8 is a map of soil classes related to septic suitability within the watershed. Soils labeled “very limited” indicate that the soil has at least one feature that is unfavorable for septic systems. Approximately 97.6% of the Geist Reservoir/Upper Fall Creek Watershed is mapped as “very limited” with regards to soils being suitable for septic systems. Approximately 2.4% of the soils within the watershed are “not rated.” These soils have not been assigned a rating class because it is not industry standard to install a septic system in these geographic locations. Soils designated “not limited” were not found in the Geist Reservoir/Upper Fall Creek Watershed.

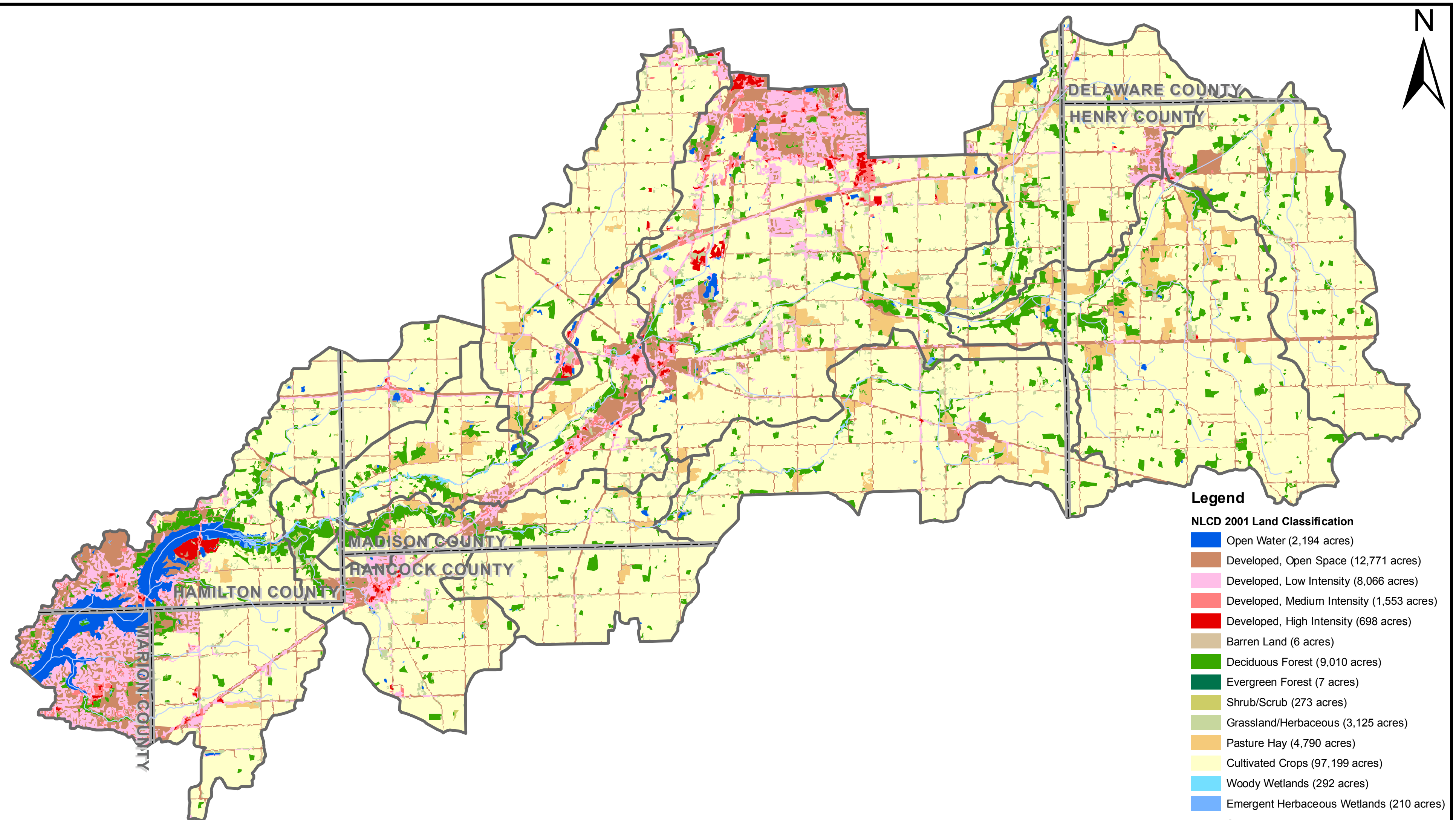
Landuse

The Geist Reservoir/Upper Fall Creek Watershed consists of approximately 190,194 acres of mixed land use, according to the 2001 National Land Cover Data (NLCD) published by the USGS (Exhibit 9; Table 5). The NLCD 2001 includes nineteen land classifications ranging from cultivated crops to high intensity developed land. In order to utilize the most current available data, the 2008 National Agricultural Imagery Program orthophotography was obtained for Delaware, Hancock, Henry, Madison, and Marion Counties and the 2008 Hamilton County Orthophotography was obtained for Hamilton County. These aerial images were compared to the NLCD 2001 in order to determine if any changes in land use had occurred. Based on the 2008 aerial, minor changes in land use when looking at the overall watershed (less than .1%) were seen in comparison to the 2001 information.

Table 5: 2001 Watershed Landuse

Landuse Classification	Acres	Percentage
Open Water	2,194	1.56%
Developed, Open Space	12,771	9.11%
Developed, Low Intensity	8,066	5.75%
Developed, Medium Intensity	1,553	1.11%
Developed, High Intensity	698	0.50%
Barren Land	6	0.005%
Deciduous Forest	9,010	6.43%
Evergreen Forest	7	0.005%
Shrub/Scrub	273	0.19%
Grassland/Herbaceous	3,125	2.23%
Pasture Hay	4,790	3.42%
Cultivated Crops	97,199	69.33%
Woody Wetlands	292	0.21%
Emergent Herbaceous	210	0.15%

This watershed has historically been dominated by agricultural land and comprises 72.755% (Barren Land, Pasture Hay, and Cultivated Crops) of its area. Additionally, forests and



Data Source: 2001 Land Cover in Indiana, Derived from the National Land Cover Database (Indiana Geological Survey publication date 20030901)

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TITLE:	**Land Use Map**
BASE LAYER:	NLCD 2001
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206
PROJECT:	**Geist Reservoir/Upper Fall Creek Watershed Management Plan**
PROJECT NO.:	09006
EXHIBIT:	9
SHEET:	1
OF:	1
QUADRANGLE:	N/A
DATE:	09/30/10
SCALE:	1" = 16,000'

wetlands comprise only 10.775% (open water, forest, shrub/scrub, grassland herbaceous, woody wetlands and emergent herbaceous), and urban and residential lands comprise 16.47% of the watershed. Only 9% of the entire watershed is categorized as green space (i.e. forest and wetland areas). The developed areas only consist of 16.47% of the watershed but can have a major impact on water quality of stormwater runoff. As urban areas continue to develop within the watershed, the agencies with regulatory authority should pay careful attention to the characteristics of the existing areas and require (as much as the law allows) that developments incorporate best management practices (including avoidance of significant natural areas, buffers, etc.) within their projects.

Notable Natural Resources and Recreational Facilities

The Indiana Department of Natural Resources Division of Nature Preserves was contacted to provide any Indiana Natural Heritage Data or related records for all high quality natural communities or natural areas documented within the Geist Reservoir/Upper Fall Creek Watershed. Their response indicated that there were two known high quality natural communities within the watershed: Fort Benjamin Harrison State Park and Stout Woods Forest Preserve. However, further evaluation of the locations of these two areas indicated that they were both located outside of the Geist Reservoir/Upper Fall Creek Watershed.

A number of recreational opportunities are also scattered throughout the Geist Reservoir/Upper Fall Creek Watershed. The recreational facilities and parks serve as an opportunity for the public to enjoy the natural landscape within their community as well as learn about valuable natural resources. As shown in Table 6, the Indiana Department of Natural Resources Outdoor Recreational Facilities database indicated that there are 29 recreational facilities (excluding schools) within the watershed.

Table 6: Recreational Facilities

Name	Location	Name	Location
50th and Main Street Park	Anderson	Indiana Gun Club	Fortville
Aker Park	Anderson	Landmark Park	Fortville
Alvin D. Brown Memorial Park	Pendleton	Lost Lake Campground	Daleville
Belmont Park	Anderson	Markleville Community Park	Markleville
Circle Park	Anderson	Meadowbrook Park	Anderson
Dietrich Memorial Park	Middletown	Meadowbrook Parkway	Anderson
Falls Park	Pendleton	Pine Lakes Camping and Fishing	Pendleton
Fortville American Legion Park	Fortville	Putt-Putt Golf and Games	Anderson
Fortville Park & The Boys and Girls Club	Fortville	Southside Sports Complex	Anderson
Fred Glad Courts	Middletown	Spring Valley Campground	Middletown
Gazebo Park	Middletown	Valley View Golf Club	Middletown
Geist County Park	Fortville	Vernon Township Park	McCordsville
Geist Reservoir – Admirals Pointe	Indianapolis	Whetstone Church Park	Anderson
General Pulaski Park	Anderson	Wooded Wetlands and East Recreation Complex	Pendleton
Idlewold Country Club	Pendleton		

Other Planning Efforts

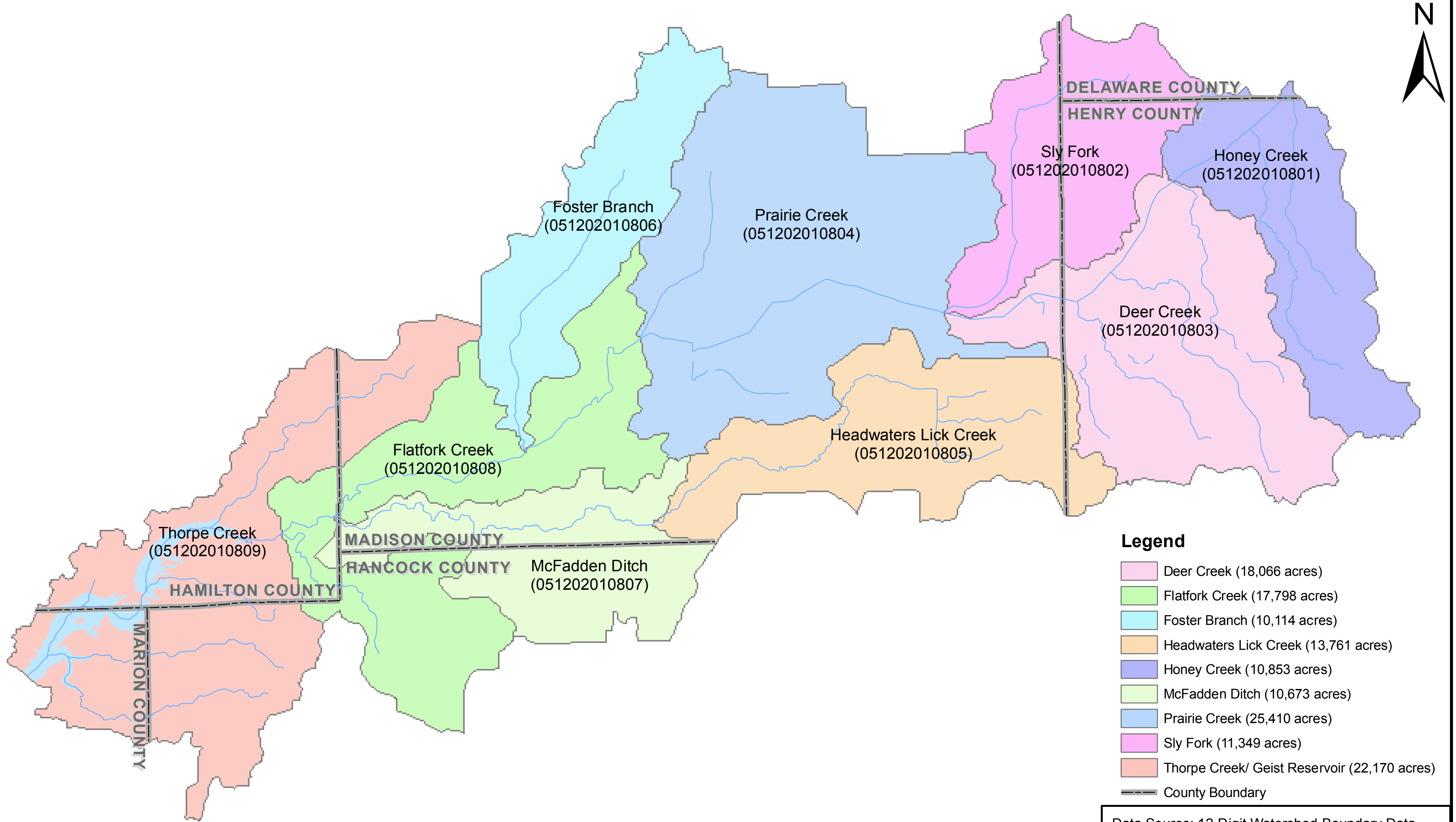
The Geist/Upper Fall Creek Watershed and the Upper White River Watershed have been the focus of scientific research recently due to the toxic blue-green algae issues in the reservoir, and therefore some watershed planning and monitoring efforts have been ongoing that provide information to this WMP. Additionally, the Geist/Upper Fall Creek Watershed is a developing watershed and the incorporated entities within the watershed have comprehensive plans and stormwater quality management plans that have been approved and are being used to manage growth within these communities. See Table 7 for available planning efforts being completed by the communities/agencies within the watershed. The list of Approved MS4 Communities was created using IDEM Rule 13 List of Designated MS4 Entities Currently Permitted and the SWQMPs were obtained from the community websites.

These planning documents provide a glimpse into the future for potential land use change that may impact the water quality of the Geist/Upper Fall Creek Watershed. This information is important to incorporate and make our best attempt to look forward with nonpoint source modeling techniques to predict future conditions. As in many cases, land use is a primary determinant of water quality conditions.

Table 7: Other Planning Efforts		
Watershed Management Plans		**Approved MS4 Communities**
Lower Fall Creek WMP		Delaware County
		Hamilton County (SWQMP 1/31/2005)
Comprehensive Plans		Hancock County
Hamilton County		Madison County
Hancock County		City of Anderson
Madison County		Town of Pendleton
Marion County		Town of Ingalls
Town of Pendleton		Town of Fortville
		Town of McCordsville
Long Term Control Plans (for Combined Sewer Overflow)		City of Lawrence
Community	No. of CSO's	Town of Fishers (SWQMP 1/31/2005)
Town of Middletown	3	
Town of Fortville	7	

Part Two of the Watershed Inventory

Hydrologic unit codes (HUCs) were developed by the United States Geological Survey (USGS) in cooperation with the United States Water Resources Council (USWRC) and the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS). Most federal and state agencies use this coding system. HUCs are a way of cataloguing portions of the landscape according to their drainage. Landscape units are nested within each other and described as successively smaller units. The hydrologic code attached to a specific watershed is unique, enabling different agencies to have common terms of reference and agree on the boundaries of the watershed. These commonly understood boundaries foster understanding of how landscapes function, where water quality problems should be addressed, and who needs to be involved in the planning process. The Geist Reservoir/Upper Fall Creek Watershed in itself is a 10-digit HUC 0512020108 that, for this project, consists of nine 12-digit Hydrologic Unit Codes or HUCs (Exhibit 10).



Data Source: 12-Digit Watershed Boundary Data (USDA-NRCS National Cartography and Geospatial Center, publication date 1999)

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TITLE: **Subwatershed Map**

PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**

BASE LAYER: HUC 12 Boundaries

PROJECT NO.: 09006

EXHIBIT: 10

SHEET: 1 OF: 1

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

QUADRANGLE: N/A

DATE: 09/30/10

SCALE: 1" = 16,000'

Table 8: 12-Digit Hydrologic Unit Codes			
Subwatershed Name	**HUC**	**Acres**	**Percentage**
Honey Creek	051202010801	10,853	7.74%
Sly Fork	051202010802	11,349	8.10%
Deer Creek	051202010803	18,066	12.89%
Prairie Creek	051202010804	25,410	18.12%
Headwaters Lick Creek	051202010805	13,761	9.82%
Foster Branch	051202010806	10,114	7.21%
McFadden Ditch	051202010807	10,673	7.61%
Flatfork Creek	051202010808	17,798	12.70%
Thorpe Creek	051202010809	22,170	15.81%

Available water quality, biological and landuse information was collected for the watershed. This information was then analyzed on a subwatershed (HUC 12) scale in order to prioritize and rank the subwatersheds relative to one another. A list of the data and studies utilized for this WMP are detailed below, however the results/analysis are discussed in the respective 12-digit HUC subwatershed sections.

Available Data and Studies

Lower Fall Creek Watershed Management Plan

Lower Fall Creek is not in the Upper Fall Creek/Geist Reservoir Watershed, however it does directly discharge to the Lower Fall Creek watershed and therefore is included in this WMP. The Lower Fall Creek Watershed drains approximately 57,800 acres of rural, suburban, and urban land in Central Indiana. The Lower Fall Creek Watershed consists of 6 14-digit Hydrologic Unit Code (HUC) watersheds. These include: 05120201110-010, 020, 030, 040, 050, and 060. The Marion County Soil and Water Conservation District submitted a Section 319 Non Point Source Program grant application to IDEM in 2006 to develop a Watershed Management Plan for the Lower Fall Creek Watershed. The grant application was approved in 2007 and Christopher B. Burke Engineering, Ltd. was hired to complete the plan.

The Lower Fall Creek Watershed Steering Committee focused on three pollutants (sediment, nutrients and pathogens) throughout the identification of the Critical Areas, development of the proposed best management practice recommendations, and development of the goals and decisions to improve water quality. Public education and outreach was also included as a goal of the WMP. This information was reviewed and included for information purposes only due to the fact that the Geist Reservoir/Upper Fall Creek watershed ultimately drains to this watershed.

IDEM 303(d) List

The IDEM Assessment Branch evaluates all the data they collect to develop the 305(b) report, and the 303(d) list. The 305(b) report is a document that summarizes the quality of surface waters throughout Indiana and the designated uses of these waters. Evaluations are based on different stream segments or lakes, and are discussed in the context of watersheds. To complete the evaluation, IDEM considers not only the data they collect, but data collected by other entities as long as that data meets the rigorous quality controls that IDEM uses in the collection and analysis of their own data. Other data that does not meet these standards may be used informally to validate data that does meet the quality controls.

Section 303(d) of the 1972 Federal Clean Water Act (CWA) requires each state to identify those waters that do not meet the state's water quality targets for designated uses. These streams are to be listed on the State's 303(d) list of impaired waters. For such waters, the State is required to establish total maximum daily loads (TMDLs) to meet the state water quality targets. As defined by IDEM, a TMDL established under section 303(d) of the federal Clean Water Act, is a calculation of the maximum amount of pollutant that a waterbody can receive and still meet water quality targets, and allocates pollutant loadings among point and nonpoint sources.

To determine if a waterbody should be listed on Indiana's 303(d) list, the IDEM Assessment Branch has developed a surface water quality monitoring strategy to assess the quality of Indiana's ambient waters. The goals of this monitoring strategy are: measure the physical, chemical, bacteriological and biological quality of the aquatic environment in all river basins and identify factors responsible for impairment; assess the impact of human and other activities on the surface water resource; identify trends through the analysis of environmental data; and provide environmental quality assessment to support water quality management programs. Known impairments in this watershed are specified in Part Two of the Watershed Inventory: Subwatershed Summaries.

Once data is collected, waterbodies are evaluated by a team of water-quality professionals within IDEM to determine if the waterbodies meet the water-quality standards set by the State, and that all designated uses are met. If a stream fails to meet these requirements, as outlined in the 303(d) listing methodology, the waterbody is considered impaired and must be listed on the 303(d) list, and a TMDL developed to address the problem.

As defined by IDEM, a TMDL is a tool for implementing water quality targets and is based on the relationship between pollutant sources and in-stream water quality conditions. The TMDL establishes the allowable loadings or other quantifiable parameters for a water body and thereby provides the basis to establish water quality-based controls. These controls should provide the pollutant reduction necessary for a water body to meet water quality targets.

The TMDL process provides a flexible assessment and planning framework for identifying load reductions or other actions needed to attain water quality targets (i.e. water quality goals to protect aquatic life, drinking water, and other water uses). The process has three steps:

- Identify Quality Limited Waters - States must identify and prepare a list of waters that do not or are not expected to meet water quality targets after applying existing required controls.
- Establish Priority Waters/Watersheds - States must prioritize waters/watersheds and target high priority waters/watersheds for TMDL development.
- Develop TMDLs - For listed waters, States must develop TMDLs that will achieve water quality targets, allowing for seasonal variations and an appropriate margin of safety. A TMDL is a quantitative assessment of water quality problems, contributing

sources, and load reductions or control actions needed to restore and protect individual water bodies.

States are responsible for implementing the TMDL process. EPA reviews and approves lists of quality-limited waters and specific TMDLs. If EPA disapproves lists or TMDLs, EPA is required to establish the lists and/or TMDLs. Landowners, other agencies, and other stakeholders can often assist States or EPA in developing TMDLs for specific watersheds.

Draft TMDLs have been determined for pollutants that do not already have state regulated targets. This information is provided within the appropriate pollutant section within this plan. It should be noted that if a stream is not listed on the 303(d) list it may be impaired; however the data (or lack thereof) does not indicate the impairment at the time of publication. Exhibit 11 identifies all streams within the watershed which are listed on the 303(d) list.

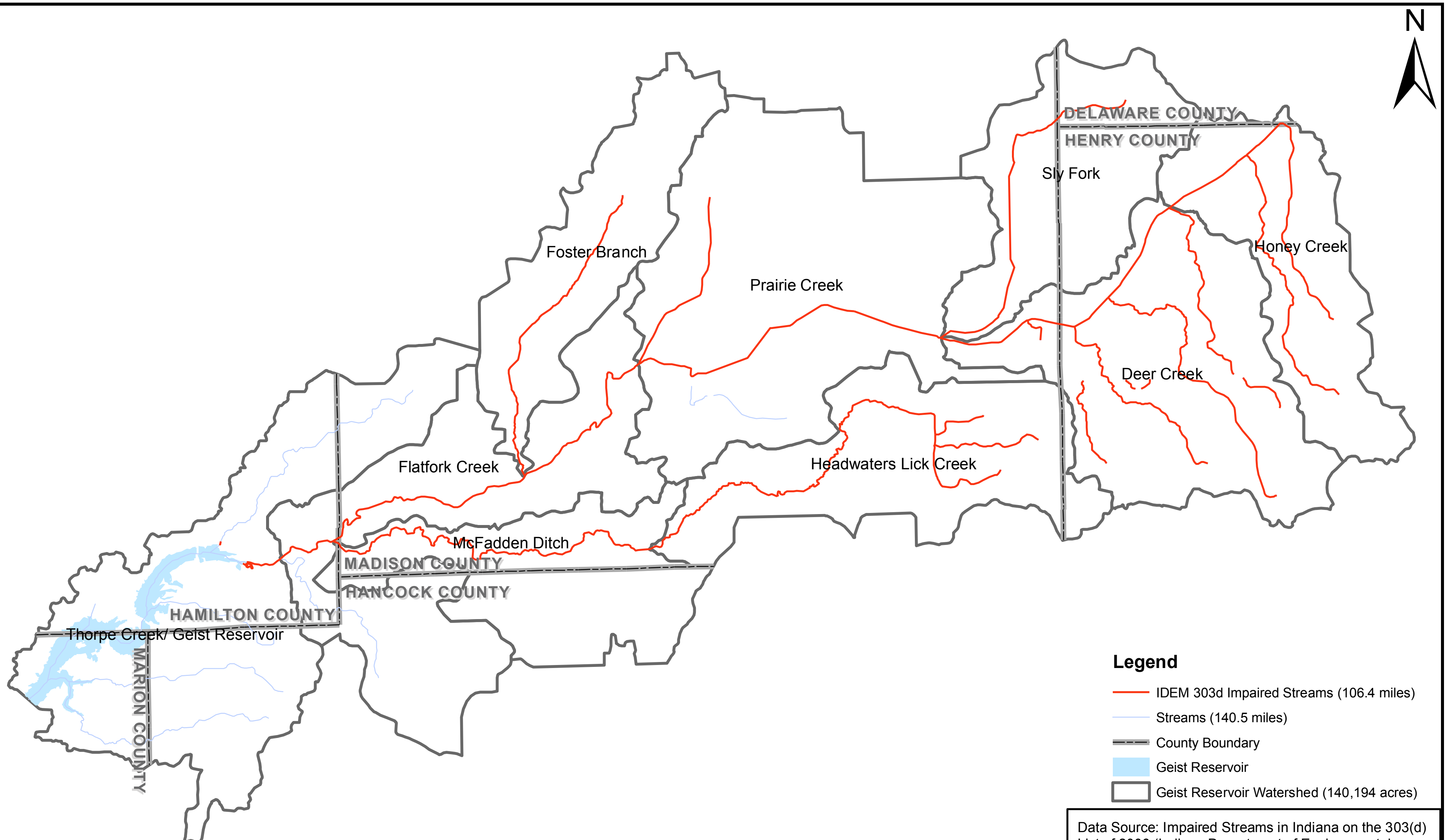
IDEM Water Quality Sampling
Available water quality data from IDEM for the Geist Reservoir/Upper Fall Creek Watershed between 1996 and 2009 was obtained and evaluated to determine where water-quality problems were noted in the watershed.

The following is a list of the IDEM data obtained for this WMP.

- 1991, 1996, 2001, 2006 Fish Tissue
- 1992, 1996, 2001, 2006 Macroinvertebrates
- 1996, 2001 Sediment Bio
- 1996 Synoptic
- 1996 Watershed
- 1999-2009 Fixed Station
- 2001, 2006 Corvallis
- 2001 Corvallis Biological
- 2001 *E.coli* – Upper WFWR
- 2001 Pesticides
- 2002-2006 Clean Sampling and Ultra-Clean Analyses
- 2006 Corvallis *E.coli*
- 2008 Fall Creek IBC Study
- 2008-2009 Upper Fall Creek WQ Monitoring Program

It should be noted that three IDEM sampling locations were within Geist Reservoir. Two of the sampling locations identified various Fish Tissue and Sediment Bio Studies. One sampling location was noted in the 2008 Fall Creek IBC Study. The information associated with these locations was omitted in the data analysis portion of the WMP as it is reservoir specific and does not accurately depict water quality within the subwatershed. This information is, however, included in the Appendix for information and future use purposes.

The data that was analyzed included field data, general chemistry data and metals data where available. In comparison to the CIWRP data, the IDEM data was all inclusive without a differentiation between base flow or storm flow events. Therefore, an overall average approach of this data was used in order to get a better depiction of how the watershed



Data Source: Impaired Streams in Indiana on the 303(d) List of 2006 (Indiana Department of Environmental Management, publication date 20060621)

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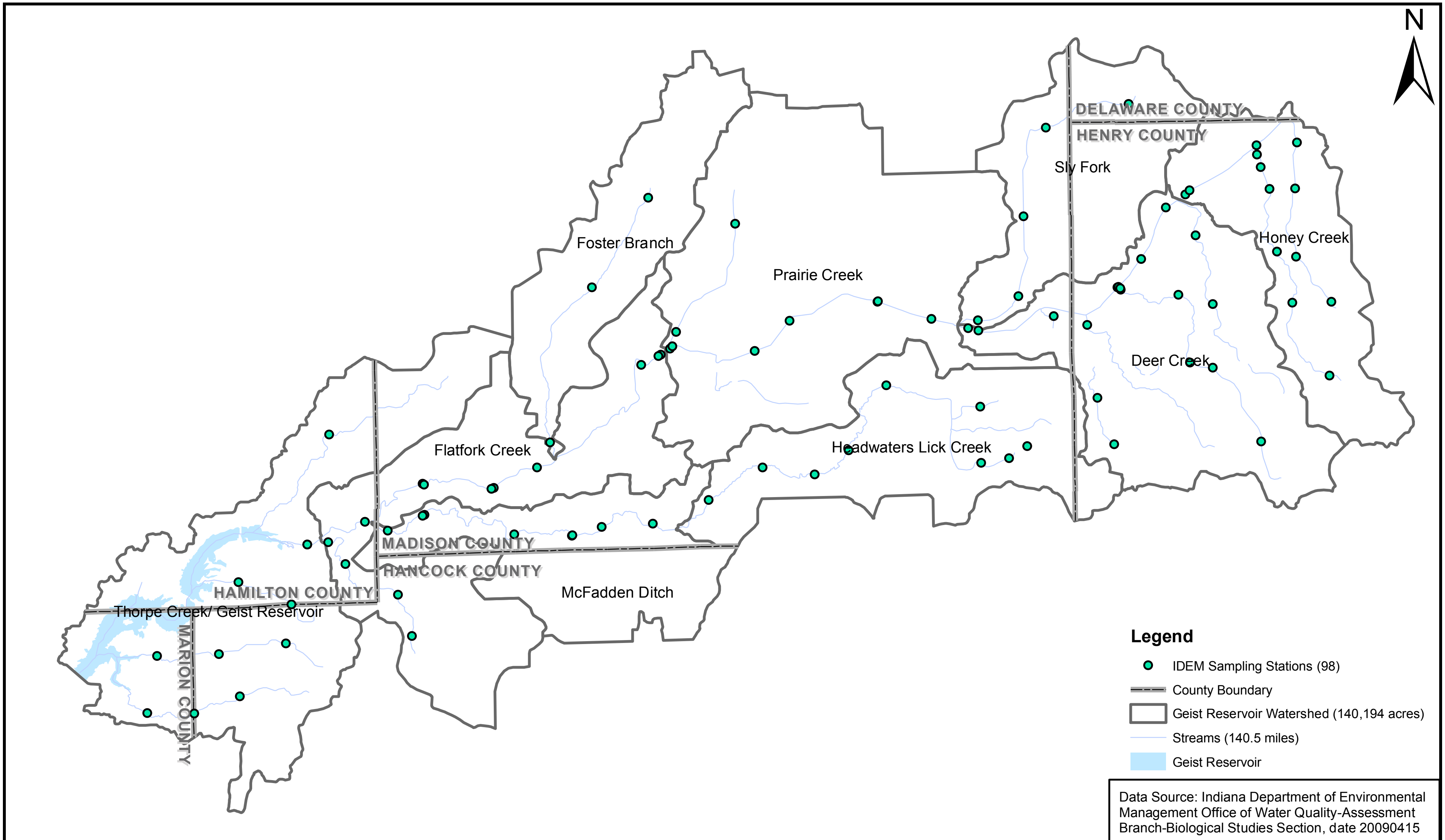
TITLE: **IDEM 303(d) Impaired Streams Map**	PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**		
BASE LAYER: 303(d) Impaired Streams	PROJECT NO.: 09006	EXHIBIT: 11	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'



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TITLE: **IDEM Sampling Stations**

BASE LAYER: IDEM Sampling Locations

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

PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**

PROJECT NO.:	EXHIBIT:	SHEET:
09006	12	1 OF: 1
QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'

actually functions at any given time. Site locations were spread throughout the watershed as shown on Exhibit 12 and the data was analyzed on a subwatershed scale as detailed in each subwatershed section.

Several water quality parameters which have standard targets associated with them were screened to determine which subwatersheds demonstrated impairments or degradations. The water quality parameters evaluated from the historical data set and their suggested targets are listed below with a detailed explanation of the parameter and the impairment that it may indicate. All parameters were summarized as means for comparison to water quality targets and other subwatersheds.

Dissolved Oxygen – Dissolved oxygen is the gaseous form of oxygen and is essential for respiration of aquatic organisms (i.e. fish and plants). Dissolved oxygen enters water by diffusion from the atmosphere and as a byproduct of photosynthesis by algae and plants. Oxygen saturation in water would equal 100% if equilibrium were reached. Values greater than 100% saturation indicate photosynthetic activity within the water or highly turbulent water. Large amounts of dissolved oxygen in the water indicate excessive algae growth. Dissolved oxygen is consumed by respiration of aquatic organisms and during bacterial decomposition of plant and animal matter. Levels of Dissolved Oxygen less than 4 mg/L and greater than 12 mg/L exceed the water quality standard for Dissolved Oxygen as described in Indiana Administrative Code (IAC) 327 IAC 2-1.5-8.

Escherichia coli (E.coli) – *E.coli* is a member of the fecal coliform group of bacteria. When this organism is detected within water samples, it is an indication of fecal contamination. *E.coli* is an indigenous fecal flora of warm-blooded animals. Contributions of detectable *E.coli* colonies may appear within water samples due to the input from human or animal waste. Failing septic tanks, and wildlife are some known sources of *E.coli* impairments in waterbodies. Common sources of animal waste are agricultural feedlots (pigs, cattle, etc.), Canada goose waste, or bird waste (such as Canada geese or gulls). Rain storm events or snow melts frequently wash waste and the associated *E.coli* into surface water systems. Rain storm events that exceed the capacity of local sewer systems result in combined sewer overflows that can also be a source of *E.coli*. Land use within the Geist Reservoir Watershed is predominately agricultural and requires drain tiles due to soil type. Field tiles are not sources of *E.coli* but they can carry *E.coli* from land applied manure and runoff from the fields and pastures. The single sample state standard in Indiana for *E.coli* according to Indiana Administrative Code (IAC) 327 IAC 2-1-6 is 235 CFU/100 mL. The measure of CFU per 100 mL means the count of colony forming units (CFU) that exist in 100 milliliters of water.

After 2000 IDEM began using the Most Probable Number (MPN) method instead of CFU for measuring *E.coli.* Based on a study performed by the Department of Statistical Science at Duke University, estimating procedures for MPN and CFU have intrinsic variability and are subject to additional uncertainty arising from minor variations in experimental protocol. It has been observed empirically that the standard multiple-tube fermentation (MTF) decimal dilution analysis MPN procedure is more variable than the membrane filtration CFU procedure, and that MTF derived MPN estimates are somewhat higher on average than CFU estimates, on split samples from the same water bodies.

Nitrogen – Nitrogen is an essential nutrient for organism growth. Nitrogen can enter water bodies from the air and as inorganic nitrogen and ammonia for use by bacteria, algae and larger plants. The four common forms of nitrogen are:

- Nitrite (NO2-) – is an intermediate oxidation state of nitrogen, both in the oxidation of ammonia to nitrate and in the reduction of nitrate. Nitrite is a negative charged ionized form of nitrogen (anion).
- Nitrate (NO3-) – Nitrate generally occurs in surface runoff from agricultural fields and can also be conveyed through some groundwater systems. In excessive amounts, it contributes to the illness known as methemoglobinemia in infants. Nitrate is a negative charged ionized form of nitrogen (anion).
- Ammonia (NH3) and Ammonium (NH4+ or simply NH4) – Ammonia has a polar charge and can be toxic to fish. Ammonium is a positive charged ionized form (cation) and is considered nontoxic. Ammonia is present naturally in surface waters. Bacteria produce ammonia as they decompose dead plant and animal matter. The concentration of ammonia is generally low in groundwater because it adheres to soil particles and clays and does not leach readily from soils. It can also be found in some areas with industrial discharges.
- Organic nitrogen (TKN) – is defined functionally as organically bound nitrogen in the trinegative oxidation state. Organic nitrogen includes nitrogen found in plants and animal materials, which includes such natural materials as proteins and peptides, nucleic acids and urea. In the analytical procedures, Total Kjeldahl Nitrogen (TKN) determines both organic nitrogen and ammonia. TKN is determined in the same manor as organic nitrogen with the exception that the ammonia is not driven off before the digestion step.

Levels of Nitrate and Nitrite greater than 10 mg/L exceed the water quality standard for those waters designated as a drinking water source for Nitrate and Nitrite as described in Indiana Administrative Code (IAC) 327 IAC 2-1-6. However, for this analysis, levels above 1.6 mg/L were evaluated as the US EPA nutrient criterion for this eco-region.

pH (Acidic and Alkaline) – The pH of a water body reflects the hydrogen ion activity in the water body. pH is defined as the –log [H+]. A low pH signifies an acidic medium (lethal effects of most acids begin to appear at pH = 4.5) while a high pH signifies an alkaline medium (lethal effects of most alkalis begin to appear at pH = 9.5). Neutral pH is 7. The actual pH of a water sample indicates the buffering capacity of that water body. Levels of pH less than 6 and greater than 9 exceed the water quality standard for pH as described in Indiana Administrative Code (IAC) 327 IAC 2-1.5-8. pH values can change rapidly when algae is present. Algae removes dissolve carbon dioxide during photosynthesis. Carbon dioxide is acidic and therefore this process will cause pH values to rise.

Phosphorus – Phosphorus is an essential nutrient for organism growth. Phosphorus can be found in dissolved and sediment-bound forms. However, phosphorus is often locked up in all plant life, including algae. In the watershed, phosphorus is found in fertilizers and in human and animal wastes. The availability of phosphorus determines the growth and production of algae and makes it a limiting nutrient in the system. 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 US EPA recommended water quality target. For this analysis, subwatersheds were evaluated based on EPA's recommended target.

Total Suspended Solids (TSS) – Total suspended solids is a water quality measurement which refers to the portion of total solids retained by a filter, where as total dissolved solids (TDS) refers to the portion that passes through the filter. The principal factors affecting separation of TSS and TDS are the type of filter holder, pore size, porosity, area, and thickness of the filter and the physical nature, particle size, and amount of material deposited on the filter. Measurements of TSS can vary widely in watershed streams based on stream flow at the time of sampling. TSS measurements and modeling are frequently used to represent sediment loading. Levels of TSS greater than 30 mg/L exceed the IDEM statewide draft TMDL target.

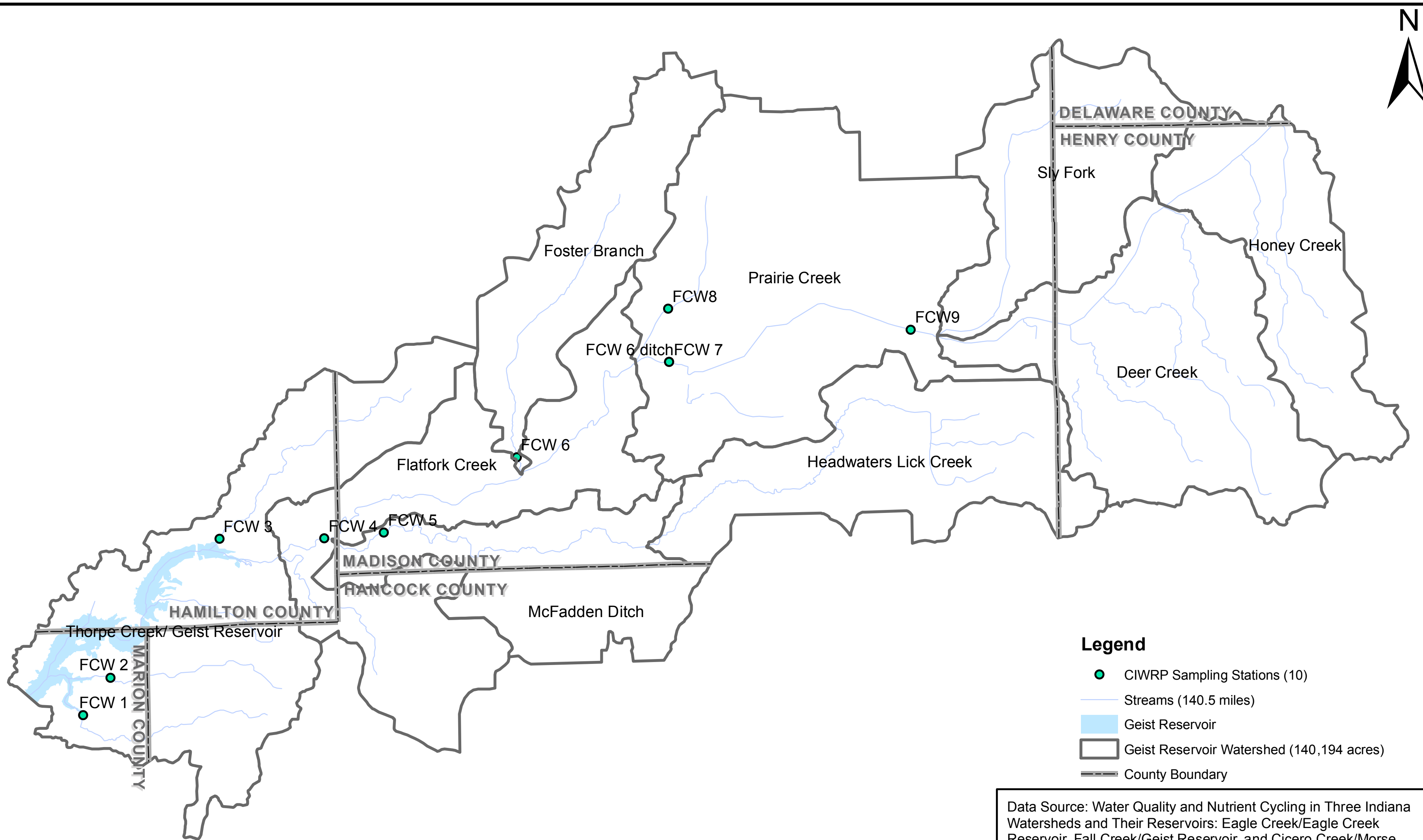
Turbidity – The water's transparency can be affected by two primary factors: algae and suspended particulate matter. An increase in the amount of the phytoplankton or suspended particles signifies an increase in the water's turbidity. Levels of Turbidity greater than 10.4NTU exceed the US EPA recommended water quality limits.

Atrazine – Atrazine is an herbicide used to stop pre- and post-emergence broadleaf and grassy weeds in major agricultural crops, especially corn. Atrazine is the most widely used herbicide in conservation tillage systems, which are designed to prevent soil erosion. It may also used in conventional tillage applications. Its use is controversial due to its effects on nontarget species, such as on amphibians, and because of widespread contamination of waterways and drinking water supplies. There are also thought to be implications for human birth defects, low birth weights and menstrual problems. Levels of Atrazine greater than 0.003 mg/L exceed the US EPA drinking water standards. The CEES Atrazine data was unable to be released for purposes of this WMP. However, this concern was discussed at the Steering Committee meetings based on the knowledge of this data and usage throughout the watershed.

Central Indiana Water Resources Partnership (CIWRP) Studies

Central Indiana Water Resources Partnership is a long-term research and development partnership between IUPUI's Center for Earth and Environmental Sciences (CEES) and Veolia Water Indianapolis, LLC. In 2003, CIWRP completed a study encompassing Geist Reservoir and the Upper Fall Creek Watershed (Appendix G). Water Quality samples were collected within the watershed during seasonal base and event flow throughout 2003 (Exhibit 13). Data collected during the CIWRP study was obtained for analysis for this watershed management plan.

The CIWRP Study included ten sampling locations within the Geist Reservoir/Upper Fall Creek Watershed. There are two sampling locations at the same site within the Prairie Creek Subwatershed. Based on the sampling locations, not all subwatersheds could be defined by a sample location. In order to use this data for subwatershed comparisons, some subwatersheds were grouped together and represented by a single sampling site. Several water quality parameters which have standard targets associated with them were screened to determine which subwatersheds demonstrated impairments or degradations. All parameters were summarized as means for comparison to water quality targets and other subwatersheds.



Data Source: Water Quality and Nutrient Cycling in Three Indiana Watersheds and Their Reservoirs: Eagle Creek/Eagle Creek Reservoir, Fall Creek/Geist Reservoir, and Cicero Creek/Morse Reservoir. Central Indiana Water Resources Partnership, 20030430

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TITLE: **CIWRP Water Quality Sampling Stations**

PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**

BASE LAYER: CIWRP Sampling Locations

PROJECT NO.:	EXHIBIT:	SHEET:
09006	13	1 OF: 1

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

QUADRANGLE:	DATE:	SCALE:
N/A	09/30/10	1" = 16,000'

Based on the information obtained for the CIWRP 2009 Research Program website, CIWRP also continues to do blue-green algae research within Geist Reservoir which recently has included documentation on the occurrence of taste and odor compounds as well as cyanotoxins. Exposure to a blue-green algae during recreational activities such as swimming, wading, and water-skiing may lead to rashes, skin, eye irritation, and other uncomfortable effects such as nausea, stomach aches, and tingling in fingers and toes.

There are three main goals for this continued research: 1) to document algal community composition and abundance; 2) to determine the relationship between physical and chemical reservoir conditions and algal community structure and abundance; and 3) to document the occurrence of cyanobacterial toxins and taste and odor compounds. Results of the 2008 study provided important information regarding differences and similarities of phytoplankton community structure and the occurrence of cyanotoxins and taste and odor metabolites in the reservoir. A summary of the 2008 research project as well as the presentation given by Dr. Lenore Tedesco, Nicolas Clercin (CEES) and Mark Gray (Veolia Water) on the findings specifically in Geist Reservoir can be found in Appendix G. The Geist Reservoir study sites included seven sites. All seven sites were evaluated for water quality parameters and two of these sites were evaluated for algal toxins. Samples were collected 11 times from May to November.

IDEM Biological Sampling

Available biological data from IDEM for the Geist Reservoir/Upper Fall Creek Watershed was obtained and evaluated to determine where water-quality problems were noted in the watershed (see Appendix F for a complete list of IDEM data). Data included macroinvertebrate, fisheries and habitat data where available. IDEM sampling locations were spread throughout the watershed as shown on Exhibit 12 and the data was analyzed on a subwatershed scale as detailed in each subwatershed section. As stated in IDEM's Surface Water Quality Assessment Program – Macroinvertebrate Community Assessment Program objectives, any biological community assessment is a measurement of an ecosystem and how it responds to environmental stresses and gives an overall picture of the conditions, at the point being assessed. When conducted in conjunction with chemical analysis of specific water quality parameters and aquatic habitat quality, this information can provide a complete and comprehensive understanding of the ecological quality of the watershed.

Macroinvertebrate data was analyzed based on the Macroinvertebrate Index of Biotic Integrity (mIBI). Macroinvertebrate monitoring followed the US EPA Rapid Bioassessment Protocol single habitat, family level approach method. The mIBI is designed to assess biotic integrity directly through ten metrics which evaluate a macroinvertebrate community's species richness, evenness, composition, and density within the stream. These metrics include the family-level HBI (Hilsenhoff's Family Biotic Index), number of taxa, number of individuals, Percent Dominant Taxa, EPT index, EPT count, EPT count to total number of individuals, EPT count to Chironomid count, Chironomid count, and number of individuals per number of squares sorted. Values for the ten metrics are compared with corresponding ranges and a rating of 0, 2, 4, 6, or 8 is assigned to each metric. A final score of 0 – 2 is a severely impaired stream, 2 – 4 is moderately impaired, 4 – 6 is slightly impaired and 6 – 8 is not impaired for biological quality. The average of these ratings gives a total mIBI score.

Fisheries data was analyzed based on the Index of Biotic Integrity (IBI). The IBI is based on fish surveys with the rating dependent on the abundance and composition of the fish species in a stream. Fish communities are useful for assessing stream quality because fish represent the upper level of the aquatic food chain and therefore reflect conditions in the lower levels of the food chain. Fish population characteristics are dependent on the physical habitat, hydrologic and chemical conditions of the stream, and are considered good indicators of overall stream quality because they reflect stress from both chemical pollution and habitat perturbations. For example, the presence of fish species that are intolerant of pollution are an indicator that water quality is good. The IBI is calculated on a scale of 12 to 60, the higher the score the better the stream quality. When more than one data set was available, the IBI scores were summarized as means for comparison to other subwatersheds.

Habitat data was analyzed based on the IDEM Qualitative Habitat Evaluation Index (QHEI) habitat assessment approach which evaluates physical characteristics of a stream. Habitat incorporates all aspects of physical and chemical constituents along with the biotic interactions. Habitat includes all of the in-stream and riparian habitat that influences the structure and function of the aquatic community in a stream. The presence of an altered habitat structure is considered one of the major stressors of aquatic systems. The maximum score that can be obtained using the IDEM QHEI is a value of 100. QHEI scores below 51 indicate that the stream is non-supporting for aquatic communities. QHEI scores form 51 to 64 are partially supporting to aquatic communities and scores above 64 are fully supporting. QHEI can also be broken down in several different categories that range from Excellent (70-100), Good (55-69), Fair (43-54), Poor (31-42), to Very Poor (<30). When more than one data set was available, the QHEI scores were summarized as means for comparison to other subwatersheds.

V3 Reservoir Shoreline Investigation

V3 completed at Reservoir Shoreline Investigation of Geist Reservoir in June 2009, using both field observations and aerial photography. During the survey, areas of unprotected shoreline were identified in order to gain an understanding of where erosion may be a concern as well as areas that can be included in implementation projects. Unprotected areas ranged from naturally eroding shoreline (i.e. tree coverage prohibiting vegetation growth with solid root mass for stabilization) to lack of sediment and erosion control measures causing eroded shoreline due to construction activities (i.e. Rule 5 violations). An exhibit showing the areas of unprotected shoreline is included in Appendix J along with a copy of the field notes.

V3 Aquatic Vegetation Management Plan

The purpose of an aquatic vegetation management plan is to identify aquatic weed problem areas, describe management objectives, prescribe management strategies, and determine funding needs and sources necessary for the control of invasive aquatic vegetation.

Aquatic vegetation is an important component of lake ecosystems in Indiana; however as a result of many factors, aquatic vegetation can develop to a nuisance level. Nuisance quantities of aquatic vegetation are described as plant growth that negatively impacts lake uses such as swimming, boating, and fishing. Exotic species typically reach nuisance quantities as they outcompete native species and proliferate rapidly.

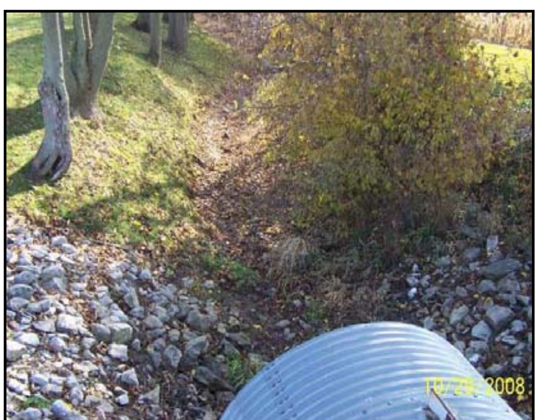
The goals outlined in the vegetation management plan were created based on the results of vegetation surveys and interaction with the Upper White River Watershed Alliance, Veolia Water, Watershed Stakeholders and IDNR biologists. The Geist Reservoir Vegetation Management Plan was created as a proactive measure to effectively propose exotic species management and to help reach the management goals established by the IDNR for all public lakes in Indiana.

It is important to note that all management actions proposed are related to invasive exotic species within Geist Reservoir. The vegetation survey results identified Eurasian watermilfoil as the only exotic species currently present within Geist Reservoir and is really the only vegetation providing any sort of habitat structure. Based on these findings, a recommendation of no treatment or management was made.

Windshield Survey

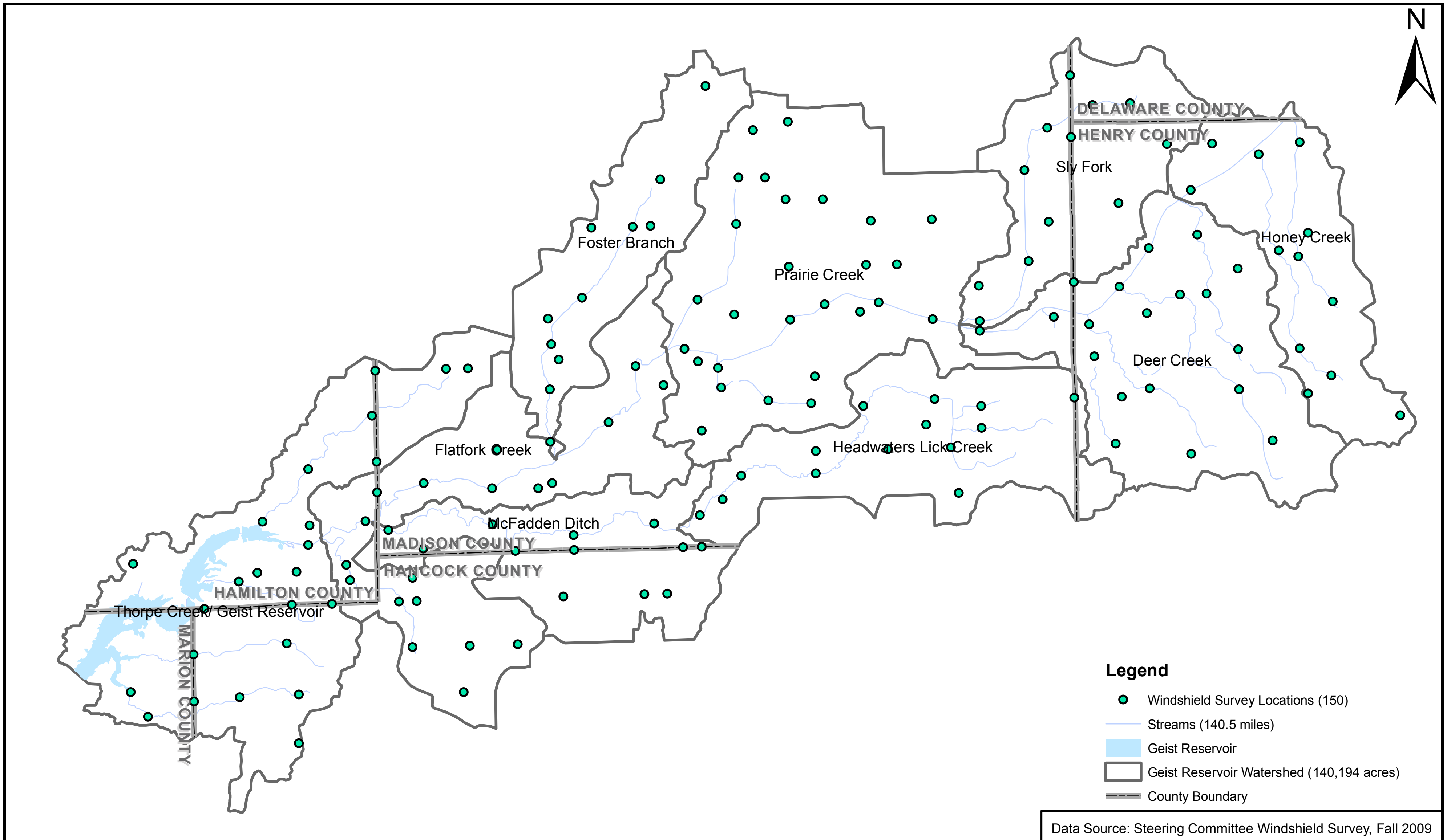
A windshield survey is a type of watershed assessment conducted by an observer traversing the watershed in a motorized vehicle. Real time data is then collected at predetermined stream crossings and accessible locations. Survey locations were split up per subwatershed based on the size of the subwatershed with a total of 100 waterway crossing points and 50 land points. The locations of the waterway crossing points were determined based on ease of access to the streams at roadway crossings (i.e. bridge and/or culvert crossings). The locations of the land points were also determined based on ease of access and were generally located at roadway crossings within the subwatershed. As shown in Exhibit 14, all of the locations identified for windshield survey analysis are spread out throughout each subwatershed in order to provide an overall representation of the subwatershed. The index maps for each subwatershed with the site location identification are included in Appendix H.

Observations were made during October/November 2009 by Steering Committee volunteers. Observations including general site information (i.e. location and weather), land use, land odor, evidence of best management practices, water color/appearance, water odor, evidence of algae, streambank erosion, stream buffers & type, in-stream debris, available shade/stream cover and in-stream habitat were recorded for 150 locations throughout the watershed (Exhibit 14) on standardized survey forms (Appendix H). While all of this information is valid for an overall understanding of the subwatershed, five of the major parameters (animal access, tillage type, streambank erosion, stream buffers and in-stream debris) were used as a part of the subwatershed assessments and the identification of subwatershed priority areas and specific source critical areas. The remainder of the information obtained during the windshield survey should be reevaluated during the feasibility phases of plan implementation.



Example of Rip-Rap Stabilized Streambank

Streambank erosion is a natural process within a stream system; however erosion is often accelerated through alterations to the natural



Data Source: Steering Committee Windshield Survey, Fall 2009

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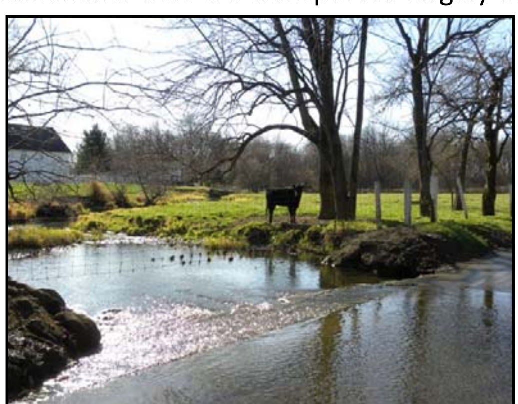
TITLE: Windshield Survey Stations	PROJECT: Geist Reservoir/Upper Fall Creek Watershed Management Plan		
BASE LAYER: Windshield Survey Locations	PROJECT NO.: 09006	EXHIBIT: 14	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance, P.O. Box 2065, Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'

system (e.g. changes in landuse, animal access to streams, etc). This accelerated erosion can contribute high sediment loads to the receiving stream, 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. Suspended sediment is a component of the amount of particulate matter in the water column and contributes to increases in the total suspended solids values, making it more difficult and often times impossible for fish and aquatic macroinvertebrates to live. 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 the large swings in DO. Streambank erosion was assessed on a subwatershed scale at each of the waterway crossing points. Identification of streambank erosion was broken up into the following categories: absent, stabilized (rip-rap, coir log, etc.), present > 3 feet tall and present < 3 feet tall.

Example of Absent Stream Buffer

Stream buffers are areas of natural vegetation between a surface water body and the surrounding land use. Buffers were only identified as adequate if they were at least ten feet in width. As shown on the example picture, Absent Buffers are those where the agricultural land or development is farmed/built up to the top of the stream bank leaving no possibility of runoff from being filtered through a grassed or treed area before entering the stream. 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. Buffers provide water quality protection by reducing the amount of pollutants in the runoff before it enters the water body. Constructed filter strips can also provide localized erosion protection and habitat for wildlife. Stream buffers were assessed on a subwatershed scale at each of the waterway crossing points. Identification of buffers was broken up into the following categories: absent, present > 50 feet and present (minimum 10 feet) < 50 feet. In areas of agricultural drain tile, the effectiveness of stream buffers can be lower than in areas without these drainage systems especially for contaminants that are transported largely as dissolved load such as nitrate and certain pesticides, including Atrazine. It should be noted that the 30 feet reference in the BMP section is in regards to the minimum required buffer width for funding opportunities from the USDA and in general is a standard minimum for water quality. The 50 foot reference is for the windshield survey. It was determined to use 50 feet instead of 30 feet since this parameter wasn't going to actually be measured but observed from a vehicle and therefore leaving some room for interpretation.



Example of Animal Access to Stream

In-stream debris was also noted during the windshield survey. In-stream debris can inhibit wildlife and aquatic habitat, increase flooding risks, and introduce additional pollutants. This information is valuable for the purposes of determining public education opportunities. Debris was assessed on a subwatershed scale based on the presence and type of debris (trash, deposits, log jam, etc) identified during the windshield survey. Animal access was assessed on a subwatershed scale based on the presence of animals or indicators of access.

Nonpoint Source Pollution Modeling

Nonpoint source pollution is a type of pollution generated from diffused sources in both public and private domains. As defined by EPA, the pollution from nonpoint sources originates from urban runoff, construction activities, manmade modification of hydrologic regime of a watercourse (i.e. retention, detention, channelization, etc.), silviculture, mining, agriculture, irrigation return flows, solid waste disposal, atmospheric deposition, stream bank erosion, and individual or zonal sewage disposal. Therefore, nonpoint pollution sources have their origin in a wide spectrum of public and private activities and, when not known or properly controlled, could affect, the water quality in a certain area.

Since runoff from the rainfall flows over or through the land and collects pollutants and nutrients prior to entering waterways, the overall characteristics and land use types of a watershed greatly influences the water quality. Each land use type includes the cumulative effects of various land covers, and natural and man-made activities. Therefore, each land use type can have an adverse affect on water quality, by contributing different pollutant amounts and concentrations. The cumulative effect of this pollution throughout the watershed represents the contribution of nonpoint source pollution.

Nonpoint source pollution management is highly dependent on hydrologic simulation models, and use of computer modeling is often the only viable means of providing useful input information for adopting the best management decisions. As previously mentioned, the nonpoint pollution sources are generated by activities that are spatially distributed on the analyzed watershed or study area. Due to this spatial distribution of nonpoint pollution sources, the computation models used to study pollutant transport and stream bank erosion require large amounts of data for analysis in even a small watershed.

For the Geist Reservoir/Upper Fall Creek Watershed, a tabular based nonpoint source pollution loading model was used to assess the nonpoint source pollution of three main pollutant parameters (Total Nitrogen (N), Total Phosphorus (P) and Total Sediment) that have been identified as elements of concern by both stakeholders and water sampling events. This model is known as the Spreadsheet Tool for Estimating Pollutant Load (STEPL). STEPL employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs).

For each subwatershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using the known BMP efficiencies.

The STEPL model was executed for each HUC 12 subwatershed within the Geist Reservoir/Upper Fall Creek Watershed. It should be noted that all computation models have assumptions and limitations. Therefore, the provided analytical results may not represent the exact pollution loads. In these conditions, even if the results are relative, they still can provide useful information for targeting and prioritizing subwatersheds for Best Management Practices (BMPs).

It is also important to note that the above presented nonpoint source modeling does not specifically include bank erosion and mass wasting, which can contribute additional pollutant loads of sediment, nitrogen, and phosphorus. However, certain landuses within the model have input values that incorporate some bank erosion that is typical for that land practice.

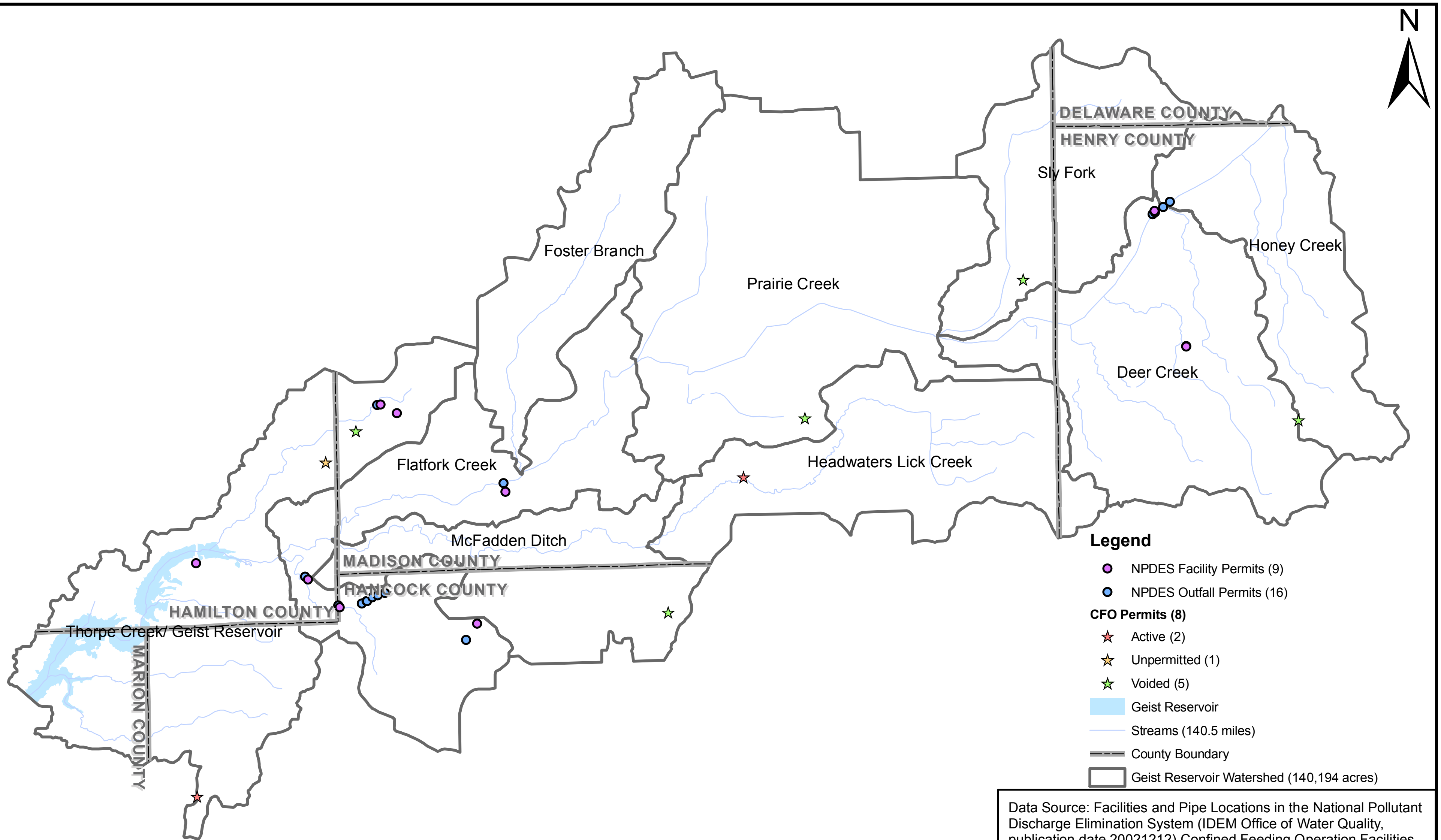
NPDES Permitted Facilities & Confined Feeding Operations

The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Records for NPDES facilities and Confined Feeding Operations within the watershed were obtained from IDEM (Exhibit 15) and are analyzed on a subwatershed scale. The CFO compliance information obtained from IDEM did not include the type of operation for all of the CFOs within the watershed. Therefore, this information was not provided in the plan, however all obtained data is included on the Appendices CD. The permit status of the CFO is provided on Exhibit 15 as well as on each individual subwatershed exhibit and in each subwatershed section in the Subwatershed Summary.

Based on information obtained from IDEM, the State of Indiana's efforts to control the direct discharge of pollutants to waters of the State were inaugurated by the passage of the Stream Pollution Control Law of 1943. The vehicle currently used to control direct discharges to waters of the State is the NPDES Permit Program. This was made possible by the passage of the Federal Water Pollution Control Act Amendments of 1972 (also referred to as the Clean Water Act). These permits place limits on the amount of pollutants that may be discharged to waters of the State by each discharger. These limits are set at levels protective of both the aquatic life in the waters which receive the discharge and protective of human health.

There are several different types of permits that are issued in the NPDES permitting program including Municipal, Semi-Public or State (sanitary-type discharger); Industrial (wastewater generated in producing a product); and Wet Weather/Storm Water-related (wastewater resulting from precipitation coming in contact with a substance which is either dissolved or suspended in the water).

The purpose of the NPDES permit is to control the point source discharge of pollutants into the waters of the State such that the quality of the water of the State is maintained in accordance with the standards contained in 327 IAC 2. The NPDES permit requirements must ensure that, at a minimum, any new or existing point source must comply with



Data Source: Facilities and Pipe Locations in the National Pollutant Discharge Elimination System (IDEM Office of Water Quality, publication date 20021212) Confined Feeding Operation Facilities in Indiana (IDEM Office of Land Quality, publication date 20090604)

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TITLE: **NPDES Permit Locations**	PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**		
BASE LAYER: NPDES Permitted Locations	PROJECT NO.: 09006	EXHIBIT: 15	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'

technology-based treatment requirements that are contained in 327 IAC 5-5-2. According to 327 IAC 5-2-2, "Any discharge of pollutants into waters of the State as a point source discharge, except for exclusions made in 327 IAC 5-2-4, is prohibited unless in conformity with a valid NPDES permit obtained prior to discharge." This is the most basic principal of the NPDES permit program.

The majority of NPDES permits have existed since 1974. This means that most of the permit writing is for permit renewals. Approximately 10% of each year's workload is attributed to new permits, modifications and requests for estimated limits. NPDES permits are designed to be re-issued every five years but are administratively extended in full force and effect indefinitely if the permittee applied for a renewal before the current permit expires.

Confined Feeding Operations (CFOs) are also considered a point source requiring an NPDES permit. Indiana law defines a confined feeding operation as any animal feeding operation engaged in the confined feeding of at least 300 cattle, or 600 swine or sheep, or 30,000 fowl. IDEM regulates these confined feeding operations. The animals raised in confined feeding operations produce manure and wastewater which is collected and stored in pits, tanks, lagoons and other storage devices. The manure is then applied to area fields as fertilizer. When stored and applied properly, this beneficial reuse provides a natural source of nutrients for crop production. It also lessens the need for fuel and other resources that are used in the production of commercial fertilizer. Confined feeding operations, however, can also pose environmental concerns, including manure leakage or spillage from storage pits, lagoons or tanks; and improper application of manure to the land. These environmental concerns are manifest as excessive nutrients, especially nitrogen and phosphorus, and bacterial contamination (*E.coli*).

CFOs within the watershed were categorized based on their permitted status – active, expired or voided. An active CFO indicates that the farm has a current approval, the manure management plan is up to date and the farm can operate. An expired CFO indicates that the farm did not start construction within two years of their approval date, so their approval expired. A voided CFO indicates that the farm has closed or gone beneath the numbers required to be in the CFO program. The CFO information obtained from IDEM included permits that date back to 2002 and are as recent as 2008.

Marion County Health Department Water Quality Data

In January of 1997, Marion County Health Department (MCHD) started an ambient sampling project for Fall Creek. This project consisted of nine sites sampled five times per month, with geometric means calculated for each site's *E.coli* data. The purpose of the project was to find non-combined sewer overflow (CSO) influences of *E.coli* to Fall Creek. In 1999, the sampling points were adjusted to coincide with the City's CSO projects to help determine their overall impact to water quality, as well as to maintain data for historical comparison and continue working on non-CSO influences. Presently, six sites on Fall Creek are sampled five times per month, with geometric means calculated for each site's *E.coli* data. Analysis includes – *E.coli*, Temperature, pH, Conductivity, Total Dissolved Solids, and Dissolved Oxygen.

MCHD also samples several sites throughout the county through an herbicide monitoring program and a macroinvertebrate collection program.

The MCHD sites are located downstream of the Geist Reservoir/Upper Fall Creek Watershed and therefore were not used in this analysis. This data may be useful during implementation to determine the downstream impact of BMPs in the upper reaches of the watershed.

Hamilton County Health Department Recreational Water Sampling

The objective of the Hamilton County Recreational Water Sampling Program is to monitor and evaluate *E.coli* levels in Hamilton County's recreational waterways. The Hamilton County Health Department mapped approximately nineteen locations where the public is most likely to come into contact with surface water. The sampling locations were selected by the Health Department Administrator and Vector Biologist. Sites were selected based on the probability of full body contact and the ability to collect and deliver samples to the Indiana State Department of Health Laboratory in Indianapolis. Water samples are collected during the recreational season, from April through October. Sampling over this period provides valuable information concerning fluctuations of *E.coli* levels in Hamilton County's recreational waterways. Since it naturally occurs in the digestive tract of humans and other warm blooded animals, the presence of *E.coli* in water indicates contamination from raw sewage. Exposure to elevated levels of *E.coli* can cause illness and infections. According to the Indiana Department of Environmental Management, samples exceeding 235 colonies per 100 milliliters are in violation of the state code requirements for recreational waterways.

There are three sampling locations within the Upper Fall Creek/Geist Reservoir Watershed. Samples have been taken at these locations since May 20, 2004 totaling 108 samples. Twenty-three times the samples exceeded the maximum level of *E.coli* and were considered unsatisfactory.

Indiana Clean Lakes Program

The Indiana Clean Lakes Program was created in 1989 as a program within IDEM's Office of Water Management. The program is administered through a grant to Indiana University's School of Public and Environmental Affairs. The program is a comprehensive, statewide public lake management program focusing on public information and education, technical assistance, volunteer lake monitoring, lake water quality assessment and coordination with other state and federal lake programs.

Sampling information for Geist Reservoir is available through the Indiana Clean Lakes Program for the years 1991, 1996 and 2002. The sampling location had a maximum depth of 6.7m and secchi depths were measured at 0.4m, 0.8m, and 0.3m in 1991, 1996, and 2002 respectively.

IDEM *Cylindrospermopsis raciborskii* Report

The Distribution and Abundance of Cylindrospermopsis raciborskii in Indiana Lakes and Reservoirs report was prepared by the Indiana University School of Public and Environmental Affairs program and was administered by the Indiana Department of Environmental Management Office of Water Quality through the Clean Water Act Section 205(j) funds.

Samples were collected from Geist Reservoir during routine lake assessments through the Indiana Clean Lakes Program in August of 2002. The sample measured 1,861 cells/ml of *C. raciborskii* which is well below the relatively mild and/or low probability of adverse health effects category. As mentioned in the report, the extent of this study was limited and should not be considered an all inclusive report on *C. raciborskii* in the Geist Reservoir. This information does however express that the overall health of the reservoir and that it is conducive to producing this potentially toxic alga.

IDEM Mid-water Planktonic Invertebrate Report
The purpose of this study was driven by the Eagle Creek fish kill in 2000 and was completed to determine the relative abundance of the populations of light responsive zooplankton within Eagle Creek, Morse and Geist Reservoirs.

Three samples were taken within the Geist Reservoir, one sample at the upper end of the reservoir (shallow end sample), one in the middle and one at the downstream end of the reservoir (mid and deep end samples). Out of the three reservoirs, Geist had the second highest number of collected zooplankton (6,945). The abundance of zooplankton, if detailed sample analysis was completed at a lower taxonomic level, would provide a better indication of reservoir health in that they are a food base for vertebrate and invertebrate predators.

US Filter/Indianapolis Water (Veolia Water)
Bi-weekly sampling near Geist Reservoir has been conducted since October of 2002. Two sampling sites are located at Florida Road and Thorpe Creek and at County Line and Bee Camp within the Thorpe Creek Subwatershed. Samples are collected biweekly for cations, anions, total phosphorus, alkalinity, turbidity and pH. This data was not included in the WMP analysis; however it may be useful during implementation to determine the downstream impact of Best Management Practices in the upper reaches of the watershed.

Subwatershed Summary
The following sections break down the water quality information obtained for the WMP by subwatershed. Sample locations from the previously mentioned available data and studies are provided on a detailed exhibit for each subwatershed. Sample locations from these studies may occur at the same site with the symbols overlapping (symbols were chosen in order to determine whether the icons were overlapping). For clarification on individual study sites, the overall watershed maps should be consulted (Exhibits 12-15). A comparison of the subwatersheds is provided at the end of this section as a way to understand the differences in water quality parameters from one subwatershed to another.

In general, the overall characteristics and land use types of a watershed greatly influences the water quality since runoff from rainfall flows over or through the land and collects pollutants and nutrients prior to entering waterways. The IDEM data included 93 stations within the watershed that analyzed *E.coli*, Nitrate+Nitrite, Total Phosphorus, Total Suspended Solids and Turbidity. The CIWRP Study included 10 sampling locations within the Geist Reservoir/Upper Fall Creek Watershed and analyzed *E.coli*, Nitrate+Nitrite, Total Phosphorus, Total Suspended Solids and Turbidity. Based on the CIWRP sampling locations, not all subwatersheds could be defined by a sample location. In order to use the CIWRP data for subwatershed comparisons, some subwatersheds were grouped together and represented by a single CIWRP sampling site. CIWRP water quality samples were collected within the watershed during seasonal base and event flow. In comparison to the CIWRP data, the IDEM data was all inclusive without a differentiation between base flow or storm flow events. Therefore, an overall average approach of this data was used in order to get a better depiction of how the watershed actually functions at any given time. Depending on the pollutant, both types of samples can result in elevated values. For example, the *E.coli* values shown in the subwatershed tables are extremely elevated when compared to the IDEM data. This is a major concern in the watershed and is reflected so in the problems and goals described later in the WMP.

Nonpoint source pollution modeling is a quantitative way to evaluate the effects of land use on water quality for comparison purposes. A nonpoint source pollution model was created for the WMP. The results are provided in an overall summary in Part Three of the Watershed Inventory. It should be noted that all computation models have assumptions and limitations. Therefore, the provided analytical results may not represent the exact pollution loads. In these conditions, even if the results are relative, they still can provide useful information for targeting and prioritizing subwatersheds for Best Management Practices (BMPs). Part Three of the Watershed Inventory explores the relationships of nonpoint source modeling among all 10 of the subwatersheds.

NPDES permits and locations of Confined Feeding Operations can also be indicative of the land use and the subsequent water quality of a subwatershed. Records for NPDES facilities and Confined Feeding Operations within the watershed were obtained from IDEM and are analyzed on a subwatershed scale. The CFO compliance information obtained from IDEM did not include the type of operation for all of the CFOs within the watershed. Therefore, this information was not provided in the plan, however all obtained data is included on the Appendices CD. The permit status of the CFO is provided in each subwatershed section where appropriate in the Subwatershed Summary.

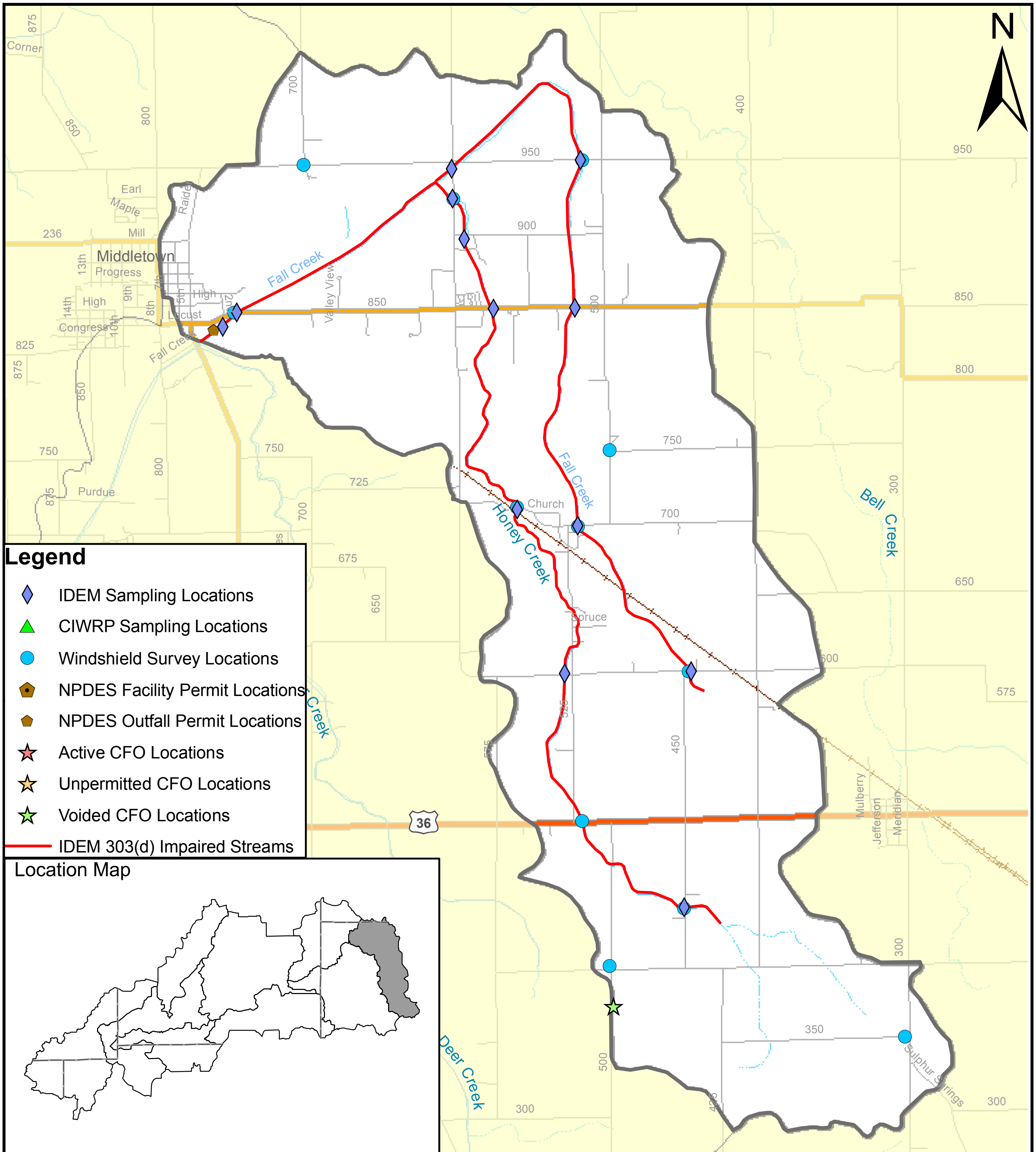
Honey Creek Subwatershed

The Honey Creek Subwatershed (HUC 12 – 051202010801) is located primarily in Henry County with a small portion in Delaware County as shown in Exhibit 16. The subwatershed encompasses approximately 10,853 acres and includes the Honey Creek tributary and the headwaters of Fall Creek.

Water Quality Information

According to the IDEM 305(b) list, the streams within the Honey Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. Recreational uses within the subwatershed fall within category 5A, signifying that the available data indicates that at least one designated use is not supported impaired or is threatened, and a TMDL is needed. The fishable uses fall within category 3, signifying that there is insufficient available data to make a use support determination, and the aquatic life uses fall within category 2 signifying that available data indicates that some but not all of the designated uses are supported. The 303(d) list indicates that approximately 14.2 miles of streams within the subwatershed are impaired for *E.coli*, which includes Honey Creek and Fall Creek.

A total of 13 IDEM sampling stations are located within the Honey Creek Subwatershed. Twelve of these stations have water quality sampling information. Available data at these



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TITLE:	**Honey Creek Subwatershed Map (HUC-12: 051202010801)**
BASE LAYER:	StreetMap USA
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206
PROJECT:	**Geist Reservoir/Upper Fall Creek Watershed Management Plan**
PROJECT NO.	09006
EXHIBIT:	16
SHEET:	1 OF: 1
QUADRANGLE:	N/A
DATE:	09/30/10
SCALE:	1" = 5000'

stations included sampling from the 2001 *E.coli* – West Fork White River Study (WFWR), 2008 Fall Creek Impaired Biotic Communities (IBC) Study and 2008-2009 Upper Fall Creek Water Quality Monitoring Program.

No CIWRP sampling sites were located within the Honey Creek Subwatershed; therefore it was grouped with the sample associated with the Deer Creek and Sly Fork Subwatersheds.

Table 9 below summarizes the IDEM and CIWRP sampling mean value of each parameter for all of the data screened and the corresponding water quality target.

Table 9: Honey Creek IDEM and CIWRP Water Quality Sampling Summary			
Water Quality Parameter	**IDEM Mean Value**	**CIWRP Mean Value**	**Water Quality Target**
Dissolved Oxygen	8.5 mg/L	11.6 mg/L	between 4.0 and 12.0 mg/L
E.coli	1646 CFU/100mL	42940 CFU/100mL	235 CFU/100mL
Nitrate + Nitrite	3.4 mg/L	2.6 mg/L	1.6 mg/L
pH	7.9	7.8	between 6.0 and 9.0
Total Phosphorus	0.098 mg/L	0.173 mg/L	0.076 mg/L
TSS	13.6 mg/L	74.1 mg/L	30.0 mg/L
Turbidity	36.8 NTU	68.9 NTU	10.4 NTU
Atrazine	Not Sampled	Not Sampled	0.003 mg/L

Based on the available water quality information, the Honey Creek Subwatershed consistently tests higher than the water quality targets for *E. coli*, Nitrate + Nitrite, Total Phosphorus, TSS and Turbidity. Dissolved Oxygen and pH fall within the acceptable ranges in both data sets and therefore are not a concern for this subwatershed.

Habitat/Biological Information

IDEM has completed several habitat and biological studies within the Geist Reservoir/Upper Fall Creek Watershed. Within the Honey Creek Subwatershed, 12 of the IDEM sites had habitat/biological information available. Sampling data was available from the 1992 Macroinvertebrate Study, 1996 Macroinvertebrate Study, and the 2008 Fall Creek IBC Study. Table 10 summarizes the IDEM mean value for the Macroinvertebrate Index of Biotic Integrity (mIBI), the Index of Biotic Integrity (IBI) and the QHEI habitat assessment for the available data.

Table 10: Honey Creek IDEM Habitat/Biological Sampling Summary	
Habitat/Biological Parameter	**IDEM Mean Value**
mIBI	5.5
IBI	41.8
QHEI	59.8

With a mIBI score of 5.5, the Honey Creek Subwatershed is slightly impaired for macroinvertebrate communities and an IBI score of 41.8 indicates that the fish community is fair. A QHEI score of 59.8 correlates to a good habitat scoring which would indicate that the slight impairment seen in the macroinvertebrate community is not likely caused by the lack/quality of habitat. As stated in the Water Quality Information section, E. coli, Nitrogen and Phosphorus consistently exceed the water quality targets indicating the slight impairment seen in the macroinvertebrate community may be influenced by the impaired water chemistry within the subwatershed.

Landuse Information

Landuse within the Honey Creek Subwatershed consists primarily of agricultural uses with a small area in the northwest portion of the subwatershed of low intensity developed area associated with Middletown.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey which included 8 stream crossing sites and 4 land/field sites within the Honey Creek Subwatershed. Observations including streambank erosion, stream buffers, and conventional tillage practices were recorded for each site and the results are summarized in Table 11 below.

Table 11: Honey Creek Windshield Survey Summary

Parameter	Observations
Streambank Erosion	2/8 sites with erosion >3' 1/8 site with erosion <3'
Stream Buffers	2/8 sites with no buffers 6/8 sites with buffers <50'
In-stream Debris	0/8 sites with debris
Animal Access to Streams	0/8 sites with animal access
Conventional Till	10/12 sites under conventional till

The Honey Creek Subwatershed contains one voided confined feeding operation located south of the intersection of 400 N and 500W in Henry County.

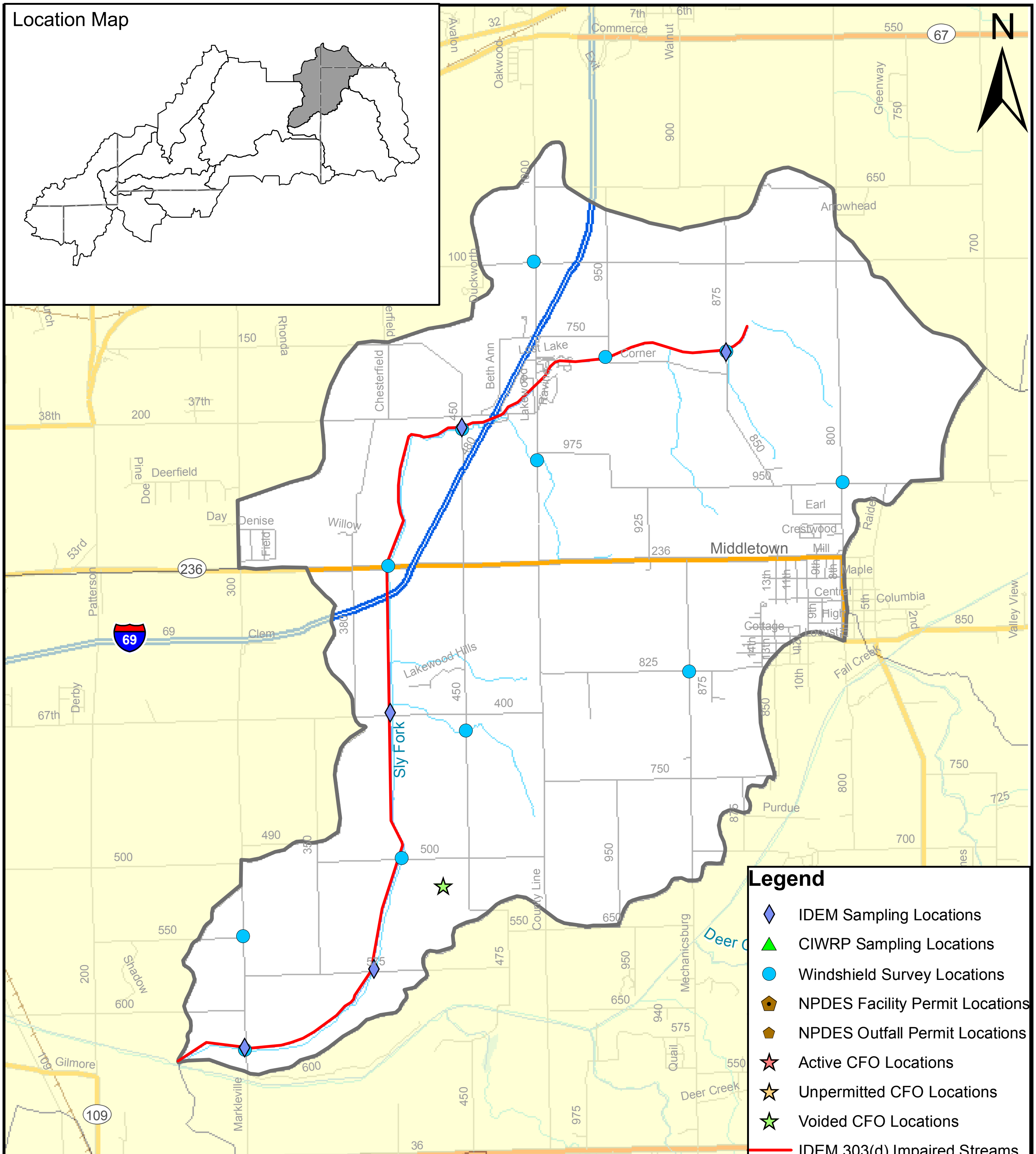
There is one NPDES permit is active within the Honey Creek Subwatershed, the Middletown Wastewater Treatment Plant (WWTP) permit number IN0020770. The WWTP is located at 215 S, 8th Street in Middletown; however one of the WWTP outfalls is located within the Honey Creek Subwatershed. According to compliance records, there has been no formal enforcement actions within the last 5 years, however there have been 22 noted effluent exceedances within the last 3 years. These exceedances were reported in both total residue chlorine and total suspended solids.

Sly Fork Subwatershed

The Sly Fork Subwatershed (HUC 12 – 051202010802) encompasses portions of Delaware, Henry County, and Madison County as shown in Exhibit 17. The subwatershed encompasses approximately 11,349 acres and includes the Sly Fork tributary.

Water Quality Information

According to the IDEM 305(b) list, the streams within the Sly Fork Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. Recreational uses within the subwatershed fall within category 5A, signifying that the available data indicates that at



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TITLE: **Sly Fork Subwatershed Map (HUC-12: 051202010802)**	PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**		
BASE LAYER: StreetMap USA	PROJECT NO. 09006	EXHIBIT: 17	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 5000'

least one designated use is not supported impaired or is threatened, and a TMDL is needed. The fishable uses fall within category 3, signifying that there is insufficient available data to make a use support determination, and the aquatic life uses fall within category 2 signifying that available data indicates that some but not all of the designated uses are supported. The 303(d) list indicates that approximately 7.9 miles of Sly Fork within the subwatershed are impaired for *E.coli*.

A total of 5 IDEM sampling stations are located within the Sly Fork Subwatershed. All 5 of these stations have water quality sampling information. Available data at these stations included sampling from the 2008 Fall Creek IBC Study and 2008-2009 Upper Fall Creek Water Quality Monitoring Program.

No CIWRP sampling sites were located within the Sly Fork Subwatershed; therefore it was grouped with the sample associated with the Deer Creek and Honey Creek Subwatersheds.

Table 12 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

Table 12: Sly Fork IDEM and CIWRP Water Quality Sampling Summary			
Water Quality Parameter	**IDEM Mean Value**	**CIWRP Mean Value**	**Water Quality Target**
Dissolved Oxygen	8.9 mg/L	11.6 mg/L	between 4.0 and 12.0 mg/L
E.coli	5855 CFU/100mL	42940 CFU/100mL	235 CFU/100mL
Nitrate + Nitrite	2.1 mg/L	2.6 mg/L	1.6 mg/L
pH	7.9	7.8	between 6.0 and 9.0
Total Phosphorus	0.065 mg/L	0.173 mg/L	0.076 mg/L
TSS	13.7 mg/L	74.1 mg/L	30.0 mg/L
Turbidity	26.4 NTU	68.9 NTU	10.4 NTU
Atrazine	0.004 mg/L	Not Sampled	0.003 mg/L

Based on the available water quality information, the Sly Fork Subwatershed consistently tests higher than the water quality targets for *E. coli*, Nitrate + Nitrite and Turbidity. Total Phosphorus and TSS both tested higher than the water quality targets in the CIWRP Study; however both parameters were lower than the targets based on the IDEM data. Atrazine was not sampled during the CIWRP study but it was detected at higher levels than the target in the IDEM data. Dissolved Oxygen and pH fall within the acceptable ranges in both data sets and therefore are not a concern for this subwatershed.

Habitat/Biological Information

IDEM has completed several habitat and biological studies within the Geist Reservoir/Upper Fall Creek Watershed. Within the Sly Fork Subwatershed, all 5 IDEM sampling sites had habitat/biological information available. Sampling data was available from the 2008 Fall Creek IBC Study. Table 13 summarizes the IDEM mean value for the Index of Biotic Integrity (IBI) and the QHEI habitat assessment for the available data.

Table 13: Sly Fork IDEM Habitat/Biological Sampling Summary	
Habitat/Biological Parameter	**IDEM Mean Value**
mIBI	Not sampled
IBI	35.6
QHEI	44.8

The Sly Fork Subwatershed was not sampled for macroinvertebrate communities. An IBI score of 35.6 indicates that the fish community is poor. A QHEI score of 44.8 correlates to a fair habitat scoring which would indicate that the poor fish community is not caused solely by the lack/quality of habitat. As stated in the Water Quality Information section, E. coli and Nitrogen consistently exceed the water quality targets indicating the poor fish community may be influenced by the impaired water chemistry within the subwatershed.

Landuse Information

Landuse within the Sly Fork Subwatershed consists primarily of agricultural uses. Several areas of deciduous forest are located in the lower and western portions of the subwatershed. Low and medium intensity development is concentrated in the northeastern portion of the subwatershed and is associated with Middletown. Low intensity development is also concentrated along Interstate 69, which runs through the northwest portion of the subwatershed.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 8 stream crossing sites and 4 land/field sites within the Sly Fork Subwatershed. Observations including depth of streambank erosion, stream buffers, debris and conventional tillage practices were recorded for each site and the results are summarized in Table 14 below.

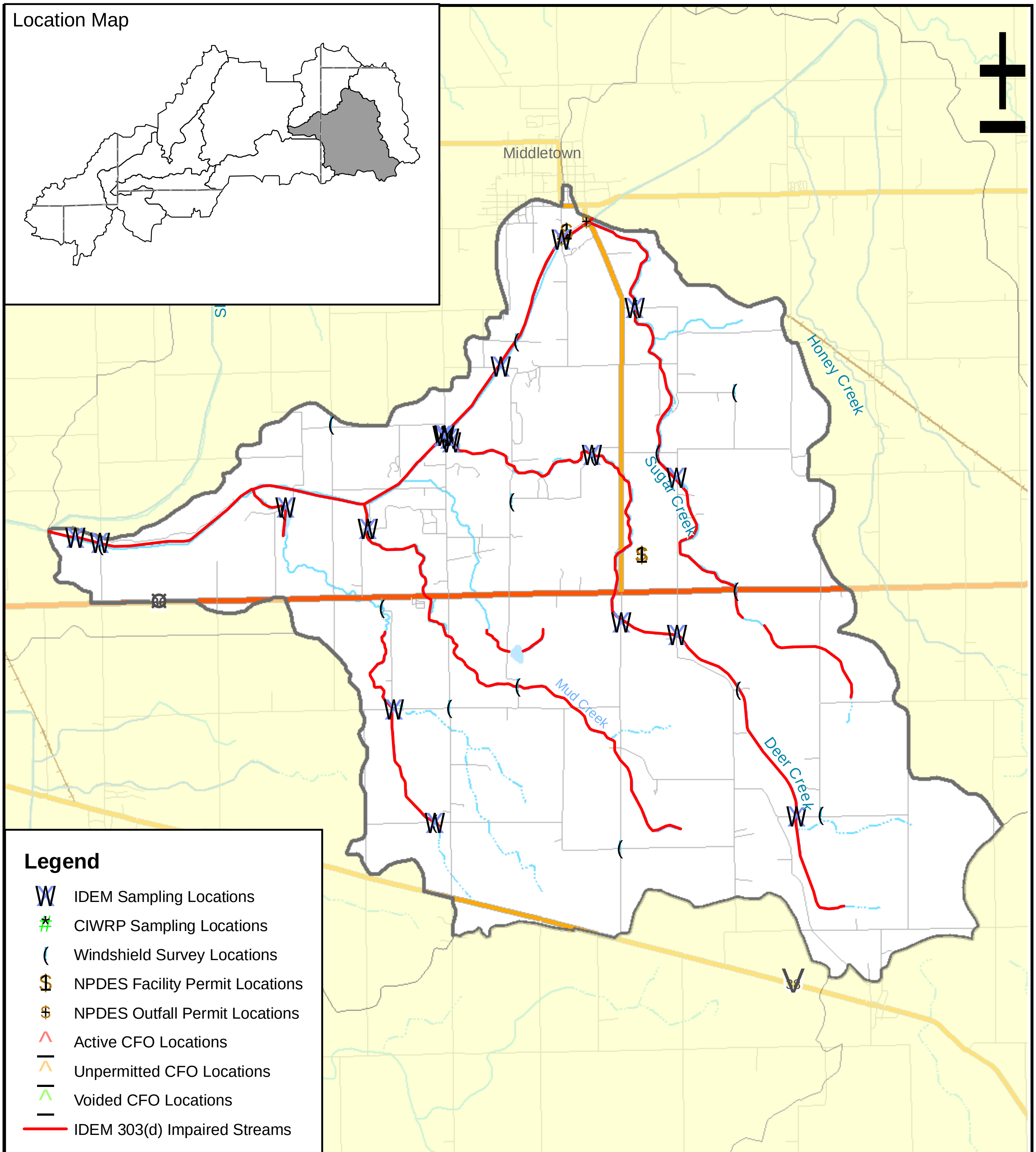
Table 14: Sly Fork Windshield Survey Summary	
Parameter	**Observations**
Streambank Erosion	1/8 site with erosion >3’ 5/8 sites with erosion <3’
Stream Buffers	1/8 site with no buffers 6/8 sites with buffers <50’
In-stream Debris	4/8 sites with debris
Animal Access to Streams	0/8 sites with animal access
Conventional Till	3/12 sites under conventional till

The Sly Fork Subwatershed contains one voided confined feeding operation located south of the intersection of 500 S and 450 E in Madison County.

There are no active NPDES permits within the Sly Fork Subwatershed.

Deer Creek Subwatershed

The Deer Creek Subwatershed (HUC 12 – 051202010803) is located primarily in Henry County with a small portion in Madison County as shown in Exhibit 18. The subwatershed



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TITLE: **Deer Creek Subwatershed Map (HUC-12: 051202010803)**	PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**		
BASE LAYER: StreetMap USA	PROJECT NO. 09006	EXHIBIT: 18	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance, P.O. Box 2065, Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 6500'

encompasses approximately 18,066 acres and includes the Deer Creek, Mud Creek, and several smaller tributaries.

Water Quality Information

According to the IDEM 305(b) list, the streams within the Deer Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. Recreational uses within the subwatershed fall within category 5A, signifying that the available data indicates that at least one designated use is not supported impaired or is threatened, and a TMDL is needed. The fishable uses fall within category 2, signifying that available data indicates that some but not all of the designated uses are supported, and the aquatic life uses fall within both categories 2 and 5A. The 303(d) list indicates that approximately 27.2 miles of streams within the subwatershed are impaired for *E.coli*, which includes Sugar Creek, Deer Creek, Mud Creek and some of the smaller tributaries.

A total of 19 IDEM sampling stations are located within the Deer Creek Subwatershed. Eighteen of these stations have water quality sampling information. Available data at these stations included sampling from the 1996 Synoptic Study, 2001 Corvallis Study, 2008 Fall Creek IBC Study and 2008-2009 Upper Fall Creek Water Quality Monitoring Program.

No CIWRP sampling sites were located within the Deer Creek Subwatershed; therefore it was grouped with the sample associated with the Sly Fork and Honey Creek Subwatersheds.

Table 15 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

Table 15: Deer Creek IDEM and CIWRP Water Quality Sampling Summary

Water Quality Parameter	IDEM Mean Value	CIWRP Mean Value	Water Quality Target
Dissolved Oxygen	8.9 mg/L	11.6 mg/L	between 4.0 and 12.0 mg/L
E.coli	3326 CFU/100mL	42940 CFU/100mL	235 CFU/100mL
Nitrate + Nitrite	2.5 mg/L	2.6 mg/L	1.6 mg/L
pH	7.8	7.8	between 6.0 and 9.0
Total Phosphorus	0.214 mg/L	0.173 mg/L	0.076 mg/L
TSS	31.9 mg/L	74.1 mg/L	30.0 mg/L
Turbidity	24.9 NTU	68.9 NTU	10.4 NTU
Atrazine	0.0019 mg/L	Not Sampled	0.003 mg/L

Based on the available water quality information, the Deer Creek Subwatershed consistently tests higher than the water quality targets for *E. coli*, Nitrate + Nitrite, Total Phosphorus, TSS and Turbidity. Atrazine was not sampled during the CIWRP study and it was detected at lower levels than the target in the IDEM data. Dissolved Oxygen and pH fall within the acceptable ranges in both data sets and therefore are not a concern for this subwatershed.

Habitat/Biological Information

IDEM has completed several habitat and biological studies within the Geist Reservoir/Upper Fall Creek Watershed. Within the Deer Creek Subwatershed, 17 of the IDEM sampling sites had habitat/biological information available. Sampling data was available from the 1992 Macroinvertebrate Study, 1996 Macroinvertebrate Study, 2001 Macroinvertebrate Study and the 2008 Fall Creek IBC Study. Table 16 summarizes the IDEM mean value for the Macroinvertebrate Index of Biotic Integrity (mIBI), the Index of Biotic Integrity (IBI) and the QHEI habitat assessment for the available data.

Table 16: Deer Creek IDEM Habitat/Biological Sampling Summary	
Habitat/Biological Parameter	**IDEM Mean Value**
mIBI	4.4
IBI	42.9
QHEI	64.9

With a mIBI score of 4.4, the Deer Creek Subwatershed is slightly impaired for macroinvertebrate communities and an IBI score of 42.9 indicates that the fish community is fair. A QHEI score of 64.9 correlates to a good habitat scoring which would indicate that the slight impairment seen in the macroinvertebrate community is not likely caused by the lack/quality of habitat. As stated in the Water Quality Information section, E. coli, TSS, Nitrogen and Phosphorus all exceed the water quality targets indicating the slight impairment seen in the macroinvertebrate community may be influenced by the impaired water chemistry within the subwatershed.

Landuse Information

Landuse within the Deer Creek Subwatershed consists primarily of agricultural uses. Several areas of deciduous forest are located in the western portion of the subwatershed along Fall Creek. Low and medium intensity development is concentrated along US Route 36 which runs east-west through the subwatershed and along Raider Road which runs north-south through the subwatershed. These areas are associated with small residential/businesses as well as a school

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 13 stream crossing sites and 6 land/field sites within the Deer Creek Subwatershed. Observations including streambank erosion, stream buffers, debris, animal access to streams and conventional tillage practices were recorded for each site and the results are summarized in Table 17 below.

Table 17: Deer Creek Windshield Survey Summary	
Parameter	**Observations**
Streambank Erosion	1/13 site with erosion >3’ 6/13 sites with erosion <3’
Stream Buffers	2/13 sites with no buffers 7/13 sites with buffers <50’
In-stream Debris	3/13 sites with debris
Animal Access to Streams	1/13 site with animal access
Conventional Till	4/19 sites under conventional till

The Deer Creek Subwatershed contains no confined feeding operations.

There are 2 NPDES permits active within the Deer Creek Subwatershed. The Middletown Wastewater Treatment Plant, permit number IN0020770, is located at 215 S, 8th Street in Middletown. The treatment plant along with 3 outfalls is located within the Deer Creek Subwatershed. According to compliance records, there has been no formal enforcement actions within the last 5 years at the treatment plant, however there have been 22 noted effluent exceedances within the last 3 years. These exceedances were reported for both total residue chlorine and total suspended solids. The Shenandoah Middle and High School, permit number IN0031712, is located at 5100 N Raider Road in Middletown. According to compliance records for the school, there has been no formal enforcement actions within the last 5 years, however there have been 20 noted effluent exceedances within the last 3 years. These exceedances were reported for *E.coli*, Nitrogen and total suspended solids.

Prairie Creek Subwatershed

The Prairie Creek Subwatershed (HUC 12 – 051202010804) is within Madison County as shown in Exhibit 19. The subwatershed encompasses approximately 25,410 acres and includes the Prairie Creek tributary.

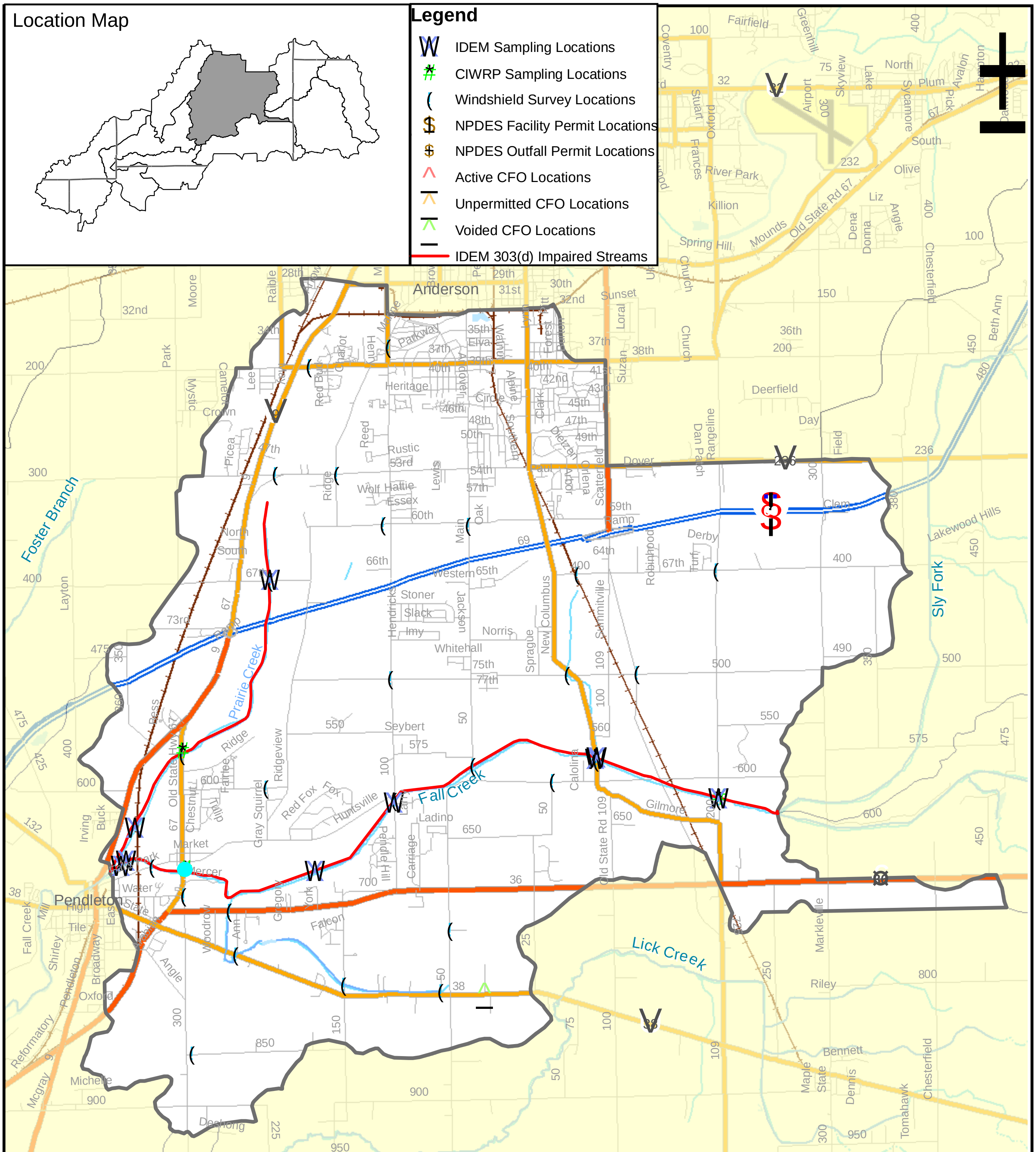
Water Quality Information

According to the IDEM 305(b) list, the streams within the Prairie Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. Recreational uses within the subwatershed fall within category 5A, signifying that the available data indicates that at least one designated use is not supported impaired or is threatened, and a TMDL is needed and category 2, signifying that available data indicates that some but not all of the designated uses are supported. The fishable uses fall within category 3, signifying that there is insufficient available data to make a use support determination, and the aquatic life uses fall within both categories 2 and 5A. The 303(d) list indicates that approximately 11.2 miles of streams within the subwatershed are impaired for *E.coli*, which includes Fall Creek and Prairie Creek.

A total of 8 IDEM water quality sampling stations are located within the Prairie Creek Subwatershed. Seven of these stations have water quality sampling information. Available data at these stations included sampling from the 1996 Watershed Study, 2001 *E.coli*- UFWR Study, 2008 Fall Creek IBC Study and 2008-2009 Upper Fall Creek Water Quality Monitoring Program.

A total of 4 CIWRP sampling sites are located within the Prairie Creek Subwatershed, however one of the sampling sites is located at the upstream end and therefore would not be representative of the water quality of the subwatershed. Therefore, the other three sites were used to represent the subwatershed.

Table 18 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.



V3 Companies 7325 Janes Avenue Woodridge, IL 60517 630.724.9200 phone 630.724.9202 fax www.v3co.com	TITLE: **Prairie Creek Subwatershed Map (HUC-12: 051202010804)**	PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**		
	BASE LAYER: StreetMap USA	PROJECT NO. 09006	EXHIBIT: 19	SHEET: 1 OF: 1
	CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 7000'

Table 18: Prairie Creek IDEM and CIWRP Water Quality Sampling Summary			
Water Quality Parameter	**IDEM Mean Value**	**CIWRP Mean Value**	**Water Quality Target**
Dissolved Oxygen	9.1 mg/L	11.0 mg/L	between 4.0 and 12.0 mg/L
E.coli	3646 CFU/100mL	47007 CFU/100mL	235 CFU/100mL
Nitrate + Nitrite	1.4 mg/L	1.8 mg/L	1.6 mg/L
pH	8.0	7.8	between 6.0 and 9.0
Total Phosphorus	0.062 mg/L	0.120 mg/L	0.076 mg/L
TSS	19.9 mg/L	48.0 mg/L	30.0 mg/L
Turbidity	32.2 NTU	47.8 NTU	10.4 NTU
Atrazine	0.0019 mg/L	Not Sampled	0.003 mg/L

Based on the available water quality information, the Prairie Creek Subwatershed consistently tests higher than the water quality targets for *E. coli*, Nitrate + Nitrite, Total Phosphorus and TSS all tested higher than the water quality targets in the CIWRP Study; however all parameters were lower than the targets based on the IDEM data. Atrazine was not sampled during the CIWRP study and it was detected at lower levels than the target in the IDEM data. Dissolved Oxygen and pH fall within the acceptable ranges in both data sets and therefore are not a concern for this subwatershed.

Habitat/Biological Information

IDEM has completed several habitat and biological studies within the Geist Reservoir/Upper Fall Creek Watershed. Within the Prairie Creek Subwatershed, there are 7 IDEM sampling sites with habitat/biological information available. Sampling data was available from the 1992 Macroinvertebrate Study and the 2008 Fall Creek IBC Study. Table 19 summarizes the IDEM mean value for the Macroinvertebrate Index of Biotic Integrity (mIBI), the Index of Biotic Integrity (IBI) and the QHEI habitat assessment for the available data.

Table 19: Prairie Creek IDEM Habitat/Biological Sampling Summary	
Habitat/Biological Parameter	**IDEM Mean Value**
mIBI	3.8
IBI	39.0
QHEI	55.3

With a mIBI score of 3.8, the Prairie Creek Subwatershed is moderately impaired for macroinvertebrate communities and an IBI score of 39.0 indicates that the fish community is fair. A QHEI score of 55.3 correlates to a good habitat scoring which would indicate that the moderate impairment seen in the macroinvertebrate community is not likely caused by the lack/quality of habitat. As stated in the Water Quality Information section E. coli is the only water quality parameter (within the IDEM data) that consistently exceeds the water quality target. Therefore, it is difficult to conclude if the moderate impairment to the macroinvertebrate community is due solely to the water chemistry at the site.

Landuse Information

Landuse within the Prairie Creek Subwatershed consists primarily of agricultural uses. Low and medium intensity development is concentrated in the northern portion of the subwatershed associated with Anderson, and in the western portion of the subwatershed associated with Pendleton. Development is also concentrated along several major roadways within the subwatershed including Interstate 69, US Route 36, State Road 9, and State Road 38.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 18 stream crossing sites and 9 land/field sites within the Prairie Creek Subwatershed. Observations including streambank erosion, stream buffers and debris were recorded for each site and the results are summarized in Table 20 below.

Table 20: Prairie Creek Windshield Survey Summary	
Parameter	**Observations**
Streambank Erosion	2/18 sites with erosion >3' 1/18 site with erosion <3'
Stream Buffers	2/18 sites with no buffers 8/18 sites with buffers <50'
In-stream Debris	6/18 sites with debris
Animal Access to Streams	0/18 sites with animal access
Conventional Till	0/27 sites under conventional till

The Prairie Creek Subwatershed contains one voided confined feeding operation located east of the intersection of State Road 38 and 50 W in Madison County.

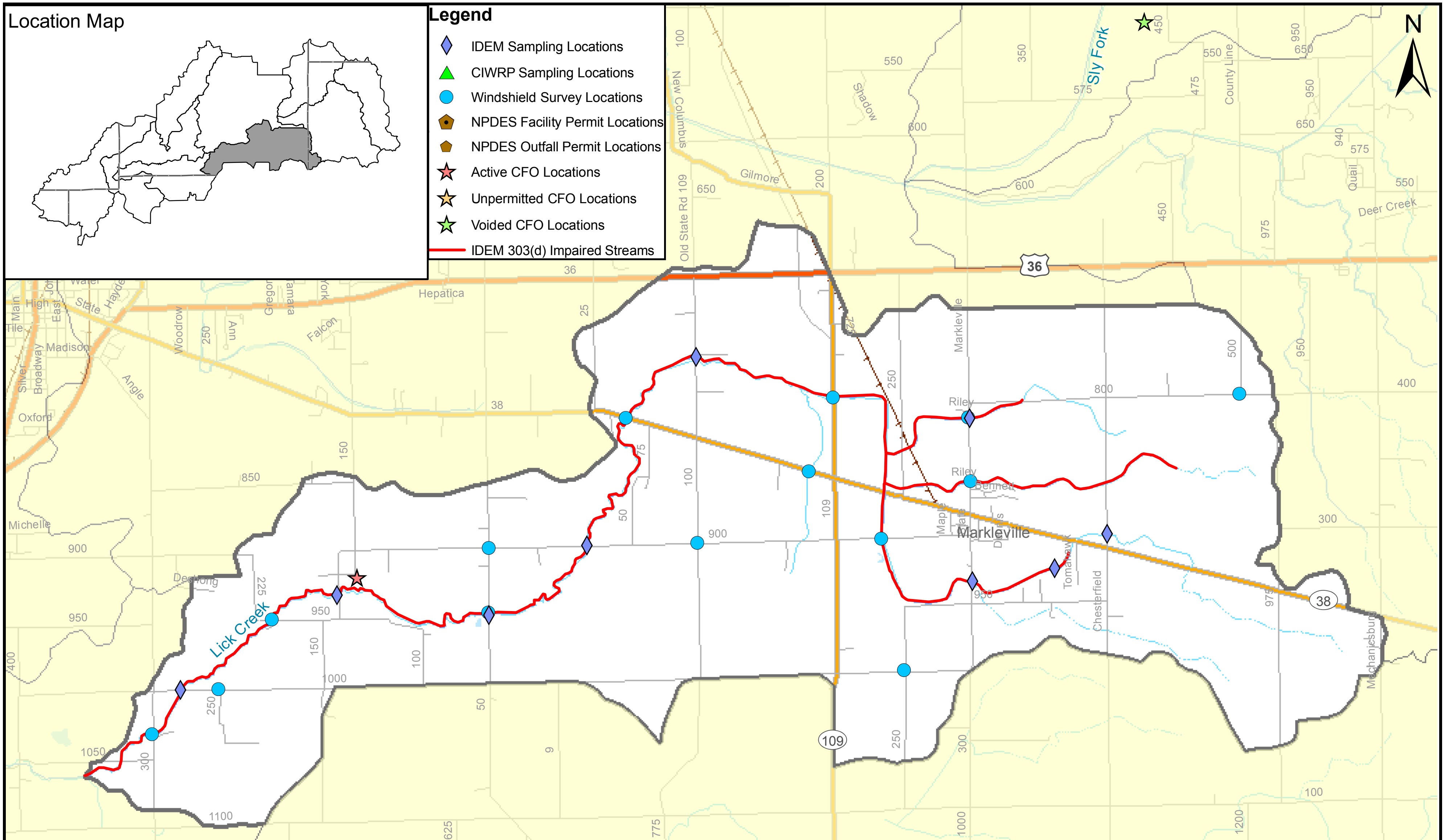
There are no active NPDES permits within the Prairie Creek Subwatershed.

Headwaters Lick Creek Subwatershed

The Headwaters Lick Creek Subwatershed (HUC 12 – 051202010805) is located primarily in Madison County with a small portion in Henry County as shown on Exhibit 20. The subwatershed encompasses approximately 13,761 acres and includes the Lick Creek tributary and several smaller tributaries.

Water Quality Information

According to the IDEM 305(b) list, the streams within the Headwaters Lick Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. Recreational uses within the subwatershed fall within category 5A, signifying that the available data indicates that at least one designated use is not supported impaired or is threatened, and a TMDL is needed. The fishable uses fall within category 3, signifying that there is insufficient available data to make a use support determination, and the aquatic life uses fall within category 2 signifying that available data indicates that some but not all of the designated uses are supported. The 303(d) list indicates that approximately 15.4 miles of streams within the subwatershed are impaired for *E.coli*, which includes all of the streams within this subwatershed.



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TITLE:	**Headwaters Lick Creek Subwatershed Map (HUC-12: 051202010805)**
BASE LAYER:	StreetMap USA
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206

PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**		
PROJECT NO.: 09006	EXHIBIT: 20	SHEET: 1 OF: 1
QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 5500'

A total of nine IDEM sampling stations are located within the Headwaters Lick Creek Subwatershed. All of these stations have water quality sampling information. Available data at these stations included sampling from the 2001 *E.coli*- WFWR Study, 2006 Corvallis and 2006 Corvallis *E.coli* Studies, 2008 Fall Creek IBC Study and 2008-2009 Upper Fall Creek Water Quality Monitoring Program.

No CIWRP sampling sites were located within the Headwaters Lick Creek Subwatershed; therefore it was grouped with the Prairie Creek Subwatershed sampling location.

Table 21 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

Table 21: Headwaters Lick Creek IDEM and CIWRP Water Quality Sampling Summary

Water Quality Parameter	IDEM Mean Value	CIWRP Mean Value	Water Quality Target
Dissolved Oxygen	8.9 mg/L	12.0 mg/L	between 4.0 and 12.0 mg/L
E.coli	3771 CFU/100mL	14383 CFU/100mL	235 CFU/100mL
Nitrate + Nitrite	1.8 mg/L	2.5 mg/L	1.6 mg/L
pH	8.0	7.8	between 6.0 and 9.0
Total Phosphorus	0.069 mg/L	0.132 mg/L	0.076 mg/L
TSS	15.2 mg/L	48.9 mg/L	30.0 mg/L
Turbidity	27.6 NTU	67.3 NTU	10.4 NTU
Atrazine	0.002 mg/L	Not Sampled	0.003 mg/L

Based on the available water quality information, the Headwaters Lick Creek Subwatershed consistently tests higher than the water quality targets for *E. coli*, Nitrate + Nitrite and Turbidity. Total Phosphorus and TSS both tested higher than the water quality targets in the CIWRP Study; however both parameters were lower than the targets based on the IDEM data. Atrazine was not sampled during the CIWRP study and it was detected at lower levels than the target in the IDEM data. Dissolved Oxygen and pH fall within the acceptable ranges in both data sets and therefore are not a concern for this subwatershed.

Habitat/Biological Information

IDEM has completed several habitat and biological studies within the Geist Reservoir/Upper Fall Creek Watershed. Within the Headwaters Lick Creek Subwatershed, 8 of the IDEM sampling sites have habitat/biological information available. Sampling data was available from the 2008 Fall Creek IBC Study. Table 22 summarizes the IDEM mean value for the Index of Biotic Integrity (IBI) and the QHEI habitat assessment for the available data.

Table 22: Headwaters Lick Creek IDEM Habitat/Biological Sampling Summary

Habitat/Biological Parameter	IDEM Mean Value
mIBI	Not Sampled
IBI	41.3
QHEI	60.0

The Headwaters Lick Creek Subwatershed was not sampled for macroinvertebrate communities. An IBI score of 41.3 indicates that the fish community is fair, and a QHEI score of 60.0 correlates to a good habitat scoring. As stated in the Water Quality Information section, E. coli and Nitrogen consistently exceed the water quality targets indicating the fair fish community may be influenced by the impaired water chemistry within the subwatershed.

Landuse Information

Landuse within the Headwaters Lick Creek Subwatershed consists primarily of agricultural uses. Several areas of deciduous forest are located along the corridor of Lick Creek. Low and medium intensity development is concentrated in the eastern portion of the subwatershed associated with Markleville.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 9 stream crossing sites and 5 land/field sites within the Headwaters Lick Creek Subwatershed. Observations including streambank erosion, stream buffers, debris, animal access and conventional tillage practices to streams were recorded for each site and the results are summarized in Table 23 below.

Table 23: Headwaters Lick Creek Windshield Survey Summary	
Parameter	**Observations**
Streambank Erosion	0/9 sites with erosion >3’ 4/9 site with erosion <3’
Stream Buffers	2/9 sites with no buffers 6/9 sites with buffers <50’
In-stream Debris	2/9 sites with debris
Animal Access to Streams	1/9 site with animal access
Conventional Till	5/14 sites under conventional till

The Headwaters Lick Creek Subwatershed contains one active confined feeding operation located south of the intersection of 900 S and 150 W in Madison County. There was one violation reported for the CFO within the subwatershed based on the inspection reports obtained from IDEM. The violation was from 2008 and was for lack of record keeping.

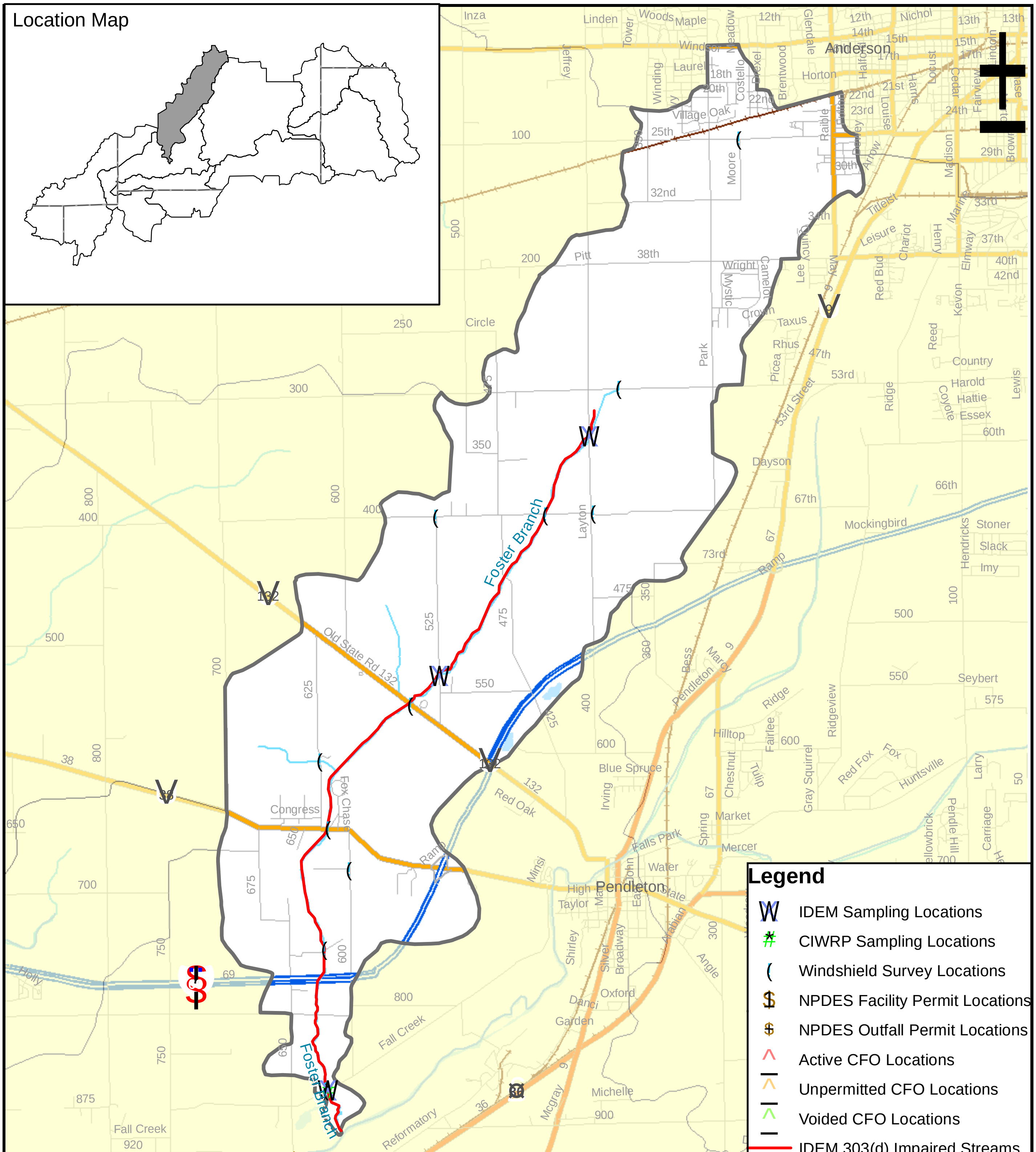
There are no other active NPDES permits within the Headwaters Lick Creek Subwatershed.

Foster Branch Subwatershed

The Foster Branch Subwatershed (HUC 12 – 051202010806) is located within Madison County as shown in Exhibit 21. The subwatershed encompasses approximately 10,114 acres and includes the Foster Branch tributary.

Water Quality Information

According to the IDEM 305(b) list, the streams within the Foster Branch Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. Recreational uses within the subwatershed fall within category 5A, signifying that the available data indicates that at least one designated use is not supported impaired or is threatened, and a TMDL is needed. The fishable uses fall within category 3, signifying that there is insufficient available data to



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TITLE:	**Foster Branch Subwatershed Map (HUC-12: 051202010806)**
PROJECT:	**Geist Reservoir/Upper Fall Creek Watershed Management Plan**
BASE LAYER:	StreetMap USA
PROJECT NO.	09006
EXHIBIT:	21
SHEET:	1 OF: 1
CLIENT:	Upper White River Watershed Alliance, P.O. Box 2065, Indianapolis, Indiana 46206
QUADRANGLE:	N/A
DATE:	09/30/10
SCALE:	1" = 6000'

make a use support determination, and the aquatic life uses fall within category 2 signifying that available data indicates that some but not all of the designated uses are supported. The 303(d) list indicates that approximately 7.1 miles of the Foster Branch Tributary within the subwatershed are impaired for *E.coli*.

A total of 3 IDEM sampling stations are located within the Foster Branch Subwatershed. All of these stations have water quality sampling information. Available data at these stations included sampling from the 2008 Fall Creek IBC Study and 2008-2009 Upper Fall Creek Water Quality Monitoring Program.

Only one CIWRP sampling site is located within the Foster Branch Subwatershed.

Table 24 below summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

Table 24: Foster Branch IDEM and CIWRP Water Quality Sampling Summary			
Water Quality Parameter	**IDEM Mean Value**	**CIWRP Mean Value**	**Water Quality Target**
Dissolved Oxygen	9.2 mg/L	11.9 mg/L	between 4.0 and 12.0 mg/L
E.coli	5669 CFU/100mL	15321 CFU/100mL	235 CFU/100mL
Nitrate + Nitrite	2.4 mg/L	3.2 mg/L	1.6 mg/L
pH	8.0	7.7	between 6.0 and 9.0
Total Phosphorus	0.064 mg/L	0.146 mg/L	0.076 mg/L
TSS	5.7 mg/L	16.9 mg/L	30.0 mg/L
Turbidity	15.9 NTU	43.5 NTU	10.4 NTU
Atrazine	0.0026 mg/L	Not Sampled	0.003 mg/L

Based on the available water quality information, the Foster Branch Subwatershed consistently tests higher than the water quality targets in *E. coli*, Nitrate + Nitrite and Turbidity. Total Phosphorus tested higher than the water quality targets in the CIWRP Study; however it was lower than the standards based on the IDEM data. Atrazine was not sampled during the CIWRP study and it was detected at lower levels than the target in the IDEM data. Dissolved Oxygen, pH and TSS fall within the acceptable ranges in both data sets and therefore are not a concern for this subwatershed.

Habitat/Biological Information

IDEM has completed several habitat and biological studies within the Geist Reservoir/Upper Fall Creek Watershed. Within the Foster Branch Subwatershed, all 3 IDEM sampling sites have habitat/biological information available. Sampling data was available from the 2008 Fall Creek IBC Study. Table 25 summarizes the IDEM mean value for the Index of Biotic Integrity (IBI) and the QHEI habitat assessment for the available data.

Table 25: Foster Branch IDEM Habitat/Biological Sampling Summary	
Habitat/Biological Parameter	**IDEM Mean Value**
mIBI	Not sampled
IBI	35.3
QHEI	37.3

The Foster Branch Subwatershed was not sampled for macroinvertebrate communities. An IBI score of 35.3 indicates that the fish community is poor, and a QHEI score of 37.3 correlates to a poor habitat scoring which would indicate that the poor fish community is likely caused by lack/quality of habitat. As stated in the Water Quality Information section, E. coli and Nitrogen consistently exceed the water quality targets indicating the poor fish community may also be influenced by the impaired water chemistry within the subwatershed.

Landuse Information

Landuse within the Foster Branch Subwatershed consists primarily of agricultural uses. Several areas of deciduous forest are located along the corridor of Lick Creek. Low and medium intensity development is concentrated in the northern portion of the subwatershed associated with Anderson, and in the southeastern portion of the subwatershed associated with Pendleton.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 7 stream crossing sites and 4 land/field sites within the Foster Branch Subwatershed. Observations including streambank erosion, stream buffers, debris and animal access to streams were recorded for each site and the results are summarized in Table 26 below.

Table 26: Foster Branch Windshield Survey Summary	
Parameter	**Observations**
Streambank Erosion	1/7 site with erosion >3' 0/7 sites with erosion <3'
Stream Buffers	0/7 sites with no buffers 3/7 sites with buffers <50'
In-stream Debris	1/7 site with debris
Animal Access to Streams	1/7 site with animal access
Conventional Till	0/11 sites under conventional till

The Foster Branch Subwatershed contains no confined feeding operations.

There are no active NPDES permits within the Foster Branch Subwatershed.

McFadden Ditch Subwatershed

The McFadden Ditch Subwatershed (HUC 12 – 051202010807) is located primarily in Madison and Hancock Counties with a small portion in Hamilton County as shown in Exhibit 22. The subwatershed encompasses approximately 10,673 acres and includes the McFadden Ditch tributary.

Water Quality Information

According to the IDEM 305(b) list, the streams within the McFadden Ditch Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. . Recreational uses within the subwatershed fall within category 5A, signifying that the available data indicates that at least one designated use is not supported impaired or is threatened, and a TMDL is needed. The fishable uses fall within category 3, signifying that there is insufficient available data to make a use support determination, and the aquatic life uses fall within category 2 signifying that available data indicates that some but not all of the designated uses are supported. The 303(d) list indicates that approximately 9.0 miles of the McFadden Ditch within the subwatershed are impaired for *E.coli*.

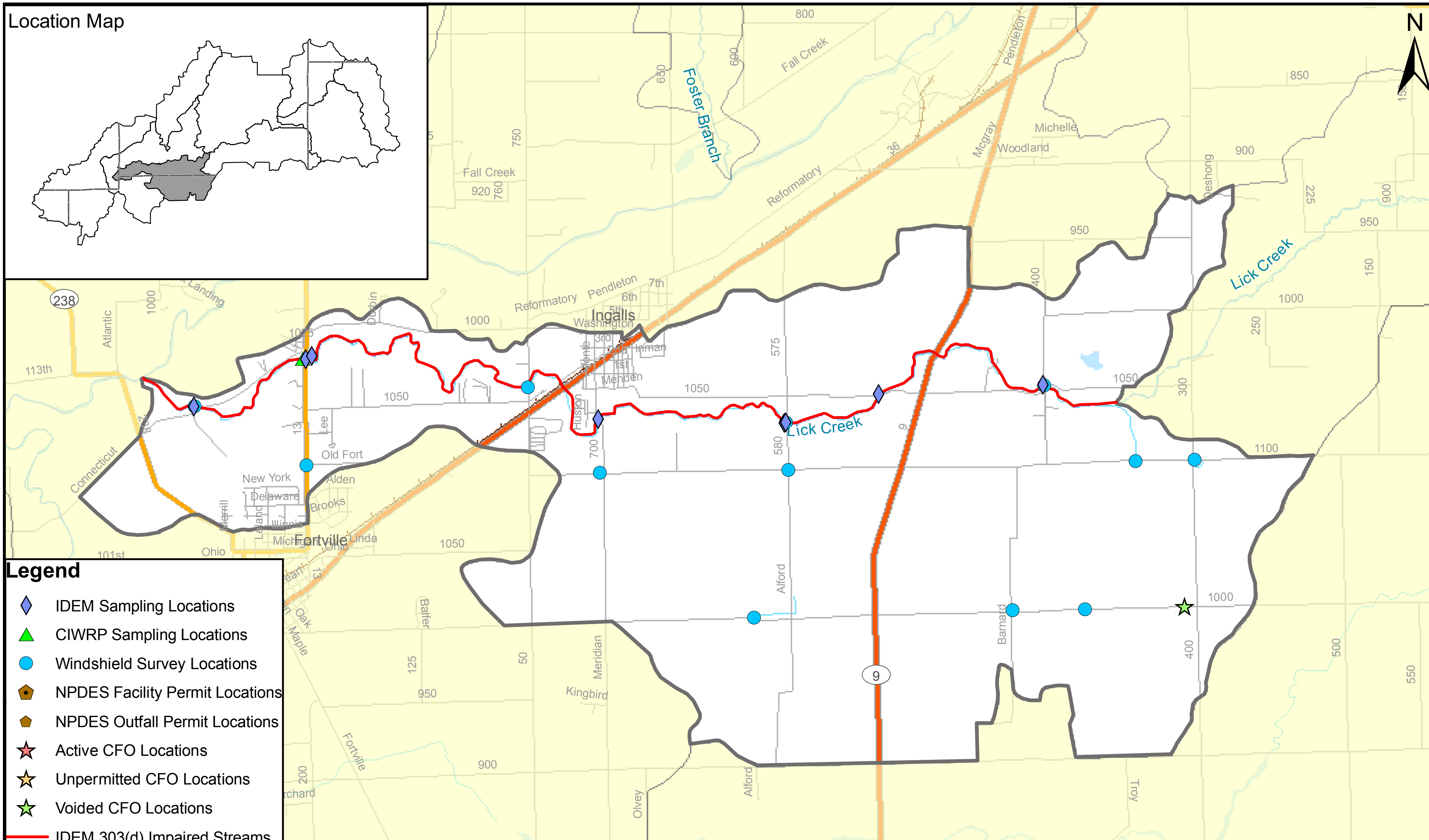
A total of 8 IDEM sampling stations are located within the McFadden Ditch Subwatershed. Seven of these stations have water quality sampling information. Available data at these stations included sampling from the 1996 Synoptic Study, 2001 *E.coli*- WFWR Study, 2008 Fall Creek IBC Study and 2008-2009 Upper Fall Creek Water Quality Monitoring Program.

One CIWRP sampling site was located within the McFadden Ditch Subwatershed.

Table 27 summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

Table 27: McFadden Ditch IDEM and CIWRP Water Quality Sampling Summary			
Water Quality Parameter	**IDEM Mean Value**	**CIWRP Mean Value**	**Water Quality Target**
Dissolved Oxygen	9.5 mg/L	12.0 mg/L	between 4.0 and 12.0 mg/L
E.coli	1436 CFU/100mL	14383 CFU/100mL	235 CFU/100mL
Nitrate + Nitrite	1.8 mg/L	2.5 mg/L	1.6 mg/L
pH	8.1	7.8	between 6.0 and 9.0
Total Phosphorus	0.081 mg/L	0.132 mg/L	0.076 mg/L
TSS	17.1 mg/L	48.9 mg/L	30.0 mg/L
Turbidity	29.5 NTU	67.3 NTU	10.4 NTU
Atrazine	0.0017 mg/L	Not Sampled	0.003 mg/L

Based on the available water quality information, the McFadden Ditch Subwatershed consistently tests higher than the water quality targets for *E. coli*, Nitrate + Nitrite, Total Phosphorus and Turbidity. TSS tested higher than the water quality targets in the CIWRP Study; however it was lower than the targets based on the IDEM data. Atrazine was not sampled during the CIWRP study and it was detected at lower levels than the target in the IDEM data. Dissolved Oxygen and pH fall within the acceptable ranges in both data sets and therefore are not a concern for this subwatershed.



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

TITLE: **McFadden Ditch Subwatershed Map (HUC-12: 051202010807)**

PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**

BASE LAYER: StreetMap USA

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

PROJECT NO.:	EXHIBIT:	SHEET:
09006	22	1 OF: 1

QUADRANGLE:	DATE:	SCALE:
N/A	09/30/10	1" = 5000'

Habitat/Biological Information

IDEM has completed several habitat and biological studies within the Geist Reservoir/Upper Fall Creek Watershed. Within the McFadden Ditch Subwatershed, 6 of the IDEM sampling sites have habitat/biological information available. Sampling data was available from the 1992 Macroinvertebrate Study and the 2008 Fall Creek IBC Study. Table 28 summarizes the IDEM mean value for the Macroinvertebrate Index of Biotic Integrity (mIBI), the Index of Biotic Integrity (IBI) and the QHEI habitat assessment for the available data.

Table 28: McFadden Ditch IDEM Habitat/Biological Sampling Summary	
Habitat/Biological Parameter	**IDEM Mean Value**
mIBI	3.6
IBI	45.2
QHEI	71.8

With a mIBI score of 3.6, the McFadden Ditch Subwatershed is moderately impaired for macroinvertebrate communities and an IBI score of 45.2 indicates that the fish community is fair to good. A QHEI score of 71.8 correlates to an excellent habitat scoring which would indicate that the moderate impairment seen in the macroinvertebrate community is not likely caused by the lack/quality of habitat. As stated in the Water Quality Information section, E. coli, Nitrogen and Phosphorus all consistently exceed the water quality targets indicating the moderate impairment seen within the macroinvertebrate community may be influenced by the impaired water chemistry within the subwatershed.

Landuse Information

Landuse within the McFadden Ditch Subwatershed consists primarily of agricultural uses. Several areas of deciduous forest are located along the corridor of Lick Creek. Low and medium intensity development is concentrated in the north central portion of the subwatershed associated with Ingalls, and in the western portion of the subwatershed associated with Fortville.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 8 stream crossing sites and 4 land/field sites within the McFadden Ditch Subwatershed. Observations including streambank erosion, stream buffers, debris and animal access to streams were recorded for each site and the results are summarized in Table 29 below.

Table 29: McFadden Ditch Windshield Survey Summary	
Parameter	**Observations**
Streambank Erosion	0/8 sites with erosion >3' 7/8 sites with erosion <3'
Stream Buffers	2/8 sites with no buffers 7/8 sites with buffers <50'
In-stream Debris	3/8 sites with debris
Animal Access to Streams	1/8 site with animal access
Conventional Till	0/12 sites under conventional till

The McFadden Ditch Subwatershed contains one voided confined feeding operation located west of the intersection of 1000 N and 400 E in Hancock County.

There are no active NPDES permits within the McFadden Ditch Subwatershed.

Flatfork Creek Subwatershed

The Flatfork Creek Subwatershed (HUC 12 – 051202010808) is located primarily in Hancock and Madison Counties with a small portion in Hamilton County as shown in Exhibit 23. The subwatershed encompasses approximately 17,798 acres and includes the Flatfork Creek tributary and Fall Creek.

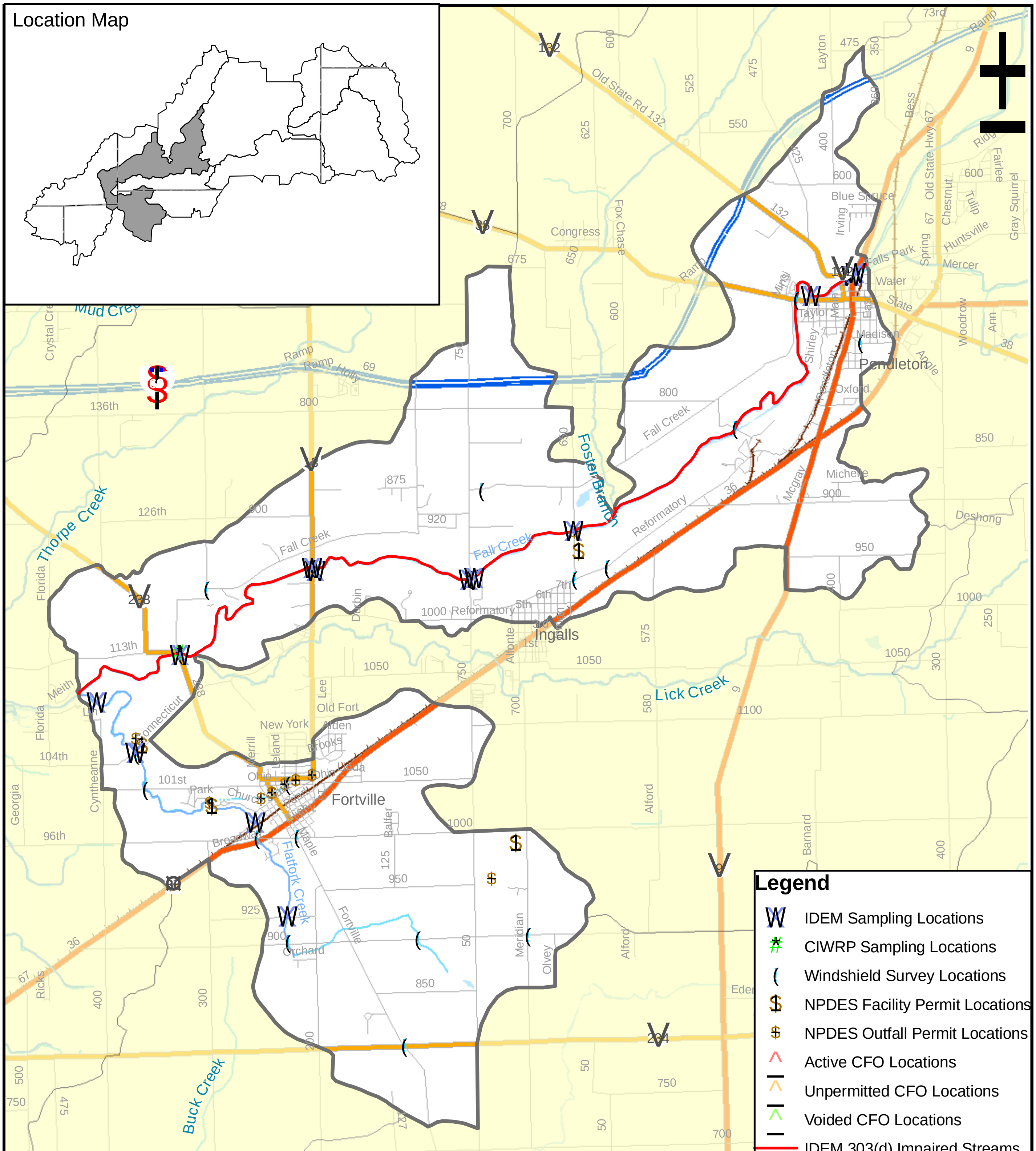
Water Quality Information

According to the IDEM 305(b) list, the streams within the Flatfork Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. Recreational uses within the subwatershed fall within category 5A, signifying that the available data indicates that at least one designated use is not supported impaired or is threatened, and a TMDL is needed and category 2, signifying that available data indicates that some but not all of the designated uses are supported. The fishable uses fall within category 3, signifying that there is insufficient available data to make a use support determination, and the aquatic life uses fall within both categories 2 and 5A. The 303(d) list indicates that approximately 10.8 miles of Fall Creek within the subwatershed are impaired for *E.coli*.

A total of 12 IDEM sampling stations are located within the Flatfork Creek Subwatershed. Ten of these stations have water quality sampling information. Available data at these stations included sampling from the 1996 Synoptic Study, 1996 Watershed Study, 1999-2009 Fixed Station, 2001 Corvallis Study, 2001 *E.coli*- Upper WFWR, 2001 Pesticides Study, 2002-2006 Clean Sampling and Ultra-Clean Analyses, 2008 Fall Creek IBC Study and 2008-2009 Upper Fall Creek Water Quality Monitoring Program.

Only one CIWRP sampling site is located within the Flatfork Creek Subwatershed.

Table 30 summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.



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

TITLE:	Flatfork Creek Subwatershed Map (HUC-12: 051202010808)
BASE LAYER:	StreetMap USA
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206
PROJECT:	Geist Reservoir/Upper Fall Creek Watershed Management Plan
PROJECT NO.	09006
EXHIBIT:	23
SHEET:	1 OF: 1
QUADRANGLE:	N/A
DATE:	09/30/10
SCALE:	1" = 7000'

Table 30: Flatfork Creek IDEM and CIWRP Water Quality Sampling Summary			
Water Quality Parameter	**IDEM Mean Value**	**CIWRP Mean Value**	**Water Quality Target**
Dissolved Oxygen	9.4 mg/L	12.1 mg/L	between 4.0 and 12.0 mg/L
E.coli	487 CFU/100mL	36843 CFU/100mL	235 CFU/100mL
Nitrate + Nitrite	2.6 mg/L	2.5 mg/L	1.6 mg/L
pH	8.1	7.9	between 6.0 and 9.0
Total Phosphorus	0.083 mg/L	0.165 mg/L	0.076 mg/L
TSS	21.3 mg/L	52.2 mg/L	30.0 mg/L
Turbidity	23.0 NTU	67.2 NTU	10.4 NTU
Atrazine	0.0012 mg/L	Not Sampled	0.003 mg/L

Based on the available water quality information, the Flatfork Creek Subwatershed consistently tests higher than the water quality targets in *E. coli*, Nitrate + Nitrite, Total Phosphorus and Turbidity. TSS tested higher than the water quality targets in the CIWRP Study; however it was lower than the targets based on the IDEM data. Atrazine was not sampled during the CIWRP study and it was detected at lower levels than the target in the IDEM data. Dissolved Oxygen and pH fall within the acceptable ranges in both data sets and therefore are not a concern for this subwatershed.

Habitat/Biological Information

IDEM has completed several habitat and biological studies within the Geist Reservoir/Upper Fall Creek Watershed. Within the Flatfork Creek Subwatershed, 8 of the IDEM sampling sites had habitat/biological information available. Sampling data was available from the 1992 Macroinvertebrate Study, the 1996 Macroinvertebrate Study and the 2008 Fall Creek IBC Study. Table 31 summarizes the IDEM mean value for the Macroinvertebrate Index of Biotic Integrity (mIBI), the Index of Biotic Integrity (IBI) and the QHEI habitat assessment for the available data.

Table 31: Flatfork Creek IDEM Habitat/Biological Sampling Summary	
Habitat/Biological Parameter	**IDEM Mean Value**
mIBI	4.2
IBI	37.0
QHEI	65.9

With a mIBI score of 4.2, the Flatfork Creek Subwatershed is slightly impaired for macroinvertebrate communities and an IBI score of 37.0 indicates that the fish community is poor to fair. A QHEI score of 65.9 correlates to a good habitat scoring which would indicate that the slight impairment seen in the macroinvertebrate community and the poor to fair fish community is not likely caused by the lack/quality of habitat. As stated in the Water Quality Information section, E. coli, Nitrogen and Phosphorus all consistently exceed the water quality targets indicating the slight impairment seen in the macroinvertebrate community and the poor to fair fish community may be influenced by the impaired water chemistry within the subwatershed.

Landuse Information

Landuse within the Flatfork Creek Subwatershed consists primarily of agricultural uses. Low and medium intensity development is concentrated in the northeastern portion of the subwatershed associated with Pendleton, the central portion of the subwatershed associated with Ingalls, and in the western portion of the subwatershed associated with Fortville.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 13 stream crossing sites and 6 land/field sites within the Flatfork Creek Subwatershed. Observations including streambank erosion, stream buffers, debris and conventional tillage practices were recorded for each site and the results are summarized in Table 32 below.

Table 32: Flatfork Creek Windshield Survey Summary	
Parameter	**Observations**
Streambank Erosion	2/13 sites with erosion >3' 4/13 sites with erosion <3'
Stream Buffers	2/13 sites with no buffers 11/13 sites with buffers <50'
In-stream Debris	1/13 site with debris
Animal Access to Streams	0/13 sites with animal access
Conventional Till	2/19 sites under conventional till

The Flatfork Creek Subwatershed contains no confined feeding operations.

There are 4 NPDES permits active within the Flatfork Creek Subwatershed. Alcatel-Lucent USA Inc, permit number IN0057720, is located at 9874 N Meridian Road in Fortville. The facility along with one outfall is located within the Flatfork Creek Subwatershed. According to compliance records, there have been no formal enforcement actions within the last 5 years; however there has been one noted effluent exceedance within the last 3 years. This exceedance was reported for pH. The Fall Creek RSD Wastewater Treatment Plant, permit number IN0049026, is located at 9378 S 650 W in Pendleton. The treatment plant along with one outfall is located within the Flatfork Creek Subwatershed. According to compliance records for the treatment plant, there has been no formal enforcement actions within the last 5 years, however there have been nine noted effluent exceedances within the last 3 years. These exceedances were reported for *E.coli* and total phosphorus. The Fortville Municipal Wastewater Treatment Plant, permit number IN0020958, is located at 500 W Church Street in Fortville. The treatment plant along with 7 outfalls is located within the Flatfork Creek Subwatershed. According to compliance records, there has been no formal enforcement actions within the last 5 years at the treatment plant, however there have been 17 noted effluent exceedances within the last 3 years. These exceedances were reported for *E.coli* and nitrogen. The Flatfork Creek Wastewater Treatment Plant, permit number IN0054771, is located at 16266 Connecticut Avenue in Fortville. The treatment plant along with one outfall is located within the Flatfork Creek Subwatershed. No compliance records are available for this facility.

Thorpe Creek Subwatershed

The Thorpe Creek Subwatershed (HUC 12 – 051202010809) encompasses portions of Hamilton, Hancock, Madison, and Marion Counties as shown in Exhibit 24. The subwatershed contains approximately 22,170 acres and includes the Bee Camp Creek and Thorpe Creek tributaries and several smaller tributaries. Geist Reservoir is located in the western portion of the subwatershed.

Water Quality Information

According to the IDEM 305(b) list, the streams within the Thorpe Creek Subwatershed are designated for Recreational, Fishable, and Aquatic Life Use. Geist Reservoir is also designated for Recreational, Fishable, Aquatic Life, and Drinking Water Use. Recreational uses within the streams of the subwatershed fall within category 2, signifying that available data indicates that some but not all of the designated uses are supported. The fishable uses fall within both categories 3, signifying that there is insufficient available data to make a use support determination and 5B, signifying that the available data indicates that at least one designated use is not supported impaired or is threatened, and a TMDL is needed. Aquatic life uses fall within both categories 2 and 5A. Recreational and aquatic life uses within Geist Reservoir fall within category 3, signifying that there is insufficient available data to make a use support determination. While fishable and drinking water uses within the reservoir fall within categories 5B and 5A, respectively signifying that the available data indicates that at least one designated use is not supported impaired or is threatened, and a TMDL is needed. The 303(d) list indicates that approximately 0.8 miles of Fall Creek within the subwatershed are impaired for *E.coli* and that Geist Reservoir is impaired for Algae, Taste/Odor and PCBs in Fish Tissue.

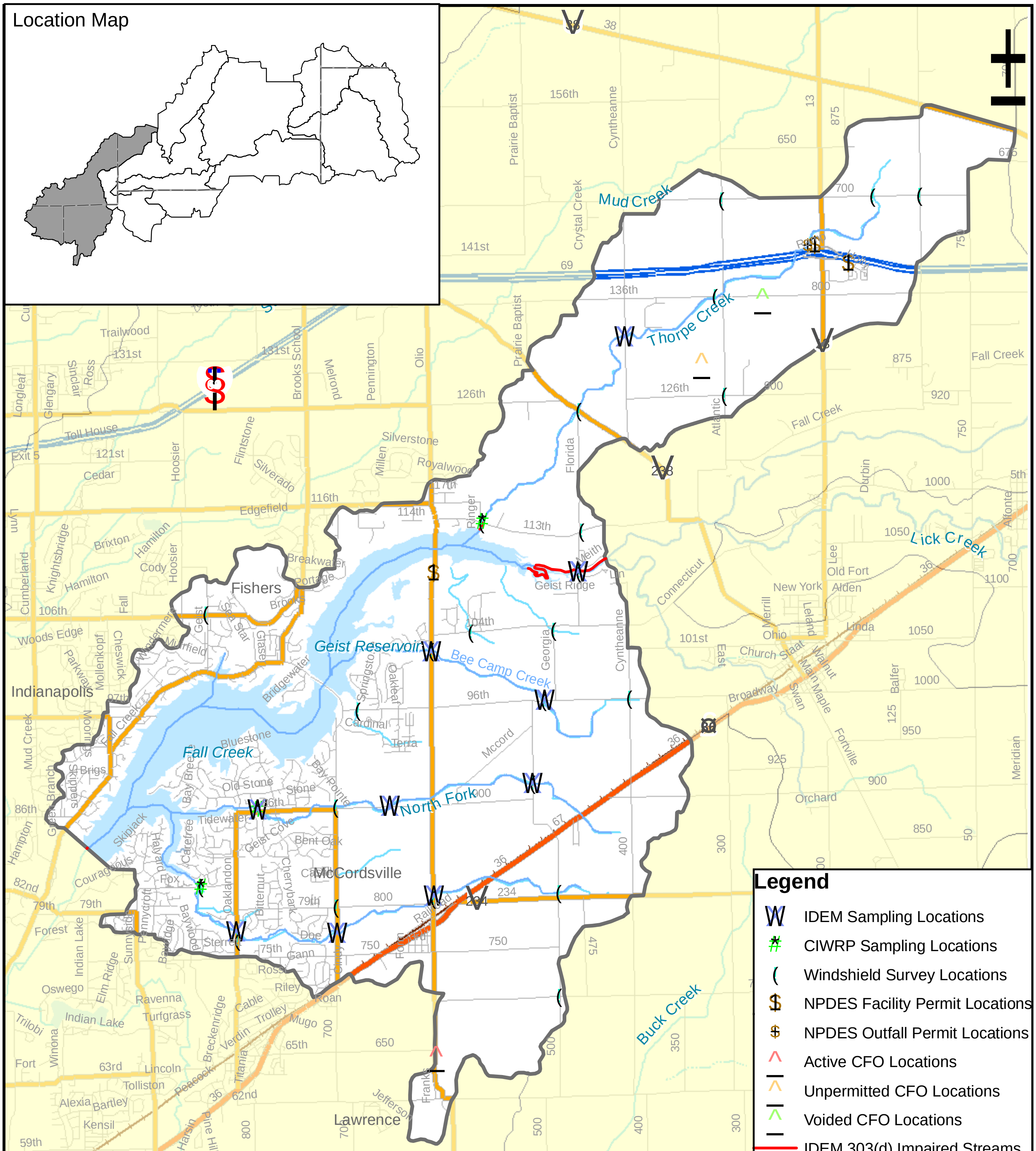
A total of 10 IDEM sampling stations are located within the Thorpe Creek Subwatershed. Nine of these stations have water quality sampling information. Available data at these stations included sampling from the 2008 Fall Creek IBC Study.

There are 3 CIWRP sampling sites located within the Thorpe Creek Subwatershed.

Table 33 summarizes the IDEM and CIWRP sampling mean value of each parameter screened and the corresponding water quality target.

Table 33: Thorpe Creek IDEM and CIWRP Water Quality Sampling Summary			
Water Quality Parameter	**IDEM Mean Value**	**CIWRP Mean Value**	**Water Quality Target**
Dissolved Oxygen	7.2 mg/L	11.5 mg/L	between 4.0 and 12.0 mg/L
E.coli	Not sampled	38437 CFU/100mL	235 CFU/100mL
Nitrate + Nitrite	4.4 mg/L	3.4 mg/L	1.6 mg/L
pH	7.8	7.7	between 6.0 and 9.0
Total Phosphorus	1.066 mg/L	0.193 mg/L	0.076 mg/L
TSS	20.8 mg/L	53.1 mg/L	30.0 mg/L
Turbidity	43.4 NTU	82.8 NTU	10.4 NTU
Atrazine	0.0016 mg/L	Not Sampled	0.003 mg/L

Based on the available water quality information, the Thorpe Creek Subwatershed consistently tests higher than the water quality targets for Nitrate + Nitrite, Total



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

TITLE: **Thorpe Creek Subwatershed Map (HUC-12: 051202010809)**	PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**		
BASE LAYER: StreetMap USA	PROJECT NO. 09006	EXHIBIT: 24	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance, P.O. Box 2065, Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 7500'

Phosphorus and Turbidity. TSS tested higher than the water quality targets in the CIWRP Study; however it was lower than the targets based on the IDEM data. *E.coli* data was not available in the IDEM data; however the water quality targets for *E.coli* were significantly exceeded in the CIWRP study. Atrazine was not sampled during the CIWRP study and it was detected at lower levels than the target in the IDEM data. Dissolved Oxygen and pH fall within the acceptable ranges in both data sets and therefore are not a concern for this subwatershed.

Habitat/Biological Information

IDEM has completed several habitat and biological studies within the Geist Reservoir/Upper Fall Creek Watershed. Within the Thorpe Creek Subwatershed, 9 of the IDEM sites have habitat/biological information available. Sampling data was available from the 2008 Fall Creek IBC Study. Table 34 summarizes the IDEM mean value for the Index of Biotic Integrity (IBI) and the QHEI habitat assessment for the available data.

Table 34: Thorpe Creek IDEM Habitat/Biological Sampling Summary	
Habitat/Biological Parameter	**IDEM Mean Value**
mIBI	Not Sampled
IBI	33.6
QHEI	58.4

The Thorpe Creek Subwatershed was not sampled for macroinvertebrate communities. An IBI score of 33.6 indicates that the fish community is poor, and a QHEI score of 58.4 correlates to a good habitat scoring which would indicate that the poor fish community is not likely caused by lack/quality of habitat. As stated in the Water Quality Information section, Nitrogen and Phosphorus consistently exceed the water quality targets indicating the poor fish community may be influenced by the impaired water chemistry within the subwatershed.

Landuse Information

Landuse within the Thorpe Creek Subwatershed consists primarily of agricultural uses however significant development is also located within the subwatershed. Medium and high intensity development is concentrated in western portion of the subwatershed associated with Indianapolis, Fishers, McCordsville, and Lawrence.

During October/November 2009, the Steering Committee volunteers conducted a windshield survey at 16 stream crossing sites and 8 land/field sites within the Thorpe Creek Subwatershed. Observations including streambank erosion, stream buffers, debris and conventional tillage practices were recorded for each site and the results are summarized in Table 35 below.

Table 35: Thorpe Creek Windshield Survey Summary	
Parameter	**Observations**
Streambank Erosion	2/16 sites with erosion >3’ 3/16 sites with erosion <3’
Stream Buffers	7/16 sites with no buffers 6/16 sites with buffers <50’
In-stream Debris	7/16 sites with debris
Animal Access to Streams	0/16 sites with animal access
Conventional Till	4/24 sites under conventional till

The Thorpe Creek Subwatershed contains one voided confined feeding operation, one unpermitted CFO and one active CFO. The voided CFO is located east of the intersection of Atlantic Avenue and 800 S in Madison County. The unpermitted CFO is located north of the intersection of 126th Street and Atlantic Avenue in Hamilton County and the active CFO is located south of the intersection of 650 N and 600 W in Hancock County. There were no violations reported for the CFOs within the subwatershed based on the inspection reports obtained from IDEM.

There are 3 other NPDES permits active within the Thorpe Creek Subwatershed. The IMI McCordsville facility, permit number ING490034, is located at 10959 Olio Road in Fortville. According to compliance records, there have been no formal enforcement actions within the last 5 years at the facility; however there has been one noted effluent exceedance within the last 3 years. This exceedance was reported for total suspended solids. The Pilot Travel Center, permit number IN0056375, is located at I-69 and State Road 13 in Pendleton. There are no compliance records available for this facility. The Carefree Mobile Home Park, permit number IN0043281, is located on West Carefree Drive in Pendleton. There are no compliance records available for this facility.

Part Three of the Watershed Inventory

Watershed Inventory Summary and Ranking

As detailed in Part Two of the Watershed Inventory, available water quality, biological and landuse information was analyzed on a subwatershed (HUC 12) scale. The following tables summarize the data that was analyzed and presented in Part Two of the Watershed Inventory for easy comparison between the subwatersheds.

In order to gain an understanding of the relationships between the subwatersheds and identify the areas of highest concern, a ranking system was established. Ranking was assigned based on each data set with the most impacted watershed receiving the lowest score (e.g. 1). The scores were then averaged based on the number of data sets that were available for that subwatershed and the lowest average scoring subwatershed received the lowest overall score (e.g. 1). Therefore a subwatershed with a ranking of 1 is the lowest ranked subwatershed meaning it is the worst ranked subwatershed for that specific data set/pollutant. A subwatershed with a ranking of 10 is the highest ranked subwatershed meaning it is the best ranked subwatershed for that specific data set/pollutant. A value of

NR, or Not Ranked, is given for those subwatersheds where the parameter or pollutant was not collected or sampled. Specific ranking methodologies are explained for each table.

Water Quality Information

The IDEM 303(d) Summary information is ranked based on the number of impairments per subwatershed. For example, Thorpe Creek had three impairments; the highest number of impairments compared to the other subwatersheds and therefore was ranked 1 for this data set. The rest of the subwatersheds have only impairment and therefore were all ranked second.

Table 36: IDEM 303(d) Summary		
Subwatershed	**IDEM 303(d) Impairments**	**IDEM 303(d) Ranking**
Honey Creek	*E.coli*	**2**
Sly Fork	*E.coli*	**2**
Deer Creek	*E.coli*	**2**
Prairie Creek	*E.coli*	**2**
Headwaters Lick Creek	*E.coli*	**2**
Foster Branch	*E.coli*	**2**
McFadden Ditch	*E.coli*	**2**
Flatfork Creek	*E.coli*	**2**
Thorpe Creek	Algae, Taste/Odor, PCBs in fish tissue	**1**

The IDEM Water Quality Sampling Summary information is ranked for each impairment based on the value of the impairment (i.e. Sly Fork Creek had the seventh highest value for Total Phosphorus). The Overall IDEM WQ Rank left column was determined based on adding each impairment rank and dividing by the number of times it was ranked. For example, Honey Creek has a total rank of 4.75 = [(6+2+3+8)/4] and was ranked for all 4 impairments. Similarly, Thorpe Creek has a total rank of 1.67 = [(1+1+3)/3] and was ranked for only 3 impairments. The right column of the Overall IDEM WQ Rank is ranking the left column from 1 to 10 (1 being the worst case and 10 being the best case).

Table 37: IDEM Water Quality Sampling Summary										
Subwatershed	***E.coli* (CFU/100ml)**		**Nitrate + Nitrite (mg/L)**		**Total Phosphorus (mg/L)**		**TSS (mg/L)**		**Overall IDEM WQ Rank**	
	Value	**Rank**	**Value**	**Rank**	**Value**	**Rank**	**Value**	**Rank**		
Honey Creek	1646	6	3.4	2	0.098	3	13.6	8	4.75	**4**
Sly Fork	5855	1	2.1	6	0.065	7	13.7	7	5.25	**5**
Deer Creek	3326	5	2.5	4	0.214	2	31.9	1	3	**2**
Prairie Creek	3646	4	1.4	8	0.062	9	19.9	4	6.25	**8**
Headwaters Lick Creek	3771	3	1.8	7	0.069	6	15.2	6	5.5	**6**
Foster Branch	5669	2	2.4	5	0.064	8	5.7	9	6	**7**
McFadden Ditch	1436	7	1.8	7	0.081	5	17.1	5	6	**7**
Flatfork Creek	487	8	2.6	3	0.083	4	21.3	2	4.25	**3**
Thorpe Creek	--	NR	4.4	1	1.066	1	20.8	3	1.67	**1**

The CIWRP Studies Summary information is has a ranking system that starts with a straight rank for each impairment based on the value of the impairment. Then, each subwatershed has an overall rank based on those individual impairment rankings. This is the same methodology used for the IDEM Water Quality Sampling Summary. It should be noted that the CIWRP data samples were collected during base and storm flow conditions. Depending on the pollutant, both types of samples can result in elevated values. For example, the *E.coli* values shown in the table below are extremely elevated when compared to the IDEM data. This is a major concern in the watershed and is reflected so in the problems and goals described later in the WMP.

Table 38: CIWRP Studies Summary										
Subwatershed	***E.coli* (CFU/100ml)**		**Nitrate + Nitrite (mg/L)**		**Total Phosphorus (mg/L)**		**TSS (mg/L)**		**Overall CIWRP WQ Rank**	
	Value	**Rank**	**Value**	**Rank**	**Value**	**Rank**	**Value**	**Rank**		
Honey Creek	42940	2	2.6	3	0.173	2	74.1	1	2	**2**
Sly Fork	42940	2	2.6	3	0.173	2	74.1	1	2	**2**
Deer Creek	42940	2	2.6	3	0.173	2	74.1	1	2	**2**
Prairie Creek	47007	1	1.8	5	0.120	6	48.0	5	4.25	**4**
Headwaters Lick Creek	14383	6	2.5	4	0.132	5	48.9	4	4.75	**5**
Foster Branch	15321	5	3.2	2	0.146	4	16.9	6	4.25	**4**
McFadden Ditch	14383	6	2.5	4	0.132	5	48.9	4	4.75	**5**
Flatfork Creek	36843	4	2.5	4	0.165	3	52.2	3	3.5	**3**
Thorpe Creek	38437	3	3.4	1	0.193	1	53.1	2	1.75	**1**

According to the IDEM 303(d) list, the majority of the waterbodies within the watershed do not meet their designated uses. This is supported by the data compiled from IDEM water quality studies and the CIWRP 2003 study. *E.coli* targets were exceeded in all subwatersheds, with Prairie Creek being the greatest contributor in the CIWRP study and Sly Fork in the IDEM data. Nitrate + Nitrite and phosphorus levels were also exceeded in several subwatersheds, with Thorpe Creek being the largest contributor of both in the two data sets.

Total sediment loads were analyzed based on the total suspended solids in the samples. Total suspended solid levels were exceeded in eight of the nine subwatersheds based on the CIWRP data, however only 1 subwatershed exceeded the targets based on the IDEM data. Deer Creek was the largest contributor in the IDEM data, with Deer Creek, Sly Fork and Honey Creek tied in the CIWRP data.

Habitat/Biological Information

The IDEM Habitat/Biological Sampling Summary ranking systems is the same as the IDEM Water Quality Sampling Summary and the CIWRP Studies Summary.

Table 39: IDEM Habitat/Biological Sampling Summary								
Subwatershed	**mIBI Score**		**IBI Score**		**QHEI Score**		**Overall IDEM Bio Rank**	
	Value	**Rank**	**Value**	**Rank**	**Value**	**Rank**		
Honey Creek	5.5	5	41.8	7	59.8	5	5.67	**5**
Sly Fork	--	NR	35.6	3	44.8	2	2.5	**2**
Deer Creek	4.4	4	42.9	8	64.9	7	6.33	**7**
Prairie Creek	3.8	2	39.0	5	55.3	3	3.33	**3**
Headwaters Lick Creek	--	NR	41.3	6	60.0	6	6	**6**
Foster Branch	--	NR	35.3	2	37.3	1	1.5	**1**
McFadden Ditch	3.6	1	45.2	9	71.8	9	6.33	**7**
Flatfork Creek	4.2	3	37.0	4	65.9	8	5	**4**
Thorpe Creek	--	NR	33.6	1	58.4	4	2.5	**2**

Landuse Information
Windshield survey observations were made during October/November 2009 by Steering Committee volunteers. Observations including general site information (i.e. location and weather), land use, land odor, evidence of best management practices, water color/appearance, water odor, evidence of algae, streambank erosion, stream buffers & type, in-stream debris, available shade/stream cover and in-stream habitat were recorded for 150 locations throughout the watershed on standardized survey forms. It was determined by the Steering Committee to collect as much data as possible at all of these sites. While all of this information is valid for an overall understanding of the subwatershed, five of the major parameters (streambank erosion, stream buffers, in-stream debris, conventional till and livestock access) were used as a part of the subwatershed assessments and the identification of subwatershed priority areas and specific source critical areas as these parameters help verify the water quality data and BMP recommendations. The results of the survey are summarized in Table 40. The remainder of the information obtained during the windshield survey should be reevaluated during the feasibility phases of plan implementation.

Identification of streambank erosion was broken up into the following categories: absent, stabilized (rip-rap, coir log, etc.), present > 3 feet tall and present < 3 feet tall. Identification of buffers was broken up into the following categories: absent, present > 50 feet and present (minimum 10 feet) < 50 feet. In-stream debris, conventional till and livestock access were evaluated based on the number of sites identified. The Windshield Survey Summary ranking is a straight rank based on the Value for each parameter.

Table 40: Windshield Survey Summary										
Subwatershed	Streambank Erosion (sites with >3ft/<3ft)		Stream Buffer (sites with absent/ insufficient)		In-Stream Debris (number of sites)		Conventional Till (number of sites)		Livestock Access (number of sites)	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank	Value	Rank
Honey Creek	2/1	3	2/6	5	0	7	10	1	0	2
Sly Fork	1/5	5	1/6	6	4	3	3	4	0	2
Deer Creek	1/6	4	2/7	4	3	4	4	3	1	1
Prairie Creek	2/1	3	2/8	3	6	2	0	6	0	2
Headwaters Lick Creek	0/4	8	2/6	5	2	5	5	2	1	1
Foster Branch	1/0	6	0/3	7	1	6	0	6	1	1
McFadden Ditch	0/7	7	2/7	4	3	4	0	6	1	1
Flatfork Creek	2/4	1	2/11	2	1	6	2	5	0	2
Thorpe Creek	2/3	2	7/6	1	7	1	4	3	0	2

The number of instances of streambank erosion, inadequate buffers, in-stream debris, direct livestock access and areas under conventional till were identified during the windshield survey. Thorpe Creek had the largest number of instances for inadequate stream buffers. Flatfork Creek had the largest number of sites with erosion, while Honey Creek had the highest frequency of areas under conventional till. Prairie Creek had the most sites with in-stream debris identified. McFadden Ditch, Foster Branch, Deer Creek and the Headwaters of Lick Creek all tied for the largest numbers of direct livestock access.

The NPS Modeling Summary ranking is the same as the ranking system used for Table 37: IDEM Water Quality Sampling Summary.

Table 41: NPS Modeling Summary								
Subwatershed	N Load (lb/ac/yr)		P Load (lb/ac/yr)		Sediment Load (t/ac/yr)		Overall NPS Modeling Rank	
	Value	Rank	Value	Rank	Value	Rank		
Honey Creek	4.85	4	0.90	2	0.22	1	2.33	**2**
Sly Fork	4.86	3	0.86	4	0.20	3	3.33	**4**
Deer Creek	4.74	7	0.85	5	0.20	3	5	**6**
Prairie Creek	5.22	1	0.89	3	0.19	4	2.67	**3**
Headwaters Lick Creek	4.86	3	0.89	3	0.21	2	2.67	**3**
Foster Branch	5.02	2	0.91	1	0.21	2	1.67	**1**
McFadden Ditch	4.75	6	0.86	4	0.20	3	4.33	**5**
Flatfork Creek	4.86	3	0.86	4	0.20	3	3.33	**4**
Thorpe Creek	4.76	5	0.85	5	0.20	3	4.33	**5**

Prairie Creek was the largest contributor of nitrogen concentration (pounds per acre) according to the nonpoint source modeling results. Compared to Deer Creek (the lowest contributor), the percent difference was only 9.7% showing that all subwatersheds contribute a similar amount of nitrogen based on landuse information. Phosphorus concentration showed a similar trend with Foster Creek being the largest contributor, but only 6.8% different than Deer and Thorpe Creek the lowest contributors. Slightly more variability was seen with the sediment concentration results with 11.8% difference between the largest and lowest contributors, Honey Creek and Prairie Creek, respectively.

The NPDES Permits Summary ranking is a straight rank based on the Value for each parameter.

Table 42: NPDES Permits Summary				
Subwatershed	**CFOs (violations active/expired/void)**		**NPDES Outfalls (Exceedances)**	
	Value	**Rank**	**Value**	**Rank**
Honey Creek	0 vio. (0/0/1)	3	1-TSS	3
Sly Fork	0 vio. (0/0/1)	3	No outfalls	NR
Deer Creek	0 vio. (0/0/0)	NR	4-*E.coli*, 14-N, 2-TSS	2
Prairie Creek	0 vio. (0/0/1)	3	No outfalls	NR
Headwaters Lick Creek	1 vio. (1/0/0)	1	No outfalls	NR
Foster Branch	0 vio. (0/0/0)	NR	No outfalls	NR
McFadden Ditch	0 vio. (0/0/1)	3	No outfalls	NR
Flatfork Creek	0 vio. (0/0/0)	NR	8-*E.coli*, 9-N, 5-P	1
Thorpe Creek	0 vio. (1/1/1)	2	1-TSS	3

Thorpe Creek has the largest number of confined feeding operations, whereas Flatfork Creek has the largest number of facilities and outfalls permitted through the NPDES program.

Subwatershed Overall Ranking

The available water quality, biological and landuse information summarized above was divided into two criteria: Current Water Quality Impairment and Land Use and Industrial Impairments and Concerns. These categories were then used to determine the overall rank of the individual subwatersheds.

Current Water Quality Impairment

The current water quality impairment category includes all pertinent available water quality studies and quantitative data that were utilized in this analysis. It should be noted that not all available data for the watershed was used in the analysis. This data is easily compared to standard water quality targets and therefore easily used to gage the current health of the subwatersheds. Table 43 identifies the rankings of the subwatersheds based on the current water quality impairments.

The left column of the Current Rank for the Current Water Quality Impairment Ranking is based on the total of each parameter ranking divided by the number of times it was ranked. For example, Foster Branch has a Current Rank of 3.5 which correlates to (2+4+7+1)/4. The right column is a straight ranking based on the left column.

Table 43: Current Water Quality Impairment Ranking						
Subbasin	**IDEM 303(d)**	**CIWRP WQ**	**IDEM WQ**	**IDEM Bio**	**CURRENT RANK**	
Honey Creek	2	2	4	5	3.25	**4**
Sly Fork	2	2	5	2	2.75	**2**
Deer Creek	2	2	2	7	3.25	**4**
Prairie Creek	2	4	8	3	4.25	**6**
Headwaters Lick Creek	2	5	6	6	4.75	**7**
Foster Branch	2	4	7	1	3.5	**5**
McFadden Ditch	2	5	7	7	5.25	**8**
Flatfork Creek	2	3	3	4	3	**3**
Thorpe Creek	1	1	1	2	1.25	**1**

Land Use and Industrial Impairments and Concerns
The land use and industrial impairments and concerns category includes land use and social based data. This data is not easily compared to water quality targets but can be helpful in determining the chances of ongoing or future water quality impairments. The Land Use and Industrial Impairments and Concerns Ranking table includes a summary of the rankings from the Windshield Survey Summary table, the NPS Modeling Summary table and the NPDES Permits Summary table then ranks each subwatershed based on those rankings. The two columns of rankings under the Current Rank column were determined in the same manner as the Current Rank columns in the Current Water Quality Impairment Ranking table.

Table 44: Land Use and Industrial Impairments and Concerns Ranking										
Subbasin	**NPS Modeling**	**Stream Erosion**	**Stream Buffer**	**In-Stream Debris**	**Conven-tional Till**	**Live-stock Access**	**CFOs**	**NPDES Facilities**	**LAND USE RANK**	
Honey Creek	2	3	5	7	1	2	3	3	3.25	**4**
Sly Fork	4	5	6	3	4	2	3	NR	3.86	**6**
Deer Creek	6	4	4	4	3	1	NR	2	3.86	**6**
Prairie Creek	3	3	3	2	6	2	3	NR	3.14	**3**
Headwaters Lick Creek	3	8	5	5	2	1	1	NR	3.57	**5**
Foster Branch	1	6	7	6	6	1	NR	NR	4.5	**8**
McFadden Ditch	5	7	4	4	6	1	3	NR	4.29	**7**
Flatfork Creek	4	1	2	6	5	2	NR	1	3	**2**
Thorpe Creek	5	2	1	1	3	2	2	3	2.38	**1**

Overall Subwatershed Ranking

Once the subwatersheds were ranked based on the two established criteria, an overall ranking was assigned. The following table shows the Overall Subwatershed Ranking. The right column of the Overall Rank is ranking the left column from 1 to 10 (1 being the worst case and 10 being the best case).

Table 45: Overall Subwatershed Ranking				
Subbasin	**Current Rank**	**Land Use Rank**	**OVERALL RANK**	
Honey Creek	4	4	4	**3**
Sly Fork	2	6	4	**3**
Deer Creek	4	6	5	**5**
Prairie Creek	6	3	4.5	**4**
Headwaters Lick Creek	7	5	5.5	**6**
Foster Branch	5	8	6.5	**7**
McFadden Ditch	8	7	7.5	**8**
Flatfork Creek	3	2	2.5	**2**
Thorpe Creek	1	1	1	**1**

Analysis of Stakeholder Concerns

As discussed in Section 1, stakeholder concerns were gathered at the public meetings. The Watershed Inventory provided a means of verifying these concerns or in some cases developing additional concerns. Further discussion on which concerns the steering committee wanted to focus on occurred during the October and November Steering Committee meetings. Table 46 lists these concerns and identifies which concerns are supported by evidence from the Watershed Inventory (windshield survey, IDEM Data, CIWRP data, etc.) and which concerns will be focused on by the group. This table helps verify which concerns are supported by the collected data versus what is perception, what evidence there is for each concern, whether the concern is quantifiable, and whether the concern is outside the project's scope. For example, Legislative Action on Phosphorus Ban was a concern identified during the May public meetings. This concern is supported by data based on the IDEM and CIWRP water quality data for Phosphours exceedances in the watershed and therefore shows the linkage between the concerns and the water quality data (as well as the other data sources evaluated as a part of this WMP).

Table 46: Analysis of Stakeholder Concerns					
Concern	**Supported by Data?**	**Evidence**	**Quanti-fiable?**	**Outside Scope?**	**Group Focus?**
Quality of drinking water	Yes	IDEM, CIWRP Data (*E.coli*, N, P, TSS)	Yes	No	Yes
Organic (leaves, grass clippings, pet/wildlife waste) debris	Yes	IDEM, CIWRP Data (*E.coli*, N, P)	Yes	No	Yes
Quality of surface water runoff	Yes	IDEM, CIWRP Data (*E.coli*, N, P, TSS)	Yes	No	Yes
Rule 5 erosion control Enforcement	Yes	IDEM, CIWRP Data (TSS)	Yes	No	Yes
Sediment from storm drains	Yes	IDEM, CIWRP Data (TSS)	Yes	No	Yes
Encourage and improve public perception of native landscaping	No	None, brought up during Public Meeting	No	No	Yes
Maintenance of culverts and roadways	No	None, brought up during Public Meeting	No	Yes	No
Changing actions/perceptions towards urban fertilizer use	No	None, brought up during Public Meeting	No	No	Yes
Dredging in the reservoir	Yes	IDEM, CIWRP, Windshield Survey Data (TSS)	Yes	No	Yes
Enhance wildlife habitat and recreational uses of reservoir	Yes	IDEM, Windshield Survey Data (mIBI, IBI, QHEI)	Yes	No	Yes
Encourage public participation	No	None, brought up during Public Meeting	No	No	Yes
Outreach that is solution based	No	None, brought up during Public Meeting	No	No	Yes
Education to the public	No	None, brought up during Public Meeting	No	No	Yes
Education to the recreational users at marinas	No	None, brought up during Public Meeting	No	No	Yes
Exotic species control – Eurasian Watermilfoil	Yes	AVMP	Yes	No	Yes
Concern over blue green algae	Yes	CIWRP Data	Yes	Yes	Yes
Legislative action on phosphorus ban	Yes	IDEM, CIWRP Data (P)	Yes	No	Yes
Lack of funding sources for urban areas	No	None, brought up during Public Meeting	No	No	Yes
Recognition of problems at State level	No	None, brought up during Public Meeting	No	No	Yes
Lack of regulations	No	None, brought up during Public Meeting	No	No	Yes
Lack of Ag Stakeholder Involvement	No	None, brought up during Public Meeting	No	No	Yes
Lack of sufficient buffers	Yes	IDEM, CIWRP Data (N, P, TSS)	Yes	No	Yes
Streambank erosion	Yes	IDEM, CIWRP Data (TSS)	Yes	No	Yes
Lack of conservation tillage	Yes	IDEM, CIWRP Data (TSS)	Yes	No	Yes
Livestock access to streams	Yes	IDEM, CIWRP Data (*E.coli*, N, P, TSS)	Yes	No	Yes

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 six general areas. Table 47 lists the concerns that the group and the problem associated with each group. Some concerns are listed in several problem groups as they cover a wide variety of issues.

Table 47: Concerns and Associated Problems	
Concern	**Problem Category**
-Encourage and improve public perception of native landscaping -Changing actions/perceptions towards fertilizer use -Encourage public participation -Outreach that is solution based -Education to the public -Education to the recreational users at marinas -Legislative action on phosphorus ban -Recognition of problems at State Level -Lack of regulations -Lack of Ag Stakeholder Involvement	Public Participation/Education and Outreach
-Quality of drinking water -Organic debris entering waterways -Quality of surface water runoff -Enhance wildlife habitat and recreational uses of the reservoir -Livestock access to streams -Streambank erosion -Lack of sufficient buffers	*E.coli* Levels
-Quality of drinking water -Organic debris entering waterways -Quality of surface water runoff -Changing actions/perceptions towards fertilizer use -Enhance wildlife habitat and recreational uses of the reservoir -Public concern over blue green algae -Legislative action on phosphorus ban -Recognition of problems at State level -Lack of regulations -Lack of sufficient buffers -Livestock access to streams	Nutrient Levels

Table 47, cont.: Concerns and Associated Problems	
Concern	**Problem Category**
-Quality of drinking water -Quality of surface water runoff -Erosion control and enforcement – Rule 5 -Dredging in the reservoir -Enhance wildlife habitat and recreational uses of the reservoir -Lack of conservation tillage practices in watershed -Livestock access to streams -Stream erosion -Lack of sufficient buffers	Erosion and Sedimentation
-Enhance wildlife habitat and recreational uses of the reservoir -Exotic species control (Eurasian Watermilfoil)	Exotic Species in the Reservoir
-Encourage and improve public perception of native landscaping -Enhance wildlife habitat and recreational uses of the reservoir -Outreach is solution based -Lack of funding sources for urban areas	Lack of Funding Sources for Urban Areas

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 six 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.

Public Participation/Education and Outreach

Stakeholders in the Geist Reservoir/Upper Fall 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.

E.coli Levels

E.coli levels in the watershed regularly exceed the state standard, based on current and historical water quality data results.

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 6,000%, while in the IDEM data all subwatersheds exceeded the target by at least 107%.

Nutrient Levels

Nutrient concentrations within all subwatersheds frequently exceed water quality targets thereby aiding the growth of algae within the reservoir.

IDEM 303d list, IDEM water quality data and the CIWRP study all 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 12%, while in the IDEM data one subwatershed was below the target and the other eight exceeded the target by at least 11%. Similarly, the phosphorus target of 0.076 mg/L was exceeded in all subwatersheds according to the CIWRP data by at least 58% and 5 subwatersheds exceeded the target by at least 7% in the IDEM data.

Erosion and Sedimentation

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

The CIWRP study verified the exceedances of total suspended solids that directly correlates to the problem statement. According to the CIWRP data, eight subwatersheds exceeded the TSS target of 30 mg/L by at least 60%, while in the IDEM data one subwatershed exceeded the target by 6%.

Exotic Species in the Reservoir

Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.

The data analyzed during the Watershed Inventory did not include information on aquatic plant species. Sampling conducted for the Aquatic Vegetation Management Plan in June and August 2009 did however verify the presence of Eurasian Watermilfoil at several locations within the reservoir.

Lack of Funding Sources for Urban Areas

There is a lack of funding for the implementation of Best Management Practices within urban areas.

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

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 48 lists the potential causes and sources for each problem.

Table 48: Potential Causes & Sources

Problem Statement	Potential Causes	Potential Sources
Stakeholders in the Geist Reservoir/Upper Fall 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 -Lack of understanding of nonpoint sources	- N/A, not applicable for administrative or social problems
E.coli levels in the watershed regularly exceed the state standard, based on current and historical water quality data results.	-Illegal or improper septic systems -Inadequately functioning septic systems -Unsewered communities -Undersized/old combined sewer systems -Improper disposal of pet/wildlife 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 and/or poor soils -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/wildlife waste is disposed of directly into the reservoir and streams -Confined Feeding Operations -Areas where live stock have direct access to streams -Areas with inadequate buffers -Locations of NPDES permitted facilities not in compliance

Table 48: Potential Causes & Sources		
Problem Statement	**Potential Causes**	**Potential Sources**
Nutrient concentrations within all subwatersheds frequently exceed water quality targets thereby aiding the 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 -Improper disposal of yard waste -Lack of adequate buffers -Livestock access to ditches/streams	-Turf areas (e.g. residential, golf courses, parks, etc.) that drain directly to the reservoir/waterbody with no or inadequate buffers -Conventionally tilled agricultural fields that drain directly to ditches/streams with no or inadequate buffers -Areas with inadequate buffers
Soil erosion and sedimentation within the watershed is degrading the water quality 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
Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.	-Lack of native vegetation -Shallow body of water -Transfer of aquatic plant fragments -Uncontrolled growth in high density vegetation areas -Uncontrolled growth in recreational areas	-Public introducing aquarium plants into natural waterways -Vegetation fragmented by watercraft -Fragments transferred from watercraft in known infested waters
There is a lack of funding for the implementation of Best Management Practices within urban areas.	-Lack of unified approach -Lack of perceived benefits/impacts -Lack of interest -Lack of time and commitment	- N/A, not applicable for administrative or social problems

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 causes 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 Geist Reservoir/Upper Fall Creek Watershed. With the extent of water quality data available from IDEM data and the CIWRP study, it was determined that the most accurate estimate would incorporate the available water quality data rather than the modeling results.

Two data sets, IDEM (2008-2009) and CIWRP (2003), sampled for Nitrate + Nitrite, Total Phosphorus, *E.coli* and TSS. Instead of averaging these two data sets together, the IDEM data was used for this calculation as it was the most recent data available. The mean value of each parameter was 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 Geist Reservoir/Upper Fall Creek Watershed. The station, number 03351500, is located on Fall Creek near Fortville. Average annual flow data is available for this station from 1942-2008. At the gage site, the drainage area is 169 square miles and the average annual flow is 182.1 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 standard 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 eco-region.

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 maximum 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 49-51 show the current, target and reduction loads of *E.coli*, Nitrate+Nitrite and Total Phosphorus within the watershed. Since the current TSS concentration was less than the target in eight of the nine subwatersheds, no reduction is required in these subwatersheds.

The Deer Creek Subwatershed averaged higher than the target in TSS at 31.9 mg/L. The current load of the Deer Creek Subwatershed was calculated to be 954.0 ton/year. With the target of 30 mg/L or 897.2 ton/year, the reduction required is 56.8 ton/year, or 6.0% for this subwatershed.

Only IDEM *E.coli* values were used to create Table 49. CIWRP data exists for this parameter, however, the IDEM data is more recent. Thorpe was not measured for *E.coli* based on the most recent IDEM data. There is older data from CIWRP, but it was not used in the creation of this table since the values were much larger than the IDEM data and the IDEM data is showing exceedances in all subwatersheds.

Table 49: *E.coli* Pollutant Loading

Subbasin	Flow Rate (cfs)	Current Loading		Target Loading		Reduction
		Concentration (CFU/100mL)	Load (CFU/year)	Concentration (CFU/100mL)	Load (CFU/year)	Needed (CFU/year)
Honey Creek	18.3	1646	2.7×10^{14}	235	3.8×10^{13}	2.3×10^{14} (85.7%)
Sly Fork	19.1	5855	1.0×10^{15}	235	4.0×10^{13}	9.6×10^{14} (96.0%)
Deer Creek	30.4	3326	9.0×10^{14}	235	6.4×10^{13}	8.4×10^{14} (92.9%)
Prairie Creek	42.8	3646	1.4×10^{15}	235	9.0×10^{13}	1.3×10^{15} (93.6%)
Headwaters Lick Creek	23.2	3771	7.8×10^{14}	235	4.9×10^{13}	7.3×10^{14} (93.8%)
Foster Branch	17.0	5669	8.6×10^{14}	235	3.6×10^{13}	8.2×10^{14} (95.9%)
McFadden Ditch	18.0	1436	2.3×10^{14}	235	3.8×10^{13}	1.9×10^{14} (83.6%)
Flatfork Creek	30.0	487	1.3×10^{14}	235	6.3×10^{13}	6.8×10^{13} (51.7%)
Thorpe Creek	37.3	Not Sampled	N/A	235	7.8×10^{13}	N/A

Table 50: Nitrate+Nitrite Pollutant Loading						
Subbasin	Flow Rate (cfs)	Current Loading		Target Loading		Reduction
		Concentration (mg/L)	Load (lb/year)	Concentration (mg/L)	Load (lb/year)	Needed (lb/year)
Honey Creek	18.3	3.4	122,400	1.6	57,600	64,800 (52.9%)
Sly Fork	19.1	2.1	79,000	1.6	60,200	18,800 (23.8%)
Deer Creek	30.4	2.5	149,600	1.6	95,800	53,800 (36.0%)
Prairie Creek	42.8	1.4	118,000	1.6	134,800	N/A (0.0%)
Headwaters Lick Creek	23.2	1.8	82,200	1.6	73,000	9,200 (11.1%)
Foster Branch	17.0	2.4	80,200	1.6	53,600	26,600 (33.3%)
McFadden Ditch	18.0	1.8	63,800	1.6	56,600	7,200 (11.1%)
Flatfork Creek	30.0	2.6	153,400	1.6	94,400	59,000 (38.5%)
Thorpe Creek	37.3	4.4	323,000	1.6	117,400	205,600 (64.0%)

Table 51: Total Phosphorus Pollutant Loading						
Subbasin	Flow Rate (cfs)	Current Loading		Target Loading		Reduction
		Concentration (mg/L)	Load (lb/year)	Concentration (mg/L)	Load (lb/year)	Needed (lb/year)
Honey Creek	18.3	0.098	3,600	0.076	2,800	800 (22.4%)
Sly Fork	19.1	0.065	2,400	0.076	2,800	N/A (0.0%)
Deer Creek	30.4	0.214	12,800	0.076	4,600	8,200 (64%)
Prairie Creek	42.8	0.062	5,200	0.076	6,400	N/A (0.0%)
Headwaters Lick Creek	23.2	0.069	3,200	0.076	3,400	N/A (0.0%)
Foster Branch	17.0	0.064	2,200	0.076	2,600	N/A (0.0%)
McFadden Ditch	18.0	0.081	2,800	0.076	2,600	200 (6.2%)
Flatfork Creek	30.0	0.083	5,000	0.076	4,400	600 (8.4%)
Thorpe Creek	37.3	1.066	78,200	0.076	5,600	72,600 (93.0%)

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 Geist Reservoir/Upper Fall Creek Watershed.

The goal statements indicate the ultimate goal for a specific project. In some cases this goal may not be maintainable in the short term; therefore there is also a list of short 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. The goal statements themselves are typically the 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 Geist Reservoir/Upper Fall 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.

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 all stakeholders on nature of nonpoint sources
- Coordinate with County SWCDs to get more agriculture stakeholders involved in plan implementation
- Educate homeowners in urban communities about the use of fertilizers
- Coordinate efforts with the UWRWA, local MS4s 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
- Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans

- Educate agricultural stakeholders about the use of Atrazine and its impacts to water quality
- Review education and outreach program within the watershed and continue development and implementation of the program

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.

Goal Statement: Reduce *E.coli* concentrations to meet the state standard of 235 CFU/100mL.

Short Term Objectives:

- Partner with NRCS, SWCDs and County Officials/Boards to promote and implement cost share and/or education programs
- Encourage proper disposal of pet and/or Canada goose waste
- Educate stakeholders using septic systems about the importance of septic system maintenance
- 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.)

Long Term Objectives:

- Continue viable and effective short term goals
- Educate the agriculture stakeholders on the benefits of manure management practices
- 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

Pet and wildlife waste is not a fully documented problem, but was brought up at Steering Committee meetings as a concern. This was specifically commented on by UWRWA as well.

Nutrient Levels

Problem Statement: Nutrient concentrations within all subwatersheds frequently exceed water quality targets thereby aiding the 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.

Short Term Objectives:

- Educate the public and stakeholders of the importance of reduced application of fertilizers or use of low phosphorus or no phosphorus fertilizers
- Partner with NRCS, SWCDs, MS4s and County Officials/Boards to promote and implement cost share and/or education programs
- Educate local, regional, and state officials on the need for regulations for urban areas (specifically for phosphorus)

- 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
- Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans
- Establish a monitoring program or group to collect samples

Erosion and Sedimentation

Problem Statement: Soil erosion and sedimentation within the watershed is degrading the water quality 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.

Short Term Objectives:

- Partner with NRCS, SWCDs, MS4s, County Officials/Boards, High Schools and FFA programs to promote and implement cost share and/or education programs in order to reduce erosion from agricultural lands
- Encourage enforcement of erosion control practices associated with the issuance of Rule 5 construction permits
- 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
- Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans
- Establish a monitoring program or group to collect samples

Exotic Species in the Reservoir

Problem Statement: Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.

Goal Statement: Reduce and control the growth of exotic plants within the reservoir.

Short Term Objectives:

- Educate the public and stakeholders on how exotic species are introduced and ways to control new introductions
- Partner with the marinas, fishing tournament groups, homeowner organizations, etc to promote and implement cost share and/or education programs

Long Term Objectives:

- Continue viable and effective short term objectives
- Regular update of AVMP and implementation according to recommendations

Lack of Funding Sources for Urban Areas

Problem Statement: There is a lack of funding for the implementation of Best Management Practices within urban areas.

Goal Statement: Identify and utilize existing BMP funding sources and encourage the development and enhancement of additional and non-traditional funding sources.

Short Term Objectives:

- Educate homeowners and stakeholders on the benefits and importance of urban BMPs
- Partner with MS4s, SWCDs, foundations, community groups, judicial services, community service programs, high schools, etc to identify existing and develop new funding sources for urban BMP implementation
- Research/educate homeowners on do-it-yourself BMPs

Long Term Objectives:

- Continue viable and effective short term objectives
- Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans
- Encourage demonstration projects throughout the watershed in cooperation with MS4s Education and Outreach programs
- Partner with MS4s, SWCDs, foundations, community groups, judicial services, community service programs, high schools, etc to promote and implement cost share opportunities for implementation of BMPs

Indicators

Indicators are measurable parameters or criteria which can be 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 52 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 L. 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 52: 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 *E.coli* concentrations to meet the state standard of 235 CFU/100mL	-Observed *E.coli* loadings -Number or stream miles of stabilized streambanks and associated load reductions -Number of direct animal access to streams 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 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 Loadings -Number of 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 sediment loads to meet the IDEM statewide draft TMDL target of 30 mg/L for TSS	-Observed TSS concentrations -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 to streams points eliminated and associated load reductions
Reduce and control the growth of exotic plants within the reservoir	-Number of areas identified in updated AVMP -Number of areas treated according to AVMP recommendations -Number of areas with excessive growth
Identify and utilize existing BMP funding sources and encourage the development and enhancement of additional and non-traditional funding sources	-Number of existing funding sources utilized -Number of new/non-traditional funding sources indentified -Number of demonstration projects installed -Number of urban BMPs installed (e.g. pond shoreline plantings, rain gardens)

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 Geist Reservoir/Upper Fall 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 Critical 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 five subwatersheds were also categorized as medium priority and low priority. The intent of this ranking is that if all projects are implemented in the High Priority Areas, then a medium priority area should be evaluated for project implementation. Exhibit 25 shows these the priority subwatershed areas and the ranking of the remaining subwatersheds.

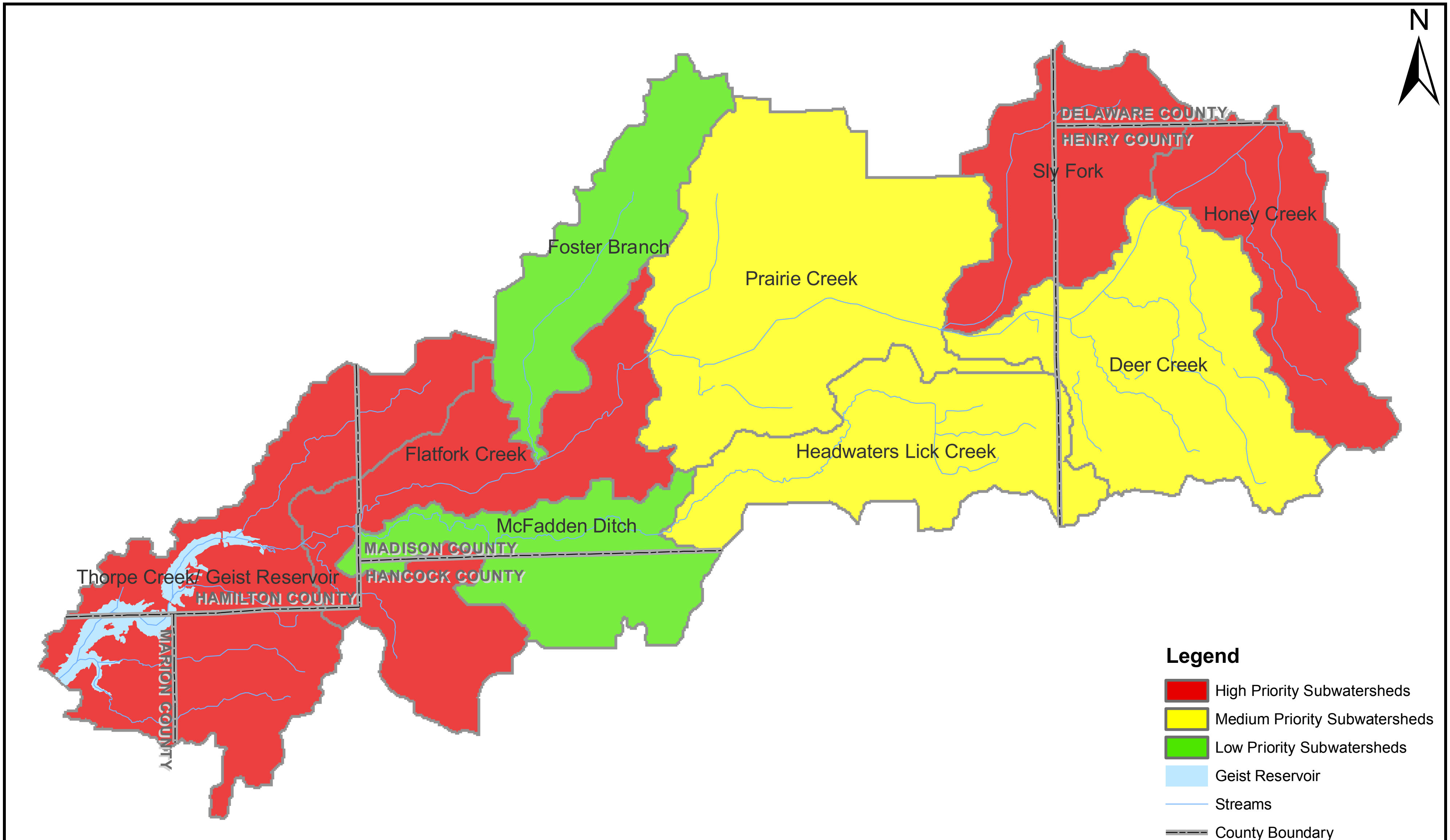
Thorpe Creek Subwatershed

As discussed in the Watershed Inventory in Section 2, the Thorpe Creek Subwatershed shows the highest level of water quality impairment and the highest level of land use and industrial impairments based on the available data. Geist Reservoir is also located within the subwatershed and serves as a drinking water supply to the Indianapolis Water Company's Fall Creek Water Treatment Facility.

The Thorpe Creek Subwatershed exceeded the targets of *E. coli* and the water quality targets for Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the targets of Nitrate + Nitrite and Phosphorus in the IDEM data (no *E. coli* information was available within the IDEM data) and needs reductions of 64.0% and 93.0% for Nitrate+Nitrite and Phosphorus, respectively to meet the target loads set for the subwatershed.

During the windshield survey, 2 of the 16 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 13 sites showed areas with no or inadequate stream buffers (see Exhibit 27), 7 locations had in-stream debris and conventional tillage practices were seen in 4 locations (see Exhibit 29). Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Thorpe Creek Subwatershed is a High Priority Subwatershed Area for Best Management Practice implementation.

The Thorpe Creek Subwatershed is 54% agricultural with urban areas concentrated in the western portion of the subwatershed associated with the City of Indianapolis, Town of Fishers, Town of McCordsville, and the City of Lawrence. Therefore the BMPs suggested in



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

TITLE:	**Subwatershed Priority Areas**
BASE LAYER:	HUC-12 Boundaries
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206

PROJECT:		
Geist Reservoir/Upper Fall Creek Watershed Management Plan		
PROJECT NO.: 09006	EXHIBIT: 25	SHEET: 1 OF: 1
QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'

Table 54 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* (according to the CIWRP data). The Carefree Homes Mobile Home Park has a NPDES permit within the Thorpe Creek Subwatershed. There was one TSS exceedance reported for this outfall based on the information obtained from IDEM. There is also one active CFO located within the subwatershed. These could be potential sources for elevated *E. coli* levels. 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 31.7% 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 critical for E. coli and 54% agricultural with one active CFO, 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 help reduce pollutant loadings within the subwatershed.

The windshield survey results showed that the subwatershed has at least 9 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 30 miles of major stream corridor 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 54% agricultural land with at least 4 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. Tillage information for Hancock County (2007) indicates that approximately 3% of corn fields within the County operate using conventional tillage practices. Grassed waterways and Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

The Thorpe Creek Subwatershed includes a portion of the City of Indianapolis, Town of Fishers, Town of McCordsville, and City of Lawrence. Urban runoff is often a significant source of nonpoint source pollution within a watershed. The implementation of BMPs such as bioretention practices, filtration basins, pervious pavement, naturalized detention basins, infiltration trenches, naturalized stream buffers, and rain barrels/rain gardens 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 64.0% 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 53 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 Thorpe 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.

Honey Creek Subwatershed

The Honey Creek Subwatershed shows a moderate level of current water quality impairment (ranked fourth) and a moderate level of land use and industrial impairments (ranked fourth) based on the available data. The Honey Creek Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality targets for *E. coli*, Nitrate + Nitrite and Phosphorus in the IDEM data. Reductions of 85.7%, 52.9% and 22.4% are needed for *E. coli*, Nitrate + Nitrite, and Phosphorus respectively to meet the target loads set for the subwatershed. The current loading of TSS (according to the IDEM data) within this subwatershed meets the target, therefore no reduction is necessary.

During the windshield survey, 2 of the 8 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 8 sites showed areas with no or inadequate stream buffers (see Exhibit 27) and conventional tillage practices were seen in 10 of the locations (see Exhibit 29) within the Honey Creek Subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Honey Creek Subwatershed is a High Priority Subwatershed for Best Management Practice implementation.

The Honey Creek Subwatershed is approximately 84% agricultural with only a small urban area concentrated in the northwest portion of the subwatershed associated with Middletown. Therefore, the BMPs suggested in Table 54 for this subwatershed are agricultural/rural focused and are beneficial in reducing pollutant loadings for more than one impairment.

Although the windshield survey did not show any locations where animals could access streams, 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 85.7% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in E. coli based on Table 53 Best Management Practice Load Reduction Summary in Section 6.

The windshield survey results also showed that the subwatershed has at least 4 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 14 miles of major stream corridor 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, naturalized stream buffers and stream restoration within the subwatershed as a best management practice for reducing Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 84% agricultural land with at least 10 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 tillage information for Henry County, approximately 24% of corn fields in the County operate using conventional tillage practices. Grassed waterways and Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

Approximately 36.9% 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.

Based on this information, BMP implementation projects are very feasible within the Honey 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.

Flatfork Creek Subwatershed

The Flatfork Creek Subwatershed shows a high 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 Flatfork Creek Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality targets for *E. coli*, Nitrate + Nitrite and Phosphorus in the IDEM data. Reductions of 51.7%, 38.5%, and 8.4% 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 (according to the IDEM data), therefore no reduction is necessary.

During the windshield survey, 2 of the 13 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 2 sites showed areas with no stream buffers (see Exhibit 27), 1 location had in-stream debris and conventional tillage practices were seen in 2 of the locations (see Exhibit 29) within the Flatfork Creek Subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Flatfork Creek Subwatershed is a High Priority Subwatershed for Best Management Practice implementation.

The Flatfork Creek Subwatershed is approximately 71% agricultural with urban areas concentrated in the northeastern portion of the subwatershed associated with Town of Pendleton, the central portion of the subwatershed associated with Town of Ingalls, and in the western portion of the subwatershed associated with Town of Fortville. Therefore, the BMPs suggested in Table 54 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 Fortville Municipal Wastewater Treatment Plant has an outfall permit for seven locations within the Flatfork Creek Subwatershed. Similarly, the Fall Creek RSD Wastewater Treatment Plant and the Flatfork Wastewater Treatment plant each have a permit for one outfall within the subwatershed which are all potential sources for elevated *E. coli* levels. There were 8 *E.coli*, 9 N and 5 P exceedances reported for these outfalls based on the information obtained from IDEM. 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 32.3% 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 71% agricultural 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 51.7% 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 53 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen. Grassed waterways and Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

The windshield survey results showed that the subwatershed has at least 4 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 15 miles of major stream corridor 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, naturalized stream buffers and stream restoration within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

The Flatfork Creek Subwatershed includes a portion of the Town of Pendleton, Town of Ingalls and Town of Fortville. Urban runoff is often a significant source of nonpoint source pollution within a watershed. The implementation of BMPs such as infiltration trenches and rain barrels/rain gardens within urban areas has the potential to significantly reduce the pollutant loadings within the watershed.

Based on this information, BMP implementation projects are very feasible within the Flatfork 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.

Sly Fork Subwatershed

The Sly Fork Subwatershed shows a high level of current water quality impairment (ranked second) and a moderate level of land use and industrial impairments (ranked sixth) based on the available data. The Sly Fork Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality target for *E. coli*, Nitrate + Nitrite in the IDEM data. Reductions of 96.0% and 23.8%

needed for *E. coli* and Nitrate + Nitrite, respectively to meet the target loads set for the subwatershed.

During the windshield survey, 1 of the 8 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 7 sites showed areas with insufficient or no stream buffers (see Exhibit 27), 4 locations had in-stream debris and conventional tillage practices were seen in 3 of the locations (see Exhibit 29) within the Sly Fork Subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Sly Fork Subwatershed is a High Priority Subwatershed for Best Management Practice implementation.

The Sly Fork Subwatershed is approximately 78% agricultural with the only urban area concentrated in the northeastern portion of the subwatershed associated with the Town of Middletown. Therefore, the BMPs suggested in Table 54 for this subwatershed are agricultural/rural focused and are beneficial in reducing pollutant loadings for more than one impairment.

Although the windshield survey did not show any locations where animals could access streams, the subwatershed is 78% agricultural 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 96.0% 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 53 Best Management Practice Load Reduction Summary in Section 6. Exclusionary fencing also provides 70% removal of TSS, 60% of Phosphorus and 65% of Nitrogen. Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

The windshield survey results showed that the subwatershed has at least 2 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 8 miles of major stream corridor 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 within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

Approximately 39.1% 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 Sly Fork 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

Deer Creek Subwatershed
The Deer Creek Subwatershed shows a moderate level of current water quality impairment (ranked fourth) and a moderate level of land use and industrial impairments (ranked sixth) based on the available data. The Deer Creek Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the IDEM data. Reductions of 92.9%, 36.0%, 64.1% and 6.0% 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 13 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 9 sites showed areas with inadequate or no stream buffers (see Exhibit 27), 3 locations had in-stream debris, 1 livestock access point to a stream was observed and conventional tillage practices were seen in 4 of the locations (see Exhibit 29) within the Deer Creek Subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the Deer Creek Subwatershed is a Medium Priority Subwatershed for Best Management Practice implementation.

The Deer Creek Subwatershed is approximately 82% agricultural with no significant urban areas. Therefore, the BMPs suggested in Table 54 for this subwatershed are agricultural/rural focused and are beneficial in reducing pollutant loadings for more than one impairment.

The subwatershed is critical for *E. coli.* The Middletown Wastewater Treatment Plant has an outfall permit for three locations within the Deer Creek Subwatershed. Similarly, the Shenandoah Middle and High School has a NPDES permit within the subwatershed which are all potential sources for elevated pollutant levels. There were 4 E.coli, 14 N and 2 TSS exceedances reported for these outfalls based on the information obtained from IDEM. The potential for wetland restoration within the subwatershed, to help reduce E. coli levels, is feasible due to 25.9% 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.

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 92.9% 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 53 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 3 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 27 miles of major stream corridor 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 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 82% agricultural land with at least 4 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 Phosphorus loadings. Based on the tillage information for Henry County, approximately 24% 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.

Based on this information, BMP implementation projects are very feasible within the Deer 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.

Prairie Creek Subwatershed

The Prairie Creek 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 Prairie Creek Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality target for of *E. coli* in the IDEM data. Reductions of 93.6% for *E. coli*, is needed to meet the target load set for the subwatershed.

During the windshield survey, 2 of the 18 stream sites showed areas of streambank erosion that exceeded 3 feet (see Exhibit 28), 10 sites showed areas with no or inadequate stream buffers (see Exhibit 27) and 6 locations had in-stream debris. 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 63% agricultural with urban areas concentrated in the northern portion of the subwatershed associated with Anderson, and in the western portion of the subwatershed associated with Pendleton. Therefore, the BMPs suggested in Table 54 for this subwatershed are agricultural/rural and urban focused and are beneficial in reducing pollutant loadings for more than one impairment.

Although the windshield survey did not show any locations where animals could access streams, 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 93.6% in order to meet the target loads. Implementation of the exclusionary fencing alone provides a 90% reduction in E. coli based on Table 53 Best Management Practice Load Reduction Summary in Section 6.

The windshield survey results also showed that the subwatershed has at least 4 sites with no stream buffers or evidence of streambank erosion greater than 3 feet in depth. The subwatershed has approximately 14 miles of major stream corridor 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, naturalized stream buffers and stream restoration within the subwatershed as a best management practice for reducing Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 63% agricultural land and the tillage information for Madison County indicates that approximately 73% of corn fields in the County operate using conventional tillage practices, promoting no-till or reduced till (conservation tillage) practices within this subwatershed would also help to reduce pollutant loadings. Grassed waterways and Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

Approximately 34.5% 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 Prairie Creek Subwatershed includes a portion of the City of Anderson and the Town of Pendleton. Urban runoff is often a significant source of nonpoint source pollution within a watershed. The implementation of BMPs such as infiltration trenches and rain barrels/rain gardens within urban areas has the potential to significantly reduce the pollutant loadings within the watershed.

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.

Headwaters Lick Creek Subwatershed

The Headwaters Lick Creek Subwatershed shows a low level of current water quality impairment (ranked seventh) and a moderate level of land use and industrial impairments (ranked fifth) based on the available data. The Headwaters Lick Creek Subwatershed exceeded the water quality targets for *E. coli*, Nitrate + Nitrite, Phosphorus and TSS in the CIWRP study and exceeded the water quality target for *E. coli*, Nitrate + Nitrite in the IDEM data. Reductions of 93.8% and 11.1% needed for *E. coli* and Nitrate + Nitrite, respectively to meet the target loads set for the subwatershed.

During the windshield survey, 4 of the 9 stream sites showed areas of minor streambank erosion (see Exhibit 28), 8 sites showed areas with insufficient or no stream buffers (see Exhibit 27), 2 locations had in-stream debris, 1 location of animal access to the stream (Exhibit 26) was observed and conventional tillage practices were seen in 5 of the locations (see Exhibit 29) within the Headwaters Lick Creek Subwatershed. Based on these findings and as outlined in Part Three of the Watershed Inventory (Watershed Ranking tables and summaries), the subwatershed is a Medium Priority Subwatershed for Best Management Practice implementation.

The Headwaters Lick Creek Subwatershed is approximately 85% agricultural with the only urban area concentrated in the eastern portion of the subwatershed associated with Markleville. Therefore, the BMPs suggested in Table 54 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 and there is 1 active CFO. 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 93.8% 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 53 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 6 sites with no stream buffers or evidence of streambank erosion. The subwatershed has approximately 25 miles of major stream corridor 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 within the subwatershed as a best management practice for reducing *E. coli*, Nitrate+Nitrite, Total Phosphorus and TSS.

Since the subwatershed is 85% 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 tillage information for Madison County, approximately 73% of corn fields in the County operate using conventional tillage practices. Nutrient/Waste Management plans would also be a beneficial BMP within these agricultural areas for reduction of all pollutants.

Approximately 30.1% 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 Headwaters Lick 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.

Low Priority Subwatersheds

The McFadden Ditch and Foster Branch Subwatersheds are both considered Low Priority areas.

The McFadden Ditch Subwatershed shows a low level of current water quality impairment (ranked eighth) and a low level of land use and industrial impairments (ranked seventh). The Foster Branch Subwatershed shows a moderate level of current water quality impairment (ranked fifth) and a low level of land use and industrial impairments (ranked eighth).

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.

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

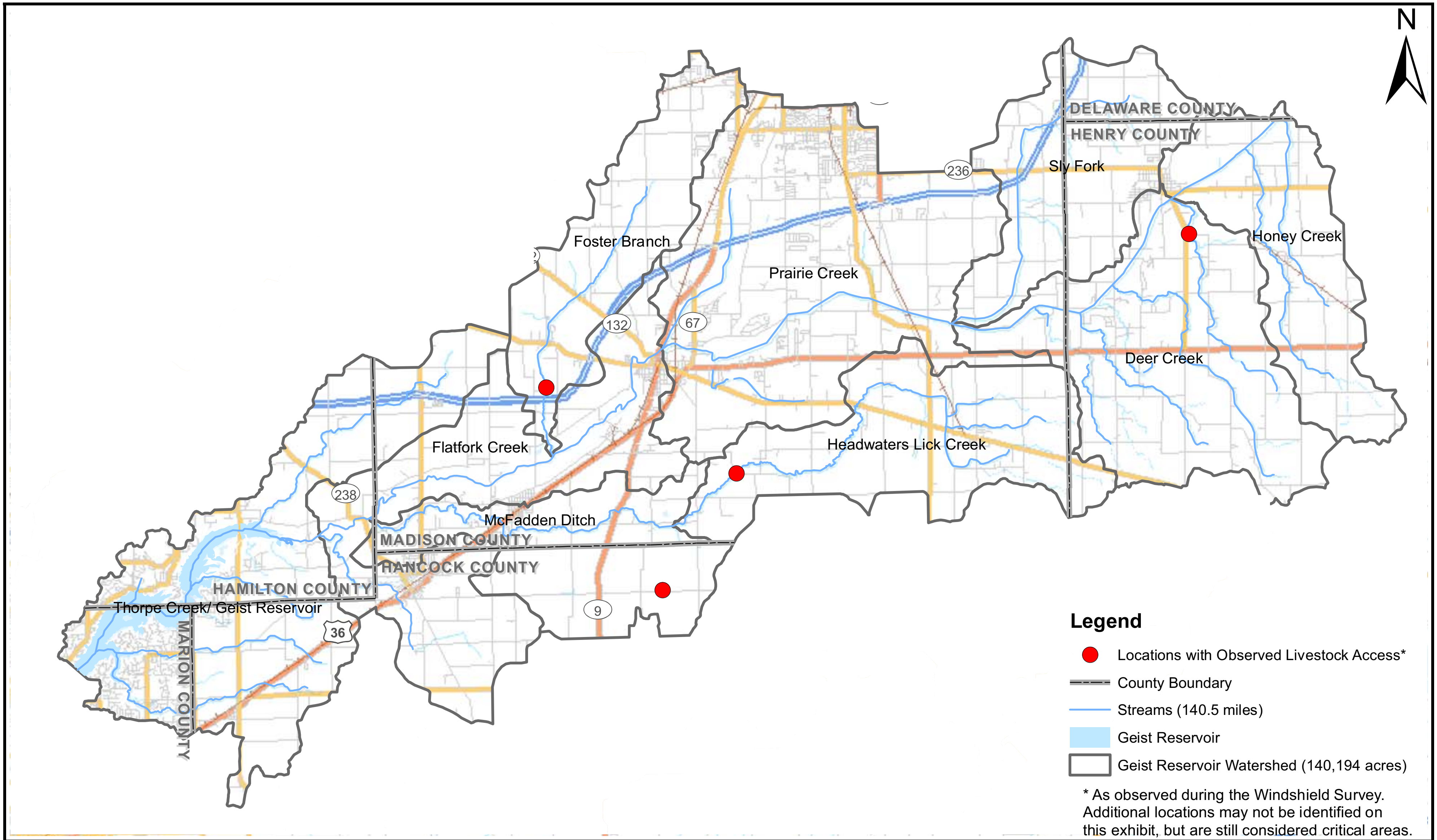
All areas in the watershed where livestock have direct access to the stream are identified as being critical.

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 26 shows the locations where direct animal access to streams 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 to streams 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 and the surrounding land use. 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.



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7325 Janes Avenue
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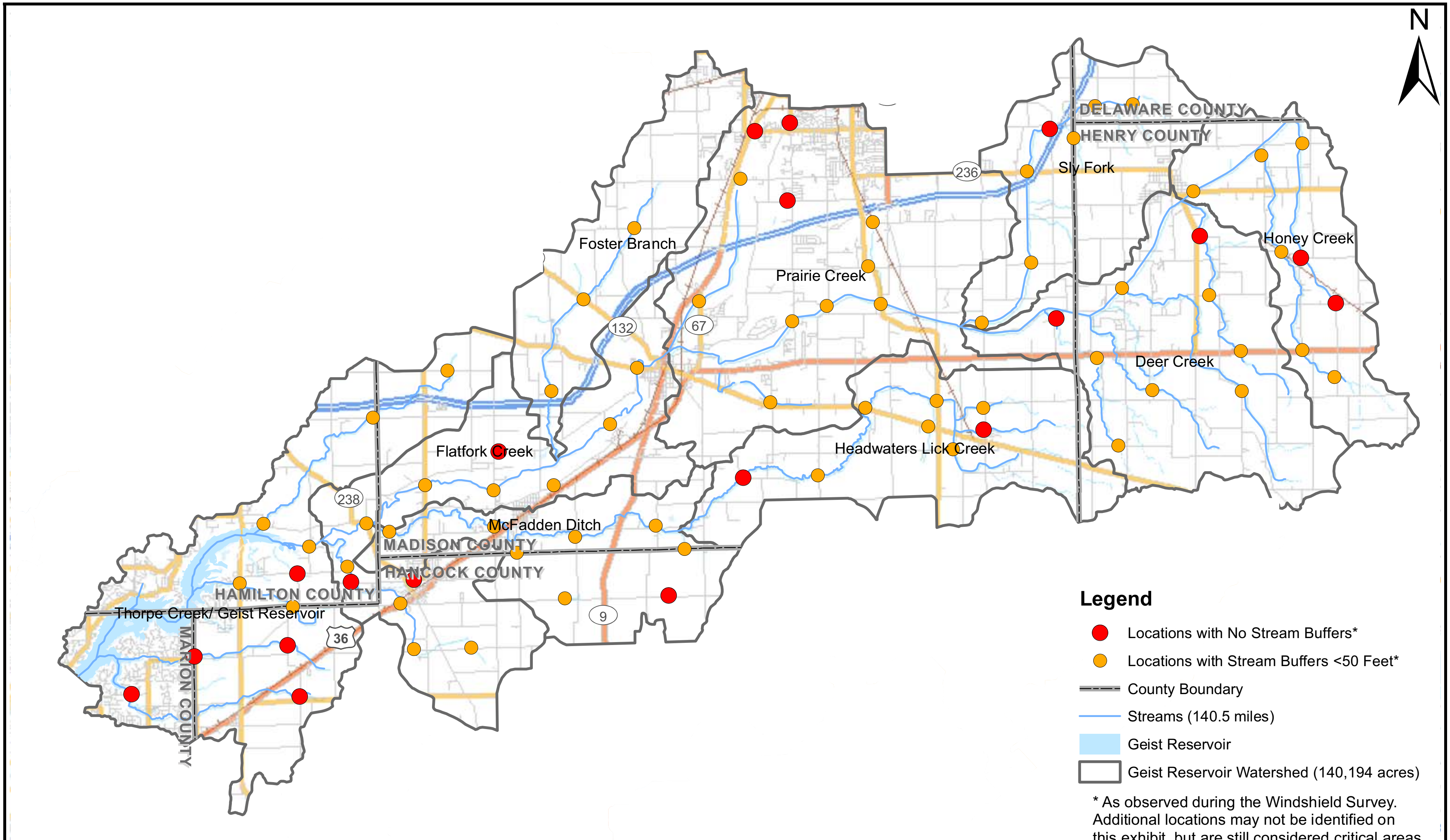
TITLE:	**Livestock Access Critical Area Exhibit**
BASE LAYER:	HUC-12 Watershed Boundaries
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206
PROJECT:	**Geist Reservoir/Upper Fall Creek Watershed Management Plan**
PROJECT NO.:	09006
EXHIBIT:	26
SHEET:	1 OF: 1
QUADRANGLE:	N/A
DATE:	09/30/10
SCALE:	1" = 16,000'



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TITLE: **Stream Buffers Critical Areas**	PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**		
BASE LAYER: HUC-12 Watershed Boundaries	PROJECT NO.: 09006	EXHIBIT: 27	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance, P.O. Box 2065, Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'

Stream buffers were assessed on a subwatershed scale at each of the waterway crossing points. Identification of buffers was broken up into the following categories: absent, present > 50 feet and present (minimum 10 feet) < 50 feet. Insufficent buffers include the buffers identified as less than 50 feet. Exhibit 27 shows the locations where absent or insufficient stream buffers were 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 absent or insufficient buffers may not be specifically identified, but are still considered critical areas. It should be noted that the 30 feet reference in the BMP section is in regards to the minimum required buffer width for funding opportunities from the USDA and in general is a standard minimum for water quality. The 50 foot reference is for the windshield survey. It was determined to use 50 feet instead of 30 feet since this parameter wasn't going to actually be measured but observed from a vehicle and therefore leaving some room for interpretation.

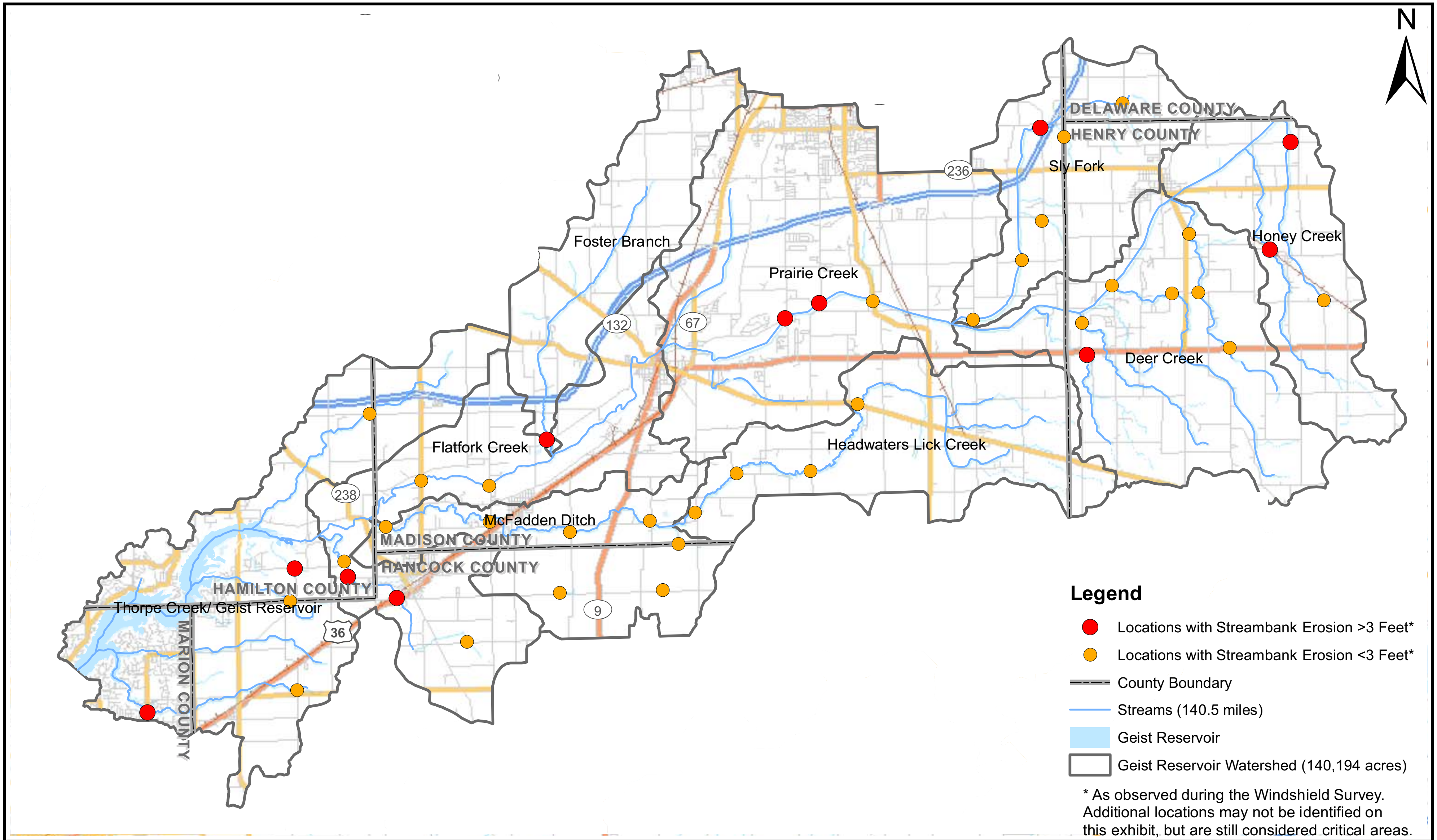
Excessive Streambank Erosion
All areas where excessive streambank erosion is occurring are identified as being critical.

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.

Streambank erosion was assessed on a subwatershed scale at each of the waterway crossing points. Identification of streambank erosion was broken up into the following categories: absent, stabilized (rip-rap, coir log, etc.), present > 3 feet tall and present < 3 feet tall. Excessive streambank erosion includes those areas where erosion was identified as being greater than 3 feet. Exhibit 28 shows the locations where excessive streambank erosion 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 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, especially those adjacent to waterways, are identified as being critical.

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 29 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.



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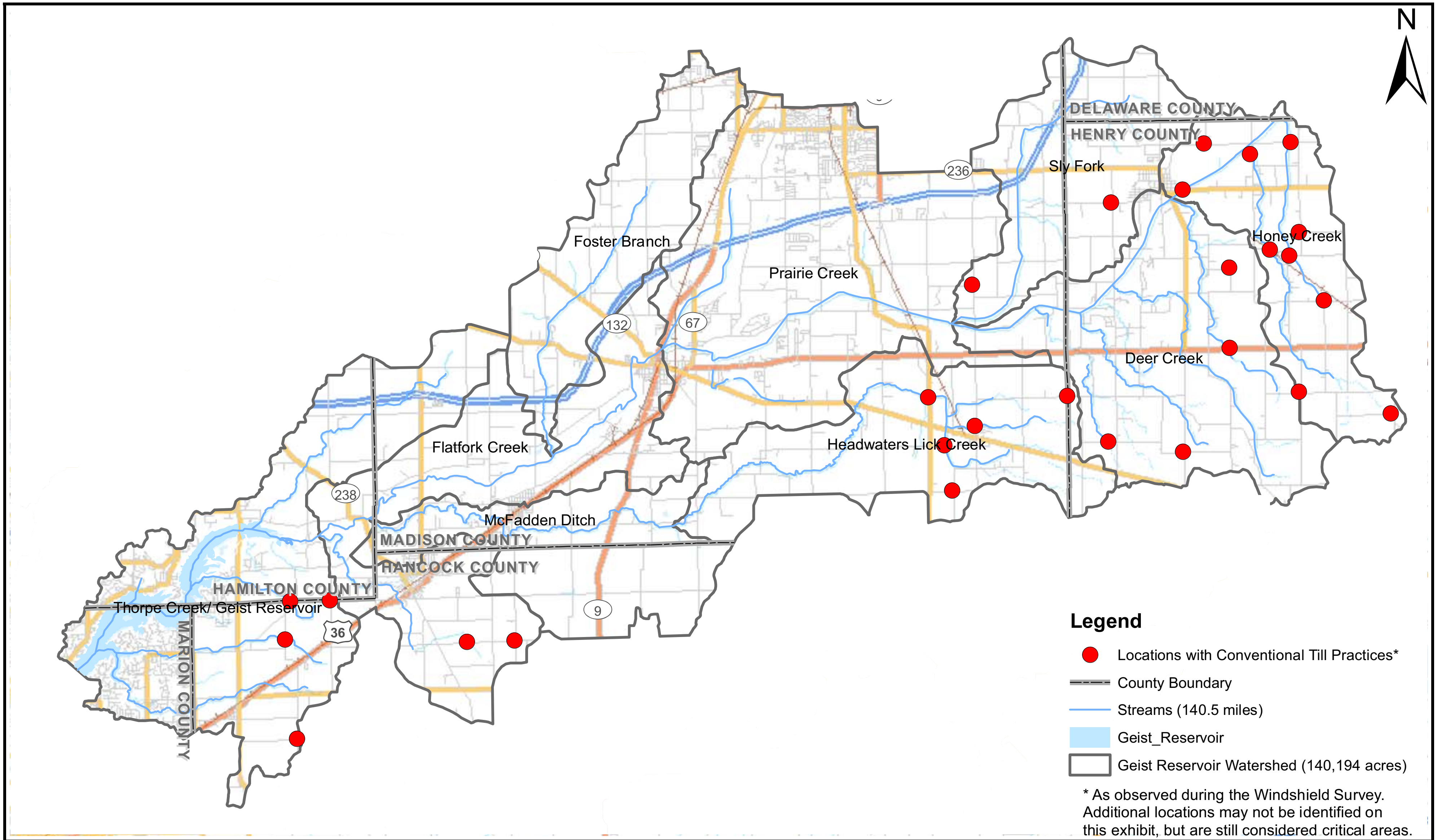
TITLE:	**Streambank Erosion Critical Areas**
BASE LAYER:	HUC-12 Watershed Boundaries
CLIENT:	Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206

PROJECT:		
Geist Reservoir/Upper Fall Creek Watershed Management Plan		
PROJECT NO.: 09006	EXHIBIT: 28	SHEET: 1 OF: 1
QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'



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TITLE: **Conventional Till Critical Areas**	PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**		
BASE LAYER: HUC-12 Watershed Boundaries	PROJECT NO.: 09006	EXHIBIT: 29	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance, P.O. Box 2065, Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/30/10	SCALE: 1" = 16,000'

Section 6 – Choose Measures/BMPs to Apply

BMPs

The watershed restoration and management techniques described in this section, when applied to the Geist Reservoir/Upper Fall Creek Watershed, can help achieve the watershed goals and objectives to decrease the concentrations of sediment and nutrient loads 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. 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 for one year or less.

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.

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 Geist Reservoir/Upper Fall 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 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 *Geist* 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 Geist Reservoir/Upper Fall 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 Geist Reservoir/Upper Fall 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/Field Maintenance and Repair
Septic, or on-site waste disposal systems, are the primary means of sanitary flow treatment in the unincorporated parts of the Geist Reservoir/Upper Fall Creek Watershed. Because of the prohibitive cost of providing centralized sewer systems to many areas, septic tank systems and fields 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 as well as being a direct source for elevated *E.coli* counts. Therefore, it is imperative for homeowners not to ignore septic failures. If plumbing fixtures back up or will not drain, the system is failing. The difficulty with this issue is that perception is that if you don't see it then it's not a problem. Until damage occurs to the actual property or homeowner, regular maintenance or repair isn't happening. Funding for this practice is limited as well.

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 Geist Reservoir/Upper Fall 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 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 Geist Reservoir/Upper Fall 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 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. Therefore, when looking at overall reductions in a given subwatershed, an aggregate for all BMPs implemented with each associated tributary area will be need to be evaluated.

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 53 shows the expected load reductions and associated costs for each BMP.

Table 53: 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 54 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 49-51 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 53 for its associated critical impairment. Certain BMPs are suggested for more than one impairment (i.e. Buffer/Filter Strips are suggested for *E.coli*, Nitrate+Nitrite, Total Phosphorus, 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 54: BMP Selection		
Critical Area	**Reason for being Critical**	**Suggested BMP**
High Priority Subwatersheds		
Thorpe 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
	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
	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
		Grassed Waterway
		Infiltration Trench
		Naturalized Stream Buffer
		Rain Barrel/Rain Garden
		Stream Restoration

Table 54 cont.: BMP Selection		
Critical Area	**Reason for being Critical**	**Suggested BMP**
High Priority Subwatersheds		
Honey 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
	Conventional Tillage Practices	Education and Outreach
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)
	Streambank Erosion	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Grassed Waterways
		Infiltration Trench
		Naturalized Stream Buffer
		Rain Barrel/Rain Garden
		Stream Restoration
Flatfork Creek	*E.coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	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
		Grassed Waterway
		Infiltration Trench
		Naturalized Stream Buffer
		Rain Barrel/Rain Garden
		Stream Restoration

Table 54 cont.: BMP Selection		
Critical Area	**Reason for being Critical**	**Suggested BMP**
High Priority Subwatersheds		
Sly Fork Creek	*E.coli*	Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
		Wetland Restoration
	In-stream Debris	Education and Outreach
Medium Priority Subwatersheds		
Deer Creek Prairie Creek Headwaters Lick Creek	*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
		Stream Restoration
		Wetland Restoration
	Livestock Access	Alternative Watering System
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
	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
		Grassed Waterway
		Infiltration Trench
		Naturalized Stream Buffer
		Rain Barrel/Rain Garden
		Stream Restoration

Table 54 cont.: BMP Selection		
Critical Area	**Reason for being Critical**	**Suggested BMP**
Low Priority Subwatersheds		
McFadden Ditch Foster Branch	*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
Specific Source Critical Areas		
Livestock Access		Alternative Watering System
		Education and Outreach
		Exclusionary Fencing
		Nutrient/Waste Management
Absent or Insufficient Stream Buffers		Education and Outreach
		Buffer/Filter Strips
		Stream Restoration
Excessive Streambank Erosion		Alternative Watering System
		Buffer/Filter Strips
		Education and Outreach
		Exclusionary Fencing
		Grassed Waterway
		Infiltration Trench
		Naturalized Stream Buffer
		Rain Barrel/Rain Garden
		Stream Restoration
Agricultural Areas Practicing Conventional Tillage		Education and Outreach
		Nutrient/Waste Management
		No-till/Reduced Till (Conservation Tillage)

Incentives/Cost Share Opportunities

There are a number of incentive programs to implement BMP projects. Funding 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. It will be the decision of the Steering Committee to prioritize the implementation projects for the watershed which will guide the decision of which funding opportunity to choose. The following is a description of the known funding sources applicable for implementation of this WMP.

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 nonpoint 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 (ie. 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 Geist Reservoir/Upper Fall Creek WMP is very ambitious and continued implementation of the plan will require and even greater degree of cooperation and coordination among partners and funding for projects. It will be the decision of the Steering Committee to prioritize the implementation projects for the watershed which will also guide the decision of which funding opportunity to choose (as described in the Incentives/Cost Share Opportunities section of this WMP).

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 Geist Reservoir/Upper Fall 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.

Table 55: 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 GWA website on a monthly basis -Link UWRWA Geist page to efforts on GWA 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/nature of nonpoint sources	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
	Coordinate with Count SWCDs to get more agriculture stakeholders involved in plan implementation	All stakeholders and landowners within the watershed	-Identify GWA liaison to coordinate with SWCDs within first 6 months -Meet with County SWCD representative within 1 year -Identify key Ag stakeholders and set up 2 meetings with appropriate SWCD representative to discuss plan implementation within 1 year	$1,000 - $2,600 (Estimated $100/hour for 6 hours to compile list and 2 hours per meeting for 2-10 meetings)	PP – SWCDs TA – SWCDs
	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 55, cont.: Public Participation/Education and Outreach Action Register					
Objective		**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Short Term Objectives (cont.) (0-5 Years)	Work with Indiana Wildlife Federation on efforts to educate on and reduce the use of fertilizers containing phosphorus	Indiana Wildlife Federation	-Identify GWA 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 1 year -Complete chosen Education/Outreach mechanism within 2 years	$150 - $4,000 (for direct cost of chosen outlet)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, County Health Dept., Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, County Health Dept., Veolia, IDEM, DNR, Consultant
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
	Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans	All stakeholders and landowners within the watershed	-Identify GWA liaison to coordinate with local officials -Meet with municipal staff representatives -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
	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
	Review education and outreach program within the watershed and continue development and implementation of the program	N/A	-Review tasks and effectiveness at GWA/Sub-Committee Meetings	N/A	PP – N/A TA – N/A

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.

Goal Statement: Reduce *E.coli* concentrations to meet the state standard of 235 CFU/100mL.

Table 56: *E.coli* Levels Action Register					
	Objective	**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
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 immediate implementation within 6 months -Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 3 years	$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
	Partner with NRCS, SWCDs and County Officials/Boards to promote/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 – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	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 1 year -Complete chosen Education/Outreach mechanism within 1 year	$150 - $4,000 (for direct cost of chosen outlet)	PP – UWRWA, MS4s, SWCDs, County Surveyor's, County Health Dept., Veolia, IDEM, DNR TA – UWRWA, MS4s, SWCDs, County Surveyor's, County Health Dept., Veolia, IDEM, DNR, 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

Table 56, cont.: *E.coli* Levels Action Register					
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 agriculture stakeholders on the benefits of manure management practices	Agricultural landowners	-Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2	$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
	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 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

Nutrient Levels

Problem Statement: Nutrient concentrations within all subwatersheds frequently exceed water quality targets thereby aiding the 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.

Table 57: Nutrient Levels Action Register					
Objective		Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Short Term Objectives (0-5 Years)	Educate the public and stakeholders of the importance of reduced application of fertilizers or use of low phosphorus or no phosphorus fertilizers	Urban & agricultural landowner, fertilizer companies and operators	-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
	Partner with NRCS, SWCDs, MS4s and County Officials/Boards to promote/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 – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Educate local, regional, and state officials on the need for regulations for urban areas (specifically for phosphorus)	Local, regional and state officials	-Identify GWA 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
	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/Residential 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 57, cont.: Nutrient Levels Action Register					
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
	Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans	All stakeholders and landowners within the watershed	-Identify GWA liaison to coordinate with local officials -Meet with municipal staff representatives -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
	Establish a monitoring program or group to collect samples	Other groups/ organizations with similar watershed goals	-Identify any monitoring efforts currently being within the watershed by other groups within -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

Problem Statement: Soil erosion and sedimentation within the watershed is degrading the water quality 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.

Table 58: Erosion and Sedimentation Action Register					
Objective		Target Audience	Task	Cost	Possible Partner (PP) and Technical Assistance (TA)
Short Term Objectives (0-5 Years)	Partner with NRCS, SWCDs, MS4s, County Officials/Boards, High Schools and FFA programs to promote/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 – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant
	Encourage enforcement of erosion control practices associated with the issuance of Rule 5 construction permits	Local MS4s and SWCDs	-Identify enforcement officers within 6 months -Educate public on how to identify potential violators utilizing most effective Education/Outreach outlet within 3 years -Establish reporting mechanism with enforcement officers within 5 years	$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 – IDEM, MS4s, SWCDs TA – IDEM, MS4s, SWCDs, 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/Residential 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 58, cont.: Erosion and Sedimentation Action Register					
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				
	Work with local municipalities to incorporate smart growth principles and green infrastructure practices into zoning/stormwater ordinances and comprehensive plans	All stakeholders and landowners within the watershed	-Identify GWA liaison to coordinate with local officials -Meet with municipal staff representatives -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
	Establish a monitoring program or group to collect samples	Other groups/ organizations with similar watershed goals	-Identify any monitoring efforts currently being 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

Exotic Species in the Reservoir

Problem Statement: Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.

Goal Statement: Reduce and control the growth of exotic plants within the reservoir.

Table 59: Exotic Species in the Reservoir Action Register					
	Objective	**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Short Term Objectives (0-5 Years)	Educate the public and stakeholders on how exotic species are introduced and ways to control new introductions	Reservoir Users	-Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 3 years	$150 - $8,000 (for direct cost of chosen outlets per year)	PP – UWRWA, MS4s, Veolia, IDEM, DNR TA – UWRWA, MS4s, Veolia, IDEM, DNR, Consultant
Short Term Objectives (0-5 Years)	Partner with the marinas, fishing tournament groups, homeowner organizations, etc to promote/implement cost share and/or education programs	Reservoir Users	-Identify reservoir organizations within 1 year -Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 3 years	$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, Veolia, IDEM, DNR TA – UWRWA, MS4s, Veolia, IDEM, DNR, Consultant
Long Term Objectives (6-20 Years)	Continue viable and effective short term objectives				
Long Term Objectives (6-20 Years)	Regular update of AVMP and implement according to recommendations	Reservoir Users	-Complete AVMP update	$5,000-$10,000 per update	PP – DNR TA – Consultant

Lack of Funding Sources for Urban Areas

Problem Statement: There is a lack of funding for the implementation of Best Management Practices within urban areas.

Goal Statement: Identify and utilize existing BMP funding sources and encourage the development and enhancement of additional and non-traditional funding sources.

Table 60: Lack of Funding Sources for Urban Areas Action Register					
	Objective	**Target Audience**	**Task**	**Cost**	**Possible Partner (PP) and Technical Assistance (TA)**
Short Term Objectives (0-5 Years)	Educate homeowners and stakeholders on the benefits and importance of urban BMPs	Urban 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, Veolia, IDEM, DNR TA – UWRWA, MS4s, Veolia, IDEM, DNR, Consultant
	Partner with MS4s, foundations, community groups, judicial services, community service programs, high schools, etc to identify existing and develop new funding sources for urban BMP implementation	Other groups/organizations with similar watershed goals	-Identify existing funding sources within 6 months -Identify/encourage organizations/entities to incorporate funding mechanisms not already in place within 1 year	$600 - $1,200 (Estimated $100/hour for 6 to 12 hours of time)	PP – UWRWA, MS4s, County Surveyor's TA – N/A
	Research/educate homeowners on do-it-yourself BMPs	Urban landowners	-Create a list of potential BMPs for immediate implementation within 6 months -Choose the 4 most effective outlets from the Education/Outreach Menu and complete 2 within 3 years	$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 TA – UWRWA, MS4s, County Surveyor's, Consultant

Table 60, cont.: Lack of Funding Sources for Urban Areas Action Register					
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				
	Encourage demonstration projects throughout the watershed in cooperation with MS4s Education and Outreach programs	Urban landowners	-Identify/prioritize eligible projects and complete based on priority	Varies based on BMP chosen (see Section 6 for estimated costs)	PP – UWRWA, MS4s, County Surveyor's TA – UWRWA, MS4s, County Surveyor's, Consultant
	Partner with MS4s, foundations, community groups, judicial services, community service programs, high schools, etc to promote and implement cost share opportunities for implementation of BMPs	Other groups/organizati ons with similar watershed goals	-Identify eligible projects and complete	$600 - $1,200 (Estimated $100/hour for 6 to 12 hours of time)	PP – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's TA – UWRWA, NRCS, SWCDs, MS4s, County Surveyor's, Consultant

Partnerships

To help achieve the objectives of the Watershed Management Plan, three sub-committees have been formed to spearhead and guide the activities necessary. The sub-committees will work to develop beneficial partnerships with other local and regional groups. These sub-committees include:

1. Education and Outreach/Awareness and Communications Sub-Committee
2. Fund Raising Sub-Committee
3. Product/Services Sub-Committee

The Education and Outreach/Awareness and Communications Sub-Committee will work with local schools, corporations, and government bodies to assist with natural resource education. Members of this committee will research and provide or create educational materials that promote watershed awareness. They will develop key themes and messages for the watershed. Members will also write editorials and solicit donations or grants to cover publication and outreach costs. Coordination with the UWRWA, MS4s, SWCDs, County Officials/Boards and other local groups on education and outreach materials will be the responsibility of this sub-committee.

The Fund Raising Sub-Committee effort is focused on the securing of funds for efforts of implementation within the watershed. Members will work to ensure the ability of the group to match grant requirements and raise funds for special events or actions. The sub-committee will work to create a community/resident base sponsorship/partnership, corporate sponsorship/partnership and local business sponsorships/partnerships. Members will research additional grant sources and opportunities for the watershed.

The Product/Services Sub-Committee will help ensure “green” product availability and ensure “green” communications awareness at retail locations. Members will also work directly with lawn care service providers to educate and obtain a commitment to offer “green solutions”. Members will identify and establish collaborative relationships with entities that have potential influence on water quality and will contact legislators and other influential members of local government to inform of current Geist Reservoir/Upper Fall Creek Watershed activities and issues.

The establishment and specific tasks assigned to each of the Sub-Committee groups will allow for multiple avenues of watershed improvement to be pursued. Awareness of issues and impairments within the watershed will increase stakeholder participation and will hopefully increase membership of the Geist Reservoir/Upper Fall Creek Watershed Steering Committee.

Section 8 – Tracking Effectiveness

Evaluating Plan Performance

This Management Plan is meant to be a flexible tool to achieve water quality improvements within the Geist Reservoir/Upper Fall 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.

In order to evaluate the implementation progress, a milestone completion log (Table 61) was completed for all milestones identified in the Action Register. An indicator tracking log (Table 62) was also created to evaluate the overall impact of implementation of the WMP. The indicators will be based on records maintained by the Steering Committee and in coordination with the partners identified within the Action Register. Available sampling data from IDNR, IDEM and CIWRP on-going studies and/or an implemented water monitoring program will be utilized to determine the loading of pollutants and changes based on the implementation of the plan.

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 January 2010. Dates were assigned to each milestone timeframe based on the implementation start date.

Table 61: Task Completion Log		
Task	**Start Date**	**Completion Date**
Monthly (Beginning March 2011)		
Update GWA website on a monthly basis		
6 months (Completed September 2011)		
Link UWRWA Geist page to efforts on GWA website		
Compile a list of publications willing to feature watershed articles		
Identify all Education and Outreach focused organizations/ committees within the watershed		
Identify GWA liaison to coordinate with IWF		
Identify GWA liaison to coordinate with County SWCDs		
Identify erosion control enforcement officers within the watershed		
Research/compile a list of all available existing urban BMP funding sources		
Create a list of potential do-it-yourself BMPs for homeowners		
Create a list of potential BMPs for Canada goose waste disposal		
1 year (Completed March 2011)		
Identify all local, state and/or federal programs focused on nutrient management, erosion control and *E.coli* reduction		
Identify reservoir organizations for partnership on education and funding opportunities for exotic species management		
Meet with County SWCDs and identified key Ag stakeholders		
Complete 2 Education/Outreach Menu items focused on stakeholders and their impact to the watershed and nature of nonpoint sources		
Complete 2 Education/Outreach menu items focused on the use of fertilizers and low/no phosphorus products		
Complete 2 Education/Outreach Menu items on use of low/no P fertilizers		
Complete 1 Education/Outreach Menu item focused on importance of septic system maintenance		
Identify/encourage organizations to incorporate funding mechanisms for urban BMPs		
Attend at least one meeting focused on coordinating efforts with IWF		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		
2 years (Completed March 2012)		
Complete 1 Education/Outreach Menu item focused on importance of septic system maintenance		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		

Table 61, cont.: Task Completion Log		
Task	**Start Date**	**Completion Date**
3 years (Completed March 2013)		
Coordinate with IWF and ILMWG on on-going efforts at the state level		
Identify avenues to communicate P regulation concerns to local officialsl		
Educate public on how to identify potential erosion control violators		
Attend at least one meeting for each educational and outreach organization and evaluate the required efforts for coordination		
Complete 2 Education/Outreach Menu items focused on do-it-yourself BMPs for homeowners		
Complete 2 Education/Outreach Menu items focused on exotic species and methods to control introduction		
Complete 2 Education/Outreach Menu items focused on the proper disposal of Canada goose waste		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		
5 years (Completed March 2015)		
Identify eligible projects for cost share opportunities in nutrient management and complete at least 1		
Identify eligible projects for cost share opportunities in erosion and sediment control and complete at least 1		
Establish reporting mechanism for erosion and sediment control violations		
Promote and implement agricultural BMPs		
Promote and implement urban BMPs		
6-20 years (March 2016 – February 2030)		
Identify GWA liaison to coordinate with local officials with regards to incorporation of smart growth principles and green infrastructure practices into ordinances and comprehensive plans		
Complete 1 Education/Outreach Menu item focused on use of Atrazine and its impacts to water quality within Ag community		
Review education and outreach program and continue development and implementation		
Complete 2 Education/Outreach Menu items focused on manure management practices		
Identify all currently permitted point dischargers		
Research possible regulation changes for point dischargers		
Educate to determine best practices and reducing pollutant targets		
Establish a monitoring program or group to collect samples for nutrients, sediment and *E.coli*		
Identify GWA liaison to coordinate with local, regional and state officials for phosphorus regulations		
Indentify/prioritize eligible urban BMPs and complete based on priority		
Identify areas where conservation tillage is currently practiced and identify/incorporate eligible cost share programs		
Complete AVMP update		
Identify/prioritize eligible eroded streambank projects and complete based on priority		

Table 62: Indicator Tracking Log																	
Year of Implementation	# of updates to website	# of programs/ideas utilized from Education/Outreach Menu	# of existing funding sources utilized for urban BMPs	# of new/nontraditional funding sources for BMP implementation utilized	# of agricultural fields that have stopped utilizing Atrazine	# of point dischargers reducing their pollutant loadings	# of observed Nitrate + Nitrite 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	# of areas in reservoir treated according to AVMP recommendations
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 & Related Organizations

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

Appendix E – Public Meeting Agendas & Sign-In Sheets

Appendix F – IDEM Data

Appendix G – CIWRP Data

Appendix H – Windshield Survey Data

Appendix I – NPDES/CFO Compliance

Appendix J – Reservoir Shoreline Investigation

Appendix K – Nonpoint Source Modeling

Appendix L – Education and Outreach Menu

Appendix M – Highly Erodible Land Documentation

Appendix A – Acronyms and Abbreviations

ACOE- Army Corps of Engineers

BFE- Base Flood Elevation
BMP- Best Management Practices

CAP- Continuing Authorities Program
CEES- Center for Earth and Environmental Science
CFO- Confined Feeding Operation
cfs- cubic feet per second
CFU- Colony Forming Units
CIWRP- Central Indiana Water Resources Partnership
CREP- Conservation Reserve Enhancement Program
CRP- Conservation Reserve Program
CSOs- Combined Sewer Overflows
CSP- Conservation Stewardship Program
CWA- Clean Water Act

DO- Dissolved Oxygen

EPA- Environmental Protection Agency
EPT- Ephemeroptera, Plecotera, Trichoptera
EQIP - Environmental Quality Incentives Program

FEMA- Federal Emergency Management Agency
FFA- Future Farmers of America
FIRM- Flood Insurance Rate Maps
FSA- Farm Service Agency

GWA- Geist Watershed Alliance

HBI- Hilsenhoff Family Biotic Index
HEL- Highly Erodible Land
HUC- Hydrologic Unit Code

IAC- Indiana Administrative Code
IBC- Impaired Biotic Communities
IBI- Index of Biotic Integrity
IDEM- Indiana Department of Environmental Management
IDNR- Indiana Department of Natural Resources
INDOT- Indiana Department of Transportation
IWF – Indiana Wildlife Federation
IUPUI- Indiana University Purdue University Indianapolis

LARE- Lake and River Enhancement Program

MCHD- Marion County Health Department
mg/L- milligrams per liter
mIBI- Macroinvertebrate Index of Biotic Integrity
MS4s- Municipal Separate Storm Sewer System

N- Total Nitrogen
NLCD- National Land Cover Data
NH3- Ammonia
NH4 - Ammonium
NO2- Nitrite
NO3- Nitrate
NOAA- National Oceanic and Atmospheric Administration
NPDES- National Pollutant Discharge Elimination System
NPS- Nonpoint Source
NRCS- Natural Resource Conservation Service
NTU- Nephelometric Turbidity Units

P- Total Phosphorus
PCB - Polychlorinated Biphenyls
PRD- Planned Residential Developments
PUD- Planned Unit Developments

QHEI- Qualitative Habitat Evaluation Index

STEPL- Spreadsheet Tool for Estimating Pollutant Load
SWCD- Soil & Water Conservation District

T&E- Threatened and Endangered
TDS- Total Dissolved Solids
TKN- Total Kjeldahl Nitrogen
TMDL- Total Maximum Daily Load
TSS- Total Suspended Solids

ug/L- Micrograms per Liter
USDA – United States Department of Agriculture
USGS-United States Geological Survey
USLE- Universal Soil Loss Equation
USWRC – United States Water Resources Council
UWRWA- Upper White River Watershed Alliance

WHIP- Wetland Habitat Incentive Program
WMP- Watershed Management Plan
WRP- Wetland Reserve Program
WWTP – Wastewater Treatment Plant

Appendix B – References

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Appendix C – Stakeholder Groups and Related Organizations

Stakeholder groups identified within the watershed as well as representatives from the groups that participated on the Steering Committee are listed below.

Ball State Facilities

- Kevin Kenyon

City of Anderson

City of Indianapolis

City of Lawrence

Delaware County Soil and Water Conservation District

Geist Lake Coalition

Geist Marina

- Kent Duckwall

Geist Watershed Alliance (GWA)

- Scott Rodgers

Hancock County Soil and Water Conservation District

- Cindy Newkirk

Hamilton County Soil and Water Conservation District

- Shaena Reinhart

Hamilton County Surveyor's Office

- Kenton C. Ward, Hamilton County Survey
- Robert Thompson

Henry County Soil and Water Conservation District

- Kellie Harding

Henry County Surveyor

- Richard Byers

Indiana Department of Environmental Management (IDEM)

- Bonny Elifritz
- Ernest Johnson

Indiana Department of Natural Resources (IDNR)
- Angela Sturdevant

Indiana University Purdue University Indianapolis (IUPUI) – Center for Earth and Environmental Science (CEES)
- Angela Cowan
- Lenore Tedesco

Indiana Wildlife Federation
- Marija Watson

Madison County Soil and Water Conservation District
- Stephen Schmidt

Madison County Surveyor
- Patrick Manship

Marion County Soil and Water Conservation District
- Glenn Lange
- Ron Lauster

Shorewalk Condo Associations Dredging Committee
- Sharon Ferguson

Sierra Club
- Bowden Quinn

Town of Fishers
- Jason Armour

Town of Fortville

Town of Ingalls

Town of Markleville

Town of McCordsville

Town of Middletown

Town of Pendleton
- Tim McClintick
- Doug McGee

Upper White River Watershed Alliance (UWRWA)

- Jill Hoffman
- Kelly Levengood

V3 Companies
- Ed Belmonte
- Jessica Dunn
- Carrie Pintar
- Jessica Spurlock
- Greg Wolterstorff

Veolia Water Indianapolis, LLC
- Paul Whitmore

Watershed Residents
- Jo Biggers
- Stephanie Box
- Glenn Brown
- William Ellingson
- Dean Farr
- Sarah Kempfer
- Jhani Laupus
- Matthew Newell
- Nina Sidibe
- Janice Snell
- Wendy Thanisch
- Victor Wakley

White River Watchers
- Crist Blassaras
- Judy DeLury

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

Steering Committee Agendas, Sign-In Sheets and Minutes for the Steering Committee Meetings held on the following dates are included in this appendix.

- February 18, 2009
- March 18, 2009
- April 15, 2009
- August 19, 2009
- October 21, 2009
- November 10, 2009
- December 9, 2009

Geist/Fall Creek Watershed Alliance
STEERING COMMITTEE MEETING
6:30 to 8:30 pm Wednesday, February 18th 2009
Geist Lake Marina
11695 Fall Creek Road
Indianapolis, Indiana 46256
317-849-8455

AGENDA

1. Welcome and Introductions (approximately 6:30-6:45)

2. Discussion regarding Watershed Management Plan (approximately 6:45-7:25)

   - Upper Fall Creek Wastershed

   - Baseline/Benchmark Conditions

     Data Sets from IDEM and IUPUI Sampling Efforts

   - Identifying Problems/Causes, Sources, Critical Areas

3. Discussion Regarding Aquatic Vegetation Management Plan (approximately 7:25-7:30)

4. Break (approximately 7:30-7:35)

5. Project Timeframes and Schedule (approximately 7:35-7:45)

6. Project Commencement Press Release (approximately 7:45-7:55)

7. Initial Watershed Plan Public Meeting (approximately 7:55-8:05)

   - Date and Location

   - Introduction of the Study

   - Identifying Stakeholders

   - Obtaining Public Input

8. Steering Committee Meetings (approximately 8:05-8:15)

    - Approaching Desired Target Members

    - Recruitment from Public Meeting

    - Steering Committee Meeting Details (Locations, Times etc)

9. Geist Reservoir Watershed Events, Activities, and Misc. Topics (approximately 8:15-8:25)

    - Outreach

    - Geist Goes Green (Feb 27 to Mar 1) and (Mar 6 to 8)

    - FTP site

10. Closing and Adjournment (approximately 8:25-8:30)

Upper White River Watershed Alliance

GEIST
WATER QUALITY
GET ON BOARD

Geist/Fall Creek Watershed Alliance Steering Committee Meeting February 18, 2009 Sign-In Sheet

Name	Phone	Email or Address
Ed Belmonte	630-729-6160	EBelmonte@V3co.com
CARRIE PINTAR	630-729-6134	cpintar@v3co.com
WENDY THANISCH	317-579-9551	WENDY@OUTSOURCEDWRITING.COM
[illegible]	317-823-3980	[illegible]
Glenn Lange	317-786-1776	glenn-lange@[illegible]swcd.org
Shaena Smith	317-773-2181	shaena.smith@in.nacdnet.net
DICK BYERS	765 529 4802	rbyers@henryco.net
Jason Armour	317-595-3461	armourjt@fishers.in.us
BOB THOMPSON	776-8495	RCT@CO.HAMILTON.IN.US
TIM McCLINTICK	765 778 3139	tmcclintick@town.pendleton.in.us
Victor WAKLEY	317-590-1461	VictorWakley@HOTMAIL.COM
KENT DUCKWALL	849-8455	KDUCKWALL@MarinaLimited.com
SCOTT RODGERS	826-9551	SCOTT@SCOTTR.COM
Jill Hoffmann	891-8820	jhoffmann@empowerresults.com
Paul Whitmore	263-6517	paul.whitmore@veoliawaterna.com
Janice Snell	845-0994	snell57@AOL.com

Geist/Fall Creek Watershed Alliance
STEERING COMMITTEE MEETING
6:30 to 8:30 pm Wednesday, February 18th 2009
Geist Lake Marina

AGENDA with Notes

1. Welcome and Introductions – 16 people in attendance, see sign-in sheet.

2. Discussion regarding Watershed Management Plan – Carrie Pintar provided the attached presentation regarding the following: Upper Fall Creek Watershed Background Information, Baseline/Benchmark Conditions; Brief Presentation of the Data Sets from IDEM and IUPUI Sampling Efforts; Ed Belmonte discussed Project requirements of incorporating the existing study results and public input with respect to identifying problems, causes, sources and critical areas. Also discussed the Aquatic Vegetation Management Plan, the history of the Lake and River Enhancement Program with regards to the Aquatic Vegetation Management Plan and getting participation from the public and steering committee for field days.

3. Project Commencement Press Release – the group discussed need for press release to get public informed since the last press release was approximately last summer. Paul volunteered with Wendy's assistance to put this together and have for the next steering committee meeting. Wendy to put article in the At Geist publication. Paul also to research various media outlets to get as much exposure as possible. Discussed need to get local Senators and Representatives up to speed and involved with the Watershed Management Plan. Senator Gard has been involved in the past.

4. Initial Watershed Plan Public Meeting – the first public meeting is planned for April and may be held at the Yacht Club. The target group for the first meeting will be the urban and reservoir residents. The second public meeting is planned for June, and will target the upstream portions of the watershed with an emphasis on rural and agricultural areas. The two locations and times were determined based on the targeted groups and their concerns (i.e. reservoir folks – algae and farmers – flooding). Outreach options were discussed with regards to what is currently working for the communities within the watershed and what could be done now to get public informed of the project.

5. Steering Committee Meetings – the next steering committee meeting will be held on March 18th at 5:30pm. The preferred location will be to have the meeting in Fishers, although other locations are possible. Meetings will be moved to first Wednesday of each month with the locations varying each month to potentially reach more people. Discussed having each entity give brief update on what they are doing with regards to programs, public outreach, festivals…etc.

6. Geist Reservoir Watershed Events, Activities, and Misc. Topics – the Upper White River Watershed Alliance will soon have a website where our steering committee can access a password protected FTP site to share information easily. The Geist Lake Marina will be hosting a Geist Goes Green event on the weekends of both February 27 to March 1 and March 6 to 8.

Geist/Fall Creek Watershed Alliance
STEERING COMMITTEE MEETING
5:30pm – 7:30pm Wednesday, March 18th 2009
Holy Cross Lutheran Church
8115 Oaklandon Road
Indianapolis, Indiana 46236
317-823-5801

AGENDA

1. Welcome and Introductions
2. Current Agency/Organization Purpose, Programs & Objectives
3. Update on Geist Goes Green Event
4. Break
5. Update on Contract Tasks
    i. Compiling of Historical Information
    ii. Model Nonpoint Source Pollution In Lakes & Subwatersheds
    iii. Complete a Five-Year Aquatic Vegetation Management Plan
    iv. Create a Public Information Handout
        1. Update on Press Release Creation
        2. Discussion on Further Public Outreach Opportunities
6. April Steering Committee Meetings
    i. Pendleton Town Hall – April 15th, 2009 5:30pm
7. Discussion on Public Meeting
    i. Date, Location, Time…etc.
8. Closing and Adjournment

Upper White River Watershed Alliance
c/o IUPUI – Center for Earth & Environmental Science
723 West Michigan Street, SL118
Indianapolis, IN 46202
317-274-7154

GEIST
WATER QUALITY
GET ON BOARD

Geist/Fall Creek Watershed Alliance Steering Committee Meeting March 18, 2009 Sign-In Sheet

Name	Phone	Email or Address
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Geist/Fall Creek Watershed Alliance
STEERING COMMITTEE MEETING
6:30 to 8:30 pm Wednesday, March 18th 2009
Holy Cross Lutheran Church

AGENDA with Notes

1. Welcome and Introductions – 14 people in attendance, see sign-in sheet.

2. Current Agency/Organization Purpose, Programs & Objectives – Each Agency/Organization present discussed their objectives, programs and public outreach efforts.

3. Update on Geist Goes Green Event – Discussed the Geist Goes Green Event held at the Geist Marina on the last weekend in February and the first weekend in March. The event was not as well attended as hoped for. Planning is underway for next year's event focusing on only one weekend instead of two as well as marketing the event better for more exposure.

4. Break

5. Update on Contract Tasks

   i. Compiling of Historical Information – Updated group on the historical information that IDEM has available for the watershed and reservoir. IDEM is currently going through the QA/QC process with last years data and cannot provide that to us yet. Also working on obtaining the reports that were mentioned in the CEES 2003 report.

   ii. Model Nonpoint Source Pollution In Lakes & Subwatersheds – Discussed the three different models available for nonpoint source pollution and the pros and cons of each. It was recommended by V3 that a combination of two of the models be used due to the site specific information one model can provide and the ability to analyze BMPs with a different model. Both will benefit the watershed plan.

   iii. Complete a Five-Year Aquatic Vegetation Management Plan – Updated group on the timeframe for the first sampling efforts (May 15th – June 30th) and possibilities of getting some steering committee members involved. Emphasis on how the current vegetation in the reservoir interrelates with the health of the reservoir should be taken into consideration during the plan preparation.

iv. Create Public Information Handout

1. Update on Press Release – Article on AtGeist.com. Veolia to use this as a base and create a draft press release to send to the group for review.

2. Discussion on Further Public Outreach Opportunities – The Geist Watershed Alliance is planning on putting together a committee separate from the steering committee to standardize the public outreach process for the group.

6. April Steering Committee Meeting – The April Steering Committee meeting with be at the Pendleton Town Hall on April 15, 2009 from 6:00pm to 8:00pm.

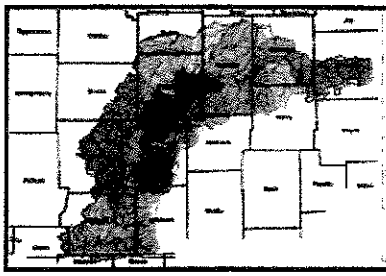
7. Discussion on Public Meeting – The first public meeting is in the planning process and timing will be determined based on the legislative session timeframe. It is anticipated that the meeting will be held sometime early to mid May.

8. Closing and Adjournment

Geist/Fall Creek Watershed Alliance
STEERING COMMITTEE MEETING
6:00pm – 8:00pm Wednesday, April 15th 2009
Pendleton Town Hall
100 West State Street
Pendleton, Indiana 46064

AGENDA

1. Welcome and Introductions
2. Current Agency/Organization Purpose, Programs & Objectives
3. Discussion of Website and Link to FTP Site
4. Update on Watershed Plan Tasks
5. Water Quality 101, informational / refresher
6. May Steering Committee Meetings
    i. Date, Location, Time…etc.
7. Discussion on Public Meeting, Pending Legislative Session
    i. Date, Location, Time…etc.
8. Miscellaneous Issues and Discussion
9. Closing and Adjournment



Upper White River Watershed Alliance
c/o IUPUI – Center for Earth & Environmental Science
723 West Michigan Street, SL118
Indianapolis, IN 46202
317-274-7154

GEIST
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Geist/Fall Creek Watershed Alliance Steering Committee Meeting April 15, 2009 Sign-In Sheet

Name	Email	Phone
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Geist/Fall Creek Watershed Alliance
STEERING COMMITTEE MEETING
6:00pm – 8:00pm Wednesday, April 15th 2009
Pendleton Town Hall
100 West State Street
Pendleton, Indiana 46064

AGENDA

1. Welcome and Introductions – 11 people in attendance, see sign-in sheet

2. Current Agency/Organization Purpose, Programs & Objectives – Each Agency/Organization present discussed their objectives, programs and public outreach efforts. This activity will be shortened in subsequent meetings.

3. Discussion of Website and Link to FTP Site – Upper White River Watershed Alliance's website can be accessed by entering http://UWRWA.org then look to the middle of the page within the blue box underneath the large "Are You?" to see the Geist/Fall Creek Subwatershed.

4. Update on Watershed Plan Tasks – Updated group on the historical information gathered to date, including IDEM's Comparison of the Mid-Water Planktonic Invertebrate Communities, Indiana Clean Lakes Program, IDEM database data sets, IDEM's Distribution and Abundance of *Cylindrospermopsis raciborskii*, and also on obtaining other reports that were mentioned in the CEES 2003 report.

5. Water Quality 101, informational / refresher – Topics covered included watersheds, succession nature of lakes/sediment deposition, meandering nature of stream /sediment deposition, conductivity, pH, salinity, turbidity, total suspended solids / sediment deposition, nutrients, algae, bacteria, and flooding.

6. May and June Steering Committee Meetings – the next Steering committee meeting Wednesday May 20th from 6:00pm to 8:00pm. The May 20th meeting will be held at the Fishers Municipal Building, 1 Municipal Drive, Fishers 46038. (**This**

meeting may be postponed in light of the newly scheduled May 21st Public Meeting) The June meeting is scheduled for Wednesday June 17th at Holy Cross Lutheran Church, 8115 Oaklandon Road, Indianapolis 46236.

7. Closing and Adjournment

Geist/Fall Creek Watershed Alliance
STEERING COMMITTEE MEETING
6:00 to 8:00 pm Wednesday, August 19th 2009
Fishers Town Hall Administration Conference Room
One Municipal Drive
Fishers, Indiana 46038

AGENDA

1. Welcome and Introductions
2. Review of Historical Data Collected
    i. Shoreline stabilization survey
    ii. CEES Survey Updates
3. Discussion of Pre-Treatment Tier II Aquatic Vegetation Results
4. Outreach
    i. Watershed Signage
    ii. Geist Reservoir/Fall Creek Clean-Up
5. Define Mission, Vision or Purpose Statement for the Watershed
6. Nonpoint Source Pollution Model
    i. Memo approval process
    ii. Preliminary modeling results
7. Windshield Survey Locations
    i. Discussion of suggested data sheet survey form
    ii. Discussion of suggested location survey points
    iii. Acquiring volunteers to implement windshield survey
8. Next Steering Committee Meetings
9. Miscellaneous Issues and Discussion
10. Closing and Adjournment

Upper White River Watershed Alliance
c/o IUPUI – Center for Earth & Environmental Science
723 West Michigan Street, SL118
Indianapolis, IN 46202
317-274-7154

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Geist/Fall Creek Watershed Alliance
Steering Committee Meeting
August 19, 2009 Sign-In Sheet

Name	Phone	Email or Address
Victor Wakley	590-1461	VictorWakley@Hotmail.com
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[illegible]		
Holly Jones		~~holly~~ hjones@empowerresults.com
Kelly Levengood		

Geist/Fall Creek Watershed Alliance
STEERING COMMITTEE MEETING
6:00 to 8:00 pm Wednesday, August 19th 2009
Fishers Town Hall Administration Conference Room
One Municipal Drive
Fishers, Indiana 46038

AGENDA

1. Welcome and Introductions

2. Review of Historical Data Collected

   i. Shoreline stabilization survey

   Notes: Discussed concern regarding erosion along shoreline. Contact SWCD with erosion concerns. Construction violations have been identified by boat. Department owns 22' easement around the entire shore of the lake for those encroachments.

   ii. CEES Survey Updates

   Notes: Lenore reported about the high levels of algae recorded. Wet and cool weather is not helping. Still trying to identify the source of the spike in levels. Should incorporate locations of septic areas in Watershed plan.

3. Discussion of Pre-Treatment Tier II Aquatic Vegetation Results

   Notes: Eurasian Watermilfoil discussion - Communicate with Tom Flat regarding several treatments and locations as it relates to V3 inspection dates. May be overlap of treated areas to inspection zones. See what information Tom has on coverage prior to treatment. DNR considers this a private system and will not likely fund weed control activities. To some extent the milfoil is competing with algae for nutrients – so who do we want to win? Harvest and remove nutrients with the plants. Chemical treatment of milfoil only releases more nutrients for algae. Stormwater program (IDEM) - Any chemical in the reservoir would be an illegal discharge. Not likely okay with Fishers for widespread chemical treatment.

4. Outreach

   i. Watershed Signage

   Notes: All signage completed for Eagle Creek watershed. State roads are a problem because IDEM did not want future liability of potential $200 INDOT maintenance fee. Veolia donated sign designs at Eagle Creek. $15,000 estimated for signs and posts/hardware to get installed. 40 signs total ($350 a piece). Hamilton wanted posts and hardware – no others required this. This signage provides a 24/7 outreach to the community. Can we include a “limit fertilizer” tag?

ii. Geist Reservoir/Fall Creek Clean-Up

5. Define Mission, Vision or Purpose Statement for the Watershed

Notes: Geist Watershed Alliance wrote a purpose statement that could be used along with the two presented. Shaena to provide to Ed and Greg. Steer away from land values – focus on Water Quality and Health of system. Not a lake – this is a reservoir. Management needs change as a potable water reservoir. Look at Grant Applications for purpose statement also.

6. Nonpoint Source Pollution Model

i. Memo approval process

ii. Preliminary modeling results

7. Windshield Survey Locations

i. Discussion of suggested data sheet survey form

ii. Discussion of suggested location survey points

iii. Acquiring volunteers to implement windshield survey

Notes: Discuss Empower Results input. Reviewed 100 in-stream data points. Look to also identify 50 upland locations in the watershed. Two visits to each location – vegetation down (winter) so we can see fences, livestock, erosion, pipes, etc. Might provide overview and explanation on survey form. Finalize at next meeting and send out locations for November/December visits.

8. Next Steering Committee Meetings

Next Steering Committee Meeting set for Wednesday October 21st from 6 – 8pm at the Fishers Town Hall Administrative Building.

9. Miscellaneous Issues and Discussion

Notes: How do we outreach the lake front reservoir community? They are a major impactor group. Work on commercial landscape firms to remove phosporus. Push organic and “green” landscape companies and education. 5,500 people on Homeowners Association to educate. Grass clipping and leaf raking problems. Need to get Rule 5 enforcement on Lake by SWCD. Education of landscape supplies to be Phosphorus free zone.

10. Closing and Adjournment

Geist/Fall Creek Watershed Alliance

STEERING COMMITTEE MEETING

6:00 to 8:00 pm Wednesday, October 21st, 2009

Fishers Town Hall Administration Conference Room

One Municipal Drive

Fishers, Indiana 46038

AGENDA

1. Welcome and Introductions

2. Old Business
    i. Review of WMP Process
    ii. Eurasian Watermilfoil vs. Treatment Locations
    iii. Mission & Vision Statement

3. Update on Project Schedule
    i. Timeframe for completion of Draft Report
    ii. Steering Committee Meeting Schedule
    iii. Public Meeting Timing/Location/Goals

4. Windshield Survey
    i. Discuss final survey field sheet
    ii. Discuss survey point locations
    iii. Coordination of volunteers and timeframes for completion

5. Education & Outreach
    i. UW Outreach Survey Discussion
    ii. Linking E&O to WMP
    iii. Action Items/Assignments

6. Developing Problem Statements
    i. Review of public concerns and baseline data
    ii. Critical Area Discussion
    iii. Linking Concerns, Problem Statements, Goals and Objectives Worksheet

7. Miscellaneous Issues and Discussion

8. Closing and Adjournment

<u>Future Meeting Topics</u>

Critical Area Identification

Causes & Sources

Goal Development

9 Minimum Elements

UWRWA
Upper White River Watershed Alliance

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Geist/Fall Creek Watershed Alliance
Steering Committee Meeting
October 21, 2009 Sign-In Sheet

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Geist/Fall Creek Watershed Alliance
STEERING COMMITTEE MEETING
6:00 to 9:00 pm Tuesday, November 10, 2009
Fishers Town Hall Administration Conference Room
One Municipal Drive
Fishers, Indiana 46038

AGENDA

1. Welcome and Introductions

2. Aquatic Vegetation Management Plan Update
   i. Public Meeting

3. Problem Statement Discussion
   i. Review Problem Statements & Combined Statements from Worksheets
   ii. Prioritize Based On: Urgency, Feasibility, Location

4. Causes & Sources Discussion
   i. What are some of the Causes of our Issues in the Watershed?
   ii. What are the Sources?

5. Goals, Objectives & Measurable Milestone Discussion
   i. Where Do We Want to Go and How Do We Want to Get There?
   ii. How Much Improvement do We Want to See?
   iii. How Long Will it Take?
   iv. How Will It Be Measured?

6. Critical Area Discussion

7. Miscellaneous Issues and Discussion

8. Next Meeting: December 9 – Pendleton Town Hall: 6:00p – 9:00p

9. Closing and Adjournment

UWRWA
Upper White River Watershed Alliance

GEIST
WATER QUALITY
GET ON BOARD

Geist/Fall Creek Watershed Alliance
Steering Committee Meeting
November 10, 2009 Sign-In Sheet

Name	Phone	Email or Address
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Jason Armour	317-595-3461	armourj@fishers.in.us

Geist/Fall Creek Watershed Alliance

STEERING COMMITTEE MEETING

6:00 to 9:00 pm Tuesday, November 10, 2009

Fishers Town Hall Administration Conference Room

One Municipal Drive

Fishers, Indiana 46038

AGENDA

1. Welcome and Introductions
2. Aquatic Vegetation Management Plan Update – email presentation/draft 2-3 days prior to meeting
   i. Public Meeting 1st-3rd whatever works best for school -summary now?
3. Problem Statement Discussion
   i. Review Problem Statements & Combined Statements from Worksheets
   ii. Prioritize Based On: Urgency, Feasibility, Location ?? Fishers / Hancock Co all outfalls mapped – Bee Camp WMP Bridge replacement at Olio
4. Causes & Sources Discussion
   i. What are some of the Causes of our Issues in the Watershed?
   ii. What are the Sources?
5. Goals, Objectives & Measurable Milestone Discussion
   i. Where Do We Want to Go and How Do We Want to Get There?
   ii. How Much Improvement do We Want to See?
   iii. How Long Will it Take?
   iv. How Will It Be Measured?
6. Critical Area Discussion
7. Miscellaneous Issues and Discussion
8. Next Meeting: December 9 – Pendleton Town Hall: 6:00p – 9:00p
9. Closing and Adjournment

GVW NOTES

Geist/Fall Creek Watershed Alliance
STEERING COMMITTEE MEETING
6:00 to 9:00 pm Tuesday, November 10, 2009
Fishers Town Hall Administration Conference Room
One Municipal Drive
Fishers, Indiana 46038

AGENDA

1. Welcome and Introductions

2. Aquatic Vegetation Management Plan Update
   i. Public Meeting – DRAFT – DEC 15TH
      – ELEMENTARY SCHOOL MEETING – SEND TO STEERING COMMITTEE

3. Problem Statement Discussion
   i. Review Problem Statements & Combined Statements from Worksheets
   ii. Prioritize Based On: Urgency, Feasibility, Location

4. Causes & Sources Discussion
   i. What are some of the Causes of our Issues in the Watershed?
   ii. What are the Sources?

5. Goals, Objectives & Measurable Milestone Discussion
   i. Where Do We Want to Go and How Do We Want to Get There?
   ii. How Much Improvement do We Want to See?
   iii. How Long Will it Take?
   iv. How Will It Be Measured?

6. Critical Area Discussion

7. Miscellaneous Issues and Discussion

8. Next Meeting: December 9 – Pendleton Town Hall: 6:00p – 9:00p

9. Closing and Adjournment

Linking Concerns, Problem Statements, Causes and Sources

What are the concerns in the watershed?	Problem Statement	Potential Causes (can be the same as the problem)	Potential Sources (will also help identify critical areas)
-Encourage and improve public perception of native landscaping -Changing actions/perceptions towards fertilizer use -Encourage public participation -Outreach that is solution based -Education to the public -Education to the recreational users at marinas -Legislative action on phosphorus ban -Recognition of problems at State level -Lack of regulations	Stakeholders in the Geist Reservoir/Upper Fall Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.	-Lack of interest -Lack of time and commitment -Lack of media coverage/educational material -Lack of public awareness -Lack of unified approach -Lack of perceived benefit -understanding of their impacts	N/A – none needed for administrative or social problems
-Quality of drinking water -Quality of surface water runoff -Erosion control and enforcement – Rule 5 -Sediment from storm drains -Maintenance of culverts and roadways -Dredging in the reservoir -Enhance wildlife habitat and recreational uses of reservoir	Excessive soil erosion and sedimentation within the watershed is degrading the water quality and limiting the aesthetics, wildlife habitat, and aquatic health of the streams (and reservoir) within the watershed.	-TSS levels and turbidity levels exceed water quality standards -Poor habitat evaluation scores (macros) MIBI QHEI	-Agricultural land under conventional tillage practices -Construction sites/new development -Streambank erosion -Livestock access to streams -Areas with inadequate stream buffers
-Encourage and improve public perception of native landscaping -Enhance wildlife habitat and recreational uses of reservoir -Outreach that is solution based -Lack of funding sources for urban areas	There is a lack of funding for the implementation of Best Management Practices within urban areas.	-Lack of public awareness -Lack of unified approach -~~No effort~~ additional to educate local officials, foundations and other funding sources on the importance of urban BMPs	N/A – none needed for administrative or social problems

		Causes Concern	Sources
-Enhance wildlife habitat and recreational uses of reservoir -Exotic species control (Eurasian Watermilfoil) ~~-Public concern over blue green algae~~ addressed in Nutrients	Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.	-lack of best boating practices -nuisance levels of Eurasian Watermilfoil impeding boating, swimming, fishing and degrading habitat and survival of native vegetation	-Uncontrolled growth in high density areas plants -Uncontrolled growth in recreational areas Vegetation
-Quality of drinking water -Organic debris entering waterways -Quality of surface water runoff -Changing actions/perceptions towards fertilizer use -Enhance wildlife habitat and recreational uses of reservoir -Public concern over blue green algae -Legislative action on phosphorus ban -Recognition of problems at State level -Lack of regulations	Nutrient concentrations within all subwatersheds frequently exceed the accepted water quality standards thereby aiding the growth of algae within the reservoir.	-Nitrate + nitrite levels and total phosphorus levels exceed water quality standards -Blue Green and Toxic algae levels	-Fertilizer application both urban and agricultural -Inadequately functioning septic systems -Combined sewer overflows -Residential lawns (particularly close to streams and reservoir) -Improper disposal of yard waste -Areas with inadequate buffers - pet waste - golf courses
-Quality of drinking water -Organic debris entering waterways -Quality of surface water runoff -Enhance wildlife habitat and recreational uses of reservoir	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.	-E. coli levels exceed water quality standards	-Inadequately functioning septic systems -Combined sewer overflows SSO's -Wildlife -Livestock access and manure management -Areas with inadequate buffers -Wastewater facilities (NPDES permits) -pet waste
-Quality of drinking water -Quality of surface water runoff	Concentrations of Atrazine in Geist Reservoir frequently exceed the USEPA standard of 3.0ug/L for drinking water supplies.	-Atrazine levels exceed water quality standards	-Agricultural areas utilizing Atrazine as a pesticide -Areas with inadequate buffers

Linking Concerns, Problem Statements, Causes and Sources

What are the concerns in the watershed?	Problem Statement	Potential Causes (can be the same as the problem)	Potential Sources (will also help identify critical areas)
-Encourage and improve public perception of native landscaping -Changing actions/perceptions towards fertilizer use -Encourage public participation -Outreach that is solution based -Education to the public -Education to the recreational users at marinas -Legislative action on phosphorus ban -Recognition of problems at State level -Lack of regulations	Stakeholders in the Geist Reservoir/Upper Fall Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.	- LACK OF PERCEIVED BENEFIT/IMPACTS -Lack of interest -Lack of time and commitment -Lack of media coverage/educational material -Lack of public awareness + -Lack of unified approach	N/A – none needed for administrative or social problems
-Quality of drinking water -Quality of surface water runoff -Erosion control and enforcement – Rule 5 -Sediment from storm drains -Maintenance of culverts and roadways -Dredging in the reservoir -Enhance wildlife habitat and recreational uses of reservoir	Excessive soil erosion and sedimentation within the watershed is degrading the water quality and limiting the aesthetics, wildlife habitat, and aquatic health of the streams (and reservoir) within the watershed.	-TSS levels and turbidity levels exceed water quality standards -Poor habitat evaluation scores MACRO	-Agricultural land under conventional tillage practices -Construction sites/new development -Streambank erosion -Livestock access to streams -Areas with inadequate stream buffers
-Encourage and improve public perception of native landscaping -Enhance wildlife habitat and recreational uses of reservoir -Outreach that is solution based -Lack of funding sources for urban areas	There is a lack of funding for the implementation of Best Management Practices within urban areas.	ADDITIONAL -Lack of public awareness -Lack of unified approach -~~No effort to~~ EFFORT educate local officials, foundations and other funding sources on the importance of urban BMPs	N/A – none needed for administrative or social problems

-Enhance wildlife habitat and recreational uses of reservoir -Exotic species control (Eurasian Watermilfoil) ~~-Public concern over blue green algae~~	Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.	-nuisance levels of Eurasian Watermilfoil impeding boating, swimming, fishing and degrading habitat and survival of native vegetation	Lack of understanding of - Best Boating Practices -Uncontrolled growth in high density ~~areas~~ Veg. Areas -Uncontrolled growth in recreational areas
-Quality of drinking water -Organic debris entering waterways -Quality of surface water runoff -Changing actions/perceptions towards fertilizer use -Enhance wildlife habitat and recreational uses of reservoir -Public concern over blue green algae -Legislative action on phosphorus ban -Recognition of problems at State level -Lack of regulations	Nutrient concentrations within all subwatersheds frequently exceed the accepted water quality standards thereby aiding the growth of algae within the reservoir.	-Nitrate + nitrite levels and total phosphorus levels exceed water quality standards -Blue Green and Toxic algae levels	- Pet Waste - Golf Courses -Fertilizer application both urban and agricultural -Inadequately functioning septic systems -Combined sewer overflows -Residential lawns (particularly close to streams and reservoir) -Improper disposal of yard waste -Areas with inadequate buffers
-Quality of drinking water -Organic debris entering waterways -Quality of surface water runoff -Enhance wildlife habitat and recreational uses of reservoir	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.	-E. coli levels exceed water quality standards	-Inadequately functioning septic systems -Combined sewer overflows, SSO's -Wildlife -Livestock access and manure management (Separate) -Areas with inadequate buffers -Wastewater facilities (NPDES permits) - Pet Waste
-Quality of drinking water -Quality of surface water runoff	Concentrations of Atrazine in Geist Reservoir frequently exceed the USEPA standard of 3.0ug/L for drinking water supplies.	-Atrazine levels exceed water quality standards	-Agricultural areas utilizing Atrazine as a pesticide -Areas with inadequate buffers

Linking Concerns, Problem Statements, Goals and Objectives

	What are the concerns in the watershed?	Problem Statement	What would you like to see for your watershed? (Goal Statements)	How will we measure progress towards measuring these goals? (Objectives/Indicators)
1	Public Participation/ Education and Outreach	Stakeholders in the Geist Reservoir/Upper Fall Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.	Develop and implement an education and outreach program within the watershed.	-Effectively share/communicate past, current and future activities in the watershed -Educate stakeholders within the watershed on the function of a watershed and the impacts to water quality -Educate homeowners in urban communities about the use of fertilizers -Educate stakeholders using septic systems about the importance of septic system maintenance, -Coordinate efforts with the UWRWA, local MS4s and any other , NRCS, SWCDs education/outreach efforts being conducted within the watershed -Educate farmers about the use of Atrazine and its impacts to water quality Indiana Wildlife Federation -promoting Low/No-P fertilizer
2	Erosion and Sedimentation/ Impacts to Habitat and Water Quality	~~Excessive~~ soil erosion and sedimentation within the watershed is degrading the water quality and limiting the aesthetics, wildlife habitat, and aquatic health of the streams (and reservoir) within the watershed.	Reduce sediment loads to meet the IDEM draft TMDL target of 30 mg/L. TSS	MS4s CREP promote -Partner with NRCS, SWCDs and County Boards to ~~develop~~ cost share and/or education programs in order to reduce erosion from agricultural lands -Encourage the use of conservation tillage practices -Encourage enforcement of erosion control practices associated with the issuance of Rule 5 permits -Stabilize eroded streambanks within the watershed FFA groups/high school -Reduce animal access to streambanks -December effluent limits at construction sites
3	Lack of Regulations and Funding Sources for Urban Areas	There is a lack of funding for the implementation of Best Management Practices within urban areas.	Identify and utilize existing BMP funding sources and encourage the development/ enhancement of additional and non-traditional funding sources.	-Educate homeowners/stakeholders on the benefits and importance of urban BMPs -Partner with MS4s, foundations, community groups, etc to identify/develop funding sources for urban BMP implementation -Encourage demonstration projects throughout the watershed -Identify low cost alternatives to traditional urban BMPs res and commercial -SWCD's

-judicial, community services, high schools
college
-CREP funding

4	Exotic Species in the Reservoir (Eurasian Watermilfoil) and the impacts to recreation and native species	Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.	Reduce/Control the growth of exotic aquatic plants within the reservoir.	-Educate public/stakeholders on how exotic species are introduced and ways to control the introduction -Partner with the marinas, fishing tournament groups, homeowner organizations, etc. to develop cost share and/or education programs -~~Complete~~ an AVMP and treat according to recommendations update on a regular basis
5	Nutrient Levels and Impacts to Algae in the Reservoir	Nutrient concentrations within all subwatersheds frequently exceed the accepted water quality standards thereby aiding the growth of algae within the reservoir.	Reduce the nutrient loads so that there are no exceedances of Nitrate plus Nitrite of 1.6 mg/L and Total Phosphorus of 0.076 mg/L.	-Educate the public/stakeholders (urban and agricultural) of the importance of reduced application of fertilizers or use of Low-P/No-P Fertilizers -Increase the riparian buffer zones using filter strips and grassed waterways -Increase the use of BMPs such as cover crops, conservation tillage, etc , pond shoreline planting -Educate/work with point dischargers (CFOs, NPDES facilities) to reduce their nutrient loads MS4s -Partner with NRCS, SWCDs and County Boards to ~~develop~~ promote cost share and/or education programs -Educate local/regional/state officials on the need for regulations for urban areas (specifically for Phosphorus) -septic systems
6	E. Coli samples often exceed safety standards for fishable and swimmable waters	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.	Reduce *E. coli* concentrations to meet state standard of 235 CFU/100mL	-Reduce the amount of E. coli runoff from agricultural lands through the encouragement of exclusionary fencing installation CFOs, CSOs -Educate public/stakeholders and implement manure management practices -Educate/work with point dischargers to reduce the amount of E. coli runoff from point sources, failed septic systems, and package plants -Partner with NRCS, SWCDs and County Boards to develop cost share and/or education programs -Increase the riparian buffer zones using filter strips and grassed waterways -pet waste/wildlife out
7	Atrazine levels in watershed streams	Concentrations of Atrazine in Geist Reservoir frequently exceed the USEPA standard of 3.0ug/L for drinking water supplies.	Reduce Atrazine concentrations within Geist Reservoir to not exceed the USEPA standard of 3.0ug/L.	-Reduce the use of Atrazine with education on alternative practices and/or pesticides -Increase riparian buffer zones using filter strips and grassed waterways -Partner with NRCS, SWCDs and County Boards to develop cost share and/or education programs

Linking Concerns, Problem Statements, Goals and Objectives

	What are the concerns in the watershed?	Problem Statement	What would you like to see for your watershed? (Goal Statements)	How will we measure progress towards measuring these goals? (Objectives/Indicators)
1	Public Participation/ Education and Outreach	Stakeholders in the Geist Reservoir/Upper Fall Creek Watershed are not knowledgeable about their daily impact on the watershed and its water quality.	Develop and implement an education and outreach program within the watershed.	- WORK WITH INDIANA ~~STATE~~ WILDLIFE FEDERATION FOR NON-P FERTILIZER -Effectively share/communicate past, current and future activities in the watershed -Educate stakeholders within the watershed on the function of a watershed and the impacts to water quality -Educate homeowners in urban communities about the use of fertilizers -Educate stakeholders using septic systems about the importance of septic system maintenance, -Coordinate efforts with the UWRWA, local MS4s and any other education/outreach efforts being conducted within the watershed -Educate farmers about the use of Atrazine and its impacts to water quality
2	Erosion and Sedimentation/ Impacts to Habitat and Water Quality	~~Excessive~~ Soil erosion and sedimentation within the watershed is degrading the water quality and limiting the aesthetics, wildlife habitat, and aquatic health of the streams (and reservoir) within the watershed.	AVG = 17.7 ONE WITH Reduce sediment loads to meet the IDEM draft TMDL target of 30 mg/L. OF TSS	CREP WATERSHED -Partner with NRCS, SWCDs and County Boards ~~to develop~~ PROMOTE, HIGH SCHOOLS & FFA PROGRAMS cost share and/or education programs in order to reduce erosion from agricultural lands -Encourage the use of conservation tillage practices -Encourage enforcement of erosion control practices associated with the issuance of Rule 5 permits & MS4'S -Stabilize eroded streambanks within the watershed -Reduce animal access to streambanks - EFFLUENT LIMITATIONS FOR CONSTRUCTION SITES
3	Lack of Regulations and Funding Sources for Urban Areas	There is a lack of funding for the implementation of Best Management Practices within urban areas.	Identify and utilize existing BMP funding sources and encourage the development/ enhancement of additional and non-traditional funding sources.	-Educate homeowners/stakeholders on the benefits and importance of urban BMPs -Partner with /SWCD'S MS4s, foundations, community groups, etc to identify/develop funding sources for urban BMP implementation -Encourage demonstration projects throughout the watershed -Identify low cost alternatives to traditional urban BMPs - IDENTIFY EXISTING SOURCES OF FUNDING (VOLUNTEERS)

4	Exotic Species in the Reservoir (Eurasian Watermilfoil) and the impacts to recreation and native species	Excessive growth of exotic aquatic plants within the reservoir is negatively impacting the recreational uses of the reservoir and the survival of native species.	Reduce/Control the growth of exotic aquatic plants within the reservoir.	-Educate public/stakeholders on how exotic species are introduced and ways to control the introduction -Partner with the marinas, fishing tournament groups, homeowner organizations, etc. to develop cost share and/or education programs -~~Complete an~~ [Regular Update of] AVMP and treat according to recommendations
5	Nutrient Levels and Impacts to Algae in the Reservoir	Nutrient concentrations within all subwatersheds frequently exceed the accepted water quality standards thereby aiding the growth of algae within the reservoir.	Reduce the nutrient loads so that there are no exceedances of Nitrate plus Nitrite of ~~1.6 mg/L~~ and Total Phosphorus of 0.076 mg/L.	-Educate the public/stakeholders (urban and agricultural) of the importance of reduced application of fertilizers or use of Low-P/No-P Fertilizers -Increase the riparian buffer zones using filter strips and grassed waterways -Increase the use of BMPs such as cover crops, conservation tillage, etc -Educate/work with point dischargers (CFOs, NPDES facilities) to reduce their nutrient loads [Add Urban] -Partner with NRCS, SWCDs and County [Lhsts] Boards to ~~develop~~ [Promote] cost share and/or education programs -Educate local/regional/state officials on the need for regulations for urban areas (specifically for Phosphorus) [- Septic Systems]
6	E. Coli samples often exceed safety standards for fishable and swimmable waters	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.	Reduce *E. coli* concentrations to meet state standard of 235 CFU/100.	-Reduce the amount of E. coli runoff from agricultural lands through the encouragement of exclusionary fencing installation -Educate public/stakeholders and implement manure management practices -Educate/work with point dischargers to reduce the amount of E. coli runoff from point sources, ~~failed septic systems~~, and package plants [Add CFOs & CSO] -Partner with NRCS, SWCDs and County Boards to develop cost share and/or education programs -Increase the riparian buffer zones using filter strips and grassed waterways [- Septic Systems - Pet Waste]
7	Atrazine levels in watershed streams	Concentrations of Atrazine in Geist Reservoir frequently exceed the USEPA standard of 3.0ug/L for drinking water supplies.	Reduce Atrazine concentrations within Geist Reservoir to not exceed the USEPA standard of 3.0ug/L.	-Reduce the use of Atrazine with education on alternative practices and/or pesticides -Increase riparian buffer zones using filter strips and grassed waterways -Partner with NRCS, SWCDs and County Boards to develop cost share and/or education programs

Geist Reservoir/Upper Fall Creek Critical Area Identification

Data was separated out into 2 criteria: Current Water Quality Impairment and Susceptibility to Future Water Quality Impairment

<u>Current Water Quality Impairment</u>
The current water quality impairment data includes actual/quantitative data that is available for the watershed. This data is easily compared to standard water quality limits and used to gage the current health of the subwatersheds. A list of the data used for this comparison is below.

- IDEM 303(d) list
- CIWRP 2003 Study (10 stations)
  - Dissolved Oxygen
  - E. coli
  - pH
  - Nitrate + Nitrite
  - Total Phosphorus
  - Total Suspended Solids
  - Turbidity
- IDEM Water Quality Data (1996-2009: 93 stations)
  - Dissolved Oxygen
  - E. coli
  - pH
  - Nitrate + Nitrite
  - Total Phosphorus
  - Total Suspended Solids
  - Turbidity
- IDEM Biological Data (1992-2008)
  - mIBI (macroinvertebrates)
  - IBI (fish)
  - QHEI (habitat)

Each subwatershed was ranked based on each data set and then an overall Current Water Quality Impairment ranking was assigned.

Example:

	IDEM 303(d)	CIWRP	IDEM WQ	IDEM Bio	OVERALL
Sub 1	2	3	2	1	**2**
Sub 2	1	2	1	2	**1**
Sub 3	3	1	3	3	**3**

<u>Susceptibility to Future Water Quality Impairment</u>
The susceptibility to future water quality impairment data includes land use/social based data that is available for the watershed. This data is not easily compared to water quality limits but can be helpful in determining the chances of ongoing or future water quality problems. A list of the data used for this comparison is below.

- Windshield Survey (should we include stream cover for habitat?)
  - Streambank Erosion
  - Stream Buffers
  - In-Stream Debris
  - Livestock Access

Stream Cover/Habitat

- Fields under Conventional Till
- Nonpoint Source Pollution Modeling Results
    - Nitrogen Loading
    - Phosphorus Loading
    - Sediment Loading
- NPDES Permits
    - CFOs
    - Facilities/pipes

Each subwatershed was ranked based on each data set and then an overall Susceptibility to Future Water Quality Impairment ranking was assigned.

Example:

	Windshield Survey	NPS Modeling	NPDES Permits	OVERALL
Sub 1	3	2	3	**3**
Sub 2	2	1	1	**1**
Sub 3	1	3	2	**2**

Final Critical Area Identification

Once subwatersheds were ranked based on the 2 criteria, an overall ranking was assigned with highest priority being given to current impairments. The 3 top ranked subwatersheds were then identified as the critical areas.

Example:

	Current WQ Impairment	Susceptibility to Future WQ Impairment	OVERALL CRITICAL AREA RANKING
Sub 1	2	3	**2**
Sub 2	1	1	**1**
Sub 3	3	2	**3**

Additional Critical Areas

Critical areas can also be defined as specific sources anywhere within the project area that are contributing a pollutant of concern. Below is a list of suggested additional "critical areas" to identify in the Watershed Management Plan.

- ~~Residential areas immediately adjacent to a stream or the reservoir~~
- All areas where livestock have direct access to a stream
- All areas where stream buffers are absent or insufficient
- All areas where excessive streambank erosion is occurring
- All agricultural areas where conventional till is practiced extensively

LAND USE CHANGE – LISA BEAL (LAYER FOR UPWR

Geist Reservoir/Upper Fall Creek Critical Area Identification

Data was separated out into 2 criteria: Current Water Quality Impairment and Susceptibility to Future Water Quality Impairment

Current Water Quality Impairment

The current water quality impairment data includes actual/quantitative data that is available for the watershed. This data is easily compared to standard water quality limits and used to gage the current health of the subwatersheds. A list of the data used for this comparison is below.

- IDEM 303(d) list
- CIWRP 2003 Study (10 stations)
  - Dissolved Oxygen
  - E. coli
  - pH
  - Nitrate + Nitrite
  - Total Phosphorus
  - Total Suspended Solids
  - Turbidity
- IDEM Water Quality Data (1996-2009: 93 stations)
  - Dissolved Oxygen
  - E. coli
  - pH
  - Nitrate + Nitrite
  - Total Phosphorus
  - Total Suspended Solids
  - Turbidity
- IDEM Biological Data (1992-2008)
  - mIBI (macroinvertebrates)
  - IBI (fish)
  - QHEI (habitat)

Each subwatershed was ranked based on each data set and then an overall Current Water Quality Impairment ranking was assigned.

Example:

	IDEM 303(d)	CIWRP	IDEM WQ	IDEM Bio	OVERALL
Sub 1	2	3	2	1	**2**
Sub 2	1	2	1	2	**1**
Sub 3	3	1	3	3	**3**

Susceptibility to Future Water Quality Impairment

The susceptibility to future water quality impairment data includes land use/social based data that is available for the watershed. This data is not easily compared to water quality limits but can be helpful in determining the chances of ongoing or future water quality problems. A list of the data used for this comparison is below.

- Windshield Survey (should we include stream cover for habitat?)
  - Streambank Erosion
  - Stream Buffers
  - In-Stream Debris
  - Livestock Access

- future development threat talk to Lisa @ Empower

- Fields under Conventional Till
- Nonpoint Source Pollution Modeling Results
  - Nitrogen Loading
  - Phosphorus Loading
  - Sediment Loading
- NPDES Permits
  - CFOs
  - Facilities/pipes

Each subwatershed was ranked based on each data set and then an overall Susceptibility to Future Water Quality Impairment ranking was assigned.

Example:

	Windshield Survey	NPS Modeling	NPDES Permits	OVERALL
Sub 1	3	2	3	**3**
Sub 2	2	1	1	**1**
Sub 3	1	3	2	**2**

Final Critical Area Identification

Once subwatersheds were ranked based on the 2 criteria, an overall ranking was assigned with highest priority being given to current impairments. The 3 top ranked subwatersheds were then identified as the critical areas.

Example:

	Current WQ Impairment	Susceptibility to Future WQ Impairment	OVERALL CRITICAL AREA RANKING
Sub 1	2	3	**2**
Sub 2	1	1	**1**
Sub 3	3	2	**3**

Additional Critical Areas

Critical areas can also be defined as specific sources anywhere within the project area that are contributing a pollutant of concern. Below is a list of suggested additional "critical areas" to identify in the Watershed Management Plan.

- ~~Residential areas immediately adjacent to a stream or the reservoir~~
- All areas where livestock have direct access to a stream
- All areas where stream buffers are absent or insufficient
- All areas where excessive streambank erosion is occurring
- All agricultural areas where conventional till is practiced extensively

- Headwaters?
- Mining | Golf Courses | Schools
- Social indicators?

Geist/Fall Creek Watershed Alliance

STEERING COMMITTEE MEETING

6:00 to 9:00 pm Wednesday, December 9th, 2009

Pendleton Town Hall

100 West State Street

Pendleton, Indiana 46064

AGENDA

1. Welcome and Introductions
2. U.S. EPA’s 9 Elements of Watershed Plans
3. Project Schedule Update
4. Steering Committee Meeting Schedule
5. Ag & AVMP Public Meetings
6. Grant Applications & Deadlines
7. Geist WMP Comment Discussion
8. Miscellaneous Issues and Discussion
9. Closing and Adjournment

Upper White River Watershed Alliance

GEIST WATER QUALITY GET ON BOARD

Geist/Fall Creek Watershed Alliance
Steering Committee Meeting
December 9, 2009 Sign-In Sheet

Name	Phone	Email or Address
Carrie Pintar	630.729.6134	cpintar@v3co.com
Jessica Spurlock	630-729-6310	jspurlock@v3co.com
Tim McClintick	765 778 8370	tmcclintick@town.pendleton.in.us
Paul whitmore	317 263 6517	paul.whitmore@veoliawaterna.com
Shaena Reinhart	317 773 2181	shaena.reinhart@hamiltoncounty.in.gov
PATRICK MANSHIP	(765) 641-9638	pmanship@madisoncty.com
[illegible]	317/694-1271	jhain@comcast.net
KEVIN S. KENYON	765 760-7791	KSKENYON@MAC.COM
SHARON GIBSON	317-459-1740	sjfcpa@sharonfergusoncpa.com
Janice Snell	317-845-0994	snell57@AOL.COM
Judy DeLury	765-713-5782	jadelury@comcast.net
Kelly Levengood	317-385-9652	KLevengood@empowerresults.com
CRIST BLASSARAS	765-644-5073	zorbisfat@comcast.net

Geist/Fall Creek Watershed Alliance
STEERING COMMITTEE MEETING
6:00 to 9:00 pm Wednesday, December 9th, 2009
Pendleton Town Hall
100 West State Street
Pendleton, Indiana 46064

AGENDA

1. Welcome and Introductions
2. U.S. EPA's 9 Elements of Watershed Plans
3. Project Schedule Update - Draft to DNR Dec 16
4. Steering Committee Meeting Schedule
5. Ag & AVMP Public Meetings
6. Grant Applications & Deadlines
7. Geist WMP Comment Discussion
8. Miscellaneous Issues and Discussion
9. Closing and Adjournment

Ag Public Meeting - Jan 20
Pendleton Library 6-8 pm
- Fliers for website etc.
Final Public Meeting
end Feb / Early March

Jan 27 AVMP public meeting

2 Lare Grants - can submit for both
319 grants

Tree Planting - Fall Creek
Madison Ave - Dr. Shirley

- Grant timelines in milestones

Focus on $ for education
"money talks"

* homeowner info - IDEM on ftp site

Inviting fishing groups (mastheads) to Steering Com. meetings?

IMI dredging? WQ of Lakes? upcoming permit renewal

Conservation officers?
John Geno - Crist knows him

Appendix E – Public Meeting Agendas and Sign-In Sheets

Agendas and Sign-In Sheets for the Public Meetings held on the following dates are included in this appendix.

- May 21, 2009
- January 20, 2010

Geist/Fall Creek Watershed Alliance
INITIAL PUBLIC MEETING
7:00 to 9:00 pm Thursday, May 21, 2009
Red Bridge Community Building

AGENDA

1. Welcome and Introductions, Jill Hoffman of Upper Whiter River Watershed Alliance & Ed Belmonte of V3 Companies (7:00-7:05)

2. Geist Reservoir and Fall Creek Watershed Management Plan, Ed Belmonte of V3 Companies (7:05-7:25)

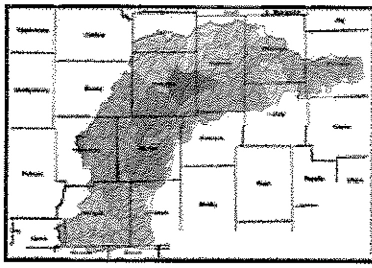
3. Harmful Algal Blooms and the Morse Reservoir, Dr. Lenore Tedesco – Director of the Center for Earth and Environmental Science, Indiana University – Purdue University Indianapolis / Upper Whiter River Watershed Alliance (7:25-7:50)

4. Questions and Discussion (7:50-8:00)

5. Break (8:00-8:05)

6. Public Participation – Water Quality Issues and Concerns from Stakeholder's within the Watershed, Ed Belmonte and Jessica Spurlock – V3 & Jill Hoffman of Upper Whiter River Watershed Alliance (8:05-8:55)

7. Thank you for your Participation, Closing and Adjournment (8:55-9:00)

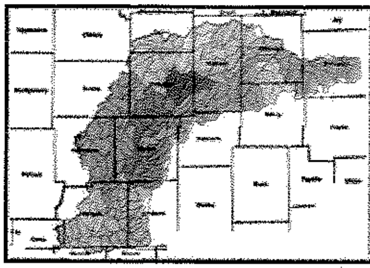


Upper White River
Watershed Alliance
c/o IUPUI – Center for Earth &
Environmental Science
723 West Michigan Street, SL118
Indianapolis, IN 46202
317-274-7154

GEIST
WATER QUALITY
GET ON BOARD

Geist/Fall Creek Watershed Alliance
Public Meeting
May 21, 2009 Sign-In Sheet

Name	Phone	Email or Address
Paul Whitmore	263 6517	paul.whitmore@veoliawaterna.com
Gwen White	234-4407 281-9445	gwhite@dnr.in.gov
Scott Rodgers	201-5012	scott@scottr.com
Ed Belmonte	630-729-6160	EBelmonte@V3co.com
LouAnn Baker	263.6572	louannbaker@veoliawaterna.com



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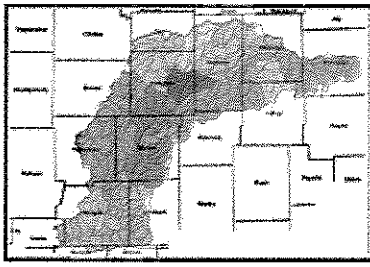
Indianapolis, IN 46202
317-274-7154

GEIST
WATER QUALITY
GET ON BOARD

Geist/Fall Creek Watershed Alliance
Public Meeting
May 21, 2009 Sign-In Sheet

Name	Phone	Email or Address
Glenn Lange	317-786-1776	glenn-lange@iaswcd.org
Bruno Pigott	317/233-2550	bpigott@idem.in.gov
David Isaacs	812-497-24[illegible]	davidi@aquaticcontrol.com
Jim Merritt	317 849-6310	Jmerritt31@yahoo.com
K. Duckwall	317 849 8455	kduckwall@marinalimited.com
Stephanie Box	317 915-8765	steff_box@hotmail.com

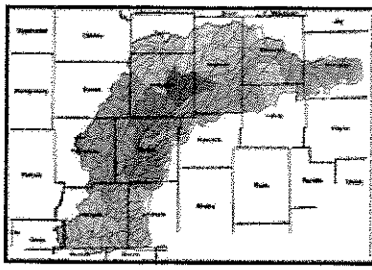


Upper White River Watershed Alliance
c/o IUPUI – Center for Earth & Environmental Science
723 West Michigan Street, SL118
Indianapolis, IN 46202
317-274-7154

GEIST
WATER QUALITY
GET ON BOARD

Geist/Fall Creek Watershed Alliance Public Meeting May 21, 2009 Sign-In Sheet

Name	Phone	Email or Address
Ernie Johnson	317 374 7712	ejohnson@Idem.IN.gov
BEVERLY GARD	317-232-9493	bgard@iga.IN.GOV
Shaena Smith	317-773-2181	ses@co.hamilton.in.us
WENDY THANSCH	317/579-9551	WENDY@OUTSOURCED-WRITING.COM
PATRICK MANSHIP	(765) 620-7585	pmanship@madisoncty.com
Rod Sawyer	576-0576	rod.sawyer@comcast.net
Janice Snell	845-0994	snell57@AOL.com
Robert Slomka	317-826-4213	diane.slomka@yahoo.com
Ed Malone	317 264-7703	ed.malone@veoliawaterna.com
Jessica Spurlock		jspurlock@v3co.com



Upper White River Watershed Alliance
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GEIST
WATER QUALITY
GET ON BOARD

Geist/Fall Creek Watershed Alliance
Public Meeting
May 21, 2009 Sign-In Sheet

Name	Phone	Email or Address
Brad Baughn	446-6773	bbaughn@idem.in.gov
Judy DeLury		jadelury@comcast.net
Crist Blassaras		zorbisfat@comcast.net
Diane Slomka		diane_slomka@yahoo.com
Kevin S. Kenyon	$765-778-0166	KSKenyon@mac.com

Geist/Fall Creek Watershed Alliance
PUBLIC MEETING
6:00 to 7:30 pm Wednesday, January 20th, 2010
Pendleton Community Public Library
595 East Water Street
Pendleton, Indiana 46064

AGENDA

1. Welcome and Introductions

2. Geist Reservoir/Upper Fall Creek Watershed Management Plan Summary

3. Your Watershed and Agricultural Land – What's the Connection?

4. Madison County Soil & Water Conservation District – On-Going Programs

5. Conservation Reserve Enhancement Program Info & Opportunities

6. Questions and Discussion

UWRWA
Upper White River Watershed Alliance

GEIST
WATER QUALITY
GET ON BOARD

Geist/Fall Creek Watershed Alliance
Public Meeting
January 20, 2010 Sign-In Sheet

Name	Phone	Email or Address	Company/Affiliation
Judy Dehury	765 713 5782	jadehury@comcast.net	White River Watchers
Steve Schmidt	765-644-4249	stephen.schmidt@in.nacdnet.net	Mad. County SWCD
KEVIN KENYON	765-760-7791	KSKENYON@MAC.COM	RESIDENT WHITE RIVER WATCHERS
Jim NORRIS	765-584-4505	jnorris@ISDA.in.gov	ISDA
SCOTT RODGERS	317-826-9551	SCOTT@SCOTTR.COM	GWA
CRIST BLASSARAS	765-644-5073	zorbisfat@comcast.net	White River Watchers
DEAN FARR	317-823-5953	dean.farr@sbcglobal.net	GWA
Janice Snell	317 845 0994	snell57@AOL.com	GWA
Mark McCauley	317-773-2181	mark_mccauley_2000@Yahoo.com	Ham. Co. SWCD

Appendix F – IDEM Data

A summary of the data obtained from IDEM within the Geist Reservoir/Upper Fall Creek watershed is provided within this Appendix. The summary contains the mean value of the parameters from all available studies. The raw data is provided on CD at the end of this report. The IDEM studies with the number of data points within the watershed are listed below.

- 1991 Fish Tissue - 3
- 1992 Macroinvertebrates - 7
- 1996 Fish Tissue – 1
- 1996 Macroinvertbrates - 4
- 1996 Sediment Bio - 1
- 1996 Synoptic - 4
- 1996 Watershed - 2
- 1999-2009 Fixed Station - 1
- 2001 Corvallis - 2
- 2001 Corvallis Biological - 1
- 2001 E. Coli – Upper WFWR - 6
- 2001 Fish Tissue - 2
- 2001 Macroinvertebrate – 1
- 2001 Pesticides - 1
- 2001 Sediment Bio – 1
- 2002-2006 Clean Sampling and Ultra-Clean Analyses -1
- 2006 Corvallis - 1
- 2006 Corvallis E. Coli - 1
- 2006 Fish Tissue – 2
- 2006 Macroinvertebrate – 1
- 2008 Fall Creek IBC Study - 66
- 2008-2009 Upper Fall Creek WQ Monitoring Program - 17

Available Data Summary

		Honey Creek	Sly Fork	Deer Creek	Prairie Creek	Headwaters Lick Creek	Foster Branch	McFadden Ditch	Flatfork Creek	Thorpe Creek	Watershed Total
IDEM Studies	303d Impaired	E. Coli	E. Coli	E. Coli	E. Coli	E. Coli	E. Coli	E. Coli	E. Coli	Algae, Taste/Odor, PCBs in fish tissue	
	1991 Fish Tissue				1				1	1	3
	1992 Macro	1		2	1			1	2		7
	1996 Fish Tissue									1	1
	1996 Macro	1		1					2		4
	1996 Sediment Bio									1	1
	1996 Synoptic			2				1	1		4
	1996 Watershed				1				1		2
	1999-2009 Fixed Station								1		1
	2001 Corvallis			1					1		2
	2001 Corvallis Biological			1							1
	2001 E. coli-Upper WFWR	1			1	1		1	2		6
	2001 Fish Tissue									2	2
	2001 Macro			1							1
	2001 Pesticides								1		1
	2001 Sediment Bio									1	1
	2002-2006 Clean Sampling and Ultra-Clean Analyses								1		1
	2006 Corvallis					1					1
	2006 Corvallis E. coli					1					1
	2006 Fish Tissue								1	1	2
	2006 Macro					1					1
	2008 Fall Creek IBC Study	11	5	14	5	8	3	5	5	10	66
	2008-2009 Upper Fall Creek WQ Monitoring Program	2	1	4	2	2	1	2	3		17

	IDEM Biological Evaluation						IDEM Water Quality Data															
	Macros mIBI		Fish IBI		Habitat QHEI		DO		E. Coli		pH		Nitrate+Nitrite		Total P		TSS		Turbidity		Atrazine	
Honey Creek	1	2	11	11	12	13	12	73	3	20	12	74	11	55	11	25	11	40	12	72		
	5.5		41.8		59.8		8.45		1645.5		7.85		3.4		0.098		13.6		36.8		N/A	
Sly Fork			5	5	5	5	5	30	1	5	5	31	5	27	5	17	5	25	5	31	3	4
	N/A		35.6		44.8		8.88		5854.7		7.91		2.12		0.065		13.7		26.4		4.03	
Deer Creek	3	4	15	15	17	19	18	122	6	28	18	126	16	91	18	79	18	66	18	123	4	4
	4.4		42.9		64.5		8.93		3325.9		7.97		2.51		0.214		31.9		24.9		1.93	
Prairie Creek	1	1	6	6	7	7	7	53	4	16	7	55	5	39	6	19	6	34	7	54	2	2
	3.8		39		55.3		9.1		3646		8.01		1.36		0.062		19.9		32.2		1.9	
Headwaters Lick Creek			8	9	8	9	9	66	4	20	9	68	8	51	8	34	8	34	9	66	3	4
	N/A		41.3		60		8.91		3771.1		7.95		1.78		0.069		15.2		27.6		2	
Foster Branch			3	3	3	3	3	24	1	5	3	25	3	20	3	12	3	15	3	25	2	2
	N/A		35.3		37.3		9.18		5669.4		7.95		2.35		0.064		5.7		15.9		2.6	
McFadden Ditch	1	1	5	5	6	6	7	40	2	15	7	40	5	26	6	17	6	23	7	40	2	3
	3.6		45.2		71.8		9.48		1435.5		8.09		1.77		0.081		17.1		29.5		1.7	
Flatfork Creek	2	4	6	6	8	10	10	222	6	133	10	222	7	172	8	154	8	148	10	218	3	14
	4.2		37		65.9		9.35		486.6		8.08		2.55		0.083		21.3		23		1.2	
Thorpe Creek			9	9	9	9	10	24			10	24	10	26	7	15	9	25	10	23	5	5
	N/A		33.6		58.4		7.3		N/A		7.87		4.09		0.848		20.8		41.9		1.6	
Limits	mIBI: 0-2 Severely Impaired; 2-4 Moderately Impaired; 4-6 Slightly Impaired; 6-8 Not Impaired		IBI: <12 No Fish; 12-22 Very Poor; 28-34 Poor; 40-44 Fair; 48-52 Good; 57-60 Excellent		QHEI: <30 Very Poor; 31-42 Poor; 43-54 Fair; 55-69 Good; 70-100 Excellent		Min 4.0mg/L Max 12.0mg/L		Max 235CFU/100mL		Min 6.0 Max 9.0		Max 1.6mg/L		Max 0.3mg/L		Max 30.0mg/L		Max 10.4 NTU			

Legend:

# of Sampling Sites	Total # of Samples
Average Value of All Samples	

Honey Creek

IDEM WQ

2001 E. coli-Upper WFWR

(FallCrFieldData.xls: Dissolved Oxygen – Turbidity; FallCrGenChem.xls: Coliforms – E_Coli)

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Coliforms (Total) (MPN/100mL)	E_ Coli (MPN/100 mL)	E coli
WWU100-0022	6/6/2001 13:15	7.77	17.04	7.86	519	209	> 2419.2	> 2419.2	2419.2
	6/13/2001 10:25	8.02	20	7.8	350	567			
	6/20/2001 10:00	7.98	19.73	8.02	664	9	> 2419.2	461.1	461.1
	6/27/2001 9:55	9	19.14	8.1	709	10	> 2419.2	579.4	579.4
	7/4/2001 10:05	8.16	17.43	7.88	660	7	> 2419.2	2419.17	2419.17
	7/10/2001 13:20	8.86	22.52	8.03	641	8	> 2419.2	> 2419.2	2419.2

2008 Fall Creek IBC Study

(FallCrFieldData.xls: Dissolved Oxygen – Turbidity; FallCrGenChem.xls: Alkalinity – TSS)

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0041	6/16/2008 10:28	8.13	16.67	86.5	7.93	503	83.4	180	15	< 4	< 0.005	0.16	260	< 0.1	8.3	0.11	20	270	0.82	2.6	320	18
	8/11/2008 16:45	6.82	18.33	70	7.82	545	46	300	21	< 4	< 0.005	0.17	350	< 0.1	1.3	< 0.05 (QJ)	49	360	0.8 (fDJ QJ	3.1	400	11 (fDJ)
	10/8/2008 10:43	3.05	14.94	31.2	7.74	687	6.7	300	19	15	< 0.005	0.2	370	0.25	1.4	0.16	46 (fDJ)	330	0.93	7.1	410	6
WWU100-0046	6/16/2008 11:10	8.23	17.89	89.3	7.98	509	89.7	160	14	13	< 0.005	0.16	280	< 0.1	6.3	0.13	26	270	0.68	2.6	340	31
	8/11/2008 17:45	9.48	21.33	104.4	8.26	505	67.1	290	17	< 4	< 0.005	0.2	330	< 0.1	0.77	< 0.05 (QJ)	48	340	0.36 (fDJ Q	2.1	390	6 (fDJ)
	10/8/2008 9:48	7.95	15.29	52	5.06	593	44.9	260	17	11	< 0.005	0.18	340	< 0.1	0.23	0.09	51 (fDJ)	310	0.54	4.4	400	27
WWU100-0047	6/16/2008 12:40	8.02	18.79	86.3	7.82	514	8.9	200	12	9	< 0.005	0.16	280	< 0.1	8.2	0.07	14	270	0.33	1.9	320	9
	8/11/2008 14:45	2.68	18.73	43.4	7.42	473	65.1	260	19	< 4	< 0.005	0.17	300	< 0.1	0.46	< 0.05 (QJ)	9.5	280	0.55 (fDJ Q	3.6	310	4 (fDJ)
	10/8/2008 12:33	3.3	15.94	34.2	7.67	789	201	300	36	240	< 0.005	0.54	420	< 0.1	0.06	0.13	8.1 (fDJ)	450	6.7	59	670	110
WWU100-0104	5/7/2008 11:45	10.14	15.16	106.3	8.01	591	0															
	6/16/2008 12:05	8.3	18.74	91.9	7.91	537	45.6	200	15	9	< 0.005	0.16	280	< 0.1	5.2	0.11	23	280	0.46	2.7	330	29
	8/11/2008 10:30	7.72	15.91	76.4	7.79	534	27.5	300	15	< 4	< 0.005	0.17	350	< 0.1	2.1	< 0.05 (QJ)	32	350	0.71	1.9	400	3 (fDJ)
	10/8/2008 9:02	5.87	15.02	59.3	7.73	622	23.1	290	16	< 4	< 0.005	0.17	360	< 0.1	1.9	< 0.05	36 (fDJ)	340	< 0.3	3.1	390	3
WWU100-0110	6/16/2008 10:20	8.5	17.99	92.7	7.98	511	135	170	17	8	< 0.005	0.18	270	< 0.1	6.2	0.15	22	280	0.67	2.9	350	36
	8/11/2008 17:15	10.06	19.38	103.7	8	510	3.9	320	21	< 4	< 0.005	0.21	300	< 0.1	2.5	< 0.05 (QJ)	27	350	0.37 (fDJ Q	2.1	390	2 (fDJ)
	10/8/2008 11:07	5.72	15.38	58.7	7.94	614	5.8	270	17	6	< 0.005	0.21	360	< 0.1	3	< 0.05	31 (fDJ)	290	< 0.3	3.6	380	12
WWU100-0112	6/16/2008 10:08	8.54	17.93	92.7	7.86	516	44.8	190	19	< 4	< 0.005	0.16	260	< 0.1	7.6	0.09	18	270	0.75	3.2	330	12
	8/11/2008 16:00	8.42	21.06	98	7.95	460	11.2	230	34	< 4	< 0.005	0.17	280	< 0.1	0.1	< 0.05 (QJ)	17	290	0.53 (fDJ Q	4.4	330	3 (fDJ)
	10/8/2008 11:32	1.05	16.3	11.8	7.7	731	40.6	340	40	26	< 0.005	0.29	380	< 0.1	0.02	0.16	14 (fDJ)	390	1.6	10	460	17
WWU100-0113	6/16/2008 10:15	8.77	17.62	99.9	7.45	529	17.4	190	19	< 4	< 0.005	0.16	260	< 0.1	8.4	0.09	16	270	0.98	2.7	320	15
	8/11/2008 15:40	7.84	19.47	83.5	7.67	527	82.4	300	38	< 4	< 0.005	0.16	310	< 0.1	0.27	< 0.05 (QJ)	12	330	0.57 (fDJ Q	4	370	3 (fDJ)
	10/8/2008 12:05	5.9	16.56	63.8	7.85	3160	99.6	280	1000	450 (fDJ)	< 0.005	0.49	310	0.55	0.12	0.25	5 (fDJ)	1800	3.6	12	1900	13
WWU100-0114	5/7/2008 11:17	12.18	15.3	125.6	8.26	573	0															
	6/16/2008 11:00	9.04	18.39	99.2	8.11	529	94.2	190	16	13	< 0.005	0.17	270	< 0.1	5.6	0.12	21	280	0.54	2.7	380	27
	8/11/2008 17:30	9.87	19.59	108	7.98	514	25.4	310	17	< 4	< 0.005	0.2	330	< 0.1	3.4	< 0.05 (QJ)	30	350	< 0.3 (fDJ C	1.8	360	3 (fDJ)
	10/8/2008 10:00	6.51	15.14	66.5	8.21	614	9.3	290	18	< 4	< 0.005	0.2	350	< 0.1	3.6	< 0.05	34 (fDJ)	310	0.43	2.6	370	1
WWU100-0115	5/7/2008 10:55	13.35	13.79	133.3	8.4	522	12.6															
	6/16/2008 9:45	8.69	17.45	93.3	7.62	472	15.5	180	18	5	< 0.005	0.16	240	< 0.1	7.3	0.12	16	230	0.67	3.6	300	9
	8/11/2008 16:30	11.69	20.8	127.3	8.16	498	13.1	270	35	< 4	< 0.005	0.69	320	< 0.1	0.18	< 0.05 (QJ)	32	360	< 0.3 (fDJ C	3.1	390	22 (fDJ)
WWU100-0116	6/16/2008 10:40	9.44	17.7	102.1	7.98	514	64.3	190	15	5	< 0.005	0.16	270	< 0.1	7	0.11	24	270	0.5	2.3	350	16
	8/11/2008 18:00	9.05	20.23	105.9	7.98	518	8.7	310	17	< 4	< 0.005	0.22	340	< 0.1	0.66	< 0.05 (QJ)	49	390	0.66 (fDJ Q	2	390	8 (fDJ)
	10/8/2008 10:16	6.28	15.05	63.5	7.93	629	8.5	280	17	10	< 0.005	0.2	370	< 0.1	0.32	< 0.05	54 (fDJ)	310	0.54	3.1	360	4
WWU100-0117	6/16/2008 10:00	6.64	17.32	71	6.64	471	16.7	180	21	11	< 0.005	0.14	230	< 0.1	6.4	0.18	15	260	0.88	4.3	300	17
	8/11/2008 15:15	9.8	19.29	104.1	7.71	585	23.1	300	51	< 4	< 0.005	0.13	320	< 0.1	4.2	< 0.05 (QJ)	17	380	0.43 (fDJ Q	2	380	3 (fDJ)

2008 Upper Fall Creek WQ Monitoring Program

(FallCrFieldData.xls: Dissolved Oxygen – Turbidity; FallCrGenChem.xls: Alkalinity – TKN)

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Coliforms (Total) (MPN/100 mL)	E_ Coli (MPN/100 mL)	E coli	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)
WWU100-0104	6/18/2008 9:10	8.26	15.56	85.1	7.95	6.15	11.7	254	< 1	16	7.8				0.2	342	< 0.1	4.7	0.05	26	350	0.3
	6/23/2008 14:30	9.36	18.46	102.6	8.03	612	2.8	282		15	6.9				< 0.1		< 0.1	3.7	0.03	31	366	0.4
	7/8/2008 9:10		19.57		7.88	617	10.7					> 2420	1553.1	1553.1								
	7/15/2008 9:20	8.74	18.36	92.3	7.88	565	14.3					> 2420	1553.1	1553.1								
	7/16/2008 9:35	7.52	19.5	83.8	7.87	598	12.5	255	< 1	15	10.2				0.2	326	< 0.1	3.3	0.08	27	363	0.5
	7/22/2008 9:40	7.92	19.67	86.9	7.53	578	14.4					> 2420	> 2420	2420								
	7/28/2008 13:40	8.19	20.75	94.5	7.92	631	4.2	306 (QJ)		15	8.4				0.2		< 0.1	2.4	0.04	33	379	0.4
	7/29/2008 9:05	8.23	18.43	87.3	7.71	661	5.1					> 2420	1046.2	1046.2								
	8/5/2008 10:10	7.94	19.48	87.1	7.73	550	18.4					> 2420	> 2420	2420								
	8/27/2008 9:18	6.92	16.88	73.5	7.85	664	8.9	297	< 1	15	6.9				0.2	375	< 0.1	2.3	0.03	36	402	0.3
	9/8/2008 15:00	8.69	18.16	94.3	7.9	662	12.2	307		15	5.3				0.2		< 0.1	2.3	< 0.03	37	393	0.2
	9/24/2008 9:55	7.14	15.28	72.5	7.74	673	11.1	298	< 1	14	6.5				0.2	382	< 0.1	2.2	< 0.03	34	390	0.2
	10/22/2008 9:20	8.68	7.51	73.7	7.83	679	9	295	< 1	15	7.4				< 0.1	393	< 0.1	2	< 0.03	33	404	0.3
	11/19/2008 9:30	10.48	3.7	80.6	8.17	694	3.5	302	< 1	17	6.9				< 0.1	364	< 0.1	2.4	< 0.03	40	401	0.3 (DJ)
	12/17/2008 9:45	11.71	2.21	85.9	8.05	639	63	275	< 1	20	6.6				0.1	396	< 0.1	2.2	< 0.03	41	401	0.2
WWU100-0114	6/18/2008 8:50	8.98	15.82	92.9	8.02	60.4	7.3	249	< 1	16	8.2				0.2	334	< 0.1	5.7	0.03	21	347	< 0.1
	6/23/2008 12:00	9.44	17.59	102	8.11	602	2.2	276		15	7.3				< 0.1		< 0.1	4.7	< 0.03	23	362	< 0.1
	7/8/2008 8:45	8.27	20.17		7.84	604	7.1					19863	1169	1169								
	7/15/2008 9:10	8.9	18.91	96.4	7.73	583	29.7					> 2420	770.1	770.1								
	7/16/2008 9:00	8.2	19.66	91.7	8.01	611	6.3	260	< 1	17	6.5				0.2	337	< 0.1	4.2	0.04	22	359	0.3
	7/22/2008 9:25	8.46	20	93.8	7.46	557	27.1					> 2420	> 2420	2420								
	7/28/2008 11:00	8.17	19.45	91.8	8	615	2.3	298 (QJ)		16	7.2				0.2		< 0.1	3.4	< 0.03	25	366	0.3
	7/29/2008 8:55	8.75	19.34	96.1	7.7	639	3.8					> 2420	613.1	613.1								
	8/5/2008 9:55	9.57	19.6	104.7	7.8	549	16.5					> 2420	> 2420	2420								
	8/27/2008 8:45	7.86	16.78	83.3	7.96	661	6.1	295	< 1	13	6.1				0.2	377	< 0.1	4.2	< 0.03	30	399	0.2
	9/8/2008 10:00	8.57	15.97	88.6	7.94	659	1.7	303		13	< 5				0.2		< 0.1	4.2	< 0.03	34	395	0.2
	9/24/2008 9:20	8.15	15.36	83	7.87	665	1.7	293	< 1	12	< 5				0.2	370	< 0.1	4.2	< 0.03	34	388	0.3
	10/22/2008 8:50	9.24	7.59	78.4	7.97	679	0	290	< 1	14	< 5				< 0.1	369	< 0.1	4.2	< 0.03	29	404	0.2
	11/19/2008 8:55	10.82	3.88	83.9	8.14	699	7.1	302	< 1	16	9				< 0.1	377	< 0.1	3.9	< 0.03	36	403	0.4 (DJ)
	12/17/2008 9:10	12.06	2.06	88.3	8.09	711	4	270	< 1	26	5.8				0.1	394	< 0.1	3.7	< 0.03	35	408	< 0.1

2009 Upper Fall Creek WQ Monitoring Program

(FallCrFieldData.xls: Dissolved Oxygen – Turbidity; FallCrGenChem.xls: Alkalinity – TSS)

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0104	2/18/2009 9:25	11.42	4.63	90.7	8	547	12.03	218	< 1	18	7.1	< 0.1	275	< 0.1	3.9	0.05	28	317	0.4	1.8	351	8
	3/11/2009 10:05	10.56	8.26	91.7	8.05	585	12	252	< 1	20	8.7	0.2	343	< 0.1	2.2	< 0.03	35	338	0.3	2.6	382	8
WWU100-0114	2/18/2009 8:52	11.97	4.18	94.1	8.04	523	9.7	202	< 1	21	6.3	0.1	274	< 0.1	4.8	0.04	23	301	0.4	1.8	334	< 4
	3/11/2009 9:40	11.19	8.05	96.6	8.03	568	6.1	235	< 1	23	7.9	0.2	310	< 0.1	3.3	< 0.03	28	326	0.4	2.5	365	5

FallCrMetals.xls

Tss	Aluminum (Total) (ug/L)	Antimony (Total) (ug/L)	Arsenic (Total) (ug/L)	Barium (Total) (ug/L)	Beryllium (Total) (ug/L)	Cadmium (Total) (ug/L)	Calcium (mg/L)	Chromium (Total) (ug/L)	Cobalt (ug/L)	Copper (Total) (ug/L)	Iron (Total) (mg/L)	Lead (Total) (ug/L)	Magnesium (mg/L)	Manganese (Total) (ug/L)	Nickel (Total) (ug/L)	Potassium (mg/L)	Selenium (Total) (ug/L)	Silicon (ug/L)	Silver (Dissolved) (ug/L)	Silver (Total) (ug/L)	Sodium (mg/L)	Thallium (Total) (ug/L)	Zinc (Total) (ug/L)
18	720	< 1	< 5	59	< 1	< 2	64	< 3	0.47	2.3	0.87	< 2	23	35	2.8	2.2	< 4	5600		< 0.3	5.4	< 1	< 6
11	210	< 1	< 5	100	< 1	< 2	84	< 3	< 0.5	< 2	0.32	< 2	33	40	1.9	3.4	< 4	3500		< 0.3	8.6	< 1	< 6
6	110	< 1	< 5	79	< 1	< 2	90	< 3	< 0.5	2.8	0.27	< 2	36	100	2.4	14	< 4	4500		< 0.3	7.7	< 1	7.7
31	1000	< 1	< 5	71	< 1	< 2	70	< 3	0.6	2.6	1.2	< 2	25	55	3.2	2.2	< 4	6000		< 0.3	5	< 1	< 6
3	130	< 1	< 5	97	< 1	< 2	80	< 3	< 0.5	< 2	0.38	< 2	32	41	1.7	1.9	< 4	3800		< 0.3	6.4	< 1	< 6
27	550	< 1	< 5	100	< 1	< 2	84	< 3	< 0.5	2.6	1.1	< 2	33	72	1.9	4.4	< 4	4500		< 0.3	5.4	< 1	7.8
9	170	< 1	< 5	43	< 1	< 2	69	< 3	0.29	< 2	0.2	< 2	25	22	2.2	1.1	< 4	4100		< 0.3	4.8	< 1	< 6
4		< 1	< 5	52	< 1	< 2	72	< 3	< 0.5	< 2		< 2	31		2.2		< 4			< 0.3		< 1	< 6
110	1000	< 1	14	160	< 1	< 2	94	< 3	1.9	4.1	4.8	2.2	45	1300	5.6	26	< 4	12000		< 0.3	13	< 1	14
29	800	< 1	< 5	72	< 1	< 2	73	< 3	0.55	2.3	1	< 2	25	42	3.1	2.2	< 4	5900		< 0.3	5.8	< 1	< 6
3		< 1	< 5	94	< 1	< 2	88	< 3	< 0.5	< 2		< 2	32		1.6		< 4			< 0.3		< 1	< 6
3	71	< 1	< 5	100	< 1	< 2	90	< 3	< 0.5	< 2	0.33	< 2	33	46	< 1.5	3.7	< 4	4900		< 0.3	6.6	< 1	< 6
36	2000	< 1	< 5	67	< 1	< 2	68	< 3	0.73	3.8	1.8	< 2	24	40	3.6	3.1	< 4	8100		< 0.3	6.6	< 1	9.8
2	30	< 1	< 5	79	< 1	< 2	75	< 3	< 0.5	< 2	0.11	< 2	29	13	< 1.5	2.2	< 4	3200		< 0.3	8.4	< 1	< 6
12	98	< 1	< 5	100	< 1	< 2	87	< 3	< 0.5	< 2	0.28	< 2	33	24	< 1.5	4.8	< 4	4600		< 0.3	7.3	< 1	8.6
12	450	< 1	< 5	52	< 1	< 2	66	< 3	0.39	2.1	0.56	< 2	23	36	2.6	2	< 4	4700		< 0.3	7.2	< 1	< 6
3	85	< 1	< 5	62	< 1	< 2	64	< 3	< 0.5	< 2	0.22	< 2	30	36	1.8	2.5	< 4	1500		< 0.3	14	< 1	< 6
17	450	< 1	9.3	110	< 1	< 2	88	< 3	0.5	2.3	0.84	< 2	40	430	2.9	14	< 4	2700		< 0.3	19	< 1	7
15	420	< 1	< 5	47	< 1	< 2	67	< 3	0.42	2	0.55	< 2	24	42	2.6	1.9	< 4	4600		< 0.3	7	< 1	< 6
3		< 1	< 5	48	< 1	< 2	76	< 3	< 0.5	< 2		< 2	30		1.9		< 4			< 0.3		< 1	< 6
13	110	< 1	8.1	160	< 1	< 2	66	< 3	0.57	2.6	0.75	< 2	36	320	3.2	16	< 4	890		< 0.3	660	< 1	9
27	1000	< 1	< 5	65	< 1	< 2	69	< 3	0.57	2.6	1.2	< 2	24	32	3.2	2.4	< 4	5700		< 0.3	6.1	< 1	6
3	60	< 1	< 5	86	< 1	< 2	82	< 3	< 0.5	< 2	0.099	< 2	31	9.3	1.5	2.2	< 4	4000		< 0.3	6.7	< 1	< 6
1	< 20	< 1	< 5	91	< 1	< 2	87	< 3	< 0.5	< 2	0.079	< 2	33	7.9	< 1.5	3.5	< 4	4500		< 0.3	5	< 1	< 6
9	430	< 1	< 5	45	< 1	< 2	59	< 3	0.33	2.2	0.51	< 2	21	24	2.5	2.1	< 4	5300		< 0.3	7.4	< 1	< 6
22	880	< 1	< 5	71	< 1	< 2	78	< 3	0.64	2.6	1.2	< 2	29	63	2.9	2	< 4	4600		< 0.3	18	< 1	< 6
16	620	< 1	< 5	64	< 1	< 2	69	< 3	0.44	2.7	0.81	< 2	25	35	2.8	2.1	< 4	5600		< 0.3	5.1	< 1	< 6
8	140	< 1	< 5	110	< 1	< 2	84	< 3	< 0.5	< 2	0.38	< 2	33	31	1.6	1.8	< 4	3800		< 0.3	5.8	< 1	< 6
4	60	< 1	< 5	120	< 1	< 2	89	< 3	< 0.5	< 2	0.24	< 2	35	29	< 1.5	4.1	< 4	4100		< 0.3	5.3	< 1	< 6
17	540	< 1	< 5	43	< 1	< 2	58	< 3	0.46	2.6	0.68	< 2	21	48	2.7	2.2	< 4	5400		< 0.3	10	< 1	< 6
3		< 1	< 5	55	< 1	< 2	82	< 3	< 0.5	< 2		< 2	28		1.7		< 4			< 0.3		< 1	< 6

FallCrMetals.xls

TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Antimony (Total) (ug/L)	Arsenic (Total) (ug/L)	Barium (Total) (ug/L)	Beryllium (Total) (ug/L)	Cadmium (Total) (ug/L)	Chromium (Total) (ug/L)	Cobalt (ug/L)	Copper (Total) (ug/L)	Iron (Total) (ug/L)	Lead (Total) (ug/L)	Manganese (Total) (ug/L)	Nickel (Total) (ug/L)	Potassium (mg/L)	Selenium (Total) (ug/L)	Silver (Total) (ug/L)	Sodium (mg/L)	Thallium (Total) (ug/L)	Zinc (Total) (ug/L)
3.4	399	10	< 1.8	1.26	76.3	< 1.6	< 1	< 1.2	< 1	1.38	354	< 1	29.3	< 1.4	1.79	< 2.2	< 1	6.73	< 1	6.37
2.5	398	< 4																		
2.6	393	13	< 1.8	1.24	78.3	< 1.6	< 1	< 1.2	< 1		332	< 1	29.7		1.69	< 2.2	< 1	6.64	< 1	< 6
3.3	411	5																		
1.5	429	8	< 1.8	1.42	104	< 1.6	< 1	< 1.2	< 1	1.09	312	< 1	41.1	< 1.4	1.74	< 2.2	< 1	6.18	< 1	< 6
1.8	428	< 4																		
1.9	427	5	< 1.8	1.27	108	< 1.6	< 1	< 1.2	< 1	1.01	302	< 1	46.2	< 1.4	1.87	< 2.2	< 1	5.92	< 1	< 6
2.5	431	< 4	< 1.8	< 1.2	105	< 1.6	< 1	< 1.2	< 1	< 1	344	< 1	42.2	< 1.4	1.95	< 2.2	< 1	6.09	< 1	< 6
2.7	427	< 4	< 1.8	< 1.2	110	< 1.6	< 1	< 1.2	< 1	1.13	414	< 1	41.2	< 1.4	2.91	< 2.2	< 1	6.75	< 1	< 6
2.1	424	< 4	< 1.8	< 1.2	102	< 1.6	< 1	< 1.2	< 1	< 1	341	< 1	49.8	< 1.4	1.51	< 2.2	< 1	8.38	< 1	< 6
3.1	391	< 4	< 1.8	< 1.2	66.3	< 1.6	< 1	< 1.2	< 1	1.3	186	< 1	14.5	< 1.4	1.98	< 2.2	< 1	6.68	< 1	< 6
2.6	389	< 4																		
2.1	394	4	< 1.8	< 1.2	70.4	< 1.6	< 1	< 1.2	< 1		123	< 1	12		1.71	< 2.2	< 1	6.82	< 1	< 6
3.1	399	< 4																		
1	429	< 4	< 1.8	< 1.2	96.8	< 1.6	< 1	< 1.2	< 1	1	84.8	< 1	8.95	< 1.4	1.98	< 2.2	< 1	5.08	< 1	< 6
1.2	423	< 4																		
1.5	420	< 4	< 1.8	< 1.2	99.9	< 1.6	< 1	< 1.2	< 1	< 1	56	< 1	6.54	< 1.4	2.04	< 2.2	< 1	5.15	< 1	< 6
1.9	430	< 4	< 1.8	< 1.2	94.8	< 1.6	< 1	< 1.2	< 1	< 1	46	< 1	5.03	< 1.4	2.08	< 2.2	< 1	5.51	< 1	< 6
2.4	430	< 4	< 1.8	< 1.2	100	< 1.6	< 1	< 1.2	< 1	1.08	80.5	< 1	8.1	< 1.4	3.81	< 2.2	< 1	5.63	< 1	< 6
2.1	429	< 4	< 1.8	< 1.2	92.4	< 1.6	< 1	< 1.2	< 1	1	89.1	< 1	10.4	< 1.4	2	< 2.2	< 1	11.1	< 1	< 6

FallCrMetals.xls

Antimony (Total) (ug/L)	Arsenic (Total) (ug/L)	Barium (Total) (ug/L)	Beryllium (Total) (ug/L)	Cadmium (Total) (ug/L)	Chromium (Total) (ug/L)	Cobalt (ug/L)	Copper (Total) (ug/L)	Iron (Total) (ug/L)	Lead (Dissolved) (ug/L)	Lead (Total) (ug/L)	Manganese (Total) (ug/L)	Nickel (Total) (ug/L)	Potassium (mg/L)	Selenium (Dissolved) (ug/L)	Selenium (Total) (ug/L)	Silver (Total) (ug/L)	Sodium (mg/L)	Thallium (Total) (ug/L)	Zinc (Total) (ug/L)
< 1.8	< 1.2	67.4	< 1.6	< 1	< 1.2	< 1	1.58	326		< 1	35.4	< 1.4	1.58		< 2.2	< 1	7.27	< 1	< 6
< 1.8	< 1.2	82	< 1.6	< 1	< 1.2	< 1	1.45	307		< 1	43	< 1.4	1.58		< 2.2	< 1	8.12	< 1	< 6
< 1.8	< 1.2	53.2	< 1.6	< 1	< 1.2	< 1	1.68	217		< 1	14.4	< 1.4	1.5		< 2.2	< 1	7.97	< 1	< 6
< 1.8	< 1.2	67.1	< 1.6	< 1	< 1.2	< 1	1.5	163		< 1	14.7	< 1.4	1.58		< 2.2	< 1	9.48	< 1	< 6

Sly Fork

IDEM WQ

2008 Fall Creek IBC Study

FallCrFieldData.xls | FallCrGenChem.xls

Site	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)
WWU100-0084	5/7/2008 14:40	11.09	15.39	113.9	8.08	662	23.7									
	6/16/2008 15:15	7.7	19.72	86.6	7.79	620	35	250	30	< 4	< 0.005	0.15	320	< 0.1	2.4	0.12
	8/12/2008 10:24							280	30	< 4 (fDJ)	< 0.005 (Q	0.17	360	< 0.1	1.4	< 0.05 (QJ
	10/7/2008 12:23	8.02	14.4	80.2	8.02	678	35	300	30	< 4	< 0.005	0.15	370	< 0.1	1.2	< 0.05 (QJ
WWU100-0088	6/16/2008 15:05	7.51	19.93	85	7.83	632	41.5	250	32	5	< 0.005	0.12	320	< 0.1	2.4	0.1
	8/12/2008 10:52							260	31	< 4 (fDJ)	< 0.005 (Q	0.16	350	< 0.1	1.5	< 0.05 (QJ
	10/7/2008 12:47	8.36	14.73	86.1	8	671	24.4	270	30	< 4	< 0.005	0.16	360	< 0.1	1.3	< 0.05
WWU100-0090	6/16/2008 11:40	8.15	18.3	88.8	7.86	625	15.5	250	35	14	< 0.005	0.16	310	< 0.1	3	0.07
	8/12/2008 13:13							260	36	4 (fDJ)	< 0.005 (Q	0.16	330	< 0.1	2.1	< 0.05 (QJ
	10/7/2008 15:37	7.63	15.77	77.3	8.01	648	41.7	240	34	< 4	< 0.005	0.14	340	< 0.1	2.4	< 0.05
WWU100-0091	5/7/2008 14:25	10.09	15.33	103.5	8.09	672	18.7									
	5/8/2008 12:55	8.44	13.54	83.7	7.74	607	39.7									
	6/16/2008 14:55	7.86	19.94	89	7.81	634	22.6	250	34	10	< 0.005	0.1	310	< 0.1	2.6	0.11
	8/12/2008 12:37							260	38	< 4 (fDJ)	< 0.005 (Q	0.17	360	< 0.1	1.7	< 0.05 (QJ
	10/7/2008 16:00	7.42	15.07	75.6	7.96	681	26.8	260	38	< 4	< 0.005	0.14	350	< 0.1	1.6	< 0.05
WWU100-0097	5/7/2008 13:40	11.67	12.15	113.8	7.64	645	9.6									
	6/16/2008 11:25	8.41	16.27	87.6	7.42	603	17.9	260	18	6	< 0.005	0.18	320	< 0.1	4.4	0.06
	8/12/2008 13:52							250	15	< 4 (fDJ)	< 0.005 (Q	0.17	360	< 0.1	4.1	< 0.05 (QJ
	10/7/2008 15:18	9.72	16.4	102.4	7.85	653	23.8	270	16	< 4	< 0.005	0.16	370	< 0.1	4.9	< 0.05

2008 Upper Fall Creek WQ Monitoring Program

FallCrFieldData.xls | FallCr(

Site	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Coliforms (Total) (MPN/100 mL)	E_Coli (MPN/100 mL)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)
WWU100-0084	6/18/2008 10:45	8.02	15.81	83.2	7.98	675	26.8	266	< 1	30	11.4			0.2	338	< 0.1
	6/25/2008 8:00	7.5	17.38	79.8	7.99	678	25	290		31	11.4			< 0.1		< 0.1
	7/8/2008 10:55		19.97		7.88	679	16.5					> 2420	920.8			
	7/15/2008 10:45	8.76	19.1	96.3	7.72	621	43.1					> 2420	816.4			
	7/16/2008 11:15	7.58	19.66	84.6	7.97	657	33.5	265	< 1	28	12.2			0.2	345	< 0.1
	7/22/2008 11:05	8.29	20.52	92.2	7.43	454	95.9					> 24200	24192			
	7/29/2008 10:20	8.86	19.65	97.2	7.71	709	8.7					> 2420	435.2			
	7/30/2008 8:00	6.5	20.32	74.3	7.89	695	14.8	312 (QJ)		31	10			0.2		< 0.1
	8/5/2008 11:30	8.87	19.86	97.4	7.79	562	84.8					> 24200	2909			
	8/27/2008 10:40	8.31	17.8	90.1	8.13	707	9.2	293	< 1	31	8.5			0.1	376	< 0.1
	9/9/2008 8:30	7.15	17.36	76.3	7.89	658	18.9	273		29	10.5			0.1		< 0.1
	9/24/2008 11:30	7.68	16.96	80.8	8.05	707	11.2	290	1	29	8.1			0.1	394	< 0.1
	10/22/2008 10:41	8.78	7.63	74.6	8.12	722	8.1	296	1	28	9.1			< 0.1	394	< 0.1
	11/19/2008 10:50	12.14	2.5	90.3	8.33	740	9.5	292	< 1	29	10.6			< 0.1	390	< 0.1
	12/17/2008 11:10	13.19	1.03	94	8.2	738	9.4	267	< 1	32	7.8			0.1	382	< 0.1

2009 Upper Fall Creek WQ Monitoring Program

FallCrFieldData.xls | FallCrGenChem.xls

Site	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)
WWU100-0084	2/18/2009 10:47	11.07	5.06	89.3	8	626	12.6	242	< 1	30	8.6	< 0.1	336	< 0.1	2.5	0.04
	3/11/2009 11:17	11.59	8.64	101.5	8.23	685	15.3	274	< 1	38	12.3	0.1	378	< 0.1	1.4	0.04

DO	8.878666667
E. Coli	5854.68
pH	7.907
Nitrate+Nit	2.118518519
Total P	0.065294118
TSS	13.72
Turbidity	26.42580645
Atrazine	4.025

Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Atrazine (Aatrex) (ug/L)
30	340	0.88	3.5	410	42	1.7 (QJ)
35	370	0.63 (QJ)	2.3	420	8	
41	410	0.63 (QJ f[	2.4	460	9	
30	350	0.53	3.4	420	31	
37	400	0.54	2.1	400	3	
43	370	0.42	2.2	440	5	
32	340	0.68	2.3	390	18	
40	380	< 0.3	1.8	430	4	
48	380	0.5	2	420	22	
						9.9 (QJ)
31	340	0.78	3.5	410	31	2 (QJ)
39	410	0.66	2.2	420	1	
44	400	0.54	2.3	440	7	
39	300	0.82	1.9	370	8	2.5 (QJ)
50	380	< 0.3	< 1	380	2	
54	390	0.35	1	440	7	

GenChem.xls

Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
2.6	0.08	29	392	0.5	3.8	447	29
2.1	0.07	34	405	0.5	2.4	475	31
2.5	0.06	33	391	0.4	2.7	440	24
1.8	0.06	39	418	0.5	3.6	462	4
1.4	0.04	39	438	0.2	1.7	454	7
1.4	0.08	40	392	0.4	2.6	452	20
1.3	0.05	42	416	0.3	2.2	443	8
0.9	0.06	35	423	0.3	3.2	453	5
1.1	0.04	49	433	0.4 (DJ)	3.3	465	< 4
1.2	0.03	48	434	0.3	3.1	457	< 4

Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
39	360	0.4	2.2	396	8
40	398	0.4	2.9	437	9

Deer Creek

IDEM WQ

1996 Synoptic

FallCrFieldData.xls | FallCrGenChem.xls

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	E_Coli (CFU/100 mL)	E Coli	Hardness (as CaCO3) (mg/L)	Phosphorus, Total (mg/L)	P	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TPH - IR (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0002	2/21/1996 15:21	13	7.09	8	281.6	12.6	270	30	50 (JH)	50	410	0.059	0.059	52	370	0.7 (B)	2.2	< 1 (U)	410	< 4 (U)
	4/23/1996 14:30	10.7	8.69	7.8	101.76	0.68	90	13			165	1 (B)	1	16	200	4.4 (B)	6.8	< 1 (U)	880	710
	5/30/1996 14:05	10.19	17.04	7.92	593.75	24.7	220 (Q)	23	200 (JH)	200	310	0.068	0.068	39 (B)	360	1 (B)	3		390	8
	7/9/1996 15:30	8.91	21.26	7.98	686	15.69	270	29			370	0.12	0.12	49	390	0.38 (JH)	1.8		430	7
	10/2/1996 13:17	7.01	18.81	7.71		36.7	310	33	200	200	370	0.12	0.12	52	430	0.5	3		480	22
	11/13/1996 10:51	11.22	4.01	7.88	668	19.1	290 (Q)	29	550	550	330	0.071	0.071	49	400	0.73	2.8		410	< 4 (U)
WWU100-0003	2/21/1996 15:45	13.1	6.3	8.3	269.399	12.5	260	24	90 (JH)	90	360	0.049	0.049	62	350	0.36 (B)	2	< 1 (U)	390	< 4 (U)
	4/23/1996 13:54	10	9	7.8	106.199	580	100	13			280	0.55 (B)	0.55	19	200	5.3 (B)	15	< 1 (U)	1000	680
	5/30/1996 14:30	10.97	16.79	8.27	573	12.19	220 (JQ)	20	60 (JH)	60	270	0.04	0.04	54 (B)	370	0.96 (B)	3		410	< 4 (U)
	7/9/1996 15:15	9.36	20.63	8.19	644	5.69	270	20			360	0.068	0.068	72	390	0.23 (JH)	1.6		420	< 4 (U)
	10/2/1996 13:30	9.26	18.27	8.09	632	7.69	280	22	250	250	350	0.051	0.051	56	370	0.31	2.6		420	< 4 (U)
	11/13/1996 11:00	12.3	3.21	8.13	613.099	15.3	270 (JQ)	24	310	310	310	0.051	0.051	49	390	0.49	2.1		400	< 4 (U)

2001 Corvallis

FallCrFieldData.xls | FallCrGenChem.xls

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	AFDM (g/M2)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	Chlorophyll a - Periphyton (mg/M2)	Chlorophyll a - Phytoplankton (ug/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phaeophyton - Periphyton (attached) (mg/M2)	Phaeophyton - Phytoplankton (suspended) (ug/L)	Phosphorus, Total (mg/L)
WWU100-0013	5/23/2001 17:00	9.3	15.3	98.19	8.25	663	27.89		240	30			6.6	< 0.005	332	< 0.1	10			0.051
	7/24/2001 8:15	7.18	22.05	85.59	8.02	671	15	29.63333	270	27	56.04	1.54	12	< 0.005 (Q	329	< 0.1	2.2 (DJ)	68.71333	1.653333	0.057
	9/18/2001 9:00	8.02	16.15	84.4	7.84	706	6.19	26.5	310	27	14.79667	0.843333	< 5	< 0.005	344	< 0.1	2	2.046667	1.22	0.063

2008 Fall Creek IBC Study

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	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	P	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)
WWU100-0087	5/7/2008 14:51	11.11	15.97	115.7	8.31	577	7.5													
	6/16/2008 15:30	8.45	20.46	96.9	8.07	542	20	230	18	< 4	< 0.005	0.19	290	< 0.1	4	0.09	0.09	24	300	0.6
	8/12/2008 9:41							260	21	< 4 (fDJ)	< 0.005 (Q.	0.26	340	< 0.1	1.6	< 0.05 (QJ)		31	360	0.61
	10/7/2008 12:33	7.76	13.98	75.7	8.23	678	12.7	300	30	< 4	< 0.005	0.21	360	< 0.1	1.7	< 0.05 (QJ)		38	380	0.54 (QJ fD
WWU100-0092	6/16/2008 14:35	8.95	24.35	110.8	8.42	453	22.5	180	21	8	< 0.005	0.13	230	< 0.1	4	0.1	0.1	16	240	0.81
	8/12/2008 11:19							180	22	23 (fDJ)	< 0.005 (Q.	0.17	220	< 0.1	0.15	0.09 (QJ)	0.09	16	230	2.4
	10/7/2008 13:00	5.86	17.75	63.7	8.41	453	11.2	190	26	42	< 0.005	0.19	230	< 0.1	0.01	0.15	0.15	18	260	1.1
WWU100-0094	5/7/2008 9:51	10.46	13.07	102.7	8.06	576	5.6													
	6/16/2008 11:30	8.16	17.91	89	5.7	525	27.5	180	27	14	< 0.005	0.18	260	< 0.1	8.1	0.12	0.12	17	260	0.56
	8/12/2008 11:20							280	27	< 4 (fDJ)	< 0.005 (Q.	0.27	350	< 0.1	1.8	< 0.05 (QJ)		20	370	0.58
	10/7/2008 13:37	5.03	14.75	50.5	8.12	605	113	300	22	46	< 0.005	0.42	330	< 0.1	0.01	1.9 (QJ)	1.9 <		350	1.8 (QJ fDJ
WWU100-0095	6/16/2008 11:15	7.52	17.62	86.4	7.75	542	79.3	160	37	18	< 0.005	0.15	250	< 0.1	8.9	0.18	0.18	16	270	0.63
	8/12/2008 12:50							280	76	4 (fDJ)	< 0.005 (Q.	0.21	340	< 0.1	0.21	0.07 (QJ)	0.07	14	440	1.9 (fDJ)
	10/6/2008 13:54	0.5	13.97	5.2	8.39	1970	5999	140	100	540	< 0.005	0.46	800	80	0.03	4.5 (QJ)	4.5 <		880	81
WWU100-0098	6/16/2008 1:35	7.66	18.88	82.7	7.89	557	67	190	20	9	< 0.005	0.15	290	< 0.1	5.3	0.18	0.18	26	300	0.91
	8/11/2008 9:20	6.34	16.07	68.1	7.75	559	57.7	330	23	< 4	< 0.005	0.18	< 1	< 0.1	2.6	< 0.05 (QJ)		37	350	0.69
	10/8/2008 8:20	5.23	15.38	53.5	7.52	732	7	270	44	6	< 0.005	0.22	360	0.12	2.9	0.13	0.13	39 (fDJ)	380	1.1
WWU100-0099	5/7/2008 13:10	9.99	13.74	99.6	8.06	607														
	6/16/2008 14:10	8.73	17.33	93.7	7.95	550	14.2	230	17	< 4	< 0.005	0.16	290	< 0.1	3.7	0.07	0.07	24	290	0.51
	8/11/2008 8:30	8.7	14.86	86.5	7.81	573	4.7	340	24	< 4	< 0.005	0.25	390	< 0.1	0.87	< 0.05 (QJ)		38	390	0.31 (fDJ)
	10/7/2008 13:18	7.78	13.81	77.5	7.88	701	13.6	320	27	< 4	< 0.005	0.22	390	< 0.1	1.2	< 0.05		41	470	0.35
WWU100-0100	6/16/2008 12:50	8.79	18.8	97.1	7.95	548	59	180	16	8	< 0.005	0.19	280	< 0.1	5.2	0.14	0.14	23	290	0.76
	8/11/2008 10:15	8.6	16.45	89.8	7.78	607	8.5	310	35	< 4	< 0.005	0.22	370	< 0.1	3.9	< 0.05 (QJ)		44	390	0.45
	10/8/2008 8:43	7.2	15.96	74.7	7.94	712	15.1	260	46	5	< 0.005	0.29	330	< 0.1	3.4	0.28	0.28	40 (fDJ)	370	< 0.3
WWU100-0101	6/16/2008 1:20	9.39	18.8	103.8	8.12	503	13.6	200	14	9	< 0.005	0.19	270	< 0.1	4.5	0.08	0.08	26	280	0.65
	8/11/2008 11:30	9.94	17.62	105.7	8.21	533	16	280	21	< 4	< 0.005	0.35	360	< 0.1	0.68	< 0.05 (QJ)		44	360	0.35
	10/8/2008 13:39	6.82	15.83	69.2	8.09	615	15.7	230	26	5	< 0.005	0.38	340	< 0.1	0.41	0.12	0.12	55 (fDJ)	330	< 0.3
WWU100-0103	6/16/2008 11:00	7.71	17.59	83.3	7.54	503	16	190	12	4	< 0.005	0.23	260	< 0.1	4.6	0.11	0.11	27	270	0.52
	8/11/2008 13:00	10.18	17.63	106.4	8.01	552		310	17	< 4	< 0.005	0.38	370	< 0.1	0.73	< 0.05 (QJ)		49	410	< 0.3
	10/8/2008 14:45	6.75	16.08	100.8	8.03	647	7	290	17	< 4	< 0.005	0.43	380	< 0.1	0.02	< 0.05		59 (fDJ)	370	< 0.3
WWU100-0105	5/7/2008 12:16	11.08	16.17	115.9	8.33	559	60.1													
	6/16/2008 13:05	10.1	20.73	114	8.05	501	82.4	170	19	12	< 0.005	0.19	260	< 0.1	7.1	0.15	0.15	22	260	1.1
	8/11/2008 10:50	6.75	17.11	70.4	7.79	542	18.5	290	33	< 4	< 0.005	0.2	340	< 0.1	0.61	< 0.05 (QJ)		32	350	0.69
	10/8/2008 13:24	5.1	15.87	51.9	7.86	652	23.7	260	35	7	< 0.005	0.19	350	< 0.1	0.92	< 0.05		36 (fDJ)	340	< 0.3
WWU100-0106	5/7/2008 12:48	10.57	15.54	109.5	8.1	607	1.3													
	6/16/2008 13:50	8.09	19.31	90.2	7.92	563	59.8	200	19	5	< 0.005	0.14	310	< 0.1	5.1	0.14	0.14	25	310	0.75
	8/11/2008 9:08	7.19	16.64	75.4	7.81	556	24.3	320	24	< 4	< 0.005	0.18	360	< 0.1	2.4	< 0.05 (QJ)		38	350	0.63 (fDJ)
	10/7/2008 14:52	8.41	14.68	84.7	8.06	723	18.3	290	37	< 4	< 0.005	0.21	370	< 0.1	2.5	< 0.05		41 (fDJ)	390	< 0.3
WWU100-0107	6/16/2008 10:30	10.35	17.23	117.7	7.55	539	53.6	180	20	5	< 0.005	0.19	280	< 0.1	8.9	0.13	0.13	23	280	0.54
	8/11/2008 12:00	9.13	18.26	99.9	8.21	562	7.2	330	35 (HJ QJ)	< 4	< 0.005	0.27	350	< 0.1	0.58	< 0.05 (QJ)		35	370	0.37
	10/8/2008 13:56	3.16	15.56	25.1	7.79	680	13.6	300	35	28	< 0.005	0.49	330	< 0.1	0.01	0.2	0.2	15 (fDJ)	360	0.5
WWU100-0108	5/7/2008 10:36	11.27	12.68	109.8	7.98	592	8.5													
	6/16/2008 10:45	8	16.5	83.8	7.63	553	13.4	230	14	< 4	< 0.005	0.24	290	< 0.1	5.3	0.06	0.06	30	270	0.35
	8/11/2008 12:30	8.32	16.96	89.4	7.74	560	9.6	290	18	< 4	< 0.005	0.4	390	< 0.1	0.7	< 0.05 (QJ)		54	390	0.33 (fDJ C
	10/8/2008 14:16	7.56	15.61	73.9	7.93	663	21.3	290	16	< 4	< 0.005	0.47	380	< 0.1	0.05	< 0.05		59 (fDJ)	360	< 0.3
WWU100-0109	6/16/2008 12:15	7.1	17.46	77.5	7.62	541	17.9	240	14	9	< 0.005	0.16	290	< 0.1	7.3	0.06	0.06	20	280	0.4
	8/12/2008 11:50							270	18	< 4 (fDJ)	< 0.005 (Q.	0.15	350	< 0.1	3.1	< 0.05 (QJ)		31	340	0.3
	10/8/2008 14:32	6.15	16.28	63.5	8.06	640	11.1	250	22	8	< 0.005	0.14	360	< 0.1	4	< 0.05		37 (fDJ)	340	1.4

2008 Upper Fall Creek WQ Monitoring Program

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	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Coliforms (Total) (MPN/100 mL)	E_Coli (MPN/100 mL)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	P	Sulfate (mg/L)
WWU100-0087	6/18/2008 10:25	8.57	16.39	89.9	8.13	607	11.7	251	< 1	18	9			0.2	306	< 0.1	3.8	0.05	0.05	26
	6/25/2008 10:00	7.67	17.87	83.7	8.11	622	5.4	282		20	6.5			0.1		< 0.1	2.7	0.03	0.03	31
	7/8/2008 10:40		20.57		7.99	605	9.5					> 2420	488.4							
	7/15/2008 10:35	9.4	19.7	102.9	7.83	565	17.2					> 2420	686.7							
	7/16/2008 11:00	8.1	20.33	91.7	8.12	600	10.6	254	< 1	19	9			0.2	324	< 0.1	2.8	0.06	0.06	24
	7/22/2008 10:55	8.18	21.65	92.7	7.46	394	75.5					> 24200	> 24200							
	7/29/2008 10:15	8.8	20.13	97	7.75	638	16.4					> 2420	488.4							
	7/30/2008 10:00	6.44	20.56	74	8	636	16.4	303 (QJ)		21	8			0.2		< 0.1	1.9	0.05	0.05	29
	8/5/2008 11:20	8.66	19.99	95.5	7.84	553	30.2					> 24200	3654							
	8/27/2008 10:25	7.8	17.85	84.6	8.14	669	13.5	292	< 1	22	5.7			0.2	361	< 0.1	1.8	0.04	0.04	34
	9/9/2008 10:30	7.35	17.28	78.2	8	636	12.2	281		22	9.7			0.2		< 0.1	1.8	0.06	0.06	35
	9/24/2008 11:10	7.64	16.22	79.3	7.99	693	4.7	296	< 1	24	< 5			0.3	383	< 0.1	1.7	0.04	0.04	39
	10/22/2008 10:30	9.13	8.06	78.5	8.02	709	3.2	294	< 1	26	6.6			0.2	391	< 0.1	1.5	< 0.03		35
	11/19/2008 10:33	11.82	3.13	89.5	8.41	686	3.1	293	< 1	23	6.1			0.1	382	< 0.1	2.2	< 0.03		36
	12/17/2008 11:00	13.17	1.54	95.1	8.3	683	7	267	< 1	24	5.8			0.4	372	< 0.1	1.8	< 0.03		35
WWU100-0099	6/18/2008 10:05	8.75	14.76	88.6	8.04	626	5.7	260	< 1	18	7.3			0.2	347	< 0.1	3	0.03	0.03	28
	6/24/2008 15:00	8.44	16.31	88.5	8.05	647	1.7	294		20	5.3			0.2		< 0.1	2.2	< 0.03		32
	7/8/2008 10:25		19.08		7.98	611	4.9					> 2420	365.4							
	7/15/2008 10:20	9.28	17.98	94.6	7.75	605	4.2					> 2420	146.4							
	7/16/2008 10:35	8.21	18.67	89.8	8.02	640	5.5	278	< 1	19	5.7			0.2	345	< 0.1	2	0.04	0.04	31
	7/22/2008 10:40	8.81	19.65	96.3	7.47	338	155					> 24200	8164							
	7/29/2008 10:00	7.64	18.24	84.1	7.93	675	2.6					> 2420	178.5							
	7/29/2008 11:30	9.17	18.57	98.1	7.71	684	3.7	316 (QJ)		22	5.6			0.3		< 0.1	1.2	0.03	0.03	36
	8/5/2008 11:05	9	19.43	97.8	7.84	505	72.6					> 24200	6867							
	8/27/2008 10:05	8.42	15.79	87.4	8.02	717	5.9	309	< 1	26	6.1			0.2	387	< 0.1	1.2	< 0.03		40
	9/9/2008 15:30	8.46	16.14	88	7.89	692	3.6	304		26	6.5			0.2		< 0.1	1	< 0.03		43
	9/24/2008 10:55	8.26	10.83	83	7.83	732	7.2	312	< 1	26	< 5			0.3	402	< 0.1	1.3	< 0.03		44
	10/22/2008 10:10	9.03	8.04	77.4	7.85	740	0.6	310	< 1	27	5.4			0.2	392	< 0.1	1.2	< 0.03		36
	11/19/2008 10:14	10.03	4.69	83.9	8.17	743	7.4	312	< 1	28	< 5			0.1	399	< 0.1	1.2	< 0.03		42
	12/17/2008 10:40	12.17	2.48	90.2	8.14	737	4.5	283	< 1	27	9.1			0.2	385	< 0.1	1.5	< 0.03		50
WWU100-0105	6/18/2008 9:25	8.55	16.17	89.3	8.01	603	14.5	229	< 1	23	9.4			0.2	317	< 0.1	6.4	0.06	0.06	22
	6/24/2008 9:20	8.13	16.77	86.3	7.97	611	4.6	261		24	8.2			0.1		< 0.1	4.4	0.04	0.04	24
	7/8/2008 9:45		21.11		7.91	621	8.7					> 2420	1203.3							
	7/15/2008 9:50	8.55	18.99	92.3	7.71	554	36.2					> 2420	1119.9							
	7/16/2008 9:50	7.87	20.57	90.1	7.95	600	11.8	241	< 1	22	9			0.2	320	< 0.1	3.7	0.07	0.07	26
	7/22/2008 10:10	8.42	20.14	93.3	7.6	325	100.2					> 24200	17329							
	7/28/2008 15:50	10.45	25.17	131.1	8.34	599	8.4	274 (QJ)		29	12			0.2		< 0.1	1.5	0.04	0.04	27
	7/29/2008 9:35	8.32	20.93	93.9	7.67	662	14.3					> 2420	686.7							
	8/5/2008 10:35	8.92	20.5	99.2	7.71	559	29.2					> 24200	6488							
	8/27/2008 9:35	4.93	18.4	54.1	7.72	683	15.1	278	< 1	32	8.5			0.2	360	< 0.1	1	< 0.03		37
	9/8/2008 13:00	11.19	19.39	124.3	8.03	690	1.4	293		33	6.9			0.2		< 0.1	1.2	< 0.03		39
	9/24/2008 10:15	6.18	16.5	64.5	7.71	710	10.4	286	< 1	32	6.9			0.2	380	< 0.1	1.3	< 0.03		39
	10/22/2008 9:38	7.71	8.38	66.7	7.88	719	3.6	284	< 1	33	5.4			0.1	394	< 0.1	1.4	< 0.03		36
	11/19/2008 9:43	10.7	2.51	79.7	8.2	751	3.2	293	< 1	40	9			< 0.1	390	< 0.1	1.3	< 0.03		41
	12/17/2008 10:00	12.44	1.12	88.7	8.09	756	2.7	268	< 1	43	7.8			0.2	387	< 0.1	1.5	< 0.03		42
WWU100-0121	6/18/2008 9:45	9.2	17.81	99.6	8.27	596	3.2	239	< 1	14	9.4			0.2	318	< 0.1	3.1	0.06	0.06	30
	6/24/2008 12:30		19.78		8	604	10.4	274		15	7.8			0.2		< 0.1	2.4	0.04	0.04	31
	7/8/2008 10:10	9.46	18.6	103	7.77	609	7.7					> 2420	488.4							
	7/15/2008 10:10	8.55	19.81	95.8	8.22	623	6.9					> 2420	613.1							
	7/16/2008 10:15	8.65	19.83	95.1	7.44	341	193.9	267	< 1	16	6.1			0.2	349	< 0.1	2.3	0.04	0.04	35
	7/22/2008 10:25	7.46	19.36	83.6	8.05	634	4.2					> 24200	15531							
	7/29/2008 9:00	8.74	19.41	95	7.76	649	6.1	297 (QJ)		17	6.4			0.3		< 0.1	1	< 0.03		37
	7/29/2008 9:45	8.68	20.27	96.1	7.84	513	66					> 2420	365.4							
	8/5/2008 10:50	8.1	18.22	88.6	8.13	657	5.2					> 24200	2351							
	8/27/2008 9:50	9.03	18.25	98.1	8.13	622	4.7	280	< 1	20	6.1			0.3	347	< 0.1	0.4	< 0.03		42
	9/9/2008 13:00	7.82	17.2	82.7	8	668	3.5	270		20	8.9			0.3		< 0.1	0.2	< 0.03		49
	9/24/2008 10:35	9.31	8.14	80.1	8.06	702	2	280	1.2	21	6.9			0.3	386	< 0.1	0.1	< 0.03		49
	10/22/2008 9:57	12.12	2.72	90.7	8.44	6.81	3.4	292	< 1	23	5.4			0.2	398	< 0.1	< 0.1	< 0.03		44
	11/19/2008 10:00	14.03	0.94	99.8	8.38	684	3.7	284	< 1	23	6.9			0.2	392	< 0.1	< 0.1	< 0.03		48
	12/17/2008 10:25	8.87	16.03	92.3	8.2	574	11.7	259	< 1	23	5.8			0.2	384	< 0.1	0.4	< 0.03		53

2009 Upper Fall Creek WQ Monitoring Program

FallCrFieldData.xls | FallCrGenChem.xls

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	P	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)
WWU100-0087	2/18/2009 10:35	11.6	4.91	93.1	8.2	564	12.7	224	< 1	21	9.8	0.1	301	< 0.1	3.4	0.05	0.05	32	324	0.4
	3/11/2009 11:04	12.21	9.02	108	8.41	602	16	257	< 1	24	7.1	0.2	350	< 0.1	2.1	< 0.03		36	350	0.3
WWU100-0099	2/18/2009 10:17	11.83	4.85	94.7	8.19	552	6.1	218	< 1	21	5.5	0.2	302	< 0.1	3.6	< 0.03		33	315	0.3
	3/11/2009 10:50	12.02	7.6	102.6	8.26	616	7.1	262	< 1	23	7.1	0.2	366	< 0.1	1.9	< 0.03		39	360	0.2
WWU100-0105	2/18/2009 9:40	11.9	4.35	94.2	8.07	537	9.8	200	< 1	24	8.2	0.1	288	< 0.1	4.4	0.05	0.05	30	311	0.4
	3/11/2009 10:17	11.73	7.79	100.7	8.23	575	8.7	227	1.3	31	10.3	0.2	320	< 0.1	2.8	< 0.03		33	335	0.3
WWU100-0121	2/18/2009 10:00	12.11	4.67	96.6	8.27	538	19.5	210	< 1	18	7.8	0.2	298	< 0.1	3.4	0.05	0.05	38	317	0.4
	3/11/2009 10:35	12.42	7.88	106.8	8.46	607	11.1	254	< 1	22	6.7	0.3	366	< 0.1	1.8	< 0.03		44	351	0.3

Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	Total POC (mg/L)	TS (mg/L)	TSS (mg/L)
16 (QJ)	400	0.5 (QJ)	2.4		380	7
42	390	0.62	2.7	1.612	410	9
44	390 (DJ)	0.32	2.1	0.365	410	< 4

TOC (mg/L)	TS (mg/L)	TSS (mg/L)	TSS	Atrazine (Aatrex) (ug/L)
2.6	360	23	23	1.6 (QJ)
1.8	380	4	4	
1.9	430	3	3	
3.8	300	10	10	
5	260	11	11	
6.4	310	5	5	
3.2	310	19	19	2.5 (QJ)
2.8	410	17	17	
13	420	45	45	
2.8	350	28	28	
5.6	500	21	21	
2.9	2100	1500 (HJ)		
2.6	380	30	30	
1.9	410	4 (fDJ)	4	
4.3	460	5	5	
2.4	330	5	5	< 0.28 (QJ)
2	440	1 (fDJ)	1	
1.5	440	< 1		
2.8	340	36	36	
2.1	430	3 (fDJ)	3	
3.4	430	5	5	
2.8	320	15	15	
1.8	390	2 (fDJ)	2	
5	370	5	5	
2.8	340	11	11	
1.6	400	1 (fDJ)	1	
2.8	410	2	2	
3.4	340	39	39	2.3 (QJ)
2.6	390	< 1 (fDJ)		
3.5	390	1	1	
2.6	360	32	32	< 0.28 (QJ)
2	450	15 (fDJ)	15	
1.9	470	9	9	
3	370	33	33	
2.9	430	2 (fDJ)	2	
14	390	6	6	
1.8	370	12	12	1.3 (QJ)
1.6	420	< 1 (fDJ)		
2	420	4	4	
1.8	330	12	12	
1.9	400	14	14	
4.7	410	8	8	

TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
348	0.4	3.2	400	9
369	0.2	2.7	400	6
357	0.2	2.4	393	10
394	0.2	2.8	421	17
403	0.2	1.3	424	4
380	0.4	2.4	415	17
400	0.2	1.8	431	< 4
414	0.2	2.8	442	< 4
391	0.2 (DJ)	1.8	417	< 4
395	0.1	2	412	< 4
358	0.3	2.9	401	< 4
385	0.2	2.2	412	< 4
378	0.3	1.8	406	< 4
409	0.2	2.7	445	4
443	0.1	1.2	461	< 4
420	0.2	1.7	436	< 4
430	0.1	1.5	458	< 4
439	0.1	1.9	469	4
423	0.1 (DJ)	1.3	456	< 4
435	< 0.1	1.6	452	< 4
346	0.5	3.5	397	8
364	0.2	3.2	393	< 4
356	0.5	2.6	400	22
370	0.4	4	411	10
396	0.3	1.7	430	< 4
402	0.3	1.8	436	< 4
404	0.3	2	440	< 4
419	0.2	2.5	450	< 4
425	0.3 (DJ)	2.6	452	< 4
431	0.2	2.8	457	< 4
340	0.3	3.2	384	7
365	0.4	2.9	390	< 4
373	0.3	2	405	6
385	0.3	2.5	426	4
395	0.2	1.2	419	< 4
374	0.2	2	409	5
393	0.2	1.8	423	< 4
417	0.2	2.4	448	< 4
393	0.2 (DJ)	1.9	416	< 4
397	0.2	1.9	422	< 4

TOC (mg/L)	TS (mg/L)	TSS (mg/L)
2	358	7
2.2	380	5
1.6	345	< 4
2	403	< 4
2	341	4
2.9	375	5
2	347	7
2.2	392	4

Prairie Creek

IDEM WQ
1996 Watershed

FallCrFieldData.xls / FallCrGenChem.xls

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	E_Coli (CFU/100 mL)	Hardness (as CaCO3) (mg/L)	Phosphorus Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0029	8/5/1996 12:00	9.53	20.57	8.07	668	2.09	290	27	600 (JH)	330	0.047	46	440	0.16 (Q)	1.5	440	< 4 (U)

2001 E. coli-Upper WFWR

FallCrFieldData.xls / FallCrGenChem.xls

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Coliforms (Total) (MPN/100mL)	E_Coli (MPN/100 mL)
WWU100-0023	8/6/2001 13:35	8.57	16.67	8.01	614	143	> 2419.2	> 2419.2
	6/13/2001	7.82	20.51	7.82	556	392		
	6/20/2001 10:20	7.92	20.03	8.03	693	15	> 2419.2	613.1
	6/27/2001 10:15	8.47	19.42	8.07	733	11	> 2419.2	816.4
	7/4/2001 10:30	8.65	17.62	7.98	668	12	> 2419.2	> 2419.2
	7/10/2001 13:40	8.4	22.68	7.96	645	12	> 2419.2	1046.24

2008 Fall Creek IBC Study

FallCrFieldData.xls

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)
WWU100-0072	5/7/2008	7.87	17.69	75.4	7.06	920	59.5
	6/17/2008 11:10	6.7	19.1	74.8	7.71	727	49.3
	8/11/2008 12:16						
	10/7/2008 8:05	7.08	15.41	72.6	8.21	1077	82.9
WWU100-0076	5/7/2008	7.75	17.57	82.8	7.86	1049	5999
	6/17/2008 10:45	4.9	18.18	53.6	7.43	807	28.7
	8/11/2008 16:00						
	10/7/2008 9:26	7.78	15.14	82.2	7.8	1495	57.6
WWU100-0078	5/7/2008	10.7	15.98	114.7	8.15	616	13.1
	6/16/2008 16:05	8.26	20.85	94.6	7.94	572	26
	8/11/2008 10:54						
	10/7/2008 9:56	7.72	13.36	75.8	8.1	680	5.5
WWU100-0080	5/7/2008	10.17	16.15	106.7	8.21	620	3.3
	6/17/2008 11:30	8.77	17.78	95	8	588	23.4
	8/11/2008 11:00						
	10/7/2008 7:45	9.04	13.8	87.6	8.19	663	1.8
WWU100-0083	6/16/2008 15:50	8.44	20.4	96.3	7.98	565	26.7
	8/12/2008 8:35						
	10/7/2008 12:05	8.96	13.87	88.8	8.17	672	11.5

FallCrGenChem.xls

	Sample Date	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Atrazine (Aatrex) (ug/L)
WWU100-0072	5/7/2008																
	6/17/2008 11:10	240	52	18	< 0.005	0.18	340	0.15	0.89	0.11	88	420	0.85	4.8	500	46	
	8/11/2008 12:16	200	76	6 (IDJ)	< 0.005 (Q	0.22	370	< 0.1	0.75	< 0.05 (QJ	110	530	0.84 (QJ)	3.1	560	3	
	10/7/2008 8:05	220	150	< 4	< 0.005	0.23	410	< 0.1	0.38	< 0.05 (QJ	120	630	0.86 (QJ (E	3.5	720	42	
WWU100-0076	5/7/2008																
	6/17/2008 10:45	270	68	27	< 0.005	0.16	350	0.29	0.38	0.12	67	480	1.3	5.8	580	31	
	8/11/2008 16:00	280	130	14 (IDJ)	< 0.005 (Q	0.16	400	< 0.1	0.2	< 0.05 (QJ	84	610	0.81 (QJ)	4.1	720	86 (IDJ)	
	10/7/2008 9:26	300	150	24	< 0.005	0.16	470	0.1	0.15	< 0.05 (QJ	120	850	0.36 (QJ (E	4.1	950	26	
WWU100-0078	5/7/2008																
	6/16/2008 16:05	250	25	12	< 0.005	0.18	300	< 0.1	3.3	0.1	24	330	0.58	2.9	380	32	1.7 (QJ)
	8/11/2008 10:54	250	26	10 (IDJ)	< 0.005 (Q	0.2	350	< 0.1	1.2	0.07 (QJ)	35	360	0.52 (QJ)	2.3	490	94 (IDJ)	
	10/7/2008 9:56	300	34	< 4	< 0.005	0.21	370	< 0.1	1.4	< 0.05 (QJ	37	360	0.59 (QJ (E	1.9	450	8	
WWU100-0080	5/7/2008																
	6/17/2008 11:30	250	27	12	< 0.005	0.18	310	< 0.1	3.2	0.1	27	330	0.55	2.8	360	23	2.1 (QJ)
	8/11/2008 11:00	270	29	< 4 (IDJ)	< 0.005 (Q	0.18	340	< 0.1	1.5	< 0.05 (QJ	34	380	0.74 (QJ)	2.2	400	< 1 (IDJ)	
	10/7/2008 7:45	270	32	< 4	< 0.005	0.21	360	< 0.1	1.4	< 0.05 (QJ	38	380	0.35 (QJ (E	1.9	430	5	
WWU100-0083	6/16/2008 15:50	220	21	5	< 0.005	0.21	310	< 0.1	3.6	0.1	25	300	0.65	2.8	410	32	
	8/12/2008 8:35	280	24	< 4 (IDJ)	< 0.005 (Q	0.21	330	< 0.1	1.4	< 0.05 (QJ	32	360	0.99 (QJ)	2	410	5	
	10/7/2008 12:05	310	30	< 4	< 0.005	0.23	360	< 0.1	1.4	< 0.05 (QJ	40	400	0.61 (QJ (E	2	440	4	

2008 Upper Fall Creek WQ Monitoring Program

FallCrFieldData.xls

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)
WWU100-0072	6/18/2008 13:00	6.8	19.2	75.7	7.79	782	45.4
	6/25/2008 14:00	7.1	22.29	84.1	7.87	836	15.6
	7/8/2008 13:10		23.48	51.2	7.79	869	10.7
	7/15/2008 12:30	8.6	22.63	100.6	7.77	813	34.1
	7/16/2008 13:15	6.98	23.6	84.3	7.84	853	29.5
	7/22/2008 12:40	6.76	22.73	77.5	7.43	466	83
	7/29/2008 12:05	7.14	24.9	89.1	7.77	793	9.3
	7/29/2008 15:50	7.91	23.24	92.9	7.74	837	10.2
	8/5/2008 13:25	8.39	22.09	96.6	7.88	722	90.5
	8/27/2008 12:35	7.75	22	91.4	8.01	853	4.2
	9/15/2008 12:30	6.6	19.05	73.6	7.82	907	29.1
	9/24/2008 13:35	8.12	20.99	92.9	7.94	880	14.8
	10/22/2008 12:25	9.74	10.23	88.2	8.15	921	26.9
	11/19/2008 12:40	14.02	3.78	108.1	8.84	819	17.6
	12/17/2008 13:00	14.57	1.15	104.4	8.35	1029	14.6
WWU100-0080	6/18/2008 13:20	8.48	17.5	91	8.12	635	22
	6/25/2008 16:00	9.17	19.96	103.6	8.19	639	4
	7/8/2008 12:50		21.22	55.3	7.97	639	11.5
	7/15/2008 12:05	9.07	20.46	101.5	7.84	592	8.98
	7/16/2008 13:35	8.63	21.44	99.8	8.22	627	14
	7/22/2008 12:15	7.91	21.8	90.2	7.34	384	111.2
	7/29/2008 11:40	8.35	21.04	96.8	8.1	656	12.8
	7/29/2008 14:00	9.12	20.82	102.1	7.81	671	5.7
	8/5/2008 13:05	8.42	20.86	94.4	7.87	568	44.5
	8/27/2008 13:00	10.18	19.68	114.7	8.33	674	5.5
	9/10/2008 14:00	9.4	17.38	100.2	8.18	657	5.4
	9/24/2008 14:00	9.57	18.6	104.3	8.27	689	1.6
	10/22/2008 12:45	11.59	9.18	102.4	8.34	699	1.2
	11/19/2008 13:03	13.76	3.12	104.2	8.67	697	5
	12/17/2008 13:20	14.83	0.9	105.1	8.46	713	8

FallCrGenChem.xls

	Sample Date	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Coliforms (Total) (MPN/100 mL)	E_Coli (MPN/100 mL)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0072	6/18/2008 13:00	234	< 1	55	18.4			0.2	362	0.1	1	0.08	81	468	0.8	5.2	587	43
	6/25/2008 14:00	254		71	11.8			< 0.1		< 0.1	0.7	0.03	91	540	0.5	3.4	578	20
	7/8/2008 13:10					> 2420	261.3											
	7/15/2008 12:30					> 2420	613.1											
	7/16/2008 13:15	249	< 1	69	12.2			0.1	405	< 0.1	0.7	0.04	97	523	0.4	3	582	21
	7/22/2008 12:40					> 24200	12997											
	7/29/2008 12:05					> 2420	191.8											
	7/29/2008 15:50	251 (QJ)		63	12			0.2		< 0.1	0.6	< 0.03	96	500	0.4	4.2	556	8
	8/5/2008 13:25					> 24200	7701											
	8/27/2008 12:35	195	< 1	98	10.5			0.2	329	< 0.1	0.3	< 0.03	94	499	0.3	2.5	557	6
	9/15/2008 12:30	237		100	9.7			0.3		< 0.1	0.8	< 0.03		625	0.5 (DJ)	2.6	684	27
	9/24/2008 13:35	185	< 1	102	8.5			0.2	343	< 0.1	0.6	< 0.03	101	535	0.5	2.6	572	13
	10/22/2008 12:25	213	< 1	97	7.8			0.2	380	< 0.1	0.5	< 0.03	100	551	0.3	2.6	596	4
	11/19/2008 12:40	209	< 1	59	11			0.1	352	< 0.1	0.6	< 0.03	99	486	0.3 (DJ)	2.4	529	5
	12/17/2008 13:00	247	< 1	93	9.9			0.1	436	< 0.1	0.8	0.03	126	611	0.5	2.8	656	6
WWU100-0080	6/18/2008 13:20	254	< 1	26	13.5			0.2	333	< 0.1	3	0.07	25	363	0.4	3.6	415	17
	6/25/2008 16:00	280		27	7.8			< 0.1		< 0.1	2.3	0.03	35	383	0.3	2.3	419	5
	7/8/2008 12:50					> 2420	613.1											
	7/15/2008 12:05					> 2420	727											
	7/16/2008 13:35	258	< 1	26	9			0.2	356	< 0.1	2.6	0.06	31	377	0.2	2.3	417	14
	7/22/2008 12:15					> 24200	24192											
	7/29/2008 11:40					> 2420	214.1											
	7/29/2008 14:00	300 (QJ)		28	7.2			0.2		< 0.1	1.9	0.04	34	401	0.3	2.7	437	10
	8/5/2008 13:05					> 24200	2909											
	8/27/2008 13:00	283	< 1	29	7.7			0.2	373	< 0.1	1.4	0.03	33	426	0.2	1.4	435	5
	9/10/2008 14:00	273		29	7.7			0.2		< 0.1	1.5	0.04	34	387	0.3	2	414	< 4
	9/24/2008 14:00	286	< 1	28	6.5			0.2	367	< 0.1	1.5	0.04	34	403	0.3	1.9	434	4
	10/22/2008 12:45	284	< 1	30	7.8			0.2	374	< 0.1	1	< 0.03	33	408	0.2	3	439	< 4
	11/19/2008 13:03	284	< 1	29	< 5			0.1	375	< 0.1	1.7	< 0.03	41	399	0.3 (DJ)	2.4	430	< 4
	12/17/2008 13:20	260	< 1	32	7.8			0.1	393	< 0.1	1.6	< 0.03	40	414	0.3	2.1	436	< 4

2009 Upper Fall Creek WQ Monitoring Program

FallCrFieldData.xls

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)
WWU100-0072	2/18/2009 12:28	11.55	5.26	93.7	8.02	871	22.7
	3/11/2009 13:05	12.59	9.82	113.4	8.21	1007	20.5
WWU100-0080	2/18/2009 12:48	11.9	5.38	96.5	8.2	612	14.8
	3/11/2009 13:25	13.75	9.61	123.3	8.56	647	8.4

FallCrGenChem.xls

	Sample Date	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0072	2/18/2009 12:28	251	< 1	66	13.3	< 0.1	390	< 0.1	1.3	< 0.03	114	519	0.5	2.9	561	9
	3/11/2009 13:05	293	< 1	82	11.5	0.2	447	0.2	0.8	< 0.03	108	607	0.7	3.3	654	8
WWU100-0080	2/18/2009 12:48	238	< 1	29	11.8	< 0.1	338	< 0.1	2.9	0.05	35	349	0.4	1.9	387	8
	3/11/2009 13:25	260	1	34	7.9	0.2	358	< 0.1	1.6	< 0.03	38	368	0.4	2.3	414	6

Lick Creek
IDEM WQ
2001 E. coli-Upper WFWR

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Coliforms (Total) (MPN/100mL)	E_Coli (MPN/100 mL)
WWU100-0007	6/6/2001 13:55	8.78	16.95	7.62	609	88	> 2419.2	2419.2
	6/13/2001	9.01	20.89	7.96	632	105		
	6/20/2001 10:35	7.98	19.77	8.01	725	18	> 2419.2	727
	6/27/2001 10:30	9.72	20.72	8.18	752	14	> 2419.2	980.4
	7/4/2001 10:50	7.88	18.11	7.78	659	26	> 2419.2	> 2419.2
	7/10/2001 13:55	8.37	23.27	8.05	646	9	> 2419.2	517.2

2006 Corvallis

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0038	5/8/2006 10:15	11.33	13.31	110.1	7.81	605	2.85	250	27	< 5	< 0.02	320	< 0.1	3.1	0.06	24	350	0.9	1.81	360	< 10
	7/10/2006 16:30	10.62	21.44	123.7	8.16	601	2.9	260	21	< 10	< 0.02	300	< 0.1	3.3	< 0.05	26	330	< 0.5 (QJ)	1.9	360	< 10
	9/5/2006 17:30	9.61	19.9	106.3	8.06	609	1.8	257	20	< 10 (Q)	< 0.02	320	< 0.1	1.8	0.13	38	320		1.84	360	< 10

2006 Corvallis E. coli

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Coliforms (Total) (MPN/100 mL)	E_Coli (MPN/100 mL)
WWU100-0038	4/10/2006 14:15	13.83	12.88	131.3	8.09	675	0	> 2420	325.5
	4/17/2006 14:15	9.41	15.83	95.2	7.74	457	62.1	> 24200	1553.1
	4/24/2006 14:35	14.53	16.44	149	8.21	672	5	> 2420	178.9
	5/1/2006 14:15	11.64	13.63	112.2	8.09	695	6.2	> 2420	285.1
	5/8/2006 14:25	13.6	16.83	140.4	8.32	612	4	> 2420	307.6

2008 Fall Creek IBC Study

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Atrazine (Aatrex) (ug/L)
WWU100-0038	6/16/2008 14:30	7.57	20.96	89.5	7.65	531	108	160	27	< 4	< 0.005	0.14	260	< 0.1	4.7	0.12	25	270	0.67	3	330	17	
	8/12/2008 10:15							270	24	< 4 (fDJ)	< 0.005 (Q	0.2	340	< 0.1	1.7	< 0.05 (QJ	29	340	< 0.3	1.7	350	10	
	10/7/2008 10:41	3.63	12.19	22.6	7.6	672	306	330	36	15	< 0.005	0.17	380	1.3	0.21	0.16 (QJ)	22	410	2.4 (QJ fD.	4.2	570	140	
WWU100-0075	5/7/2008	10.4	15.76	106.4	7.64	596	10.8																1.2 (QJ)
	6/17/2008 12:30	8.4	18.36	91.9	7.94	550	22.4	230	23	10	< 0.005	0.17	280	< 0.1	2.9	0.09	24	320	0.62	3.1	330	21	2 (QJ)
	8/11/2008 14:40							310	24	< 4 (fDJ)	< 0.005	0.17	320	< 0.1	1.5	< 0.05 (QJ	31	320	0.44	2	390	3 (fDJ)	
	10/6/2008 14:26	9.16	15.03	93.3	8.21	605	23.3	260	24	< 4 (fDJ)	< 0.005	0.22	340	< 0.1	1.2	< 0.05	36	320		2.3	400	2	
WWU100-0077	6/16/2008 16:30	6.09	22.08	72.5	7.77	539	34.8	200	23	13	< 0.005	0.17	280	< 0.1	2.8	0.14	24	280	0.79	3.4	360	33	
	8/11/2008 15:35							290	26	< 4	< 0.005	0.18	320	< 0.1	1.5	< 0.05 (QJ	32	320	< 0.3 (fDJ)	2.1	400	5 (fDJ)	
	10/6/2008 14:43	9.93	17.34	106.7	8.13	612	47.4	270	26	9 (fDJ)	< 0.005	0.23	340	< 0.1	1.3	< 0.05	37	340		2.2	400	5	
WWU100-0079	5/7/2008	10.02	16.01	105	7.59	615	6.1																< 0.28 (QJ)
	6/16/2008 16:00	6.11	22.14	75.4	7.83	546	14.5	210	25	7	< 0.005	0.17	280	< 0.1	2.5	0.12	24	280	0.79	3.5	360	13	2 (QJ)
	8/11/2008 16:30							290	28	< 4	< 0.005	0.18	330	< 0.1	1.3	< 0.05 (QJ	31	360	0.31 (fDJ)	2.1	400	3 (fDJ)	
	10/6/2008 15:00	7.18	13.44	70.1	7.95	638	18.5	290	27	8 (fDJ)	< 0.005	0.23	350	< 0.1	0.94	< 0.05	36	340		2.3	420	13	
WWU100-0081	6/16/2008 15:45	7.56	22.18	89.4	7.79	548	14.5	200	26	10	< 0.005	0.16	270	< 0.1	2.4	0.11	23	270	0.44	3.8	350	16	
	8/12/2008 9:00							270	30	< 4 (fDJ)	< 0.005 (Q	0.19	320	< 0.1	1.1	0.06 (QJ)	30	370	0.46	2	370	9	
	10/6/2008 15:17	11.82	17.49	126.1	8.31	634	36.3	290	30	< 4 (fDJ)	< 0.005	0.24	340	< 0.1	0.88	< 0.05	33	330		2.3	410	3	
WWU100-0082	5/7/2008	10.26	14.45	104.3	7.52	634	1.6																< 0.28 (QJ)
	6/16/2008 15:30	6.04	19.74	68	7.55	564	16	230	26	12	< 0.005	0.17	280	< 0.1	3	0.08	25	280	0.82	3.1	350	11	< 0.28 (QJ)
	8/11/2008 13:45	7.68	16.66	80.7	7.74	559	3.4	320	30	< 4	< 0.005	0.2	330	< 0.1	1.1	< 0.05 (QJ	36	370	< 0.3 (fDJ)	1.8	430	2 (fDJ)	
	10/7/2008 10:18	5.51	13.4	53.6	8.19	716	20.6	300	44	8 (fDJ)	< 0.005	0.26	380	< 0.1	0.77	0.05	43	410		2.1	480	13	
WWU100-0086	5/7/2008	9.5	13.16	93.3	7.97	554	0																
	6/16/2008 15:00	7.73	20.07	87.3	7.59	524	4.8	220	17	< 4	< 0.005	0.11	290	< 0.1	3.2	0.08	19	270	0.57	2.9	310	8	2.8 (QJ)
	8/12/2008 10:45							260	28	< 4 (fDJ)	< 0.005 (Q	0.16	340	< 0.1	0.59	0.05 (QJ)	28	340	1	1.9	380	15	
	10/7/2008 11:10	3.33	13.35	30.9	7.84	862	20.8	320	74	15	< 0.005	0.14	380	0.11	0.04	0.08 (QJ)	40	480	0.65 (QJ fE	4.9	580	24	
WWU100-0089	6/16/2008 14:00	8.42	20.56	96.9	7.98	565	13.5	190	33	5	< 0.005	0.15	280	< 0.1	5.6	0.06	30	300	0.59	3	340	6	
	8/12/2008 13:30							230	42	6 (fDJ)	< 0.005 (Q	0.25	300	< 0.1	0.53	< 0.05 (QJ	25	320	0.58 (fDJ)	2.9	340	2	

2008 Upper Fall Creek WQ Monitoring Program

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Coliforms (Total) (MPN/100 mL)	E_Coli (MPN/100 mL)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0075	6/18/2008 11:35	7.9	17.38	84.4	7.99	588	22.9	236	< 1	22	12.2			0.2	309	< 0.1	3.1	0.09	25	336	0.5	4.3	394	20
	7/8/2008 11:55		21.32		7.9	576	33					24192	359											
	7/10/2008 11:20	6.66	19.66	74.9	7.88	595	38.6	228		20	13.5			0.2		< 0.1	2.7	0.1	22	319	0.8	3.3	378	41
	7/15/2008 11:20	8.39	20.44	94.9	7.79	592	49					> 2420	387.3											
	7/16/2008 12:00	7.38	21.44	85.2	8.05	616	28.7	254	< 1	24	9			0.1	326	< 0.1	2.4	0.07	27	383	0.3	2.2	415	25
	7/22/2008 11:35	7.83	20.98	88	7.29	270	77.5					> 24200	17329											
	7/29/2008 10:55	8.43	21	94.7	7.74	647	18					> 2420	214.3											
	8/5/2008 12:00	7.95	20.96	89.3	7.73	523	47.3					> 24200	17329											
	8/12/2008 10:20	6.9	18.3	75.1	8.08	641	12.9	283		26	9.7			0.2		< 0.1	1.6	0.05	28	386	0.3	2.3	432	11
	8/27/2008 11:30	7.5	19.89	85.1	8.14	655	3.2	269	< 1	30	7.3			0.2	334	< 0.1	1.4	0.04	35	394	0.2	1.8	415	< 4
	9/15/2008 14:30	7.21	18.72	80	8	612	4.2	278		24	9.3			0.3		< 0.1	1.3	0.05		401	0.2 (DJ)	2.4	417	< 4
	9/24/2008 12:20	7.5	18.52	81.5	8.03	631	0.1	264	< 1	24	6.5			0.2	345	< 0.1	1.2	0.04	37	366	0.3	2.3	394	< 4
	10/22/2008 11:22	9.14	9.01	80.3	8.16	645	8	267	< 1	23	7.4			0.2	343	< 0.1	0.8	0.04	30	369	0.3	3.2	390	< 4
	11/19/2008 11:35	12.98	2.15	95.7	8.51	672	7.9	274	< 1	27	7.8			< 0.1	366	< 0.1	1.2	< 0.03	38	380	0.3 (DJ)	2.6	411	< 4
	12/17/2008 12:00	14.23	0.08	98.6	8.51	683	5.4	256	< 1	28	< 5			0.1	358	< 0.1	1.4	< 0.03	42	393	0.2	1.8	419	< 4
WWU100-0082	6/18/2008 11:08	8.04	15.95	83.4	7.95	633	7.2	249	< 1	27	8.2			0.2	332	< 0.1	3	0.05	29	365	0.4	3.4	402	5
	7/8/2008 11:10		19.84		7.85	632	6.5					> 2420	816.4											
	7/10/2008 9:00	6.56	17.55	70.4	7.74	610	8.5	257		26	10.2			0.2		< 0.1	2.5	0.06	28	354	0.6	2.8	394	11
	7/15/2008 11:00	8.84	19.16	97	7.73	641	5.6					> 2420	1046.2											
	7/16/2008 11:35	7.81	19.39	86.6	8.01	657	10	266	< 1	29	6.5			0.2	328	< 0.1	2	0.04	34	390	0.2	2	420	5
	7/22/2008 11:20	8.93	20.68	99.6	7.42	274	167					> 24200	17329											
	7/29/2008 10:35	8.72	19.08	94.5	7.7	688	5					> 2420	435.2											
	8/5/2008 11:40	8.63	19.54	94.4	7.73	546	79.5					> 24200	10462											
	8/12/2008 8:20	7.19	16.05	74.8	7.99	695	6.8	299		32	6.9			0.2		< 0.1	1.2	0.04	33	426	0.2	1.7	464	6
	8/27/2008 11:00	7.62	17.57	82.2	8.16	721	15.6	293	< 1	36	< 5			0.2	373	< 0.1	1.1	0.04	43	426	0.2	1.3	454	< 4
	9/15/2008 10:00	5.75	17.58	61.9	7.83	681	5.1	294		39	8.5			0.2		< 0.1	0.9	0.04		453	0.3 (DJ)	2.4	465	< 4
	9/24/2008 11:50	7.36	16.74	78.1	8.02	723	19.5	290	< 1	36	6.1			0.3	381	< 0.1	0.9	0.05	38	423	0.2	2	450	< 4
	10/22/2008 10:56	6.84	7.42	57.9	7.98	744	2.6	292	< 1	37	7.4			0.2	389	< 0.1	0.5	0.05	38	435	0.2	3.2	461	< 4
	11/19/2008 11:07	11.65	1.9	85.2	8.43	725	4.7	281	< 1	35	7.3			0.1	380	< 0.1	0.8	< 0.03	48	411	0.2 (DJ)	2.4	444	< 4
	12/17/2008 11:30	13.43	0.67	94.5	8.37	712	6.7	251	< 1	36	8.2			0.2	366	< 0.1	1.1	< 0.03	44	411	0.2	2.3	433	< 4

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0075	2/18/2009 11:25	11.58	4.84	92.7	8.19	578	10.4	226	< 1	27	7.1	< 0.1	289	< 0.1	2.7	0.04	30	328	0.3	1.7	363	6
	3/11/2009 11:57	12.26	9.08	108.5	8.47	610	14.7	256	< 1	29	7.9	0.1	346	< 0.1	1.5	0.03	37	349	0.3	2	387	8
WWU100-0082	2/18/2009 11:03	11.02	5.28	89.1	8.04	591	5.5	225	< 1	30	6.3	< 0.1	303	< 0.1	2.4	0.03	34	333	0.3	1.6	366	< 4
	3/11/2009 11:35	12.2	8.04	105.3	8.36	635	8.5	260	< 1	31	7.5	0.2	304	< 0.1	1.3	< 0.03	35	365	0.3	1.8	402	5

DO	8.81030303
E. Coli	3771.07
pH	7.953088235
Nitrate+Nit	1.7772
Total P	0.068823529
TSS	15.20588235
Turbidity	27.64166667
Atrazine	2

Foster Branch

IDEM WQ
2008 Fall Creek IBC Study

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Atrazine (Aatrex) (ug/L)
WWU100-0066	5/7/2008	10.52	15.88	109.6	7.68	687	4																< 0.28 (QJ)
	6/17/2008 9.45	8.74	16.79	92.8	7.77	523	15.5	200	25	14	< 0.005	0.18	260	< 0.1	4.3	0.11	28	280	0.67	3.8	360	14	2.5 (QJ)
	8/11/2008 10.11							250	32	< 4 (IDJ)	< 0.005	0.19	330	< 0.1	1.5	< 0.05 (QJ	39	370	1 (QJ)	2.3	400	3 (IDJ)	
	10/6/2008 12.50	8.64	13.97	86	8.22	693	25.7	280	33	< 4 (IDJ)	< 0.005	0.18	360	< 0.1	1.8	< 0.05	48	380	0.49	1.8	450	2	
WWU100-0070	5/7/2008	10.73	15.08	110.1	7.91	694	29.2																< 0.28 (QJ)
	6/17/2008 10.20	5.94	17.41	63.8	7.31	502	10	180	23	18	< 0.005	0.2	260	< 0.1	3.9	0.12	29	280	0.78	5	330	9	2.7 (QJ)
	8/11/2008 13.02							250	31	< 4 (IDJ)	< 0.005 (Q	0.26	370	< 0.1	0.64	< 0.05 (QJ	51	340	0.71 (QJ)	2.4	430	4	
	10/7/2008 8.35	6.5	13.62	66.8	7.93	702	18.3	270	31	< 4	< 0.005	0.27	390	< 0.1	0.11	< 0.05 (QJ	64	410	0.35 (QJ IE	2.1	480	7	
WWU100-0073	6/17/2008 10.30	5.59	17.31	60.1	7.35	497	7.6	180	23	15	< 0.005	0.2	250	< 0.1	5.2	0.12	28	260	0.67	< 5	330	2	
	8/11/2008 13.33							270	33	< 4 (IDJ)	< 0.005 (Q	0.28	370	< 0.1	0.82	< 0.05 (QJ	51	400	1.1 (QJ)	2.3	440	2 (IDJ)	
	10/7/2008 8.53	2.24	12.46	22.8	7.63	740	65.8	310	31	14	< 0.005	0.37	410	< 0.1	< 0.01	< 0.05 (QJ	67	440	0.54 (QJ IE	2.3	500	5	

2008 Upper Fall Creek WQ Monitoring Program

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Coliforms (Total) (MPN/100 mL)	E_Coli (MPN/100 mL)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0066	6/18/2008 13.55	8.6	19.52	96.3	8.01	618	2.3	206	< 1	24	13.5			0.2	290	< 0.1	4.3	0.09	29	320	0.4	5	359	10
	7/7/2008 13.00		21.26		7.92	643	7.7	249		27	6.9			0.2		< 0.1	3.8	0.04	37	371	0.4	2.8	410	6
	7/8/2008 13.35	9.22	20.43	102.9	7.82	585	6.68					> 2420	686.7											
	7/15/2008 12.50	9.01	21.35	104.1	8.12	603	7.7					> 2420	579.4											
	7/16/2008 14.00	8.3	20.8	92.7	7.33	390	48.4	232	< 1	24	8.6			0.2	329	< 0.1	3.2	0.05	33	367	0.4	3	406	4
	7/22/2008 13.00	9.17	20.75	102.5	7.74	663	7.7					> 2420	> 2420											
	7/29/2008 12.20	8.53	21.12	96.1	7.79	441	53.6					> 2420	461.1											
	8/5/2008 13.45	8.36	17.81	90.3	8.11	689	3.2					> 24200	> 24200											
	8/12/2008 13.00	9.33	19.12	104	8.27	7.02	4.9	276		32	7.7			0.2		< 0.1	1.7	0.03	40	412	0.2	2.2	454	4
	8/27/2008 13.30	8.16	16.39	85.8	7.89	668	5.3	287	< 1	30	8.1			0.2	389	< 0.1	1.7	0.03	45	464	0.2	1.4	469	< 4
	9/16/2008 8.20	9.13	18.31	98.9	8.11	691	13.3	288		30	6.1			0.2		< 0.1	1.8	0.05		457	0.1 (DJ)	2	463	< 4
	9/24/2008 14.30	11.12	9.63	99.5	8.21	7.23	2.9	277	< 1	30	6.5			0.2	370	< 0.1	1.7	0.05	45	416	0.4	2	449	< 4
	10/22/2008 13.05	13.43	3.63	102.8	8.43	690	8.2	284	< 1	32	6.6			0.1	392	< 0.1	1.5	0.04	42	428	0.2	2.3	465	< 4
	11/19/2008 13.25	14.47	0.67	102.1	8.41	763	5.8	258	< 1	32	9.4			< 0.1	365	< 0.1	1.7	< 0.03	48	399	0.2 (DJ)	2.4	429	< 4
	12/17/2008 14.00	8.8	18.22	95.8	7.95	558	13.2	249	< 1	42	10.7			0.1	377	< 0.1	1.7	< 0.03	63	446	0.2	2.2	474	< 4

2009 Upper Fall Creek WQ Monitoring Program

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0066	2/18/2009 13.10	12.04	6.01	99.1	8.12	607	18.7	206	< 1	39	10.2	0.1	315	< 0.1	3.6	0.04	41	349	0.4	2.2	395	7
	3/11/2009 13.48	13.68	8.74	123.8	8.51	715	12.1	251	< 1	54	8.7	0.2	370	< 0.1	2.1	< 0.03	50	420	0.4	2.4	472	6

DO	9.177083333
E_Coli	5689.44
pH	7.9535
Nitrate+Nit	2.3535
Total P	0.054166667
TSS	5.666666667
Turbidity	15.9112
Atrazine	2.6

McFadden Ditch
IDEM WQ
1996 Synoptic

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	E_Coli (CFU/100 mL)	Hardness (as CaCO3) (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TPH - IR (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0004	2/21/1996 14:24	12.7	6.9	8.1	273.299	14	260	26	90 (JH)	370	0.052	63	360	0.42 (B)	2.2	< 2 (U)	410	< 4 (U)
	4/23/1996 13:14	10.6	9.47	7.9	168.899	189	140	22		220	0.2 (B)	37	260	2.6 (B)	7.4	< 1 (U)	510	180
	5/30/1996 12:20	10.48	14.98	7.94	516	19	200 (Q)	25	20 (JH)	290	0.078	50 (B)	380	1.1 (B)	3		390	6
	7/10/1996 10:15	8.85	17.47	7.94	654	28.5	260	27	400 (JH)	360	0.12	56	420	0.45 (JH)	1.4		460	17
	10/2/1996 11:27	8.57	17.7	7.88	685	15.3	270	26	170	350	0.16	57	400	0.52	2.6		430	10
	11/13/1996 10:18	11.37	3.86	8	645	18.7	270 (Q)	29	240	320	0.067	61	400	0.59	2.8		400	< 4 (U)

2001 E. coli-Upper WFWR

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Coliforms (Total) (MPN/100mL)	E_Coli (MPN/100 mL)
WWU100-0026	6/6/2001 15:10	8.85	17.04	8.11	660	51	> 2419.2	1986.28
	6/13/2001	8.1	23.09	8.18	696	38		
	6/20/2001 12:10	7.85	21.67	8.22	707	28	> 2419.2	816.4
	6/27/2001 11:15	8.22	21.2	8.34	709	22	> 2419.2	816.4
	7/4/2001 12:10	8.4	19.25	8.02	511	225	> 24192	8664
	7/10/2001 14:50	8.01	22.4	8.02	574	34	> 2419.2	648.8

2008 Fall Creek IBC Study

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)
WWU100-0063	5/7/2008	9.87	16.9	105	7.88	608	4.7											
	6/17/2008 10:15	8.37	18.36	94.3	7.94	553	28.2	240	21	15	< 0.005	0.17	290	< 0.1	2.6	0.09	30	310
	8/12/2008 15:49							240	23	< 4 (fDJ)	< 0.005 (Q.	0.17	330	< 0.1	1.5	< 0.05 (QJ)	37	360
	10/6/2008 10:24	8.31	12.56	80.6	8.09	614	55.3	270	24	< 4 (fDJ)	< 0.005	0.17	340	< 0.1	1.2	< 0.05	37	340
WWU100-0065	6/17/2008 13:20	8.32	18.48	91.7	7.96	555	15.1	240	21	9	< 0.005	0.15	290	< 0.1	2.8	0.08	29	310
	8/11/2008 10:25							300	22	< 4 (fDJ)	< 0.005	0.17	340	< 0.1	1.7	< 0.05 (QJ)	36	360
	10/6/2008 13:20	8.95	13.5	87.8	8.2	617	16.6	260	23	< 4 (fDJ)	< 0.005	0.16	350	< 0.1	1.6	< 0.05	39	320
WWU100-0068	5/7/2008	9.36	16.33	98.3	7.6	620	6.9											
	6/17/2008 13:05	8.05	18.9	89.3	7.93	565	24.3	250	22	11	< 0.005	0.17	300	< 0.1	2.8	0.1	29	320
	8/11/2008 11:35							310	23	< 4 (fDJ)	< 0.005	0.17	320	< 0.1	1.8	< 0.05 (QJ)	35	380
	10/6/2008 13:39	8.54	14.52	87.4	8.09	613	35.7	260	25	< 4 (fDJ)	< 0.005	0.19	340	< 0.1	1.7	< 0.05	40	340
WWU100-0069	6/17/2008 12:55	8.5	18.92	95	7.92	567	20	240	22	5	< 0.005	0.17	300	< 0.1	2.7	0.08	29	320
	8/11/2008 12:50							260	23	< 4 (fDJ)	< 0.005	0.17	330	< 0.1	1.6	< 0.05 (QJ)	37	340
	10/6/2008 13:53	10	15.32	102.5	8.04	620	19.8	260	25	< 4 (fDJ)	< 0.005	0.2	350	< 0.1	1.5	< 0.05	38	340
WWU100-0074	6/17/2008 12:45	8.02	18.45	88.1	7.88	566	23.9	240	21	8	< 0.005	0.17	290	< 0.1	2.6	0.09	30	320
	8/11/2008 13:45							290	23	< 4 (fDJ)	< 0.005	0.15	330	< 0.1	1.3	< 0.05 (QJ)	38	350
	10/6/2008 14:09	10.05	16.33	105.6	8.12	608	24.7	280	24	4 (fDJ)	< 0.005	0.2	340	< 0.1	1	< 0.05	39	320

2008 Upper Fall Creek WQ Monitoring Program

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Coliforms (Total) (MPN/100 mL)	E_Coli (MPN/100 mL)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)
WWU100-0026	7/9/2008 9:40	8.42	21.19	94.9	8.04	597	27.3					> 2420	980.4					
	7/16/2008 9:50	9.22	21.82	105.9	7.87	618	13.2					> 2420	613.1					
	7/23/2008 9:05	8.56	21.03	96.3	7.63	323	62.9					> 24200	4352					
	7/30/2008 9:05	8.5	21.97	97.3	7.78	644	11					> 2420	435.2					
	8/6/2008 9:20	8.55	21.6	97.3	7.84	533	25.4					> 2420	1299.7					
WWU100-0063	6/18/2008 14:40	8.72	18.49	95.5	8.21	592	18.8	240	< 1	20	13.1			0.2	332	< 0.1	2.7	0.07
	7/16/2008 14:45	8.59	22.7	101.7	8.32	615	18.6	254	< 1	22	7.3			0.2	339	< 0.1	2.2	0.05
	8/11/2008 14:00	8.72	19.1	95.9	8.37	621	3.6	274		22	8.5			0.2		< 0.1	1.6	0.04
	8/27/2008 14:25	9.18	20.5	105.1	8.35	626	2	260	< 1	24	6.5			0.2	359	< 0.1	1.4	< 0.03
	9/16/2008 10:10	7.8	17.57	84.2	8.17	607	4.3	274		22	8.1			0.2		< 0.1	1.4	0.03
	9/24/2008 15:50	8.76	19.05	96.2	8.18	645	5.2	270	< 1	22	6.5			0.1	353	< 0.1	1.3	< 0.03
	10/22/2008 14:05	11.09	9.51	98.5	8.25	655	1.6	270	< 1	22	8.2			< 0.1	339	< 0.1	0.7	< 0.03
	11/19/2008 14:25	14.66	3.43	111.8	8.82	669	5.3	275	< 1	26	9			0.1	370	< 0.1	1.2	< 0.03
	12/17/2008 14:40	15	0	103.6	8.6	677	4.7	251	< 1	25	9.9			0.1	388	< 0.1	1.4	< 0.03

2009 Upper Fall Creek WQ Monitoring Program

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)
WWU100-0063	2/18/2009 14:10	12.23	4.81	98	8.33	588	8.9	230	< 1	26	7.8	< 0.1	326	< 0.1	2.5	0.04	38	338
	3/11/2009 14:50	12.87	10.81	118.6	8.55	610	10	254	< 1	28	9.5	0.2	345	< 0.1	1.2	0.03	41	357

TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Atrazine (Aatrex) (ug/L)
				1.4 (QJ)
0.82	3.4	390	21	1.8 (QJ)
0.63	2	360	2	
< 0.3	2	390	1	
0.6	3.2	320	20	
0.36 (fDJ)	2.1	410	3 (fDJ)	
	1.8	400	1	
				< 0.28 (QJ)
0.73	3.1	360	26	1.9 (QJ)
0.41 (fDJ)	2.2	400	5 (fDJ)	
	1.9	390	3	
0.44	3	370	21	
0.33 (fDJ)	2.1	380	2 (fDJ)	
	2	400	6	
0.55	3.1	360	29	
< 0.3 (fDJ)	2.3	390	4 (fDJ)	
	2.4	390	2	

Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
30	344	0.4	4.4	390	16
33	370	0.2	2.3	416	11
33	386	0.2	2.2	420	< 4
42	396	0.2	1.7	405	< 4
	406	0.2 (DJ)	2.2	416	< 4
42	381	0.2	2.1	408	< 4
32	387	0.3	3.2	412	< 4
41	379	0.2 (DJ)	2.5	416	< 4
51	401	0.3	2.3	424	< 4

TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
0.4	2.1	371	4
0.4	2.2	390	4

Flatfork Creek

IDEM WQ

1996 Synoptic

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	E_ Coli (CFU/100 mL)	E Coli	Hardness (as CaCO3) (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TPH - IR (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0001	2/21/1996 13:39	11.3	6.59	8.1	309.7	13.39	270	44	50 (JH)	50	370	0.071	66	410	0.56 (B)	1.8	< 1 (U)	460	< 4 (U)
	4/23/1996 12:12	10.2	9.8	7.69	196.5	194	150	30			250	0.21 (B)	42	290	2.7 (B)	5.8	< 1 (U)	570	260
	5/30/1996 11:40	9.66	14.64	8	620	45.79	230 (Q)	32	10 (JH)	10	310	0.078	54 (B)	360	1.2 (B)	4		440	22
	7/10/1996 10:50	8.61	18.68	8.13	709	3.17	270	42	200 (JH)	200	370	0.14	62	460	0.43 (JH)	1.9		520	24
	10/2/1996 11:02	8.62	17.51	8.02	753	16	280	48	230	230	360	0.11	63	430	0.44	3.7		490	11
	11/13/1996 9:49						270 (Q)	38	190 (JH)	190	330	0.06	54	410	0.78	3.1		430	< 4 (U)

1996 Watershed

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	E_ Coli (CFU/100 mL)	Hardness (as CaCO3) (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0006	8/5/1996 10:15	7.53	21.12	8.07	972	19.5	250	130	600 (JH)	310	0.11	47	550	0.44 (Q)	3.1	620	7

1999 Fixed Station

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	E_ Coli (CFU/100 mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Tss
WWU100-0001	4/21/1999 13:15	9.22	14.25	8.11	644	74.69	208	29	19.6		274	< 0.1	3.8	8.1	0.16	39	367	1.1	3.3	485	94	94
	5/27/1999 11:20	8.56	15.34	8.34	666	16.39	190	47	< 5	49	350	< 0.1 (J)	2.4		0.11	58	420	0.3	4.2	500	10	10
	6/23/1999 11:15	7.52	21.69	8.27	677	13.1	160		9.4	320	120	< 0.1	1.8		0.11	57	480 (H)	0.15	< 10	480	23	23
	7/21/1999 11:25	6.23	25.62	8.21	586	14.69	216	41	10	900	284	< 0.1	1.4	8.1	0.13	46	381	0.5	3.4	402	18	18
	8/26/1999 11:45	8.54	20.85	8.4	710	18.79	254	64	9.1	380	318	< 0.1	1.5	8	0.1	49	448	0.6	2.5	479	31	31
	9/21/1999 11:30	7.82	15.18	8.38	787	14.3	261	91	10.3	480	340	< 0.1	2.1	8.1	0.1	56	502	0.6	2.7	527	14	14
	10/21/1999 11:35	9.31	9.32	8.1	755	3.04	276	77	8.8	60	336	< 0.1	1.5	8	0.06	61	505	0.5	3.5	511	< 4	
	11/23/1999 11:45	8.62	12.26	8.03	736	8.07	273	65	10.8	290	345	< 0.1	1.5	8	0.07	80	491	0.6	2.9	503	13	13

2000 Fixed Station

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	E_ Coli (MPN/100 mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0001	1/20/2000 11:45	13.34	0.31	7.69	752	5.9	279	54	6.2	21	361	< 0.1	1.8 (QJ)	8.1	0.03	80	483	0.4	2	499	< 4
	2/25/2000 11:45	10.22	11.46	7.98	762	6.5	253	46	10.8	37	319	< 0.1	3.6	8	0.05	78	481	0.5	3	499	19
	3/30/2000 11:30	11.91	9.18	8.19	760	4.09	257	52	11.8	10 (QBJ)	291	1.1 (BJ)	3.1 (QJ)	8.2	0.03	69	380	0.5	2.4	395	5
	4/20/2000 11:45	8.91	16.15	8.3	751	9.6	246	46	9.8	68	368	< 0.1	3.2	8.1	0.05	68	450	0.6	2.7	483	25
	5/25/2000 11:30	7.36	19.47	8.1	355	20.39	248	41	11.6	140	366	0.1	5.1	8	0.08	57	452	0.7	2.7	500	31
	6/21/2000 12:05	6.44	22.2	7.86	415	362	147	21	42.3	< 1	228	0.1	6	7.8	0.43	31	292	2.2	4.6	549	240
	7/20/2000 11:50	7.65	21.13	8.22	685		255	55	8.2		360	< 0.1	1.9	8.2	0.05	54	462	0.3	2.1	475	10
	8/30/2000 11:50	6.78	23.19	8.18	718	6.44	261	59	9.8	140 (QJ)	365 (BJ)	0.2	1.6	7.8	0.09	59	486	0.6	2.6	516	11
	9/20/2000 11:55	8.16	18.95	8.14	752		279	51	8.7	190	408	< 0.1	1.9	8	0.08	67	484	< 0.1	2.5	514	11
	10/27/2000 12:10	7.63	17.13	8.03	751		298	49	16.1	210	384	< 0.1	1.3	7.9	0.07	58	472	0.2	3	485	4
	11/21/2000 12:30	12.8	1.34	8.42	715	2.14	298	41	13.3	990	396	< 0.1	2.6	8.2	< 0.03	67	478	0.2	2.1	488	4
	12/22/2000 11:15	14.1	-0.1	8.4	790	4.07	296	48	9.8	93	408	< 0.1	3.9	8	< 0.03	60	492	0.2	2.1	500	< 4

2001 Corvallis

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0014	5/23/2001 15:45	9.51	15.25	98.9	8.31	713	17.2	250	42	6.3	< 0.005	341	< 0.1	9	0.065	17 (QJ)	420	0.8 (QJ)	2.6	450	17
	7/2/2001 16:40	10.32	20.92	117.3	8.53	670	14.39	250	40 (DJ)	18 (DJ)	< 0.005	370.6	< 0.1	2	0.06	54	430	0.71	2.3	430	13
	8/28/2001 13:00	9.57	21.8	112.5	8.17	723	13.6	270	39	< 5	< 0.005	336	< 0.1	1.6 (QJ)	0.071	60	460	0.7 (B)	3.2	560	5

2001 E. coli-Upper WFWR

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Coliforms (Total) (MPN/100mL)	E_ Coli (MPN/100 mL)
WWU100-0024	6/6/2001 15:00	8.54	17.37	8.05	673	82	> 2419.2	> 2419.2
	6/13/2001	8.25	22.3	8.11	761	36		
	6/20/2001 12:00	7.91	21.32	8.15	782	20	> 2419.2	517.2
	6/27/2001 11:00	8.57	21.11	8.3	811	15	> 2419.2	235.9
	7/4/2001 12:00	8	19.2	8.05	674	195	> 24192	2282
	7/10/2001 14:35	7.74	23.8	8.07	683	40	> 2419.2	517.2
WWU100-0025	6/6/2001 14:35	9	17.8	8.02	666	110	> 2419.2	> 2419.2
	6/13/2001	8.82	21.87	8.1	694	35		
	6/20/2001 11:30	8.74	20.92	8.18	743	14	> 2419.2	325.5
	6/27/2001 10:45	9.5	20.87	8.36	767	12	> 2419.2	547.5
	7/4/2001 11:40	8.87	18.79	8.07	610	103	> 24192	3873
	7/10/2001 14:15	8.55	23.8	8.15	665	22	> 2419.2	648.8

2001 Fixed Station

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	E_ Coli (MPN/100 mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Tss
WWU100-0001	1/23/2001 11:55	13.22	2	8.35	796	3.19	300	46	11		300	386	< 0.1	3.3	8.1	< 0.03	63	473	0.3	1.8	473	< 4	
	2/23/2001 12:30	12.21	4.28	8.28	762	5.9	285	42	6.8 (QJ)		120	370	< 0.1	3.7	8	0.03	58	462	0.2	1.7	478	4	4
	3/28/2001	13.77	5.84	8.51	729	3.65																	
	4/26/2001 12:20	9.6	14.47	8.43	747	7.38	275	43	7.5		24	358	< 0.1	2.4	8.2	0.05	54	451	0.4	2.2	491	5	5
	5/25/2001 12:10	8.31	14.06	8.47	597	211	202	32	25.3			293	< 0.1	8.5	8.1	0.21	34	372	1.3	3.3	491	113	113
	6/20/2001 11:40	7.25	21.54	7.98	689	20.39	267	41	14.9		290	356	< 0.1	4.2	8.1	0.1	43	475	0.6	1.9	514	20	20
	7/19/2001 11:50	6.93	21.88	7.69	372	103			30.3	< 0.005	< 1		< 0.1	2.4		0.25			1.5	5.6			
	8/29/2001 12:20	7.9	21.89	8.28		12.1	275	43	8.1		220	322	< 0.1	1.7	8.3	0.07	53	476	0.3	2.5	493	15	15
	9/21/2001 12:05	7.94	18.18	7.96	531	15	248	34	11.6		1200	296	< 0.1	2.9	8.3	0.09	41	398	0.6	3.9	434	18	18
	10/26/2001 11:45	9.1	8.64	7.59	331	70	162	17	25.7		< 1	202	< 0.1	2	8	0.24	27	281	1.1	7.3	318	43	43
	11/21/2001 12:45	12.36	7.42	7.65	647	1.95	301	42	8.9		190	386	< 0.1	2.3	8.5	< 0.03	81	456	0.2	2.3	473	< 4	
	12/21/2001 12:45	8.52	5.71	8.27	564	14.3	248	30	10		980	314	< 0.1	3.2	8.3	0.09	32	386	0.6	< 1	405	13	13

2001 Pesticides

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Atrazine (Aatrex) (ug/L)
WWU100-0001	3/21/2001 10:40	12.27	8.18		8	739	8.1	< 0.1
	4/18/2001 11:45	11.37	7.48		8.28	744	11	0.2

Thorpe Creek

IDEM WQ
2008 Fall Creek IBC Study

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Atrazine (Aatrex) (ug/L)
WWU100-0050	6/17/2008 15:40	7.33	18.89	80.8	8.08	638	4.2	230	46	6	< 0.005	0.2	290	0.11	6.1	0.14	26	350	0.53	2.7	400	2	
	8/12/2008 14:45							240	95	19 (fDJ)	< 0.005	0.34	320	< 0.1	3.6	0.84 (QJ)	46	520	0.74 (fDJ)	4.2	540	7	
	10/6/2008 7:35	6.3	12.54	60.1	7.94	1401	4.3	220	260	36	< 0.005	0.54	350	< 0.1	11	4.2	95	780		7.9	880	6	
WWU100-0051	6/17/2008 15:15	7.34	19.43	82.4	8.09	530	6.6	200	27	7	< 0.005	0.17	260	< 0.1	5.1	< 0.05	20	290	1.2	2.6	320	1	
	8/12/2008 15:25							200	39	7 (fDJ)	< 0.005	0.21	250	< 0.1	0.53	< 0.05 (QJ	25	320	0.58 (fDJ)	3.4	340	4	
	10/6/2008 7:58	6.66	12.76	63.6	7.78	795	15.6	310	60	< 4	< 0.005	0.38	400	< 0.1	0.41	< 0.05	48	460	0.36	2.3	520	4	
WWU100-0052	5/7/2008	7.26	15.5	74.6	8.05	813	9.1																< 0.28 (QJ)
	6/17/2008 14:55	7.69	18.79	83.8	7.85	636	8.4	230	46	5	< 0.005	0.19	280	0.12	6.5	0.16	25	360	0.82	2.6	390	5	1.6 (QJ)
	8/12/2008 16:00							250	120	32 (fDJ)	< 0.005	0.38	320	< 0.1	5.7	0.92 (QJ)	51	590	0.84 (fDJ)	4.9	620	4	
	10/6/2008 9:01	4.07	13.06	40.5	7.59	1530	22.2	220	270	44	< 0.005	0.64	360	0.84	16	4.9	90	900	2.1	9.2	940	14 (fDJ)	
WWU100-0053	5/7/2008	9.07	16.49	102.5	8.04	568	2.6																< 0.28 (QJ)
	6/17/2008 13:50	8.75	20.12	97.3	7.93	532	9	190	27	4	< 0.005	0.15	270	< 0.1	6.6	< 0.05	19	290	0.62	2.3	310	4	1.5 (QJ)
	8/12/2008 16:40							210	34	7 (fDJ)	< 0.005	0.18	260	< 0.1	0.08	< 0.05 (QJ	26	310	0.63 (fDJ)	3.5	320	4	
	10/6/2008 8:11	5.81	13.09	61.8	7.67	660	85.1	180	64	53	< 0.005	0.54	280	< 0.1	0.1	0.17	69	380	1.5	11	470	33	
WWU100-0054	6/17/2008 14:40	7.2	19.87	83.2	7.43	549	6.6	190	29	8	< 0.005	0.16	270	< 0.1	9.9	< 0.05	15	300	0.41	2.3	340	2	
	8/13/2008 10:11							270	60	< 4	< 0.005	0.18	330	< 0.1	0.42	< 0.05 (QJ	20	430	0.4	3	440	26	
	10/6/2008 8:33	2.68	11.12	51.8	7.64	700		170	110	69	< 0.005	0.19	290	0.44	0.05	0.53	30	350	1.9	15	670	220	
WWU100-0055	5/7/2008	13.87	15.43	117.2	8.34	651	25.4																< 0.28 (QJ)
	6/17/2008 12:50	8.62	17.61	98.4	7.69	516	5.2	190	21	6	< 0.005	0.14	260	< 0.1	7.5	< 0.05	20	290	0.35	2.6	300	< 1	1.3 (QJ)
	8/13/2008 9:35							190	13	< 4	< 0.005	0.16	320	< 0.1	0.11	< 0.05 (QJ	70	390	< 0.3	1.9	390	3	
	10/6/2008 9:48	6.3	12.45	63.4	7.91	706	12.7	280	18	< 4	< 0.005	0.14	400	< 0.1	0.02	< 0.05	87	440	0.34	2.6	490	< 1	
WWU100-0056	6/17/2008 11:35	7.85	16.48	81.1	7.81	579	9.8	200	31	9	< 0.005	0.15	270	< 0.1	8.5	< 0.05	18	310	0.32	2	330	1	
	8/12/2008 17:30							280	56	< 4	< 0.005	0.17	310	< 0.1	0.12	< 0.05 (QJ	11	410	0.44	3.9	410	6	
	10/6/2008 9:19	4.49	10.31	42.9	7.56	801	497	260	99	36 (fDJ)	< 0.005	0.18	300	0.39	< 0.01	0.18	9.4	450	1.6	12	500	37	
WWU100-0057	6/17/2008 13:10	11.01	19.68	123.8	8.16	539	14.1	190	26	9	< 0.005	0.14	270	< 0.1	9.4	0.1	15	300	0.33	2.3	330	9	
	8/13/2008 8:53							300	50	< 4	< 0.005	0.16	360	0.6	0.07	0.06 (QJ)	12	430	1.7	5.2	470	47	
	10/6/2008 9:34	1.72	12.97	15.3	7.5	770	132	330	60	62 (fDJ)	< 0.005	0.19	350	8.3	0.02	0.32	11	400	10	17	570	74	
WWU100-0058	5/7/2008	9.71	16.66	101.6	7.77	565	0.8																< 0.28 (QJ)
	6/17/2008 9:40	8.11	17.82	86.4	7.85	517	8	190	30	14	< 0.005	0.16	250	< 0.1	7	0.06	17	290	0.7	2.7	330	3	2.2 (QJ)
	8/12/2008 14:48							190	36	< 4 (fDJ)	< 0.005 (Q	0.22	230	< 0.1	1.5	0.09 (QJ)	22	300	0.37	3.8	330	1	
	10/6/2008 11:39	5.86	12.62	58.5	7.92	782	33.6	230	85	21 (fDJ)	< 0.005	0.31	310	< 0.1	0.04	0.05	36	430		8	470	3	
WWU100-0120	5/7/2008	8.45	19.02	94	8.39	638	23.5																1.4 (QJ)
	6/18/2008	9.04	20.01	100.5	7.99	605	27.3																< 0.28 (QJ)

DO	7.299583333
E. Coli	
pH	7.874166667
Nitrate+Nitı	4.091153846
Total P	0.848
TSS	20.8
Turbidity	41.87391304
Atrazine	1.6

Flatfork Creek Page 2	4/25/2001 13:10	10.69	14.44		8.3	747	7	< 0.1 (QJ)
	5/2/2001 8:30	8.33	17.44		8.17	705	11.19	< 0.1
	5/9/2001 11:30	8.49	18.51		8.14	689	23	0.3
	5/16/2001 13:35	8.13	19.25		8.15	760	20	0.1
	5/23/2001 16:50	8.46	18.31		8.23	728	33	8.3
	5/31/2001 12:50	9.66	14.46		8.1	719	27	1.6
	6/5/2001 14:45	9.07	15.65	94.9	8.14	740	10.69	0.6
	6/13/2001 13:30	7.77	23.79		8.19	744	37	0.67 (qJ)
	6/20/2001 13:45	7.71	21.46		8.17	745		0.3
	6/27/2001 9:40	8.4	21		8.38	750	15	0.2
	7/5/2001 12:30	8.2	20.89		8.1	542	75	0.4
	7/11/2001 10:30	7.79	21.1		7.92	691	40	0.4
	7/18/2001 10:25	7.3	22.39		8.02	468	300	0.2

2002 Clean Sampling and Ultra-Clean Analyses

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Free) (mg/L)	Cyanide (Total) (mg/L)	DOC (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (Dissolved) (mg/L)	Nitrogen, Nitrate+Nitrite (Dissolved) (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Tss
WWU100-0001	2/11/2002 9:00	12.66	5.05	100.9	7.28	700	12	263 (fB)	32.1	21 (UJ)	< 0.012	< 0.012	1.8	0.17 (HJ)	352	0.022 (UJ)	3.09		0.041	53.7	412	0.37 (UJ)	1.9	452	7	7
	2/11/2002	13.6	5.21	109	7.36	699	12																			
	5/20/2002 9:00	10.05	10.6	92.3	7.76	630	15	243	25.4	< 28	< 0.012 (HJ)	< 0.012 (H	2.4	0.14	313	0.052	2.99	8.21	0.063	43.2	370 (HJ)	0.65	2.5	450 (HJ)	14 (HJ)	14
	8/12/2002 9:35	6.26	22.73	76.19	8.02	793	11.5	259	57.7	< 28	< 0.012 (HJ)	< 0.012 (H	2.1	0.21	337	0.039 (UJ)	2.85	8.21	0.194	59.4	458 (HJ)	0.35 (UJ)	2.1	526 (HJ)	14 (HJ)	14
	11/18/2002 9:00	11.29	4.3	87.3	7.05	843	6.9	279 (B)	49.7	14 (UJ)	< 0.012	< 0.012	2.5	0.2	372	0.015 (UJ)	1.95	8.26	0.041	74.6	484	0.4	2.8	518	4 (UJ)	4

2002 Fixed Station

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	E_ Coli (MPN/100 mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0001	1/25/2002 12:05	9.92	4.69	8.47	673	2.49	293	38.5754	7.5	310	373			8.4	< 0.03	50.3951	440	0.2094	2.315	460	< 4
	2/22/2002 12:10	9.03	5.55	8.53	644	4.46	267	37.8146	10.1	240	348	< 0.1	3.1727	8.4	< 0.03	47.2198	429	0.304	1.993	438	18
	3/22/2002 11:15	12.42	2.95	8.68	686	2.8	273	36.9759	6.3	340	356	< 0.1	3.3506	8.5	< 0.03	43.9558	424	< 0.1 (DJ)	2.076	445	4
	4/19/2002 12:05	9.13	19.7	8.11	631	16.29	265	31.9877	9.1	330	336	< 0.1	3.0252	8.3	0.0695	42.858	400	0.3869	2.627	436	24
	5/23/2002 11:20	9.2	14.27	8.01	623	10.19	279	30	10.9	93	355	< 0.1	2.8	8.4	0.06	48	414	0.3	2.4	439	13
	6/20/2002 11:30	7.64	21.7	8.13	689	17.79	297	37	7.9	550	386	< 0.1	2.6	8.5	0.09	50	448	0.4	2.5	496	29
	7/25/2002 11:55	7.02	22.54	8.19	717	17	278	48	7.2	57	355	< 0.1	3	8.5	0.16	52	464	0.3	2.6	500	20
	8/29/2002 11:15	6.95	22.14	8.34	736	16.2	266	61	5.8	410	345	< 0.1	2.8	8.2	0.2	52	477	0.3	2	508	18
	9/25/2002 11:15	8.45	15.22	8.31	739	6.23	276	63	7.3	310	339	< 0.1	2.5	8.1	0.12	67	496	0.4	2.7	525	10
	10/17/2002 11:15	11.18	13.69	7.96	750	2.49	278	70	< 5	140	397	< 0.1	2.3	8.2	0.05	60	496	0.2	2.1	518	< 4
	11/26/2002 12:15	12.17	4.59	7.75	730	2.1	277	62	6.8	190	374	< 0.1	1.7	8.1	< 0.03	69	484	0.2	2.2	499	< 4
	12/11/2002 11:55	13.46	1.82	7.73	759	2.15	292	62	6.1	150	386	< 0.1	2.4	8.1	< 0.03	68	509	0.1 (UJ)	1.6	538	< 4

2003 Clean Sampling and Ultra-Clean Analyses

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Free) (mg/L)	Cyanide (Total) (mg/L)	DOC (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (Dissolved) (mg/L)	Nitrogen, Nitrate+Nitrite (Dissolved) (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Tss
WWU100-0001	3/10/2003 9:30	12.87	0.14		7.26	413	32	127 (B)	23.9	27 (UJ)	< 0.012	< 0.012		0.1	194	0.061	4.52	8.16	0.182	26.8	224	0.98	4.7 (HJ)	316	46 (fDJ)	46
	6/16/2003 9:00	7.71	19.34	85.4	8.02	647	17	227 (B)	31.7	12 (UJ)	< 0.012	< 0.012	3.2	0.16	331	0.074	6.24	8.32	0.11	39.6	360	0.73	4.4	448	45	45
	9/23/2003 10:10	8.47	16.81	87.2	7.86	694	16	255 (B)	36.9	10 (UJ)	< 0.012	< 0.012	2.7	0.17	337	< 0.048	2.11	8.3	0.061	50.5	376	0.47	2.8	418	10 (fDJ)	10
	12/15/2003 9:15	12.77	3.4	99.9	7.06	745	9	279 (B)	35	< 28	< 0.012	< 0.012	1.9	0.14	366	0.022 (UJ)	3.05	8.18	0.028	46.6	418	0.34 (UJ)	2	458	< 7	

2003 Fixed Station

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	E_ Coli (MPN/100 mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0001	2/21/2003 11:30	13.06	1.63	7.84	738	3.3	261	73	8.6	26	380	< 0.1	2.2	8.1	< 0.03	60	488	0.2	1.6	495	< 4
	3/27/2003 12:10	10.27	11.05	8.08	614	17.2	226	45	10.6	1000	341	< 0.1	4.1	8.1	0.06	39	395	0.2 (DJ)	2.9	453	23
	4/23/2003 11:30	10.47	10.43	8.16	690	3.07	278	48	7.4	74	370	< 0.1	2.1	8.2	0.04	53	453	0.2	2.2	489	5
	5/29/2003 11:25	8.32	16.29	8.36	699	17.3	275	46	10.7		371	< 0.1	2.4	8.1	0.07	52	444	0.4	2.3	492	36
	6/25/2003 11:10	7.51	22.28	8.28	738	19.9	275		10.9	170 (fDJ)	366	< 0.1	2.7	8.2	0.07		455	0.4	2.2	509	29
	7/29/2003 14:00	8.4	21.6	8.1	751	15.8	286	43	13.7		374	< 0.1	2.3	8.2	0.06	48	444	0.3	3.2	492	13
	8/27/2003 11:05	6.88	23.25	8.37	768	9.78	263	59	8.3	820	356	< 0.1	2	8.2	0.07	55	466	0.3 (fDJ)	2.3	505	13
	9/24/2003 9:50	8.9	14.9	8.52	672	11.5	270	37	10	730	349	< 0.1	2	8.2	0.05	46	414	0.4	2.7	437	8
	10/30/2003 11:30	10.76	10.66	7.8	746	8.7	264	42	6.5 (DJ)	110	382	< 0.1	2	8.2	< 0.03	46	446	0.3	2.6	463	4
	11/25/2003 9:10	11.48	6.02	8.66	565	30.1	202	30	14.7	2000	297	< 0.1	2.9	8	0.12	32	333	0.8	4.4	372	29
	12/23/2003 10:15	10.79	6.76	8.64	597	40.5	212	43	20	1700	314	< 0.1	2.1	8	0.18	36	354	1	3.1	471	96

2004 Clean Sampling and Ultra-Clean Analyses

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Free) (mg/L)	Cyanide (Total) (mg/L)	DOC (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (Dissolved) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (Dissolved) (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0001	3/22/2004 9:30	14.02	3.24	102	7.3	699	10.4	258 (B)	37.5	14 (UJ)	< 0.012	< 0.012	1.8	0.15	330	0.025 (UJ)		2.23		8.37	0.019	45.2	402	0.34 (UJ)	2.2	414	< 7
	8/23/2004 9:00	7.14	19.32	79.8	7.99	726	5.5	250	55.4	< 5					313		< 0.1		1.8		0.098	55.4	446	0.796	3	461	9
	10/12/2004 10:30	8.52	11.91	79.4	8.02	813	2.3	260	71.9	< 10					373		< 0.5		1.65		< 0.05	69.8	462	< 0.2 (QJ)	3.7	514	4.2

2004 Fixed Station

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	E_ Coli (MPN/100 mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	P	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Tss
WWU100-0001	1/23/2004 9:15	13.84	0.27	8.79	740	4.38	247	46	6.5	200	397	< 0.1	2.8	8.1	0.03	0.03	46	456	0.3	1.7	469		
	2/19/2004 8:45	11.94	4.05	8.81	685	12.3	272	45	10.9	240	370	< 0.1	2	8.1	0.06	0.06	47	418	0.4	2.7	448	13	13
	3/15/2004 14:25	9.01	13.53	8.19	688	3.18	254	44	< 5		367	< 0.1	2.1	8.3	< 0.03		48	429	0.2	1.6	443	4 (fDJ)	4
	4/29/2004 8:45	9.78	13.89	8.44	738	6.74		51	9.8	93	354	< 0.1	1.6	8.1	0.04	0.04	49	446	0.4	2.1	465	10	10
	5/27/2004 9:05	8.49	18.94	8.44	719	19.5	265	46	11.1 (DJ)	250	351	< 0.1	2.9	8.2	0.11	0.11	41	437	0.6	2.3	483	25	25
	6/24/2004 8:50	8.3	19.05	8.32	651	18.4	244	33	12.2 (DJ)	240	304	< 0.1	2.5	8.1	0.07	0.07	38	382	0.6	3.2	434	22	22
	7/28/2004 8:40	7.73	17.34	8.15	776	13.1	273	51	9.1	180	360	< 0.1	2	8.2	0.08	0.08	54	457		2.2	508	14 (DJ)	14
	8/20/2004 8:30	5.88	20.71	8.07	789	12.3	282	64	8.2	200	347	< 0.1	1.9	8.1	0.11	0.11	50	474	0.4	2	530	13	13
	9/22/2004 8:40	6.2	16.6	8.22	816	7.05	267	73	6.8	190	375	< 0.1	2	8.1	0.06	0.06	56	497		2.2	526	8	8
	10/21/2004 8:55	6.9	11.55	8.12	745	4.41	252	51	10.6	160	356	< 0.1	1.6	8	0.05	0.05	57	452	0.5	2.6	486	6	6
	11/19/2004 9:05	7.11	12.84	8.08	782	5.15	294	60	9.7	410	361	< 0.1	1.6	8	0.05	0.05	56	468	0.4	2.1	493	10	10
	12/16/2004 8:55	10.38	3.4	8.07	771	4.34	290	50	5	260	366	< 0.1	3.2	8.2	0.03	0.03	49	446 (B)	0.4	1.7	455	< 4	

2005 Clean Sampling and Ultra-Clean Analyses

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0001	2/22/2005 11:00	11.2	5.8	89.5	7.9	653	8.24	280	34	11	308	0.18	2.7	< 0.05	40	370 (HJ)	0.78	1.09	430	10

6/27/2005 10:00	6.4	23.3	75	7.8	746	18.1	234	54.8	11.3	323	< 0.5 (QJ)	1.88	0.1	52.4	424	< 2	3.4	464	24.1
9/15/2005 9:30	6.41	21	72.3	7.8	775	13.1	244	65.6	< 10 (Q)	340	< 0.5	1.84	0.11	61.6	474	< 2	3	504	10.3
12/16/2005 11:00	13	1.4	92.5	7.8	832	3.2	288	71.5	< 10	361	< 0.5	2.08	0.07	50.5	484	< 2 (QJ)	3.1	486	< 5

2005 Fixed Station

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	E_ Coli (MPN/100 mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	P	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0001	1/26/2005 9:05	10.62	5.81	7.92	720	8.8	270	43	6.4	100	320	< 0.1	2.8	8	0.04	0.04	45	417	0.4	1.7	445	9
	2/18/2005 8:55	13.14	3.27	7.85	567	34.9	235	34	10.1	43 (fDJ)	288	< 0.1	3.2	7.9	0.04	0.04	35	337	0.5	2.3	379	26
	3/30/2005 8:45	9.33	10.77	7.95	719	9.9	266	47	6.5	120	337	< 0.1	2.3	8.1	< 0.03		43	410	0.3	2.2	436	5
	4/19/2005 8:55	6.99	17.71	7.86	732	7.28	265	54	9.3	46	330	< 0.1	1.5	8.1	0.04	0.04	50	418	0.5	2.4	454	11
	5/26/2005 8:45	7.82	15.9	7.87	715	13.2	267	42	9.8	110	347	< 0.1	3.3	8.1	0.06	0.06	47	423	0.5	2.1	464	16
	6/29/2005 8:55	6.04	22.04	7.79	724	26.4	240	49	13.5	260	356	< 0.1	2.1	8.1	0.09	0.09	52	452	0.6	2.6	490	42
	7/27/2005 9:30	5.48	23.86	7.85	704	18.6	251	50	11.4	6	340	< 0.1	2	8.1	0.13	0.13	46	434	0.6	2.6	484	30
	8/24/2005 9:30	6.34	20	7.69	801	11.6	259	71	7.8	96	348	< 0.1	1.9	8.1	0.08	0.08	49	485	0.5	2.2	523	14
	9/21/2005 8:45	6	19.1	7.5	593	39.4	206	31	19	830	280	< 0.1	2.6	8	0.17	0.17	31	344	0.9	4.8	420	53
	10/19/2005 8:40	8.63	13.37	7.85	720	5.64	289	68	8.2	180	368	< 0.1	1.7	8.1	0.04	0.04	53	516	0.1 (QJ)	2.5	507	7
	11/22/2005 8:50	10.42	6.84	7.93	639	5.18	271	43	9.4	300	369	< 0.1	2.7	8.1	0.06	0.06	48	467	0.4	3	491	< 4

2006 Clean Sampling and Ultra-Clean Analyses

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0001	3/10/2006 11:00	9.8	8.3	83	7.4	368	285	88	23.4	15.1	0.17	190	< 0.1	0.511	0.298	17.6	244	2.09	6.4	449	200
	5/15/2006 9:30	9.5	11.7	87.9	7.8	518	42	170	25.2	10.1	0.18	279	< 0.1	4.33	0.148	25.1	305	0.816	4.3	357	50

2006 Fixed Station

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	E_ Coli (MPN/100 mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	P	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0001	1/20/2006 8:55	10.01	8.06	8.07	581	22.9	218	41	13.2	550	319	< 0.1	3.9	8.1	0.09	0.09	35	369	0.6	2.8	415	30
	2/15/2006 8:45	11.52	4.71	8.23	647	8.93	276	45	7.8 (DJ)	62	337	< 0.1	2.9	8.1	0.03	0.03	52	433	0.3	2	456	11
	3/30/2006 8:45	9.17	8.25	8.32	710	7.48	257	40	7.8	64	377	< 0.1	2	8.1	< 0.03		44	407	0.3	2.2	440	9
	4/20/2006 8:35	7.18	14.85	8.12	632	20.3	238	32	14.4	280	313	< 0.1	2.9	8	0.08	0.08	41	370	0.6	3.2	418	29
	5/24/2006 9:05	6.7	14.55	8.26	694	14.9	271	35	12.4	160	351	< 0.1	3.2	8.1	0.04	0.04	45	422	0.5	2.3	460	25
	6/28/2006 9:00	8.44	19.39	8.21	565	26.9	271	40	12.4	310	346	< 0.1	2.8	8	0.1	0.1	46	485	0.6	2.4	542	34
	7/26/2006 8:50	8.02	22.6	8.27	727	16.4	274	58	10.7	220	335	< 0.1	2.1	8.1	0.12	0.12	45	460	0.5	2.7	537	21
	8/23/2006 8:45	9.13	20.63	8.31	750	14.7	268	70	8.6	270	370	< 0.1	1.8	8.1	0.1	0.1	46	491	0.4	2.8	531	16
	9/21/2006 8:30	9.01	12.73	8.27	731	8.93	269	67	8.4	340	342	< 0.1	1.9	8.2	0.07	0.07	44	478	0.4	2.4	499	12
	10/25/2006 9:00	10.91	5.97	8.49	655	5.08	277	44	8.2	170	358	< 0.1	2.2	8.1	0.07	0.07	42	447	0.3	3.3	469	5
	11/29/2006 8:59	9.15	11.93	8.2	727	6.79	277	48	6.1	440	385	< 0.1	2	8.1	0.06	0.06	42	436	0.3	2.6	475	12
	12/21/2006 8:40	11.27	7.33	8.17	712	8.45	276	42	7.4	270	382	< 0.1	2.4	8	0.03	0.03	38	429	0.3	2.4	396	8

2007 Fixed Station Monitoring

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	E_ Coli (MPN/100 mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	P	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Tss
WWU100-0001	1/24/2007 8:40	12.56	4.5	8	643	8.15	270	36	7.4	140	335	< 0.1	2.5	7.9	0.04	0.04	41	400	0.3	2.1	429	11	11
	2/22/2007 8:50	13.5	2.16	8.17	767	4.63	254	74	< 8		323	< 0.1	2	8.09	< 0.06		47.5	381	0.572	2.13	418	< 10	
	3/28/2007 8:50	8.76	15	8.12	558	57.9	215	26	15.9	370	273	< 0.1	2.2	7.9	0.08	0.08	31	322	0.6	3.4 (QJ)	379	45	45
	4/24/2007 8:35	8.37	15.6	8.19	630	13.6	261	35	12		336	< 0.1	1.9	7.9	< 0.03		43	405	0.4	2.4	466	15	15
	5/22/2007 8:25	6.01	17.68	8.51	742	14.1	274	47	10.5	96	358	< 0.1	2	8	0.05	0.05	46	422	0.4	2.36	491	23	23
	6/20/2007 8:20	7.27	20.55	8.05	745	13.7	268	61	< 5	370	367	< 0.1	1.9	8	0.09	0.09	43	464	0.4	2.6	506	19	19
	7/18/2007 8:20	6.5	21.1	8.12	686	9.66	254	63	6.9	200	352	< 0.1	1.6	8	0.09	0.09	49	454	0.4	2.7	495	11	11
	8/23/2007 8:25	6.28	23.83	8.04	549	32.4	195	35	17	980	287	< 0.1	2.4	7.9	0.14	0.14	45	359	0.8	4.9	410	37	37
	9/28/2007 8:55	7.35	18.21	7.91	785	9.39	230	80	10.4	390	339	< 0.1	1.6	7.9	0.08	0.08	54	486	0.4	3.3	549	10	10
	10/25/2007 9:05	8.82	11.27	7.91	648	4.61	257	54	10.5	180	353	< 0.1	1.6	7.9	0.04	0.04	49	439	0.4	3.6	472	6	6
	11/20/2007 8:35	9.19	11.42	8.04	804	4.26	280 (Q)	58	8.1	89	376	< 0.1	2	7.9	0.04	0.04	60	477	0.3	3.1	508	6	6
	12/20/2007 8:45	13.05	3.8	7.97	790	6.15	252	52	7.7	370	383	< 0.1	3.5	7.9	0.05	0.05	52	449	0.3	2.9	481	9	9

2008 Fall Creek IBC Study

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	Cyanide (Total) (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	P	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Tss	Atrazine (Aatrex) (ug/L)
WWU100-0040	6/17/2008 9:30	8.66	18.11	94.6	8.01	590	25.4	220	29	11	< 0.005	0.17	310	< 0.1	3.2	0.1	0.1	33	330	0.7	3.2	400	26	26	
	8/11/2008 9:08							250	40	4 (fDJ)	< 0.005 (Q	0.2	340	< 0.1	1.4	< 0.05 (QJ)		44	410	0.81 (QJ)	2.3	420	17 (fDJ)	17	
	10/6/2008 12:36	10.92	13.9	108	8.24	699	15.2	240	48	5 (fDJ)	< 0.005	0.19	350	< 0.1	1.2	< 0.05		49	360		2.1	450	3	3	
WWU100-0059	5/7/2008	8.23	16.73	87	7.88	868	1.8																		< 0.28 (QJ)
	6/17/2008 10:40	7.86	19.1	86	7.63	556	11.7	200	38	16	< 0.005	0.17	270	< 0.1	3.7	0.1	0.1	22	300	0.92	5.1	380	8	8	1.9 (QJ)
	8/11/2008 8:15							260	130	20 (fDJ)	< 0.005	0.29	310	< 0.1	1.8	< 0.05 (QJ)		42	520	0.52 (fDJ)	3.6	550	3 (fDJ)	3	
	10/6/2008 10:08	8.8	12.81	86	8.08	1550	6.2	260	330	41 (fDJ)	< 0.005	0.46	380	< 0.1	2.8	< 0.05		72	840	0.69	4.7	930	3	3	
WWU100-0061	6/17/2008 10:55	7.11	19.72	79.5	7.57	496	21	190	23	16	< 0.005	0.17	260	< 0.1	4	0.13	0.13	20	290	1.2	5.6	310	12	12	
	8/11/2008 9:05							250	34	9 (fDJ)	< 0.005	0.21	250	< 0.1	0.62	< 0.05 (QJ)		24	320	0.71 (fDJ)	4.3	330	11 (fDJ)	11	
	10/6/2008 10:41	6.67	14.86	61.9	7.82	631	8.1	280	32	4 (fDJ)	< 0.005	0.48	180	< 0.1	0.23	< 0.05		28	360		3.4	390	3	3	
WWU100-0062	6/17/2008 11:15	6.9	18.3	74.2	7.46	464	16.1	180	21	22	< 0.005	0.16	230	< 0.1	3.8	0.14	0.14	17	260	0.99	6.4	280	14	14	
	8/11/2008 9:50							290	35	< 4 (fDJ)	< 0.005	0.15	310	< 0.1	0.36	0.08 (QJ)	0.08	29	340	0.68 (fDJ)	3.6	400	8 (fDJ)	8	
	10/6/2008 11:02	2.81	12.71	28.4	7.53	540	90	240	35	16 (fDJ)	< 0.005	0.16	250	< 0.1	0.01	0.07	0.07	14	270		8.7	330	4	4	
WWU100-0064	5/7/2008	10.03	16.88	107.1	7.75	696	6.2																		< 0.28 (QJ)
	6/17/2008 9:00	8.72	18.3	95.6	7.97	609	25.6	240	34	17	< 0.005	0.17	320	< 0.1	3.2	0.13	0.13	36	340	0.88	3.2	450	31	31	1.6 (QJ)
	8/12/2008 16:30							250	46	< 4 (fDJ)	< 0.005 (Q	0.18	330	< 0.1	1.7	< 0.05 (QJ)		47	390	< 0.3	2.4	410	3	3	
	10/6/2008 12:16	11.2	14.66	112.6	8.34	828	22.3	260	82	5 (fDJ)	< 0.005	0.19	350	< 0.1	2.6	< 0.05		54	460		2.4	530	< 1		

2008 Fixed Station Monitoring

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	E_ Coli (MPN/100 mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Tss
WWU100-0001	1/24/2008 8:40	11.41	0.85	7.78	713	4.29	283	47	6	130	384	< 0.1	3.1	8	0.04	51	437	0.3	1.6	470	< 4	
	2/20/2008 8:50	13.53	2.34	7.66	641	16	216	36	8.9	240	316	< 0.1	3.7	7.9	0.06		367	0.3	2.8	410	14	14
	3/26/2008 8:50	12.22	6.84	7.88	577	13.3	237	33	12 (DJ)	230	318	< 0.1	2.7	7.8	0.03	37	361	0.4	2.8	394	13	13
	4/23/2008 8:25	6.29	16.14	7.82	691	7.16	261	40	9.4	82	348	< 0.1	2	7.9	0.03	41	389	0.3	3	432	10	10
	5/22/2008 8:40	9.85	13.33	7.81	638	10.2	259 (QJ)	38	7.8	170	371	< 0.1	2.8	7.9	0.05	43	392	0.4	3	434	11	11
	6/25/2008 8:45	8.86	19.28	7.87	643	11.9	272	38	9.4 (QJ)	220	363	< 0.1	2.6	7.9	0.06	45	403	0.4	2.6	450	17	17
	7/24/2008 9:15	7.24	20	7.81	568	21.8	216	29	14	730	301	< 0.1	2.3	8.1	0.1	28	348	0.6	4.1	400	34	34
	8/19/2008 9:10	7.2	19.74	8.01	673	8.05	269	54	8.1	110	370	< 0.1	1.9	8.2	0.04	47	455	0.2	1.9	480	11	11
	9/24/2008 9:30	7.61	18.26	7.82	863	6.71	271	68	7.3	250	360	< 0.1	2.3	8.2	0.06	51	476	0.3	2.3	508	10	10
	10/22/2008 9:05	9.54	9.78	8.01	803	2.11	265	65	7.8 (QJ)	180	378	< 0.1	1.9	8.1	0.04	41	469	0.3	3.5	492	4	4
	11/20/2008 9:39	13.63	4.05	7.9	-4	1.96	267	55	8.2	490	380	< 0.1 (QJ)	2	8.1	< 0.03	52	457	0.2	2.5	477	< 4	

12/11/2008 9:15	12.33	3.44	8.37	741	7.16	243	58	7.6	< 1 (fB)	348	< 0.1	2	8	0.04	54	422	0.4	3.3	444	7	7

2008 Upper Fall Creek WQ Monitoring Program

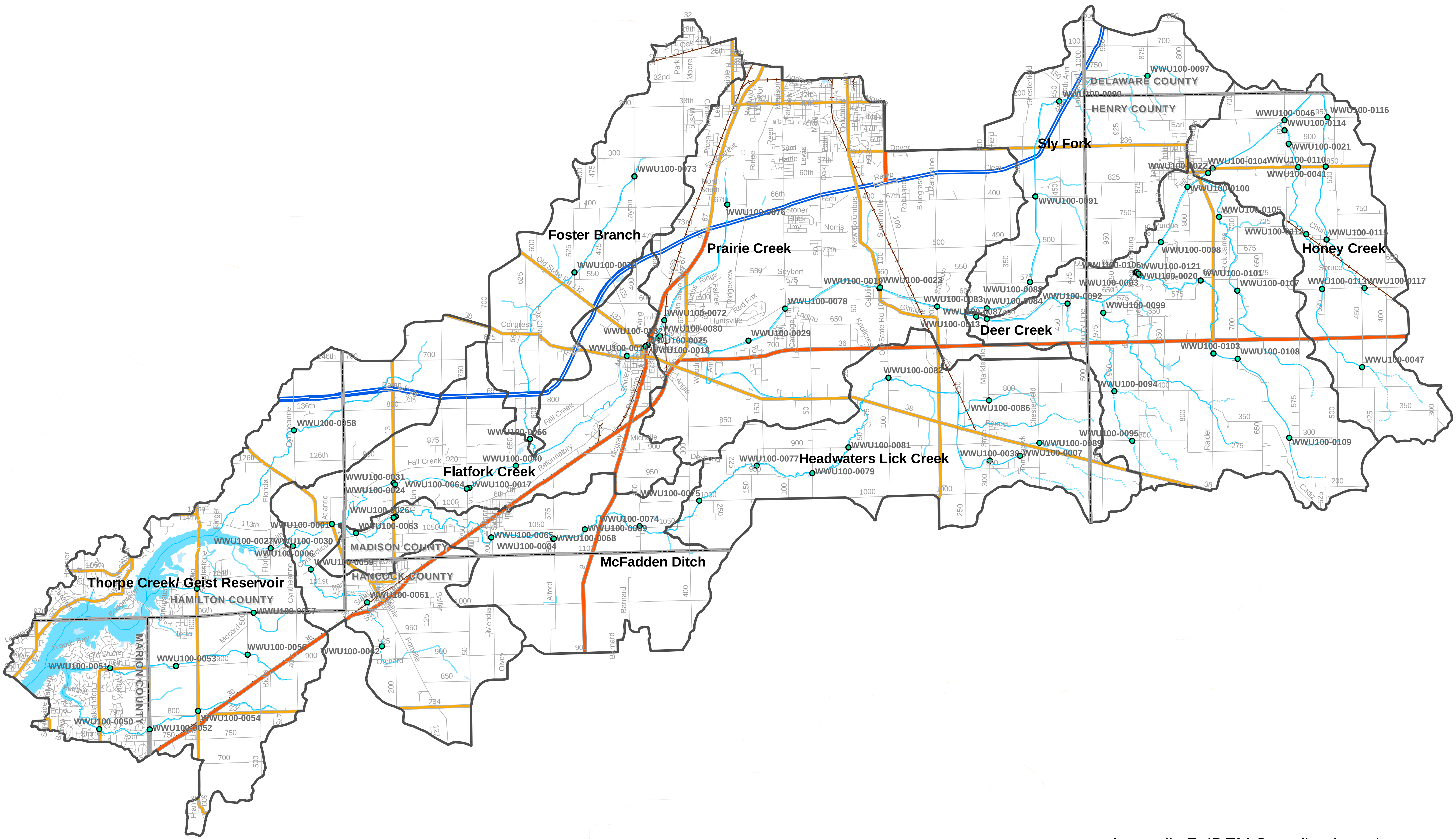
	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Coliforms (Total) (MPN/100 mL)	E_ Coli (MPN/100 mL)	E Coli	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)	Tss
WWU100-0001	7/9/2008 9:50	7.89	21.43	89.8	8.01	641	22.6					> 2420	648.8	648.8												
	7/16/2008 10:00	8.28	21.76	94.7	7.84	651	17.1					> 2420	344.8	344.8												
	7/23/2008 9:15	8.4	21.25	95.2	7.55	392	40.9					> 2420	> 2420	2420												
	7/30/2008 9:20	7.01	22.64	83.6	8.09	688	9.8					> 2420	224.7	224.7												
	7/30/2008 15:00	7.74	22.17	89	7.73	716	6.1	290 (QJ)		40	9.6				0.2		< 0.1	1.9	0.06	44	418	0.3	2.8	469	7	7
	8/6/2008 9:35	8.08	21.99	92.6	7.87	554	19.7					> 2420	1553.1	1553.1												
	9/10/2008 8:00	6.8	17.29	72.2	7.97	712	30	245		54	10.9				0.2		< 0.1	1.6	0.08	43	430	0.4	2.4	462	21	21
WWU100-0059	6/18/2008 14:57	8.1	20.21	91.8	8.12	603	8.1	212	< 1	40	15.9				0.2	287	< 0.1	3.8	0.08	23	342	0.7	6	382	6	6
	7/8/2008 8:30	6.89	21.4	79.9	8.04	660	3.7	245		47	8.2				0.2		< 0.1	3.8	0.05	26	387	0.6	3.2	422	6	6
	7/9/2008 10:10	8.14	22.23	93.5	7.95	676	6.2					1011.1	1046.2	1046.2												
	7/16/2008 10:15	8.01	24.69	98.5	8.3	764	1.5					> 2420	816.4	816.4												
	7/16/2008 15:00	9.42	22.94	111.3	7.85	750	3.4	240	< 1	75	9				0.2	338	< 0.1	2.7	0.04	30	446	0.4	2.7	478	4	4
	7/23/2008 9:30	8.7	20.67	97.2	7.56	565	14.9					> 2420	> 2420	2420												
	7/30/2008 9:30	8.31	22.91	96.9	7.75	909	3					> 2420	178.9	178.9												
	8/6/2008 9:45	7.96	22.96	93	7.85	517	19.8					> 2420	2419.2	2419.2												
	8/11/2008 10:30	7.82	18.66	85.6	8.22	955	2.2	252		134	11.7				0.3		< 0.1	2	0.06	39	560	0.5	3.6	599	< 4	
	8/27/2008 14:45	10.81	21.39	126.3	8.49	148.9	2	253	< 1	290	15.4				0.4	395	< 0.1	2.8	0.07	63	863	0.6	4	900	< 4	
	9/16/2008 13:00	8.18	18.06	88.7	8.12	1107	1.7	254		176	13.7				0.5		< 0.1	3.6	0.1		659	0.5 (DJ)	4.4	695	< 4	
	9/24/2008 16:10	9.02	20.26	101.9	8.26	1720	1.1	258	< 1	336	13.3				0.5	433	< 0.1	3.6	0.07	62	977	0.5	4.3	1050	< 4	
	10/22/2008 15:20	12.8	9.67	114.8	8.35	1680	2.8	270	< 1	322	16.5				0.5	384	< 0.1	2.9	0.07	38	915	0.7	5.7	969	< 4	
	11/19/2008 14:50	14.93	4.01	115.8	8.88	1117	19.3	256	< 1	207	15.9				0.4	325	< 0.1	2.2	0.05	52	615	0.5 (DJ)	4.1	652	6	6
	12/17/2008 14:57	17.42	0.96	124.2	8.74	1180	6.1	227	< 1	189	15.2				0.3	346	< 0.1	2.6	0.03	52	653	0.5	3.7	681	< 4	
WWU100-0064	6/18/2008 14:17	8.68	19.28	96.6	8.15	665	26.1	243	< 1	36	14.3				0.2	342	< 0.1	3.3	0.09	39	384	0.6	4.2	444	27	27
	7/9/2008 9:25	8.47	21.65	96.6	8.04	689	15.5					> 2420	686.7	686.7												
	7/16/2008 9:30	8.5	23.23	101.9	8.22	674	21.5					> 2420	517.2	517.2												
	7/16/2008 14:25	8.51	21.66	97.2	7.79	673	18	248	< 1	38	11.4				0.2	352	< 0.1	2.6	0.08	42	412	0.4	2.5	455	19	19
	7/23/2008 8:50	8.63	20.61	96.3	7.52	611	44					> 2420	> 2420	2420												
	7/30/2008 8:50	7.85	22.03	90.1	7.67	729	7.1					> 2420	191.8	191.8												
	7/30/2008 13:00	8.53	23.22	102.9	8.17	714	6.3	285 (QJ)		47	10				0.2		< 0.1	2	0.06	45	432	0.3	2.8	475	5	5
	8/6/2008 9:05	7.98	21.83	91.1	7.8	564	20.7					> 2420	2419.2	2419.2												
	8/27/2008 13:35	10.62	21.85	124.6	8.31	778	1.6	263	< 1	62	7.7				0.2	368	< 0.1	1.9	0.05	50	490	0.3	1.7	499	< 4	
	9/10/2008 10:30	8.01	16.78	84.1	8.1	826	7.5	262		75	9.3				0.2		< 0.1	2.1	0.07	58	503	0.4	2.6	521	9	9
	9/24/2008 15:15	10.87	21.16	124.7	8.22	859	3.9	260	< 1	82	8.1				0.2	370	< 0.1	2.8	0.07	48	513	0.4	2.2	534	4	4
	10/22/2008 13:43	13.57	10.68	124.3	8.5	870	1.5	265	< 1	78	7				0.2	373	< 0.1	2.4	0.06	49	503	0.3	3	537	< 4	
	11/19/2008 14:05	15.03	4.42	117.9	8.81	806	4	260	< 1	60	7.8				0.1	373	< 0.1	2.4	< 0.03	60	462	0.3 (DJ)	2.7	491	< 4	
	12/17/2008 14:19	15.72	1.38	113.3	8.58	862	5.3	254	< 1	70	13.6				0.1	365	< 0.1	2.8	< 0.03	63	497	0.3	2.3	521	< 4	

2009 Fixed Station Monitoring

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	Chloride (mg/L)	COD (mg/L)	E_ Coli (MPN/100 mL)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	pH (SU)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0001	2/25/2009 9:15	12.69	3.54	8.2	742	5.28	274	49	6.6	220	369	< 0.1	2.6	8.1	0.04	48	421	0.2	1.5	457	7
	3/18/2009	9.19	11.54	8.07	721	6.58															

2009 Upper Fall Creek WQ Monitoring Program

	Sample Date	Dissolved Oxygen (mg/L)	Water Temperature (C)	Saturation PerCent (%)	pH (SU)	Specific Conductance (uS/cm)	Turbidity (NTU)	Alkalinity (as CaCO3) (mg/L)	CBOD5 (mg/L)	Chloride (mg/L)	COD (mg/L)	Fluoride (mg/L)	Hardness (as CaCO3) (mg/L)	Nitrogen, Ammonia (mg/L)	Nitrogen, Nitrate+Nitrite (mg/L)	Phosphorus, Total (mg/L)	Sulfate (mg/L)	TDS (mg/L)	TKN (mg/L)	TOC (mg/L)	TS (mg/L)	TSS (mg/L)
WWU100-0059	2/18/2009 14:30	12.34	5.64	100.9	8.21	598	21.7	192	< 1	48	12.2	< 0.1	266	< 0.1	3.7	0.07	31	340	0.6	2.5	374	8
	3/11/2009 15:00	18.33	9.82	165.3	9	759	14.1	198	1.9	99	14.3	0.2	297	< 0.1	1.8	0.06	42	431	0.6	3.5	479	9
WWU100-0064	2/18/2009 13:52	12.21	5.47	99.4	8.24	671	52.4	235	< 1	42	12.5	0.1	350	< 0.1	3.1	0.05	46	387	0.5	2	423	9
	3/11/2009 14:25	13.42	10.71	123.5	8.6	734	13.7	259	< 1	55	9.9	0.2	369	< 0.1	2.1	0.04	53	429	0.4	2.6	476	7



Appendix F: IDEM Sampling Locations

Appendix G – CIWRP Data

A summary of the data obtained from CIWRP within the Geist Reservoir/Upper Fall Creek watershed is provided within this Appendix. The raw data is provided on CD at the end of this report.

	CEES Water Quality Data											
	DO		E. Coli		Nitrate+Nitrite		Total P		TSS		Turbidity	
Honey Creek	1	7	1	7	1	6	1	7	1	5	1	5
	11.59		42940.3		2.6		0.173		74.1		68.9	
Sly Fork	1	7	1	7	1	6	1	7	1	5	1	5
	11.59		42940.3		2.6		0.173		74.1		68.9	
Deer Creek	1	7	1	7	1	6	1	7	1	5	1	5
	11.59		42940.3		2.6		0.173		74.1		68.9	
Prairie Creek	3	16	3	16	3	13	3	16	3	11	3	11
	10.97		47006.8		1.79		0.12		48		47.8	
Headwaters Lick Creek	1	7	1	7	1	6	1	7	1	5	1	5
	12		14382.9		2.45		0.132		48.9		67.3	
Foster Branch	1	7	1	7	1	6	1	7	1	5	1	5
	11.94		15321.4		3.17		0.146		16.9		43.5	
McFadden Ditch	1	7	1	7	1	6	1	7	1	5	1	5
	12		14382.9		2.45		0.132		48.9		67.3	
Flatfork Creek	1	7	1	7	1	6	1	7	1	5	1	5
	12.08		36842.9		2.45		0.165		52.2		67.2	
Thorpe Creek	3	21	3	21	3	18	3	21	3	15	3	15
	11.47		38437.2		3.4		0.193		53.1		82.8	
Limits	Min 4.0mg/L Max 12.0mg/L		Max 235CFU/100mL		Max 1.6mg/L		Max 0.3mg/L		Max 30.0mg/L		Max 10.4 NTU	

Honey Creek
CEES 2003 Data

	Date	Esti-Q	TSSed (g/m3)	Water Surfa	Stream Bottom (	Water Dept	Sample Depth (n	Temp. (°C)	pH	SpC (mS)	TDS (g/L)	Salinity (pp	DO (mg/L)	Turbidity (N1	TSSolids (p	Silica (mg/	Silica (mg/L) (unfi	Cl- (mg/L)	SO4 (mg/l	NO2 (mg/l	NO3 (mg/l
FCW9	2/20/2003	0.70	3.1963				0.0500	0.2000	7.9100	0.6401	0.4093	0.3300	14.8400					37.0000	47.0000	<0.04	2.4000
	3/14/2003	9.83	115.4483	467	555	88	0.0500	5.5400	7.7000	0.3365	0.2154	0.1700	11.5000					16.0000	21.0000	<0.04	4.1000
	5/27/2003	1.10	11.9388	410	455	45	0.0500	15.2200	7.9500	0.6287	0.4024	0.3200	11.7100	5.0000	12.0000	7.1000	7.1000	27.0000	41.0000	<0.20	2.6000
	7/7/2003	26.01	97.7174	230	455	225	0.0500	20.8400	7.5400	0.3302	0.2114	0.1600	7.4700	48.0000	140.0000	9.0000	9.0000	12.0000	15.0000		
	10/14/2003	2.15	87.0103	350	455	105	0.0500	13.7400	7.8200	0.5024	0.3215	0.2500	7.8800	59.0000	100.0000	7.1000	7.8000	21.0000	29.0000	<0.10	2.1000
	12/22/2003	1.69	2.8723	405	455	50	0.0500	4.7400	8.0800	0.6407	0.4100	0.3300	13.2900	2.7000	1.6000	8.1000	8.5000	25.0000	38.0000	<0.10	2.7000
	1/5/2004	30.39	199.4000	255	455	200	0.0500	3.5400	7.6300	0.2480	0.1594	0.1200	14.4500	230.0000	117.0000	5.3100	4.9400	11.0000	13.0000	<0.10	1.7000
		10.2666	73.9405	352.8333	471.6667	118.8333	0.0500	9.1171	7.8043	0.4752	0.3042	0.2400	11.5914	68.9400	74.1200	7.3220	7.4680	21.2857	29.1429	#DIV/0!	2.6000

Honey Creek Page 2

Ophos (m	Total P (m	Alkalinity (r	Total Hard	NH4-N (m	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	DOC (mg	TOC (mg	Vac Line	Trans	Zero
NR	0.0250	290.0000	370.0000	0.0700	93.0000	33.0000	1.8000	21.0000	1.8000	1.8000	C	89.6000	6.3000
0.1100	0.1400	150.0000	200.0000	0.0690	53.0000	17.0000	2.7000	7.7000	5.5000	5.6000	C	31.9000	1.3000
<0.20	0.0050	260.0000	360.0000	0.1100	91.0000	32.0000	1.7000	13.0000	2.4000	2.5000	E	53.8000	8.1000
	0.3000	140.0000	170.0000	0.1000	46.0000	14.0000	4.0000	6.0000	7.7000	7.8000	C	39.9000	-1.0000
<0.10	0.4200	220.0000	270.0000	0.0200	70.0000	24.0000	5.2000	8.7000	7.8000	8.1000	E	59.0000	-1.8000
<0.10	0.0260	280.0000	360.0000	0.0600	95.0000	31.0000	1.5000	11.0000	1.7000	1.8000			
<0.10	0.2920	112.0000	140.0000	0.0200	39.0000	12.0000	4.2000	5.3000	5.0200	5.5200			
0.1100	0.1726	207.4286	267.1429	0.0641	69.5714	23.2857	3.0143	10.3857	4.5600	4.7314	#DIV/0!	54.8400	2.5800

Ophos (m	CO2 Yield	DIC (n	d13CDIC	±	d18O	±	TKN (mg/l	Total Colif	E. Coli (colo	HPC (colo	Chlo-A (mg	MIB (ppb)	Geosmin (p
NR	51.9921	62.3905	-11.5050	0.0060	-8.1620	0.0050	0.3500	15531.00	122.00	1100.00			
0.1100	18.4222	22.1066	-10.0930	0.0090	-10.0930	0.0090	0.9800	198630.00	1090.00	51000.00	0.10		
<0.20	29.3266	35.1919	-9.3960	0.0080			0.9800	17000.00	1200.00		0.30	BDL	BDL
	24.9833	29.9800	-13.1780	0.0060	-7.7750	0.0440	1.1000	>241920	>241920		0.30		
<0.10	38.9604	46.7525	-11.7730	0.0040			1.1000	>241920	51720.00		<0.1	BDL	BDL
<0.10							0.4300	3950.00	980.00		0.50	BDL	BDL
<0.10							3.1000	72700.00	3550.00		0.30	BDL	BDL
0.1100	32.7369	39.2843	-11.1890	0.0066	-8.6767	0.0193	1.1486	########	42940.2857	########	0.3000		

Calculated Location D	Comments
0.6974	Madison County Bridge #164 built in 2000. CR 200E south of 600S. South side of river east side of bridge.
NA	Landmark for water height is from railing top at south bridge support to water surface. current too swift to measure streamflow.
1.1012	Landmark to surface measured from bottom of road deck. * Local farmer said crops have been in 2 weeks. * filter stirps along stream for last 15 years - no farming to edge.
NA	Landmark to surface measured from bottom of road deck.
NA	Landmark to surface measured from bottom of road deck.
1.6868	Landmark to surface measured from bottom of road deck east side of bridge at mark.
NA	Landmark to surface measured from bottom of road deck east side of bridge at mark.

Sly Fork

CEES 2003 Data

	Date	Esti-Q	TSSed (g/m	Water Surfa	Stream Bottom (	Water Dept	Sample Depth (r	Temp. (°C)	pH	SpC (mS)	TDS (g/L)	Salinity (pp	DO (mg/L)	Turbidity (NT	TSSolids (p	Silica (mg/	Silica (mg/L) (unfi	Cl- (mg/L)	SO4 (mg/l	NO2 (mg/l	NO3 (mg/l
FCW9	2/20/2003	0.70	3.1963				0.0500	0.2000	7.9100	0.6401	0.4093	0.3300	14.8400					37.0000	47.0000	<0.04	2.4000
	3/14/2003	9.83	115.4483	467	555	88	0.0500	5.5400	7.7000	0.3365	0.2154	0.1700	11.5000					16.0000	21.0000	<0.04	4.1000
	5/27/2003	1.10	11.9388	410	455	45	0.0500	15.2200	7.9500	0.6287	0.4024	0.3200	11.7100	5.0000	12.0000	7.1000	7.1000	27.0000	41.0000	<0.20	2.6000
	7/7/2003	26.01	97.7174	230	455	225	0.0500	20.8400	7.5400	0.3302	0.2114	0.1600	7.4700	48.0000	140.0000	9.0000	9.0000	12.0000	15.0000		
	10/14/2003	2.15	87.0103	350	455	105	0.0500	13.7400	7.8200	0.5024	0.3215	0.2500	7.8800	59.0000	100.0000	7.1000	7.8000	21.0000	29.0000	<0.10	2.1000
	12/22/2003	1.69	2.8723	405	455	50	0.0500	4.7400	8.0800	0.6407	0.4100	0.3300	13.2900	2.7000	1.6000	8.1000	8.5000	25.0000	38.0000	<0.10	2.7000
	1/5/2004	30.39	199.4000	255	455	200	0.0500	3.5400	7.6300	0.2480	0.1594	0.1200	14.4500	230.0000	117.0000	5.3100	4.9400	11.0000	13.0000	<0.10	1.7000
		10.2666	73.9405	352.8333	471.6667	118.8333	0.0500	9.1171	7.8043	0.4752	0.3042	0.2400	11.5914	68.9400	74.1200	7.3220	7.4680	21.2857	29.1429	#DIV/0!	2.6000

Ophos (m	Total P (mg/L)	Alkalinity (mg/L a	Total Hard	NH4-N (m	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	DOC (mg	TOC (mg	Vac Line	Trans	Zero	CO2 Yield	DIC (n	d13CDIC	±	d18O	±	TKN (mg/l	Total Colif	E. Coli (co	HPC (color	Chlo-A (mg	MIB (ppb)
NR	0.0250	290.0000	370.0000	0.0700	93.0000	33.0000	1.8000	21.0000	1.8000	1.8000	C	89.6000	6.3000	51.9921	62.3905	-11.5050	0.0060	-8.1620	0.0050	0.3500	15531.00	122.00	1100.00		
0.1100	0.1400	150.0000	200.0000	0.0690	53.0000	17.0000	2.7000	7.7000	5.5000	5.6000	C	31.9000	1.3000	18.4222	22.1066	-10.0930	0.0090	-10.0930	0.0090	0.9800	198630.00	1090.00	51000.00	0.10	
<0.20	0.0050	260.0000	360.0000	0.1100	91.0000	32.0000	1.7000	13.0000	2.4000	2.5000	E	53.8000	8.1000	29.3266	35.1919	-9.3960	0.0080			0.9800	17000.00	1200.00		0.30	BDL
	0.3000	140.0000	170.0000	0.1000	46.0000	14.0000	4.0000	6.0000	7.7000	7.8000	C	39.9000	-1.0000	24.9833	29.9800	-13.1780	0.0060	-7.7750	0.0440	1.1000	>241920	>241920		0.30	
<0.10	0.4200	220.0000	270.0000	0.0200	70.0000	24.0000	5.2000	8.7000	7.8000	8.1000	E	59.0000	-1.8000	38.9604	46.7525	-11.7730	0.0040			1.1000	>241920	51720.00		<0.1	BDL
<0.10	0.0260	280.0000	360.0000	0.0600	95.0000	31.0000	1.5000	11.0000	1.7000	1.8000										0.4300	3950.00	980.00		0.50	BDL
<0.10	0.2920	112.0000	140.0000	0.0200	39.0000	12.0000	4.2000	5.3000	5.0200	5.5200										3.1000	72700.00	3550.00		0.30	BDL
0.1100	0.1726	207.4286	267.1429	0.0641	69.5714	23.2857	3.0143	10.3857	4.5600	4.7314	#DIV/0!	54.8400	2.5800	32.7369	39.2843	-11.1890	0.0066	-8.6767	0.0193	1.1486	########	9777.0000	########	0.3000	

Sly Fork Page 3

Geosmin (ı	Calculated Location D	Comments
	0.6974	Madison County Bridge #164 built in 2000. CR 200E south of 600S. South side of river east side of bridge.
	NA	Landmark for water height is from railing top at south bridge support to water surface. current too swift to measure streamflow.
BDL	1.1012	Landmark to surface measured from bottom of road deck. * Local farmer said crops have been in 2 weeks. * filter stirps along stream for last 15 years - no farming to edge.
	NA	Landmark to surface measured from bottom of road deck.
BDL	NA	Landmark to surface measured from bottom of road deck.
BDL	1.6868	Landmark to surface measured from bottom of road deck east side of bridge at mark.
BDL	NA	Landmark to surface measured from bottom of road deck east side of bridge at mark.

Deer Creek
CEES 2003 Data

	Date	Esti-Q	TSSed (g/m	Water Surfa	Stream Bottom (	Water Dept	Sample Depth (r	Temp. (°C)	pH	SpC (mS)	TDS (g/L)	Salinity (pp	DO (mg/L)	Turbidity (N1	TSSolids (ppm)	Silica (mg/l	Silica (mg/L) (unfi	Cl- (mg/L)	SO4 (mg/l	NO2 (mg/l	NO3 (mg/l
FCW9	2/20/2003	0.70	3.1963				0.0500	0.2000	7.9100	0.6401	0.4093	0.3300	14.8400					37.0000	47.0000	<0.04	2.4000
	3/14/2003	9.83	115.4483	467	555	88	0.0500	5.5400	7.7000	0.3365	0.2154	0.1700	11.5000					16.0000	21.0000	<0.04	4.1000
	5/27/2003	1.10	11.9388	410	455	45	0.0500	15.2200	7.9500	0.6287	0.4024	0.3200	11.7100	5.0000	12.0000	7.1000	7.1000	27.0000	41.0000	<0.20	2.6000
	7/7/2003	26.01	97.7174	230	455	225	0.0500	20.8400	7.5400	0.3302	0.2114	0.1600	7.4700	48.0000	140.0000	9.0000	9.0000	12.0000	15.0000		
	10/14/2003	2.15	87.0103	350	455	105	0.0500	13.7400	7.8200	0.5024	0.3215	0.2500	7.8800	59.0000	100.0000	7.1000	7.8000	21.0000	29.0000	<0.10	2.1000
	12/22/2003	1.69	2.8723	405	455	50	0.0500	4.7400	8.0800	0.6407	0.4100	0.3300	13.2900	2.7000	1.6000	8.1000	8.5000	25.0000	38.0000	<0.10	2.7000
	1/5/2004	30.39	199.4000	255	455	200	0.0500	3.5400	7.6300	0.2480	0.1594	0.1200	14.4500	230.0000	117.0000	5.3100	4.9400	11.0000	13.0000	<0.10	1.7000
		10.2666	73.9405	352.8333	471.6667	118.8333	0.0500	9.1171	7.8043	0.4752	0.3042	0.2400	11.5914	68.9400	74.1200	7.3220	7.4680	21.2857	29.1429	#DIV/0!	2.6000

Deer Creek Page 2

Ophos (m	Total P (mg/L)	Alkalinity (mg/L a	Total Hard	NH4-N (m	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	DOC (mg	TOC (mg	Vac Line	Trans	Zero	CO2 Yield	DIC (n	d13CDIC	±	d18O	±	TKN (mg/l	Total Colif	E. Coli (co	HPC (colo	Chlo-A (mg	MIB (ppb)
NR	0.0250	290.0000	370.0000	0.0700	93.0000	33.0000	1.8000	21.0000	1.8000	1.8000	C	89.6000	6.3000	51.9921	62.3905	-11.5050	0.0060	-8.1620	0.0050	0.3500	15531.00	122.00	1100.00		
0.1100	0.1400	150.0000	200.0000	0.0690	53.0000	17.0000	2.7000	7.7000	5.5000	5.6000	C	31.9000	1.3000	18.4222	22.1066	-10.0930	0.0090	-10.0930	0.0090	0.9800	198630.00	1090.00	51000.00	0.10	
<0.20	0.0050	260.0000	360.0000	0.1100	91.0000	32.0000	1.7000	13.0000	2.4000	2.5000	E	53.8000	8.1000	29.3266	35.1919	-9.3960	0.0080			0.9800	17000.00	1200.00		0.30	BDL
	0.3000	140.0000	170.0000	0.1000	46.0000	14.0000	4.0000	6.0000	7.7000	7.8000	C	39.9000	-1.0000	24.9833	29.9800	-13.1780	0.0060	-7.7750	0.0440	1.1000	>241920	>241920		0.30	
<0.10	0.4200	220.0000	270.0000	0.0200	70.0000	24.0000	5.2000	8.7000	7.8000	8.1000	E	59.0000	-1.8000	38.9604	46.7525	-11.7730	0.0040			1.1000	>241920	51720.00		<0.1	BDL
<0.10	0.0260	280.0000	360.0000	0.0600	95.0000	31.0000	1.5000	11.0000	1.7000	1.8000										0.4300	3950.00	980.00		0.50	BDL
<0.10	0.2920	112.0000	140.0000	0.0200	39.0000	12.0000	4.2000	5.3000	5.0200	5.5200										3.1000	72700.00	3550.00		0.30	BDL
0.1100	0.1726	207.4286	267.1429	0.0641	69.5714	23.2857	3.0143	10.3857	4.5600	4.7314	#DIV/0!	54.8400	2.5800	32.7369	39.2843	-11.1890	0.0066	-8.6767	0.0193	1.1486	########	9777.0000	########	0.3000	

Geosmin (ı	Calculated	Location D	Comments
	0.6974	Madison County Bridge #164 built in 2000. CR 200E south of 600S. South side of river east side of bridge.	
	NA		Landmark for water height is from railing top at south bridge support to water surface. current too swift to measure streamflow.
BDL	1.1012		Landmark to surface measured from bottom of road deck. * Local farmer said crops have been in 2 weeks. * filter stirps along stream for last 15 years - no farming to edge.
	NA		Landmark to surface measured from bottom of road deck.
BDL	NA		Landmark to surface measured from bottom of road deck.
BDL	1.6868		Landmark to surface measured from bottom of road deck east side of bridge at mark.
BDL	NA		Landmark to surface measured from bottom of road deck east side of bridge at mark.

Prairie Creek
CEES 2003 Data

	Date	Esti-Q	TSSed (g/m	Water Surf	Stream Bottom (	Water Dep	Sample Depth (r	Temp. (°C)	pH	SpC (mS)	TDS (g/L)	Salinity (pp	DO (mg/L)	Turbidity (N	TSSolids (ppm)	Silica (mg/	Silica (mg/L) (unf	Cl- (mg/L)	SO4 (mg/l
FCW 6 ditch	3/14/2003		29.3684					10.9300	7.7300	0.2622	0.1678	0.1300	11.3200					17.0000	10.0000
	7/7/2003		7.1503					28.1000	7.7700	0.2701	0.1729	0.1300	6.2000	4.9000	3.0000	5.5000	5.5000	22.0000	8.7000
FCW 7	2/20/2003	0.92	3.8542				0.0500	1.3400	8.1200	0.6438	0.4121	0.3300	16.8000					36.0000	47.0000
	3/14/2003	16.52	137.9427	454	544	90	0.0500	4.1000	7.6000	0.3551	0.2271	0.1700	11.5200					22.0000	22.0000
	5/27/2003	1.70	4.9485	360	409	49	0.0500	15.8300	8.0700	0.6430	0.4110	0.3300	12.3100	3.8000	6.5000	5.9000	5.6000	31.0000	43.0000
	7/7/2003	39.94	109.8969	280	409	129	0.0500	21.3800	7.5700	0.3414	0.2186	0.1700	7.2000	47.0000	120.0000	8.8000	9.2000	15.0000	17.0000
	10/14/2003	5.49	44.1451	340	409	69	0.0500	13.5900	7.8700	0.6119	0.3913	0.3100	7.9200	28.0000	50.0000	8.1000	8.8000	32.0000	38.0000
	12/22/2003	2.24	1.7708	365	409	44	0.0500	4.4900	8.0700	0.6580	0.4216	0.3400	13.0400	2.3000	0.8000	8.3000	8.5000	31.0000	40.0000
	1/5/2004	47.15	241.2371	200	409	209	0.0500	3.3600	7.6700	0.2027	0.1355	0.0800	14.6100	290.0000	161.0000	5.1200	4.7600	9.7000	9.9000
FCW8	2/20/2003	0.16	2.6621				0.0500	2.0500	7.8100	1.0250	0.6542	0.5400	15.2900					120.0000	150.0000
	3/14/2003	1.08	42.5418	163	269	106	0.0500	6.8900	7.5700	0.6385	0.4079	0.3300	11.1400					53.0000	100.0000
	5/27/2003	0.31	58.1633	100	187	87	0.0500	16.8200	7.7300	0.9254	0.5924	0.4800	9.3200	22.0000	63.0000	8.8000	8.1000	82.0000	140.0000
	7/7/2003	8.42	50.9845	11	187	176	0.0500	21.6000	7.3900	0.4858	0.3108	0.2500	5.6000	30.0000	50.0000	8.4000	8.3000	25.0000	69.0000
	10/14/2003	0.72	44.0437	95	187	92	0.0500	13.9300	7.6400	0.7554	0.4837	0.3900	8.1600	37.0000	36.0000	7.6000	7.8000	75.0000	90.0000
	12/22/2003	0.36	24.3386	100	187	87	0.0500	4.5200	7.8400	0.9278	0.5943	0.4800	12.6500	6.9000	8.0000	9.3000	8.8000	80.0000	120.0000
	1/5/2004	10.12	58.1053	20	187	167	0.0500	4.8200	7.5800	0.5117	0.3294	0.2600	12.4200	54.0000	30.0000	6.5000	6.5000	31.0000	65.0000
		9.65	53.82	207.33	316.08	108.75	0.05	10.86	7.75	0.58	0.37	0.30	10.97	47.81	48.03	7.48	7.44	42.61	60.60

NO2 (mg/l	NO3 (mg/l	Ophos (m	Total P (mg/L)	Alkalinity (mg/L a	Total Hard	NH4-N (m	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	DOC (mg	TOC (mg	Vac Line	Trans	Zero	CO2 Yield	DIC (n	d13CDIC	±	d18O	±	TKN (mg/l	Total Colif
<0.04	0.7400	0.1000	0.1400	110.0000	150.0000	0.2000	36.0000	14.0000	4.9000	9.4000	7.3000	7.0000	E	38.1000	7.1000	19.9480	23.9376	-9.6000	0.0110				86640.00
			0.1000	96.0000	120.0000	0.1000	27.0000	12.0000	4.8000	12.0000	6.8000	7.2000	C	27.3000	-0.9000	16.8934	20.2721	-7.1310	0.0070			0.7400	>241920
<0.04	2.1000	<0.10	0.0200	280.0000	340.0000	0.0400	86.0000	30.0000	1.5000	18.0000	1.7000	1.7000	C	87.3000	6.3000	50.5270	60.6324	-10.9870	0.0060	-8.0190	0.0040	0.3100	318.00
<0.04	3.9000	0.1300	0.2000	140.0000	210.0000	0.0920	54.0000	17.0000	2.9000	14.0000	5.7000	5.8000	C	33.3000	3.4000	17.9763	21.5716	-11.7810	0.0040	-10.0770	0.0070	1.0000	173290.00
<0.20	2.6000	<0.20	0.0410	260.0000	360.0000	0.1800	92.0000	32.0000	1.8000	15.0000	2.5000	2.5000				.						0.7100	10000.00
			0.2900	130.0000	170.0000	0.0920	47.0000	14.0000	4.1000	6.9000	7.2000	7.6000	C	36.4000	-1.3000	22.9449	27.5339	-13.4760	0.0050	-8.0510	0.0410	1.0000	>241920
<0.10	1.6000	<0.10	0.1700	270.0000	320.0000	0.0500	84.0000	28.0000	3.4000	15.0000	5.3000	4.9000	E	65.5000	-1.9000	43.1712	51.8054	-11.7840	0.0050			0.7800	173290.00
<0.10	2.6000	<0.10	0.0190	280.0000	370.0000	0.0400	96.0000	31.0000	1.5000	14.0000	1.7000	1.7000										0.3300	2980.00
<0.10	1.4000	<0.10	0.3790	98.0000	120.0000	0.0600	33.0000	9.5000	4.6000	4.6000	5.1300	5.9600										1.9000	46110.00
<0.04	0.8000	<0.10	0.0150	290.0000	470.0000	0.2900	120.0000	40.0000	3.2000	62.0000	2.2000	2.3000	E	89.9000	9.5000	51.4652	61.7582	-10.7460	0.0040	-7.8630	0.0070	0.5000	776.00
<0.04	3.1000	<0.10	0.0350	200.0000	340.0000	0.2600	92.0000	28.0000	2.7000	28.0000	4.7000	4.6000	E	38.1000	7.1000	19.9480	23.9376	-11.2860	0.0080	lost		0.8100	61310.00
<0.20	1.0000	<0.20	0.1100	260.0000	460.0000	0.2800	120.0000	41.0000	3.1000	38.0000	3.0000	3.3000	E	88.2000	3.5000	54.2086	65.0503	-10.6150	0.0040			0.8300	12000.00
			0.1500	150.0000	240.0000	0.1900	65.0000	18.0000	3.7000	15.0000	7.5000	7.8000	E	48.3000	2.0000	29.7094	35.6513	-13.3180	0.0100	-9.0690	0.0230	0.9000	>241920
<0.10	0.8000	<0.10	0.1300	230.0000	340.0000	<0.02	92.0000	27.0000	4.2000	39.0000	6.4000	6.5000	E	58.6000	-1.6000	38.5776	46.2931	-12.0520	0.0020			0.8100	>241920
<0.10	1.1000	<0.10	0.0230	280.0000	450.0000	0.1900	120.0000	38.0000	2.8000	41.0000	2.4000	2.5000										0.4800	4810.00
<0.10	1.5000	<0.10	0.0904	170.0000	260.0000	0.1500	70.0000	20.0000	3.4000	19.0000	4.8000	4.8900										0.8100	22820.00
#DIV/0!	1.79	0.12	0.120	202.75	295.00	0.15	77.13	24.97	3.29	21.93	4.65	4.77	#DIV/0!	55.55	3.02	33.22	39.86	-11.16	0.01	-8.62	0.02	0.79	49528.67

E. Coli (co	HPC (colo	Chlo-A (mg	MIB (ppb)	Geosmin (p	Calculated	Location D	Comments
<100	51000.00	<0.10			NA		agriculture ditch flowing into FCW6 stream
>241920		0.40			NA		CARP MOVING UPSTREAM IN DITCH.
10.00	1000.00				0.9171	State Rd 9	south of Market St. east side of bridge. North bank.
630.00	100000.00	<0.10			NA		Landmark for water hieght is from top of railing to water surface. too deep to measure streamflow. Pipe once showing now under water - small ruffle where it nears surface.
580.00		0.40	BDL	BDL	1.6975		Landmark for water surface measured from bottom of road deck.
>241920		0.30			NA		Landmark to surface measured from bottom of road deck.
3680.00		0.30	BDL	BDL	5.4925		Landmark to surface measured from bottom of road deck.
520.00		0.50	BDL	BDL	2.2376		Landmark to surface measured from bottom of road deck E side of bridge.
5680.00		0.30	BDL	BDL	NA		Landmark to surface measured from bottom of road deck E side of bridge.
98.00	1900.00				0.1562	State Rd. 9	Pipe inputting water into creek ~8m downstream of sample location.
0.00	34000.00	<0.10			1.0809		Landmark for water height is from top of bridge (cement) to water surface. suctioning bottom - sink right in.
430.00		0.40	BDL	18.00	0.3079		Landmark to surface measured to bottom of road deck.
>241920		0.30			NA		Landmark to surface measured from bottom of road deck.
10460.00		<0.1	BDL	6.80	NA		Landmark to surface measured from bottom of road deck.
3180.00		0.50	BDL	8.40	0.3638		Landmark to surface measured from bottom of road deck east side of bridge, center (at orange markind).
980.00		0.30	BDL	5.31	NA		Landmark to surface measured from bottom of road deck east side of bridge, center (at orange markind).
47006.75	37580.00	0.37					

Lick Creek
CEES 2003 Data

	Date	Esti-Q	TSSed (g/m	Water Surf	Stream Bottom (	Water Dep	Sample Depth (r	Temp. (°C)	pH	SpC (mS)	TDS (g/L)	Salinity (pp	DO (mg/L)	Turbidity (N	TSSolids (ppm)	Silica (mg/l	Silica (mg/L) (unfi	Cl- (mg/L)	SO4 (mg/l	NO2 (mg/l	NO3 (mg/l	Ophos (m	Total P (mg/L)
FCW 5	2/20/2003	0.47	3.5811				0.0500	0.2500	8.2400	0.6012	0.3852	0.3100	16.9400					32.0000	58.0000	<0.04	2.0000	<0.10	0.0230
	3/14/2003	6.79	114.8562	642			0.0500	2.5300	7.7200	0.3111	0.1990	0.1500	13.2500					18.0000	21.0000	<0.04	4.2000	0.1300	0.2200
	5/27/2003	0.77	7.9798	500	675	175	0.0500	17.1000	8.1600	0.6224	0.3982	0.3200	11.3800	6.1000	8.5000	4.9000	4.4000	26.0000	51.0000	<0.20	2.8000	<0.20	0.0610
	7/7/2003	14.20	27.4611	480	675	195	0.0500	22.8100	7.5000	0.2483	0.1590	0.1200	6.4700	24.0000	23.0000	8.1000	8.4000	9.5000	14.0000				0.2100
	10/14/2003	1.17	4.6632	590	675	85	0.0500	13.9300	7.9600	0.5836	0.3734	0.3000	8.4600	3.8000	3.6000	6.5000	6.3000	23.0000	43.0000	<0.10	1.5000	<0.10	0.0730
	12/22/2003	0.97	2.1053	590	675	85	0.0500	3.6400	8.1200	0.6403	0.4095	0.3300	13.2600	2.6000	1.6000	8.8000	8.3000	28.0000	47.0000	<0.10	2.9000	<0.10	0.0180
	1/5/2004	17.44	245.8586	450	675	225	0.0500	3.3900	7.6700	0.1848	0.1168	0.0800	14.2200	300.0000	208.0000	4.9400	4.2300	8.1000	9.9000	<0.10	1.3000	<0.10	0.3190
		5.97	58.07	542.00	675.00	153.00	0.05	9.09	7.91	0.46	0.29	0.23	12.00	67.30	48.94	6.65	6.33	20.66	34.84	#DIV/0!	2.45	0.13	0.132

Lick Creek Page 2

Alkalinity (mg/L a	Total Hard	NH4-N (m	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	DOC (mg	TOC (mg	Vac Line	Trans	Zero	CO2 Yield	DIC (n	d13CDIC	±	d18O	±	TKN (mg/l	Total Colif	E. Coli (co	HPC (color	Chlo-A (mg	MIB (ppb)
250.0000	340.0000	0.1000	87.0000	30.0000	1.3000	19.0000	1.6000	1.6000	C	84.7000	6.5000	48.7434	58.4921	-9.9750	0.0030	-8.1390	0.0060	0.3100	282.00	0.00	1750.00		
120.0000	180.0000	0.0900	48.0000	15.0000	3.0000	8.1000	6.4000	6.2000	E	38.6000	6.8000	20.4584	24.5501	-10.5750	0.0120	-9.6700	0.0000	1.2000	241920.00	410.00	100000.00	<0.10	
250.0000	360.0000	0.1300	93.0000	32.0000	1.5000	11.0000	2.1000	2.2000								-11.1210	0.0570	0.5300	8700.00	260.00		0.30	BDL
92.0000	130.0000	0.0610	35.0000	9.0000	4.6000	3.9000	7.7000	8.0000	E	29.6000	2.3000	17.5874	21.1049	-13.3600	0.0120	-7.5020	0.0380	0.7700	>241920	92080.00		0.30	
260.0000	320.0000	0.0500	85.0000	27.0000	2.9000	9.9000	5.4000	4.9000	E	67.1000	-1.9000	44.1920	53.0304	-11.1640	0.0060			0.4400	32550.00	2750.00		0.20	BDL
270.0000	360.0000	0.0400	96.0000	30.0000	1.3000	11.0000	1.6000	1.6000										0.3500	2750.00	300.00		0.50	BDL
84.0000	110.0000	0.0300	30.0000	8.5000	4.7000	4.7000	5.3200	6.3900										2.4000	64880.00	4880.00		0.50	BDL
189.43	257.14	0.07	67.71	21.64	2.76	9.66	4.30	4.41	#DIV/0!	55.00	3.43	32.75	39.29	-11.27	0.01	-9.11	0.03	0.86	58513.67	14382.86	50875.00	0.36	

Geosmin (	Calculated	Location D	Comments
	0.4709	HWY 13 sc	stream is mostly ice covered except for small open area (5-10m) with open flow below bridge. Clear water. Pebble and sand bottom.
	NA		Landmark for water height is from bridge to water surface at concrete expansion joint 1.9m south of NW drain. Uncertain of where on road deck measurement was taken. really muddy bottom. Turbid-merky water. High water level. Tire swing now under water. Streamflow too swift to measure.
BDL	0.7661		Landmark to surface measured from bottom of road deck.
	NA		Landmark to surface measured from bottom of road deck.
BDL	1.1691		Landmark to surface measured from bottom of road deck.
BDL	0.9736		Landmark to surface measured from bottom of road deck east side of bridge center stream (thawleg).
BDL	NA		Landmark to surface measured from bottom of road deck east side of bridge center stream (thawleg).

Foster Branch
CEES 2003 Data

	Date	Esti-Q	TSSed (g/m	Water Surf	Stream Bottom (	Water Dept	Sample Depth (r	Temp. (°C)	pH	SpC (mS)	TDS (g/L)	Salinity (pp	DO (mg/L)	Turbidity (N	TSSolids (ppm)	Silica (mg/l	Silica (mg/L) (unfi	Cl- (mg/L)	SO4 (mg/l	NO2 (mg/l
FCW 6	2/20/2003	0.14	2.8862				0.0500	3.0200	8.1400	0.8960	0.5733	0.4700	16.7700					110.0000	63.0000	<0.04
	3/14/2003	2.88	92.7586	167			0.0500	4.3900	7.4300	0.3502	0.2242	0.1700	12.2200					25.0000	22.0000	<0.04
	5/27/2003	0.28	2.6263	140	164	24	0.0500	15.6800	8.0900	0.6596	0.4220	0.3400	12.9600	2.4000	3.5000	3.2000	2.8000	35.0000	50.0000	<0.20
	7/7/2003	6.02	31.5183	200	164		0.0500	20.8300	7.3500	0.3623	0.2319	0.1800	7.1200	21.0000	27.0000	9.3000	9.4000	16.0000	17.0000	
	10/14/2003	0.75	11.8974	120	164	44	0.0500	13.9600	7.6700	0.5408	0.3462	0.2800	8.4900	12.0000	9.2000	7.6000	7.8000	30.0000	35.0000	<0.10
	12/22/2003	0.36	2.1111	135	164	29	0.0500	6.1400	7.9900	0.6737	0.4301	0.3500	12.2500	2.0000	1.6000	9.6000	9.8000	36.0000	48.0000	<0.10
	1/5/2004	7.11	156.0000	95	164	69	0.0500	4.7200	7.3900	0.2824	0.1810	0.1400	13.7800	180.0000	43.0000	6.5000	5.7000	16.0000	15.0000	<0.10
		2.50	42.83	142.83	164.00	41.50	0.05	9.82	7.72	0.54	0.34	0.28	11.94	43.48	16.86	7.24	7.10	38.29	35.71	#DIV/0!

NO3 (mg/l	Ophos (m	Total P (mg/L)	Alkalinity (mg/L a	Total Hard	NH4-N (m	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	DOC (mg	TOC (mg	Vac Line	Trans	Zero	CO2 Yield	DIC (n	d13CDIC	±	d18O	±	TKN (mg/l	Total Colif	E. Coli (co
2.2000	<0.10	0.0250	280.0000	400.0000	0.2400	110.0000	33.0000	1.5000	57.0000	1.7000	1.6000	E	89.6000	9.7000	51.1462	61.3754	-10.7490	0.0040	-8.1400	0.0060	0.3400	823.00	0.00
4.8000	0.1100	0.2400	130.0000	200.0000	0.0810	53.0000	16.0000	2.7000	11.0000	6.4000	6.4000	C	37.7000	3.4000	20.7791	24.9349	-10.6860	0.0140	-9.8910	0.0070	1.2000	241920.00	200.00
3.6000	<0.20	0.0260	250.0000	380.0000	0.0400	98.0000	32.0000	1.4000	13.0000	2.2000	2.2000										0.5300	4100.00	760.00
		0.2300	130.0000	180.0000	0.0810	50.0000	14.0000	3.4000	8.0000	7.0000	7.6000	E	43.5000	2.0000	26.6470	31.9764	-12.0290	0.0040	-7.8200	0.0510	0.8000	>241920	72700.00
2.7000	<0.10	0.1400	220.0000	280.0000	<0.02	74.0000	23.0000	4.1000	12.0000	6.5000	6.5000	E	58.3000	-1.6000	38.3862	46.0634	-11.4800	0.0090			0.8100	241920.00	30760.00
2.9000	<0.10	0.0180	280.0000	380.0000	0.0700	99.0000	31.0000	1.3000	13.0000	1.8000	1.7000										0.5300	18500.00	1730.00
2.8000	<0.10	0.3420	114.0000	160.0000	0.0500	42.0000	12.0000	4.0000	7.0000	5.0100	5.8100										2.5000	72700.00	1100.00
3.17	0.11	0.146	200.57	282.86	0.09	75.14	23.00	2.63	17.29	4.37	4.54	#DIV/0!	57.28	3.38	34.24	41.09	-11.24	0.01	-8.62	0.02	0.96	96660.50	15321.43

HPC (color	Chlo-A (mg	MIB (ppb)	Geosmin (p	Calculated	Location D	Comments
2900.00				0.1357	Fall Creek	limestone exposed. Small fall below sample site
51000.00	<0.10			2.8760		Landmark for water hieght is from road deck(uncertain where) to water surface (center). high turbidity. Agriculture ditch w/high flow into stream
	0.30	BDL	BDL	0.2772		Landmark to surface measured from bottom of road deck. * local farmers said well water is good and sewers upstream that used to dump.
	0.30		NA			Landmark to surface measured from bottom of road deck.
	0.20	BDL	5.10	0.7540		Landmark to surface measured from bottom of road deck.
	0.50	BDL	BDL	0.3622		Landmark to surface measured from bottom of road deck N side of bridge in center.
	0.30	BDL	BDL			Landmark to surface measured from bottom of road deck N side of bridge in center.
26950.00	0.32					

McFadden Ditch

CEES 2003 Data

	Date	Esti-Q	TSSed (g/m3)	Water Surf	Stream Bottom (	Water Dep	Sample Depth (r	Temp. (°C)	pH	SpC (mS)	TDS (g/L)	Salinity (pp	DO (mg/L)	Turbidity (N	TSSolids (ppm)	Silica (mg/l	Silica (mg/L) (unfi	Cl- (mg/L)	SO4 (mg/l
FCW 5	2/20/2003	0.47	3.5811				0.0500	0.2500	8.2400	0.6012	0.3852	0.3100	16.9400					32.0000	58.0000
	3/14/2003	6.79	114.8562	642			0.0500	2.5300	7.7200	0.3111	0.1990	0.1500	13.2500					18.0000	21.0000
	5/27/2003	0.77	7.9798	500	675	175	0.0500	17.1000	8.1600	0.6224	0.3982	0.3200	11.3800	6.1000	8.5000	4.9000	4.4000	26.0000	51.0000
	7/7/2003	14.20	27.4611	480	675	195	0.0500	22.8100	7.5000	0.2483	0.1590	0.1200	6.4700	24.0000	23.0000	8.1000	8.4000	9.5000	14.0000
	10/14/2003	1.17	4.6632	590	675	85	0.0500	13.9300	7.9600	0.5836	0.3734	0.3000	8.4600	3.8000	3.6000	6.5000	6.3000	23.0000	43.0000
	12/22/2003	0.97	2.1053	590	675	85	0.0500	3.6400	8.1200	0.6403	0.4095	0.3300	13.2600	2.6000	1.6000	8.8000	8.3000	28.0000	47.0000
	1/5/2004	17.44	245.8586	450	675	225	0.0500	3.3900	7.6700	0.1848	0.1168	0.0800	14.2200	300.0000	208.0000	4.9400	4.2300	8.1000	9.9000
		5.97	58.07	542.00	675.00	153.00	0.05	9.09	7.91	0.46	0.29	0.23	12.00	67.30	48.94	6.65	6.33	20.66	34.84

McFadden Ditch Page 2

NO2 (mg/l	NO3 (mg/l	Ophos (mg	Total P (mg/L)	Alkalinity (mg/L a	Total Hard	NH4-N (m	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	DOC (mg	TOC (mg	Vac Line	Trans	Zero	CO2 Yield	DIC (n	d13CDIC	±	d18O	±	TKN (mg/l	Total Colifo
<0.04	2.0000	<0.10	0.0230	250.0000	340.0000	0.1000	87.0000	30.0000	1.3000	19.0000	1.6000	1.6000	C	84.7000	6.5000	48.7434	58.4921	-9.9750	0.0030	-8.1390	0.0060	0.3100	282.00
<0.04	4.2000	0.1300	0.2200	120.0000	180.0000	0.0900	48.0000	15.0000	3.0000	8.1000	6.4000	6.2000	E	38.6000	6.8000	20.4584	24.5501	-10.5750	0.0120	-9.6700	0.0000	1.2000	241920.00
<0.20	2.8000	<0.20	0.0610	250.0000	360.0000	0.1300	93.0000	32.0000	1.5000	11.0000	2.1000	2.2000								-11.1210	0.0570	0.5300	8700.00
			0.2100	92.0000	130.0000	0.0610	35.0000	9.0000	4.6000	3.9000	7.7000	8.0000	E	29.6000	2.3000	17.5874	21.1049	-13.3600	0.0120	-7.5020	0.0380	0.7700	>241920
<0.10	1.5000	<0.10	0.0730	260.0000	320.0000	0.0500	85.0000	27.0000	2.9000	9.9000	5.4000	4.9000	E	67.1000	-1.9000	44.1920	53.0304	-11.1640	0.0060			0.4400	32550.00
<0.10	2.9000	<0.10	0.0180	270.0000	360.0000	0.0400	96.0000	30.0000	1.3000	11.0000	1.6000	1.6000										0.3500	2750.00
<0.10	1.3000	<0.10	0.3190	84.0000	110.0000	0.0300	30.0000	8.5000	4.7000	4.7000	5.3200	6.3900										2.4000	64880.00
#DIV/0!	2.45	0.13	0.132	189.43	257.14	0.07	67.71	21.64	2.76	9.66	4.30	4.41	#DIV/0!	55.00	3.43	32.75	39.29	-11.27	0.01	-9.11	0.03	0.86	58513.67

E. Coli (co	HPC (colo	Chlo-A (mg	MIB (ppb)	Geosmin (	Calculated	Location D	Comments
0.00	1750.00				0.4709	HWY 13 s	stream is mostly ice covered except for small open area (5-10m) with open flow below bridge. Clear water. Pebble and sand bottom.
410.00	100000.00	<0.10			NA		Landmark for water height is from bridge to water surface at concrete expansion joint 1.9m south of NW drain. Uncertain of where on road deck measurement was taken. really muddy bottom.
260.00		0.30	BDL	BDL	0.7661		Landmark to surface measured from bottom of road deck.
92080.00		0.30			NA		Landmark to surface measured from bottom of road deck.
2750.00		0.20	BDL	BDL	1.1691		Landmark to surface measured from bottom of road deck.
300.00		0.50	BDL	BDL	0.9736		Landmark to surface measured from bottom of road deck east side of bridge center stream (thawleg).
4880.00		0.50	BDL	BDL	NA		Landmark to surface measured from bottom of road deck east side of bridge center stream (thawleg).
14382.86	50875.00	0.36					

Flatfork Creek
CEES 2003 Data

	Date	Esti-Q	TSSed (g/m	Water Surf	Stream Bottom (	Water Dep	Sample Depth (r	Temp. (°C)	pH	SpC (mS)	TDS (g/L)	Salinity (pp	DO (mg/L)	Turbidity (NT	TSSolids (ppm)	Silica (mg/l	Silica (mg/L) (unf	Cl- (mg/L)	SO4 (mg/l	NO2 (mg/l	NO3 (mg/l
FCW 4	2/20/2003	1.79	4.3845				0.0500	1.6900	8.2400	0.7141	0.4569	0.3700	16.4300					58.0000	61.0000	<0.04	2.3000
	3/14/2003	34.41	172.8450	440			0.0500	2.5000	7.6800	0.3212	0.2055	0.1600	13.7800					24.0000	23.0000	<0.04	3.5000
	5/27/2003	4.23	20.7143	510			0.0500	17.1200	8.0600	0.7019	0.4494	0.3600	10.4100	8.0000	20.0000	6.5000	5.7000	46.0000	57.0000	<0.20	2.9000
	7/7/2003	72.00	37.7551	340	808	468	0.0500	22.8800	7.5500	0.3073	0.1973	0.1600	7.0600	28.0000	35.0000	8.8000	8.8000	14.0000	19.0000		
	10/14/2003	5.96	10.1031	500	808	308	0.0500	14.0500	7.9500	0.6583	0.4209	0.3400	8.1600	7.2000	9.2000	6.9000	6.7000	42.0000	50.0000	<0.10	1.8000
	12/22/2003	4.11	2.6042	500	808	308	0.0500	3.8100	8.0900	0.7059	0.4521	0.3600	13.0200	2.6000	1.6000	8.3000	8.3000	44.0000	52.0000	<0.10	2.8000
	1/5/2004	87.36	227.0833	320	808	488	0.0500	3.6800	7.7000	0.2227	0.1411	0.1000	15.6800	290.0000	195.0000	5.1200	5.1200	12.0000	13.0000	<0.10	1.4000
		29.98	67.93	435.00	808.00	393.00	0.05	9.39	7.90	0.52	0.33	0.26	12.08	67.16	52.16	7.12	6.92	34.29	39.29	#DIV/0!	2.45

Flatfork Creek Page 2

Ophos (m	Total P (mg/L)	Alkalinity (mg/L a	Total Hard	NH4-N (m	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	DOC (mg	TOC (mg	Vac Line	Trans	Zero	CO2 Yield	DIC (n	d13CDIC	±	d18O	±	TKN (mg/l	Total Colif	E. Coli (co	HPC (color	Chlo-A (mg	MIB (ppb)
<0.10	0.0250	260.0000	350.0000	0.1200	90.0000	31.0000	2.0000	30.0000	1.8000	1.8000	E	88.2000	9.7000	50.2530	60.3036	-10.5040	0.0040	-8.0950	0.0060	0.3400	272.00	10.00	1000.00		
0.1500	0.3000	120.0000	180.0000	0.1300	47.0000	14.0000	3.3000	12.0000	7.7000	6.8000	C	34.1000	3.5000	18.4222	22.1066	-11.3500	0.0040	-9.8180	0.0100	1.1000	241920.00	860.00	150000.00	<0.10	
<0.20	0.0830	260.0000	380.0000	0.1000	96.0000	33.0000	2.1000	23.0000	2.3000	2.7000								-10.6520	0.0590	0.6500	11000.00	280.00		0.30	BDL
	0.2300	120.0000	160.0000	0.0710	44.0000	12.0000	4.3000	6.9000	7.0000	7.1000	C	34.2000	-0.8000	21.2250	25.4700	-13.2600	0.0120	-7.2680	0.0420	0.7700	>241920	241920.00		0.30	
<0.10	0.0880	260.0000	340.0000	0.0600	88.0000	29.0000	3.5000	21.0000	5.0000	4.8000	E	42.3000	-1.9000	28.3696	34.0435	-11.2030	0.0050			0.3200	141360.00	4260.00		0.30	BDL
<0.10	0.0320	280.0000	380.0000	0.0800	100.0000	32.0000	1.8000	21.0000	1.7000	1.8000										0.3700	3180.00	720.00		0.50	BDL
0.1500	0.3970	98.0000	130.0000	0.0700	34.0000	7.6000	4.6000	6.6000	5.3000	6.1900										2.7000	98040.00	9850.00		0.50	BDL
0.15	0.165	199.71	274.29	0.09	71.29	22.66	3.09	17.21	4.40	4.46	#DIV/0!	49.70	2.63	29.57	35.48	-11.58	0.01	-8.96	0.03	0.89	82628.67	36842.86	75500.00	0.38	

Flatfork Creek Page 3

Geosmin (	Calculated	Location D	Comments
		1.7875	sampled from east (upstream) side of bridge. SR 238 and Fall Creek Rd.
	NA		Landmark for water height is from east side of north bridge support to water surface. Uncertain of where on road deck measurement was taken. high flow. Turbid. Cloudy. Flow too swift for streamflow measurements.
BDL		4.2252	Uncertain where Landmark to surface was measured in relation to road deck.
	NA		Landmark to surface measured from bottom of road deck.
11.00	NA		Landmark to surface measured from bottom of road deck.
BDL			Landmark to surface measured from bottom of road deck east side of bridge at center support.
BDL	NA		Landmark to surface measured from bottom of road deck east side of bridge at center support.
11.00		3.01	

Thorpe Creek
CEES 2003 Data

	Date	Esti-Q	TSSed (g/m	Water Surf	Stream Bottom (	Water Dep	Sample Depth (r	Temp. (°C)	pH	SpC (mS)	TDS (g/L)	Salinity (pp	DO (mg/L)	Turbidity (NT	TSSolids (ppm)	Silica (mg/	Silica (mg/L) (unf	Cl- (mg/L)	SO4 (mg/l
FCW 1	2/20/2003	0.08	7.0924				0.0500	0.0500	8.4900	1.2980	0.8309	0.6900	18.5600					300.0000	40.0000
	3/14/2003	1.23	38.7307	275			0.0500	2.3900	7.5100	0.3929	0.2504	0.2000	12.1000					31.0000	21.0000
	5/27/2003	0.00	14.1837	300			0.0500	17.8900	8.2600	0.6337	0.4069	0.3300	11.5500	88.0000	16.0000	6.1000	4.8000	48.0000	34.0000
	7/7/2003	2.89	74.7664	200	265	65	0.0500	22.1800	7.4200	0.3680	0.2358	0.1800	7.1700	22.0000	77.0000	9.6000	9.7000	17.0000	15.0000
	10/14/2003	1.66	90.9645	200	265	65	0.0500	14.7300	7.5400	0.3541	0.2264	0.1700	9.6600	90.0000	110.0000	7.1000	7.6000	20.0000	16.0000
	12/22/2003	0.11	1.4000	415	448	33	0.0500	4.5900	7.6300	0.7031	0.4501	0.3600	12.8100	2.9000	3.2000	5.3000	5.1000	56.0000	34.0000
	1/5/2004	3.51	196.0622	380	448	68	0.0500	4.7300	7.3500	0.2500	0.1601	0.1200	13.2500	330.0000	81.0000	5.7000	5.5000	15.0000	14.0000
FCW 2	2/20/2003	0.03	4.5042				0.0500	2.5500	8.1800	0.8152	0.5216	0.4200	18.0200					140.0000	36.0000
	3/14/2003	0.50	38.1176	232			0.0500	3.0400	7.6600	0.3853	0.2466	0.1900	12.3000					33.0000	20.0000
	5/27/2003	0.01	2.2449	200	236	36	0.0500	17.8800	8.0300	0.5624	0.3601	0.2900	9.7200	2.6000	2.5000	4.9000	3.1000	42.0000	30.0000
	7/7/2003	1.70	45.6995	160	236	76	0.0500	23.4600	7.4700	0.2683	0.1719	0.1300	7.6500	30.0000	48.0000	8.1000	8.3000	23.0000	11.0000
	10/14/2003	0.85	151.2953	150	236	86	0.0500	14.9700	7.5400	0.3375	0.2161	0.1700	8.5600	130.0000	150.0000	6.2000	6.9000	16.0000	18.0000
	12/22/2003	0.04	2.6596	190	236	46	0.0500	4.0700	7.9400	0.6389	0.4088	0.3300	11.8900	2.9000	2.4000	6.1000	6.3000	43.0000	29.0000
	1/5/2004	2.12	138.1910	165	236	71	0.0500	4.8200	7.5000	0.2625	0.1693	0.1200	13.5000	190.0000	72.0000	5.1200	5.1200	15.0000	12.0000
FCW 3	2/20/2003	0.08	25.3782				0.0500	1.1600	7.9600	0.7630	0.4881	0.4000	14.7100					97.0000	39.0000
	3/14/2003	1.63	68.0268	239			0.0500	3.0900	7.5600	0.3660	0.2343	0.1800	10.4400					41.0000	19.0000
	5/27/2003	0.13	31.5306	180			0.0500	15.6200	7.7000	0.5897	0.3768	0.3000	8.1800	22.0000	29.0000	1.6000	1.5000	37.0000	29.0000
	7/7/2003	3.18	83.6649	110			0.0500	21.9600	7.3600	0.2628	0.1681	0.1300	7.0800	49.0000	67.0000	7.8000	8.1000	12.0000	10.0000
	10/14/2003	0.26	55.7447	150			0.0500	13.7500	7.7800	0.4379	0.2806	0.2200	8.7400	61.0000	49.0000	4.8000	5.1000	27.0000	21.0000
	12/22/2003	0.19	0.5319	250			0.0500	3.2800	7.8900	0.6194	0.3961	0.3200	12.0100	1.6000	0.4000	5.3000	5.3000	46.0000	29.0000
	1/5/2004	3.96	153.8308	205			0.0500	4.1800	7.5300	0.2611	0.1673	0.1200	12.8800	220.0000	89.0000	5.8900	5.7000	18.0000	13.0000
		1.15	58.32	222.28	289.56	60.67	0.05	9.54	7.73	0.50	0.32	0.26	11.47	82.80	53.10	5.97	5.87	51.29	23.33

NO2 (mg/l	NO3 (mg/l	Ophos (m	Total P (mg/L)	Alkalinity (mg/L a	Total Hard	NH4-N (m	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Na (mg/L)	DOC (mg	TOC (mg	Vac Line	Trans	Zero	CO2 Yield	DIC (n	d13CDIC	±	d18O	±	TKN (mg/l	Total Colif
<0.04	2.8000	<0.1	0.0730	190.0000	300.0000	0.0400	76.0000	25.0000	4.0000	180.0000	2.8000	2.9000	C	62.9000	6.2000	35.0479	42.0575	-10.8420	0.0050	-9.3530	0.0060	0.4100	1019.00
<0.04	5.9000	0.1200	0.1500	150.0000	220.0000	0.0670	58.0000	17.0000	1.8000	18.0000	4.8000	4.6000	E	37.2000	7.1000	19.3738	23.2486	-11.5770	0.0120	-10.1740	0.0130	0.8700	155310.00
<0.20	4.4000	<0.20	0.1400	210.0000	300.0000	0.1500	77.0000	27.0000	2.5000	26.0000	3.7000	4.0000								-9.6240	0.0460	0.6500	17000.00
			0.1900	130.0000	180.0000	0.0780	49.0000	13.0000	2.5000	11.0000	7.0000	7.2000	E	42.7000	2.2000	26.0090	31.2108	-11.9460	0.0050	-7.7640	0.0230	0.7100	>241920
<0.10	2.5000	<0.10	0.4800	150.0000	340.0000	0.0600	92.0000	27.0000	14.0000	23.0000	13.2000	14.0000	E	32.0000	-2.5000	22.1810	26.6172	-12.4150	0.0090			1.2000	>241920
<0.10	3.7000	<0.10	0.1400	280.0000	340.0000	<0.02	92.0000	28.0000	1.9000	31.0000	2.2000	2.1000										0.4300	7120.00
>0.10	2.0000	<0.10	0.2440	112.0000	150.0000	0.0600	42.0000	10.0000	2.4000	9.4000	5.1000	5.9100										3.0000	43520.00
<0.04	2.0000	NR	0.0500	200.0000	290.0000	0.2500	74.0000	25.0000	2.2000	76.0000	3.1000	3.2000	E	61.5000	9.2000	33.5374	40.2449	-10.5510	0.0080	-9.0390	0.0090	0.4400	520.00
<0.04	5.5000	<0.10	0.1700	140.0000	210.0000	0.0640	55.0000	16.0000	2.1000	16.0000	5.7000	5.0000	C	32.1000	3.9000	16.8934	20.2721	-10.6370	0.0120	-8.7280	0.0180	0.7700	173290.00
<0.20	4.5000	<0.20	0.0360	200.0000	290.0000	0.3000	71.0000	27.0000	1.3000	20.0000	2.8000	2.9000								-10.5140	0.0080	0.5300	20000.00
			0.2400	98.0000	130.0000	0.0770	36.0000	9.4000	3.7000	7.7000	8.3000	8.6000	C	28.6000	-0.5000	17.4667	20.9600	-12.7420	0.0070	-7.2900	0.0200	0.8300	>241920
<0.10	2.3000	<0.10	0.4400	140.0000	350.0000	<0.02	95.0000	27.0000	9.0000	15.0000	9.8000	11.4000	E	34.4000	-1.8000	23.2656	27.9187	-11.7690	0.0070			1.4000	>241920
<0.10	2.7000	<0.10	0.0240	270.0000	340.0000	<0.02	90.0000	27.0000	1.4000	21.0000	2.1000	2.1000										0.5000	3450.00
<0.10	1.9000	<0.10	0.2690	112.0000	150.0000	0.0600	41.0000	11.0000	2.7000	13.0000	4.1500	4.9500										2.2000	51720.00
<0.04	4.2000	<0.10	0.0580	230.0000	320.0000	0.2200	81.0000	29.0000	1.8000	52.0000	2.4000	2.5000	C	76.4000	6.3000	43.5837	52.3004	-10.9150	0.0030	-8.0210	0.0050	0.5800	238.00
<0.04	5.0000	0.1400	0.2900	120.0000	180.0000	0.1000	49.0000	15.0000	2.9000	19.0000	7.1000	6.1000	E	37.8000	7.2000	19.6928	23.6314	-11.4900	0.0060	-7.4070	0.0270	0.9100	173290.00
<0.20	4.8000	<0.20	0.1000	220.0000	310.0000	0.0720	77.0000	29.0000	1.7000	16.0000	2.5000	3.0000								-11.3960	0.0590	0.7100	16000.00
			0.3000	92.0000	120.0000	0.0570	35.0000	9.3000	3.8000	6.8000	7.2000	7.5000	E	28.4000	2.4000	16.7580	20.1096	-12.8110	0.0060	-7.0760	0.0320	0.7100	>241920
<0.10	1.3000	<0.10	0.2800	180.0000	440.0000	<0.02	120.0000	37.0000	9.5000	23.0000	8.0000	8.9000	E	46.4000	-1.9000	30.9854	37.1825	-12.0090	0.0050			0.9200	>241920
<0.10	3.4000	<0.10	0.0190	250.0000	340.0000	0.0600	88.0000	28.0000	1.3000	19.0000	1.8000	1.8000										0.3700	2950.00
<0.10	2.3000	0.1700	0.3570	106.0000	140.0000	0.0600	39.0000	11.0000	4.2000	8.7000	5.1800	5.8900										1.7000	46110.00
#DIV/0!	3.40	0.14	0.193	170.48	259.05	0.10	68.43	21.32	3.65	29.12	5.19	5.45	#DIV/0!	43.37	3.15	25.40	30.48	-11.64	0.01	-8.87	0.02	0.94	47435.80

E. Coli (co	HPC (colo	Chlo-A (mg	MIB (ppb)	Geosmin (	Calculated	Location D	Comments
52.00	2900.00				NA	S side of F	stream is frozen. Hole created with pick ax to obtain samples.
310.00	51000.00	<0.10			1.2253		Landmark for water height is benchmark on south bridge to water surface. water flowing. water very mucky. Muddy bottom.
1400.00		0.60	BDL	9.00	-0.0002		landmark to surface measured at benchmark on bridge.
>241920		0.40			NA	NEW SITE	Landmark to surface measured from bottom of road deck.
20750.00		<0.1	BDL	BDL	1.6639		Landmark to surface measured from bottom of road deck.
740.00		0.50	BDL	BDL	0.1057		Landmark to surface measured from TOP of bridge rail. Measured from W side of bridge - center of stream.
310.00		0.30	BDL	BDL	NA		Landmark to surface measured from TOP of bridge rail. Measured from W side of bridge - center of stream.
30.00	7400.00				0.0266	S of 86th S	mucky bottom
410.00	51000.00	<0.10			0.5040		Landmark for water height is from center of bridge (south side) to water surface. eddy current near east bank
980.00		0.30	BDL	BDL	0.0109		Landmark to surface measured from bottom of road deck.
>241920		0.40			NA		Landmark to surface measured from bottom of road deck.
17230.00		<0.1	BDL	5.80	0.8541		Landmark to surface measured from bottom of road deck.
1580.00		0.50	BDL	BDL	0.0378		Landmark to surface measured from bottom of road deck.
2030.00		0.40	BDL	BDL	NA		Landmark to surface measured from bottom of road deck.
0.00	1100.00				NA	N side of b	could not measure streamflow b/c ice covered. Hole (~25cm diameter) was created with pick ax to obtain samples. Ice is ~ 10" think.
200.00	100000.00	<0.10			NA		Landmark for water height is from center of bridge to water surface. Uncertain of where on road deck measurement was taken. water too deep for streamflow measurements.
400.00		0.30	BDL	BDL	NA		Landmark to surface measured from bottom of road deck.
>241920		0.40			NA		Landmark to surface measured from bottom of road deck.
32820.00		<0.1	BDL	5.30	NA		Landmark to surface measured from bottom of road deck. Bridge collapsed - old elevation 795' 6.75"
1100.00		0.50	BDL	BDL	NA		Landmark to surface measured from top of south bridge rail. Bridge still collapsed +92.50. ~0.82m (2'7") from top of S bridge rail to elevation marker +92.50.
1080.00		0.30	BDL	BDL	NA		Landmark to surface measured from top of south bridge rail. Bridge still collapsed.
38437.24	35566.67	0.41		6.70	0.49		

Center for Earth and Environmental Science

Indiana University ~ Purdue University, Indianapolis

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http://www.cees.iupui.edu/research/water_resources/ciwrp/Algae_Information

CIWRP 2008 Research Project

About CEES

About Veolia Water Indianapolis

Blue-Green Algae Dynamics and Algal Toxicity: A Study of Central Indiana Reservoirs

Following the documentation of toxic blue-green algae and an algal toxin in Geist Reservoir last year, CIWRP research into blue-green algae has been expanded into a comprehensive research program for 2008. Last summer, blue-green algae concentrations in both Eagle Creek and Geist Reservoirs, and the detection of microcystin toxin in Geist Reservoir resulted in recreational usage advisories being posted by the Indiana State Department of Health for both reservoirs. While the 2007 summer drought conditions created unusual conditions very favorable for the proliferation of blue-green algae, potentially toxic blue-green algae blooms have been occurring in central Indiana reservoirs for several years. In fact, there have been documented cases of blooms of potentially toxic blue-green algae in several areas of Indiana since 2001. Further, a review of blue-green algae research throughout the Midwest indicates that blue-green algae blooms and the occurrence of algal toxins, especially microcystin, are becoming increasingly common in midcontinent lakes and reservoirs.

For years, CIWRP research has focused on understanding phytoplankton (typically microscopic floating plants) occurrence and dynamics in area reservoirs because several types cause taste and odor in finished drinking water. These compounds are likely familiar to you as the earthy and/or musty smell and taste sometimes present in drinking water. Nuisance algal blooms of taste and odor producing phytoplankton have been documented in Eagle Creek, Geist and Morse Reservoirs since at least 2000. Resident reservoir phytoplankton from diatoms to blue-green algae and actinomycetes (fungi-like bacteria) are known to produce taste and odor causing compounds - chemically known to be MIB (2-methylisoborneol) and geosmin. Further, certain species of blue-green algae are known to produce specific taste and odor compounds. For example, *Anabaena* has been documented as producing geosmin and potentially MIB; *Pseudanabaena* has been shown to produce MIB; *Aphanizomenon* has been shown to produce geosmin; and *Planktothrix* has been shown to produce both MIB and geosmin. Yet understanding if these same species produce taste and odor compounds locally remains unknown and anecdotal.

In recent years, concern regarding the production and occurrence of blue-green algal toxins has grown in central Indiana and nationally. Evaluation of phytoplankton community structure information from Eagle Creek, Geist and Morse Reservoirs has shown that potentially toxic blue-green algae comprise important parts of the phytoplankton communities in mid-late summer and fall in all three reservoirs. Additional reports of potentiallytoxic blue-green algae in Indiana include Ball Lake in Steuben County, Lake Lemon and Monroe Reservoir in Monroe County, and at least 20 other lakes and reservoirs statewide.

Given the ecological, recreational, and municipal uses of Eagle Creek, Geist and Morse Reservoirs, maintaining and improving their water quality has been a focus of the Central Indiana Water Resource Partnership (CIWRP). A primary focus area has been on Eagle Creek Reservoir (ECR) because of the drinking water intake location within the reservoir. In 2003, CIWRP research focused on obtaining physical, chemical, and phytoplankton data to understand how ECR's physical and chemical environments affect phytoplankton growth (Pascual and Tedesco, 2004a). Algaecide treatment was being used to control algal bloom formation more aggressively in 2003 with three algaecide treatments occurring in ECR in 2003. Thus a secondary focus of the 2003 study included determining algaecide treatment effectiveness (Pascual and Tedesco, 2004b). Subsequent research designed to develop a rapid blue-green algae mapping tool utilizing remote sensing has resulted in monitoring the distribution of blue-green algae in the three reservoirs over the past three years (Li et al., 2006). This work also included Monroe Reservoir in south-central Indiana, a drinking water supply reservoir for Bloomington and surrounding communities and an important recreational use resource. Our work provided snapshots of whole reservoir blue-green algae distributions with some information on the physical and chemical characteristics of the reservoirs and limited information on phytoplankton community structure. However, CIWRP research has not studied the occurrence of blue-green algal toxins in central Indiana reservoirs or elsewhere and information on the occurrence of algal toxins is very limited despite the fact that known toxin-producing algae comprise important components of blue-green algal populations in the three central Indiana reservoirs, as well as elsewhere throughout the state.

Given the importance of the central Indiana reservoirs for the drinking water supply and their recreational use, a comprehensive study of the phytoplankton ecology of the three reservoirs is being undertaken. Additionally, documenting the occurrence of taste and odor compounds (MIB and geosmin) as well as blue-green algae toxin occurrence will be an important part of the study and will be undertaken during the spring, summer, and fall of 2008, and potentially 2009.

The 2008 CIWRP Algal Ecology and Toxicity study has three main purposes:

1) To document algal community composition and abundance;
2) To determine the relationship between physical and chemical reservoir conditions and algal community structure and abundance; and
3) To document the occurrence of blue-green algal toxins (microcystin, anatoxin-a, and cylindrospermopsin) and taste and odor compounds (MIB and geosmin) and their relationship to algal community structure and reservoir conditions.

This study is already underway and will involve a lot of field work. We will sample Eagle Creek, Geist and Morse Reservoirs on every two weeks beginning in mid-May and extending through mid-October. This will result in at least 12 sampling events per reservoir. Additional samples may be taken in response to monitoring specific blooms or during unusual conditions. Researchers will be monitoring physical and chemical reservoir conditions important to understanding the factors that lead to algal blooms and potentially even specific species of algae. This type of monitoring will occur at a series of sites throughout each reservoir. At a few select sites, we will collect water samples throughout the water column (for example at the surface, near the bottom, and at places in the middle of the water column where different important biological conditions occur). These samples will be analyzed for a large number of parameters that can control algae community abundance and composition (eg. levels of the nutrients nitrogen and phosphorus, dissolved oxygen levels, amount of light etc). Additionally, samples will be analyzed for several measures that are created by the algal communities (eg. number and species of phytoplankton present, levels of algal pigments present, amount and type of taste and odor compounds, and amount and type of algal toxins, if any, present).

CEES is partnering with both Veolia Water Indianapolis, LLC. though the CIWRP partnership, and with the State of Indiana (Indiana Department of Natural Resources, Indiana Department of Environmental Management and Indiana State Department of Health) to conduct these studies. CIWRP funding will be the dominant funding source and will document reservoir physical and chemical conditions, algal community dynamics, taste and odor compounds, and some toxin analyses. The State of Indiana will provide limited funding for additional algal toxin analyses predominantly for Geist Reservoir with some additional analyses of Eagle Creek and Morse Reservoirs. Specifically, CEES will collect samples for algal toxin analyses and results will be provided to the State for dissemination to the public via their website at www.algae.in.gov. CEES will not make recommendations to the public regarding health and safety associated with the use of recreational waters. The State will provide additional information to the public on their website. CEES will continue to provide science-based information about blue-green algae and our understanding of the causes and conditions that help promote algal blooms as they become available.

This study is one of the first studies in Indiana that will document the occurrence of algal toxins on a biweekly basis throughout the growing season. While there have been isolated tests for algal toxins on a few select lakes and reservoirs in response to a bloom or as part of a state-wide screening for one specific algal toxin, this study will provide important comprehensive information to help assess blue-green algal occurrence and reservoir conditions that might be responsible for blooms and toxin production.

CIWRP research and the expertise of CEES researchers (especially Tedesco, Clercin, Pascual, and new graduate student Angie Cowan) continues to provide important information and analyses. Our work has been important in that we have been able to provide information to state agencies, the Indiana legislature, Veolia Water, and the general public. We hope to be able to provide solid science data to the public policy arena as Indiana works to set standards, develop policies for advisories and determine if there is a need for statewide monitoring. We have posted some background information about blue-green algae on our website as well as presentations made at a public meeting for Geist residents. We will continue to provide updates and information as we learn more about our water resources and ways to improve, enhance and protect them.

CENTRAL INDIANA
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Blue-Green Algae in Central Indiana: Results from 2008 with a Focus on Geist Reservoir

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Mark Gray
Veolia Water Indianapolis, LLC.

VEOLIA WATER

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Blue-Green Algae

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- Cyanobacteria
  - Differ from Other Bacteria
    - → Can perform photosynthesis
  - Differ from True Eukaryotic Algae
    - → Lack a well-defined nucleus
  - More Closely Related to Gram Negative Bacteria than Algae
  - 2.2-3.5 Billion Years Old
  - Naturally Occurring but Antropogenically Amplified

Causes of Algal Blooms

Biomass increases to bloom densities under conditions favorable to growth

- Sunlight (light penetration)
- Temperature – to start growth
- Nutrients – not so simple
- Modified Hydrology
  - Resuspension of Nutrient-rich Bottom Sediment
  - Flushing vs Retention Times




2008 Blue-Green Algae Research: Indianapolis Water Reservoirs

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- *Purpose*
  - *Document algae community composition and abundance*
  - *Determine relationship between physical and chemical reservoir conditions and algae, taste and odor and toxin production*
- *Biweekly Mid-May – End-December*
- *Nutrients, Algal Populations, Physical Reservoir Conditions, Taste and Odor Compounds, Algal Toxins*
- *Algal Toxin Analyses by Greenwater Labs, Florida*
- *Funded by Veolia Water Indianapolis through CIWRP with additional funds for toxin analysis from Indiana DNR*

Indianapolis Drinking Water Supply

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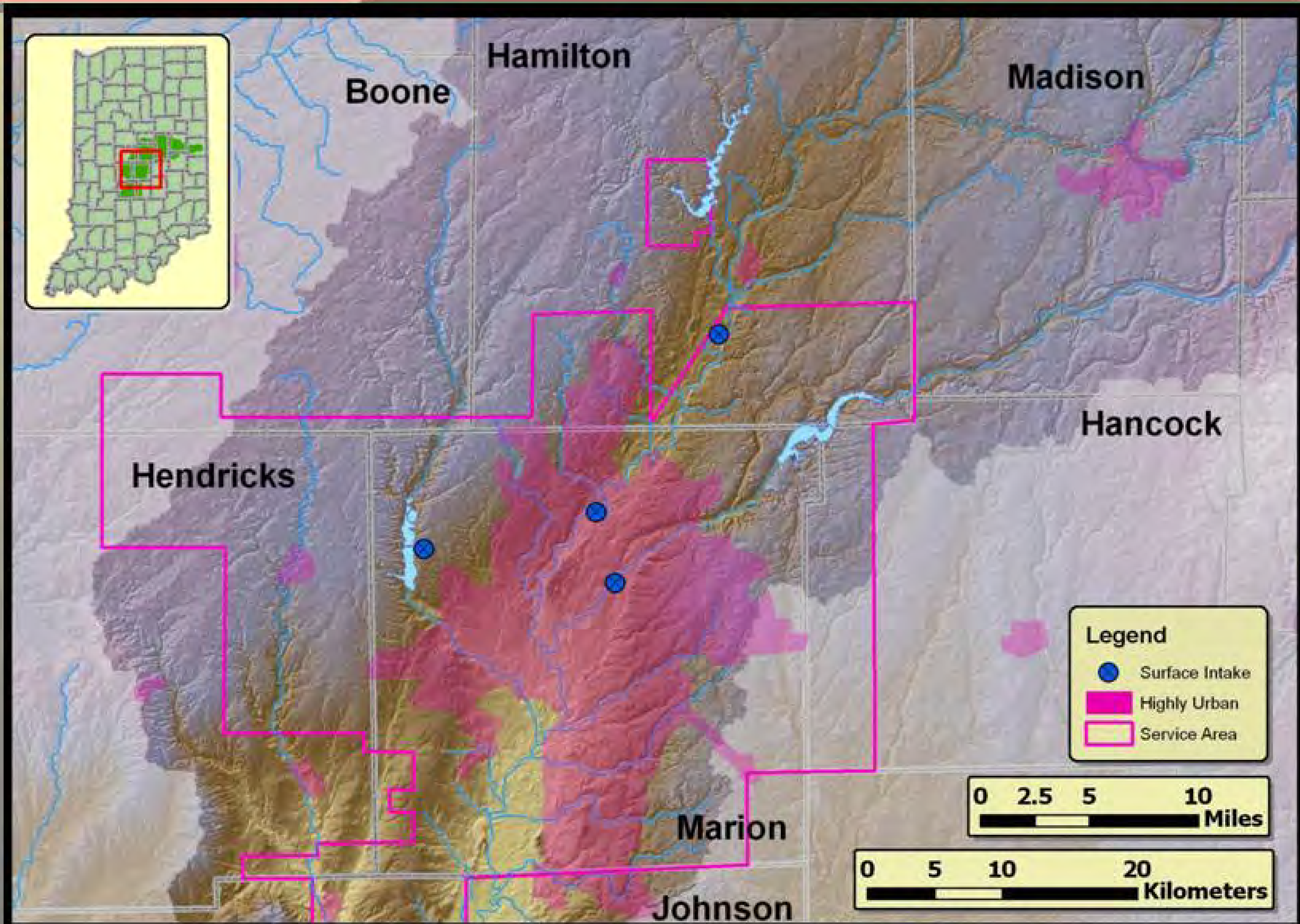

Reservoir Characteristics: Indianapolis Water Reservoirs

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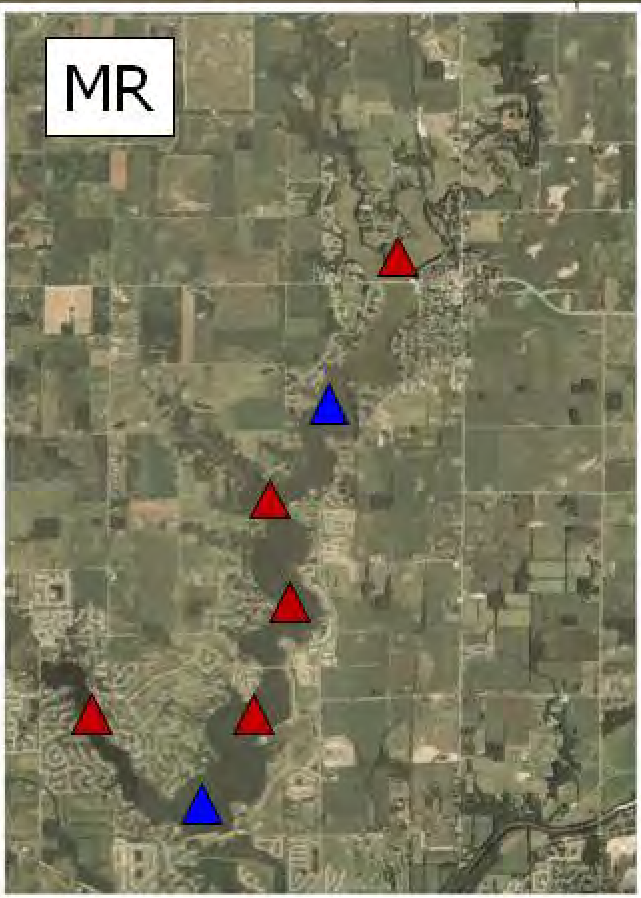
Reservoir	Eagle Creek	Geist	Morse	Units
Surface Area	5	5.9	6	km^2
Reservoir Volume	21	23.8	28	million m^3
Mean Depth	4.2	3.2	4.7	m
Watershed Area above Dam	420	560	590	km^2
% Agriculture in Watershed	52.0%	58.3%	76.9%	%
Median Photic Depth (secchi)	196	167	188	cm
Mean Total P	93	135	112	µg/L
Trophic Status	Eutrophic	Eutrophic	Eutrophic	

2008 Reservoir Study Sites
Eagle Creek, Geist, & Morse Reservoirs

▲ Water Quality Monitoring Station

▲ Water Quality and Algal Toxin



Samples for nutrients and T&O

- Surface, Bottom, Photic Depth

Samples for algae and toxins

- Integrated Photic Depth

Important Cyanobacteria Genera Found in Central Indiana Reservoirs

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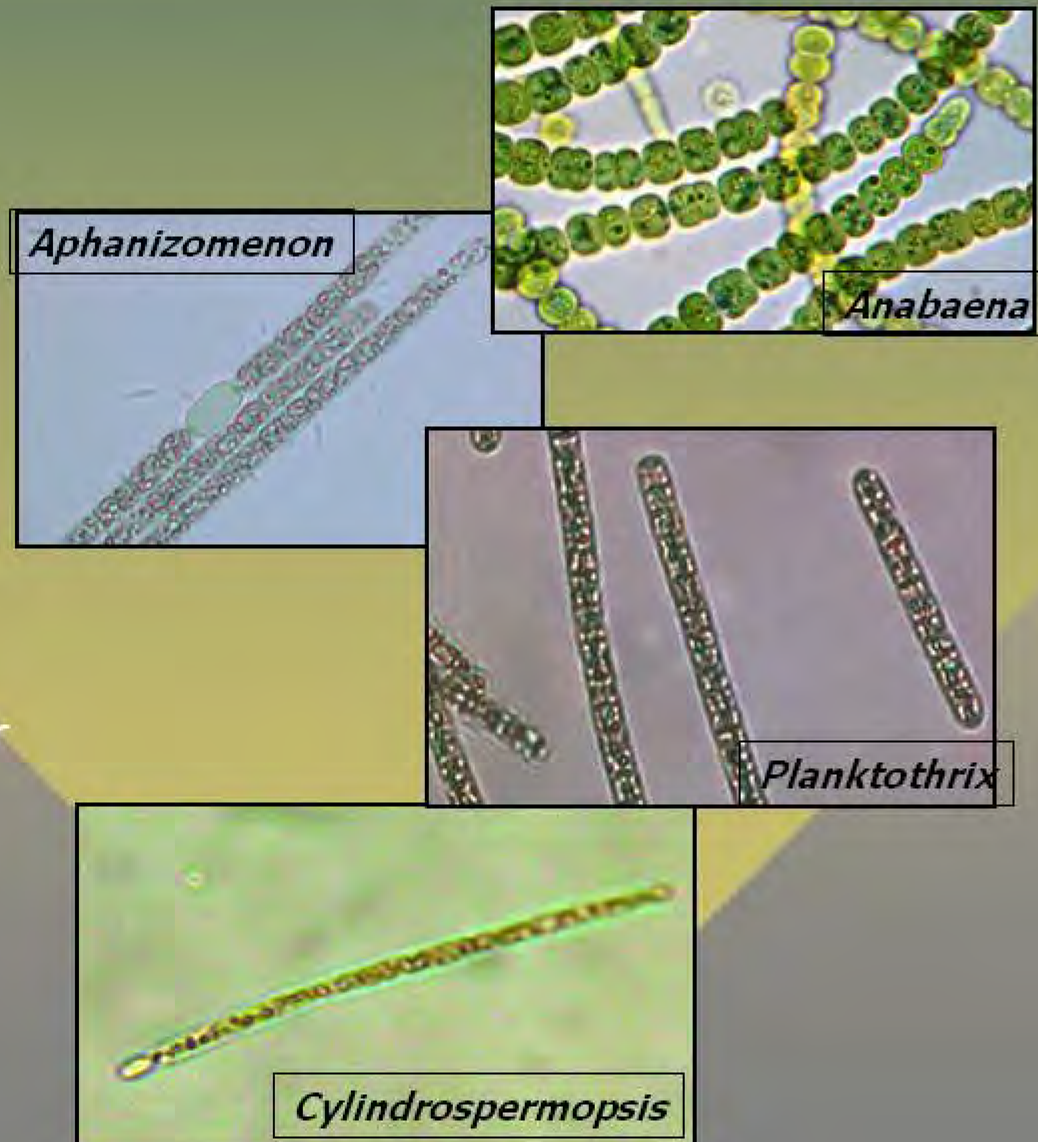
- Unicellular/Colonial – No heterocyst, Non-Nitrogen Fixer (Chroococcales)
  - *Microcystis*
  - *Merismopedia*
  - *Coelosphaerium*
- Filamentous – No heterocyst, Non-N Fixer (Oscillatoriales)
  - *Planktothrix*
  - *Oscillatoria*
  - *Limnothrix*
  - *Pseudanabaena*
- Filamentous – Heterocyst, Nitrogen Fixer (Nostocales)
  - *Cylindrospermopsis*
  - *Aphanizomenon*
  - *Anabaena*
  - *Rhaphidiopsis*



Toxins and Taste and Odor Compounds Produced by Cyanobacteria

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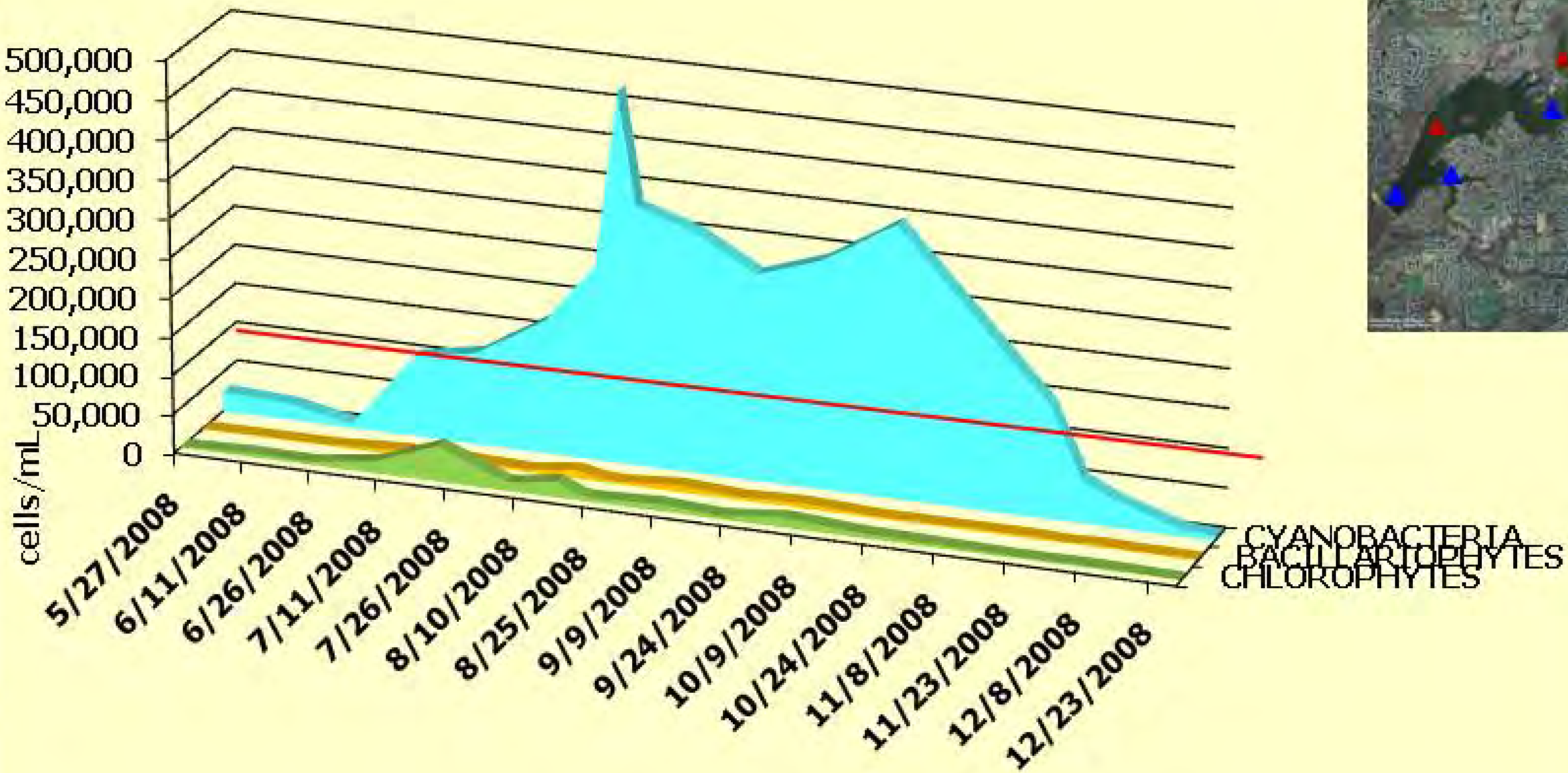
	Dermatotoxin, Irritant Toxin	Hepatotoxin (Liver)	Neurotoxin (Nervous System)	Taste/Odor
Anabaena	LPS	microcystins cylindrospermopsin	anatoxins saxitoxins	geosmin MIB?
Microcystis	LPS	microcystins		
Oscillatoria/ Planktothrix	LPS Lyngbyatoxins	microcystins	anatoxins saxitoxins	geosmin MIB
Cylindrospermopsis	LPS	cylindrospermopsin	saxitoxins	
Aphanizomenon	LPS	cylindrospermopsin microcystins	anatoxins saxitoxins	geosmin
Lyngbya	Lyngbyatoxins		saxitoxins	MIB
Snowella	LPS	microcystins		
Pseudanabaena	LPS	microcystins	anatoxin	geosmin MIB
Aphanacapsa	LPS	microcystins		

LPS = Lipopolysaccharide

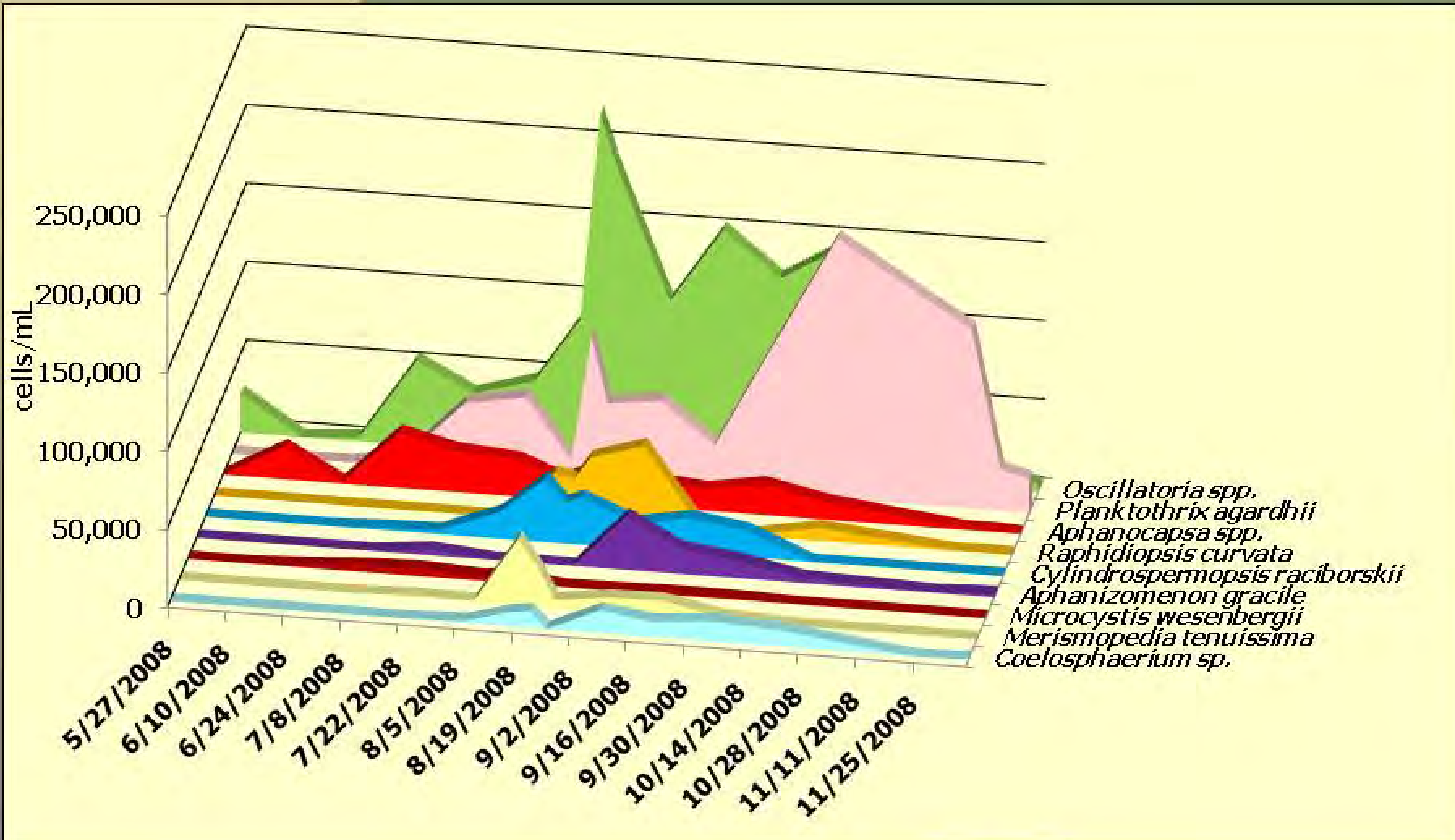
Modified from: Graham et al., 2008;
Lawton and Edwards, 2008; NOAA, 2007; Graham, 2007; Wiedner et al., 2006

2008 Algal Dynamics
Geist Reservoir @ Dam



WHO Guideline (Recreation) – Moderate Risk for Adverse Effects = 100,000 cells/mL

Species Dynamics of Cyanobacteria: Geist Dam



Cyanobacteria Populations vs Reservoir Inflow/Outflow

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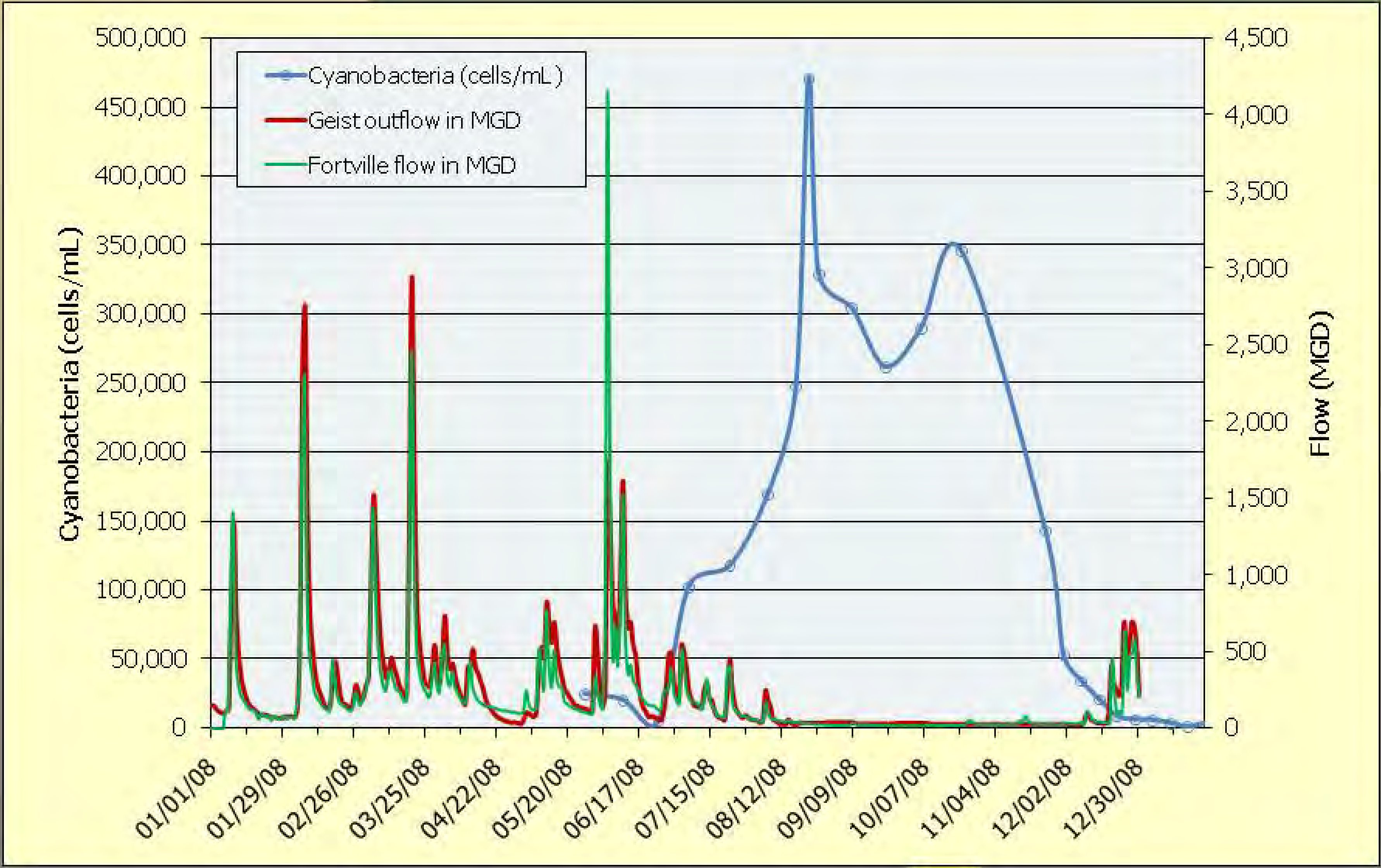
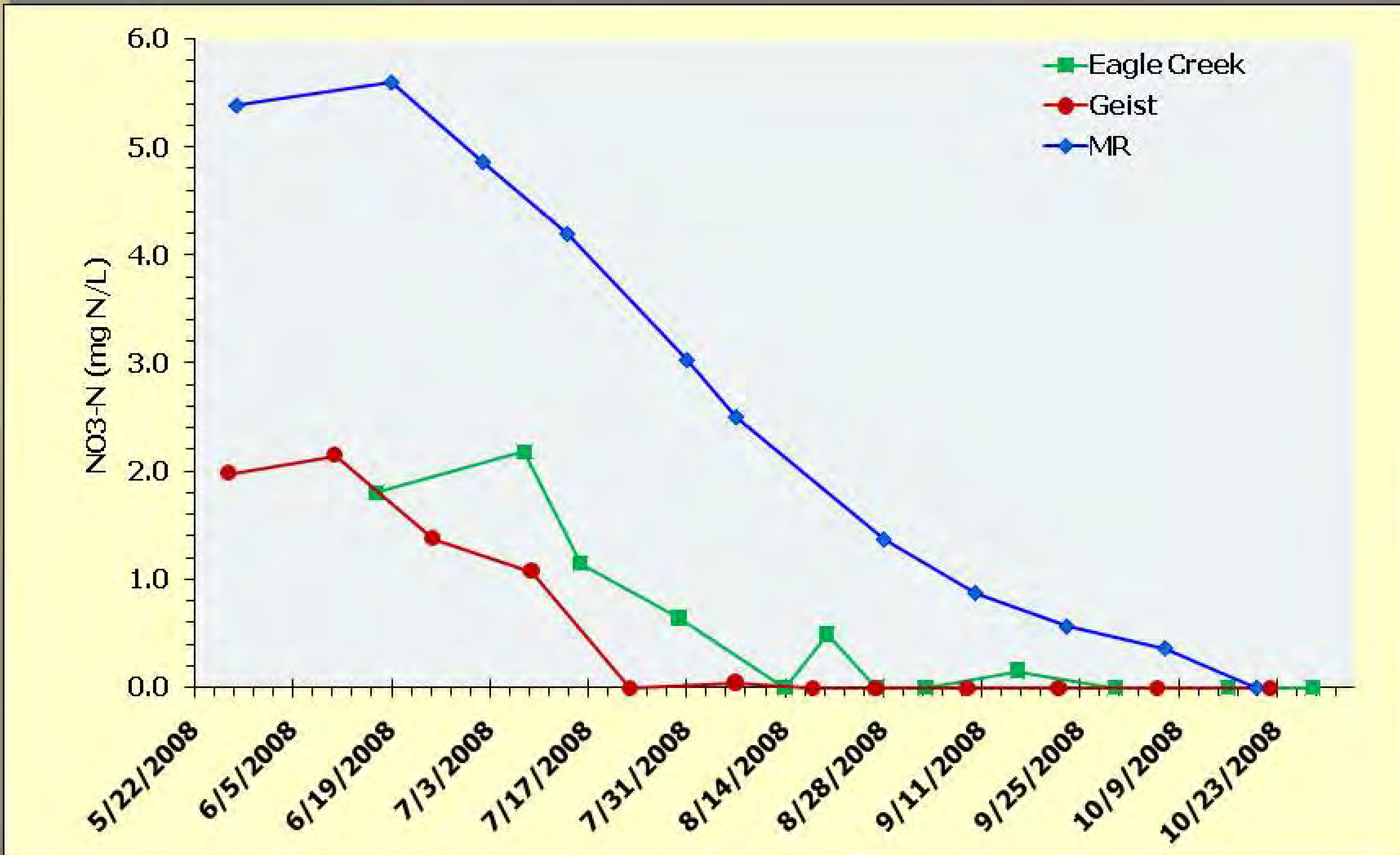
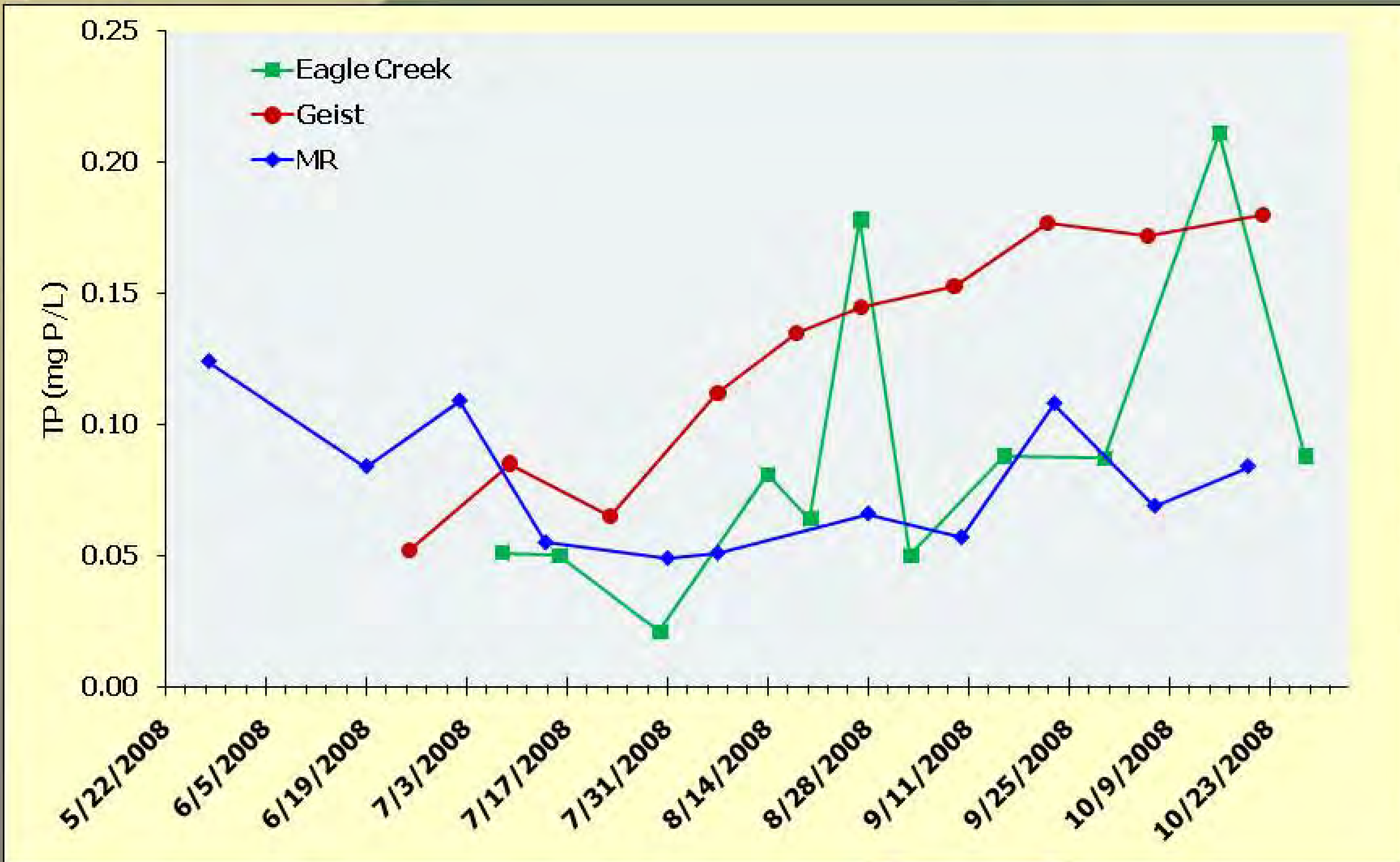


Nutrient Dynamics (Nitrate): Dam Sites



Integrated Photic Depth Samples

Nutrient Dynamics (Total P): Dam Sites



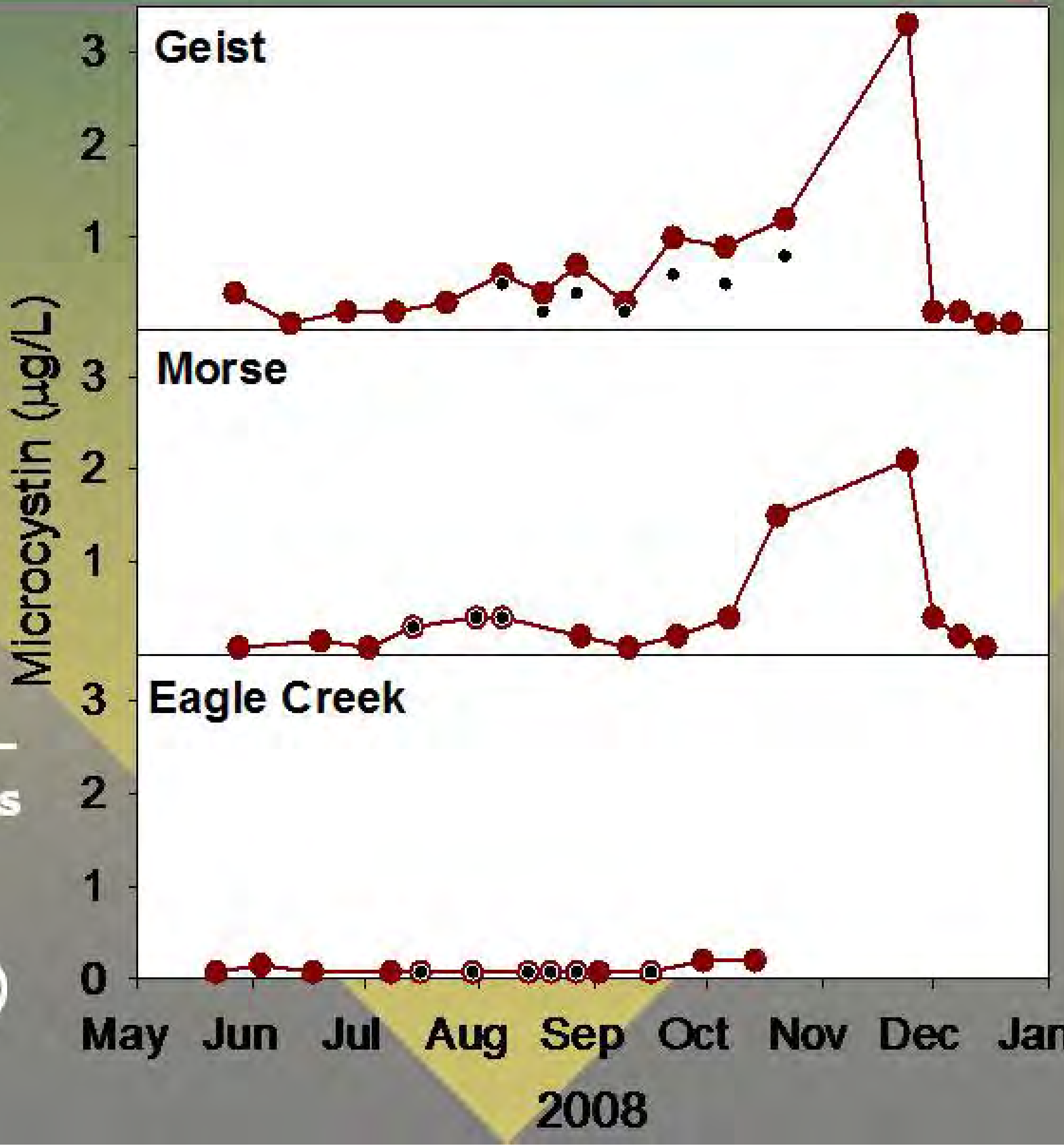
Integrated Photic Depth Samples

Algal Toxin Occurrence in Central Indiana Reservoirs

- Microcystin
  - 61% of samples positive for MYC (<0.15 ug/L detection limit)
    - All Reservoirs
      - 40 of 66 samples
      - Avg = 0.56 ug/L
    - Geist
      - 21 of 24 (88%)
      - Avg = 0.62 ug/L
    - Morse
      - 16 of 22 samples (73%)
      - Avg = 0.55 ug/L
    - Eagle Creek
      - 3 of 20 samples (15%)
      - Avg = 0.18 ug/L

WHO Guideline (Recreation) – Low Risk for Adverse Effects = 4 ug/L

- Anatoxin-a and Cylindrospermopsin (n=57)
  - Non-detect (<0.1 ug/L) in all samples

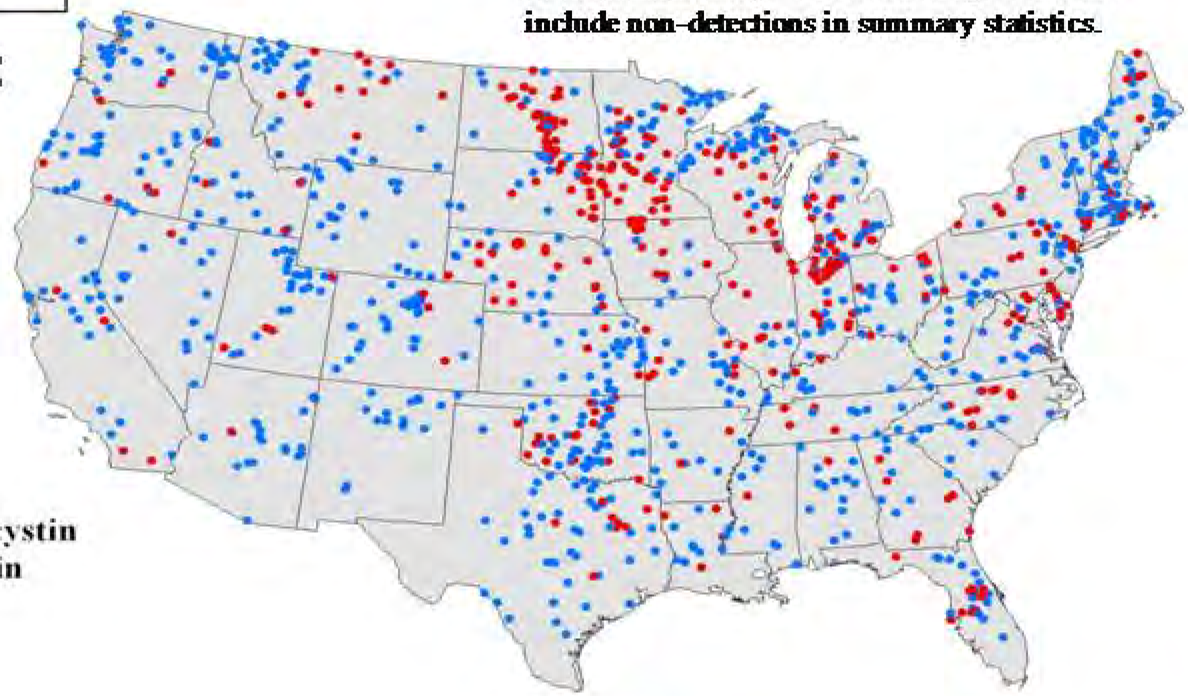


2007 EPA National Lakes Assessment: Microcystin

Concentration (ppb MCLR equivalents)	Study Lakes
Mean	3.0 (~ 1.0)
Median	0.52 (< 0.10)
Minimum	0.10 (< 0.10)
Maximum	230

1 Values outside parenthesis are summary statistics for detections only. Values inside parenthesis include non-detections in summary statistics.

% Overall Detections:
32 % (401/1238)



● No Detectable Microcystin
● Detectable Microcystin

Algal Species Dynamics in Central Indiana Reservoirs

- Shallow, frequently mixed, nutrient-rich reservoirs in Central Indiana are dominated by *Oscillatoria sp.* and *Planktothrix agardhii* throughout the growing season
- Cyanobacterial cell counts exceed 100,000 cells/mL by mid-July and persist
- Reservoirs are turbid, with shallow light penetration favoring *Oscillatoriales* which are known to be low light specialists



Microcystin Occurrence in Central Indiana Reservoirs

- Microcystin toxin was present at the three reservoirs at low levels
  - Geist Reservoir > Morse > Eagle Creek
- Ongoing data analysis continues to assess nutrient, taste and odor and microcystin relationships and trends.

2009 Cyanobacteria Research

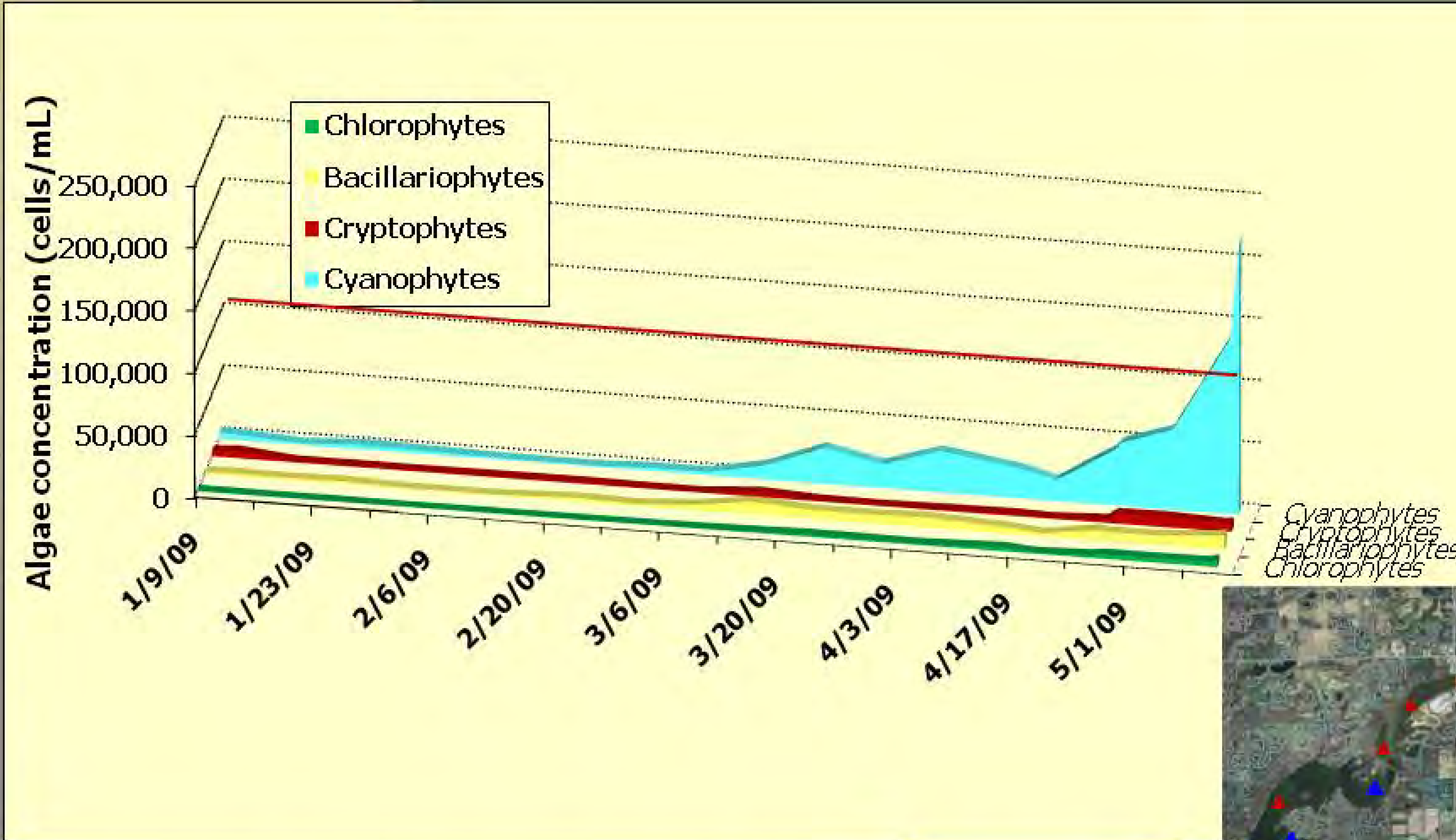
CENTRAL INDIANA WATER RESOURCES PARTNERSHIP

- Biweekly Reservoir Sampling (April-November)
  - → 4-7 Locations/reservoir
  - → Physical and Chemical Conditions
  - → Algal Identification and Enumeration
  - → Microcystin Analysis

- Whole Reservoir Spatial Distribution Sampling
  - → 15-20 sites/reservoir
  - → Two times per reservoir
  - → Same Parameters

Phytoplankton Dynamics: Geist Dam 2009

CENTRAL INDIANA WATER RESOURCES PARTNERSHIP



WHO Guideline (Recreation) – Moderate Risk for Adverse Effects = 100,000 cells/mL

What Can Recreational Users Do

- Wise Users Take Sensible Precautions
- Prepare BEFORE Entering the Water
  - Use Appropriate Gear
  - Check Weather Forecast
- While IN THE WATER
  - Recreate in Groups
  - Always Supervise Children
  - Avoid Consuming Raw (Reservoir or Lake) Water
- When you're FINISHED
  - Make Sure You Shower
  - Clean Your Equipment
- USE COMMON SENSE

What can you do NOW to help?

- Use Phosphorus-free lawn fertilizers and dishwasher detergent
- Fertilize less – first check soils nutrient levels
- Pick up pet wastes regularly
- Keep lawn clippings and leaves out of streets, waterways, and the reservoir!
- Keep household wastes out of storm sewers (including soaps from car washing)
- Collect storm water from gutters to use in gardens, create flower gardens at the base of downspouts
- Cover bare ground with plantings
- Use straw bales or silt fence when doing construction or major landscaping projects
- Plant beds of native flowers or trees with deep roots for infiltration
- Talk to your neighbors about what you are doing
- Think about how water is used around your house and how it moves across your yard!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Appendix H – Windshield Survey

A summary of the data obtained during the Windshield Survey is included in this Appendix. Survey locations were split up per subwatershed based on the size of the subwatershed with a total of 100 waterway crossing and 50 land points. Observations were made upstream and downstream at each point during October/November 2009 by Steering Committee volunteers. Copies of the original data sheets are provided on CD at the end of this report.

Windshield Survey Field Sheet

Watershed ____________________	Site ID ________________________
Date ________________________	Location _______________________
Time ________________________	Field Investigator(s) ________________

Weather (past 24 hours)		**Weather (now)**		**Wildlife Noted**
Rain	Snow	Rain	Snow	
Heavy	Overcast	Heavy	Overcast	
Steady	Partly cloudy	Steady	Partly cloudy	
Intermittent	Clear sky	Intermittent	Clear sky	

Land Use *check more than one if necessary*

- ⊕ **Residential**
  - ⊕ Single-Family
  - ⊕ Multi-Family
  - ⊕ Stormwater management practice
    - ⊕ curb and gutter
    - ⊕ retention basins
- ⊕ **Industrial**
- ⊕ **Commercial**
  (strip malls, restaurants, etc.)
- ⊕ **Forested**
- ⊕ **Mining/quarry**
- ⊕ **Wetland**
  (standing water or wetland vegetation)
- ⊕ **Agricultural**
  - ⊕ Field erosion/ gullies present
  - ⊕ Land is absent of vegetation
  - ⊕ Row Crop (corn, soybean, etc)
  - ⊕ Pasture without animals (fallow)
  - ⊕ Pasture with animals
    - ⊕ Cattle
    - ⊕ Hogs
    - ⊕ Other _____________
    - ⊕ Animals have stream access
    - ⊕ Estimated size of operation (number of head) ________
  - ⊕ Tillage type
    - ⊕ No-till
    - ⊕ Reduced till (50% residue)
    - ⊕ Conventional (black dirt)

Land Odor		**Please note if Best Management Practice implemented at location:** ____________________
Sewage	Soaps	____
Chemical	Dead Animal	____
Hydrocarbon (gas)	Other __________	____

At Stream Location Only

Water Color/Appearance *check all that apply*		**Water Odor**	
Clear	Murky	Sewage	Soaps
Green	Oily Sheen	Chemical	Dead Animal
Brown	Other ____________	Hydrocarbons (gas)	Other ____________

Algae *check all that apply*

Floating	Limited growth
Thick mats	Moderate growth
Attached to substrate	Excessive growth

Stream Erosion	**Stream Buffer**
Absent	Absent
Stabilized (rip-rap, coir log, etc.)	Present (minimum 10')
Present	> 50 feet
> 3' tall eroded	< 50 feet
< 3' tall eroded	
(Please indicate in box above the location of erosion if present.)	*(Please indicate in the box above the location of buffer if present.)*

Buffer Type: (*circle all that apply)*

Trees   Shrubs   Grasses   Other _______________

In Stream Debris *(circle all that apply)*

Trash   Deposits   Log Jam   Beaver Dam   Other_______________

Available Shade/ Stream Cover*	**In-stream Habitat** *check all that apply*	
0% Cover	Underwater tree roots	Deep Areas
1- 25% Cover	Boulders	Shallow Areas
25 - 75% Cover	Downed trees	Undercut Banks
75 – 100 % Cover		Other _______________
*How much of the stream is shaded		

Additional Notes:

Animal Access				
Watershed	Site ID	Animals with stream access		
Deer Creek	DC-W11	Yes		
Foster Branch	FB-W2	Yes		
Lick Creek	LC-W2	Yes		
McFadden Ditch	MD-W9A	Yes		

Erosion >3'					
Watershed	Site ID	Stream Erosion Quad 1	Stream Erosion Quad 2	Stream Erosion Quad 3	Stream Erosion Quad 4
Deer Creek	DC-W3	Present >3'			
Flatfork Creek	FC-W2	Present >3'			
Flatfork Creek	FC-W4	Present >3'			
Foster Branch	FB-W1	Present >3'			
Honey Creek	HC-W3	Absent	Present >3'		
Honey Creek	HC-W6	Present >3'			
Prairie Creek	PC-W13	Present >3'			
Prairie Creek	PC-W14	Present >3'			
Sly Fork	SF-W5	Present >3'	Present <3'		
Thorpe Creek/Geist Reservoir	TC-W11	Absent	Present >3'		
Thorpe Creek/Geist Reservoir	TC-W2	Absent	Stabilized	Present >3'	

Erosion <3'					
Watershed	Site ID	Stream Erosion Quad 1	Stream Erosion Quad 2	Stream Erosion Quad 3	Stream Erosion Quad 4
Deer Creek	DC-W11	Present <3'			
Deer Creek	DC-W12	Present <3'			
Deer Creek	DC-W13	Present <3'			
Deer Creek	DC-W5	Present <3'			
Deer Creek	DC-W7	Present <3'			
Deer Creek	DC-W8	Present <3'			
Flatfork Creek	FC-W1	Present <3'			
Flatfork Creek	FC-W6	Present <3'			
Flatfork Creek	FC-W8	Present <3'			
Flatfork Creek	FC-W9	Present <3'			
Honey Creek	HC-W8	Present <3'			
Lick Creek	LC-W1	Present <3'			
Lick Creek	LC-W2	Present <3'			
Lick Creek	LC-W3	Present <3'			
Lick Creek	LC-W4	Present <3'			
McFadden Ditch	MD-W1	Present <3'			
McFadden Ditch	MD-W2	Present <3'	Absent		
McFadden Ditch	MD-W4	Present <3'			
McFadden Ditch	MD-W5	Present <3'			
McFadden Ditch	MD-W6	Present <3'			
McFadden Ditch	MD-W7	Present <3'			
McFadden Ditch	MD-W9A	Present <3'			
Prairie Creek	PC-W17	Present <3'			
Sly Fork	SF-W1	Present <3'			
Sly Fork	SF-W2	Absent	Present <3'		
Sly Fork	SF-W3	Present <3'			
Sly Fork	SF-W6	Present <3'			
Sly Fork	SF-W8	Present <3'			
Thorpe Creek/Geist Reservoir	TC-W15	Stabilized	Present <3'		
Thorpe Creek/Geist Reservoir	TC-W4	Absent	Stabilized	Present <3'	
Thorpe Creek/Geist Reservoir	TC-W9	Present <3'			

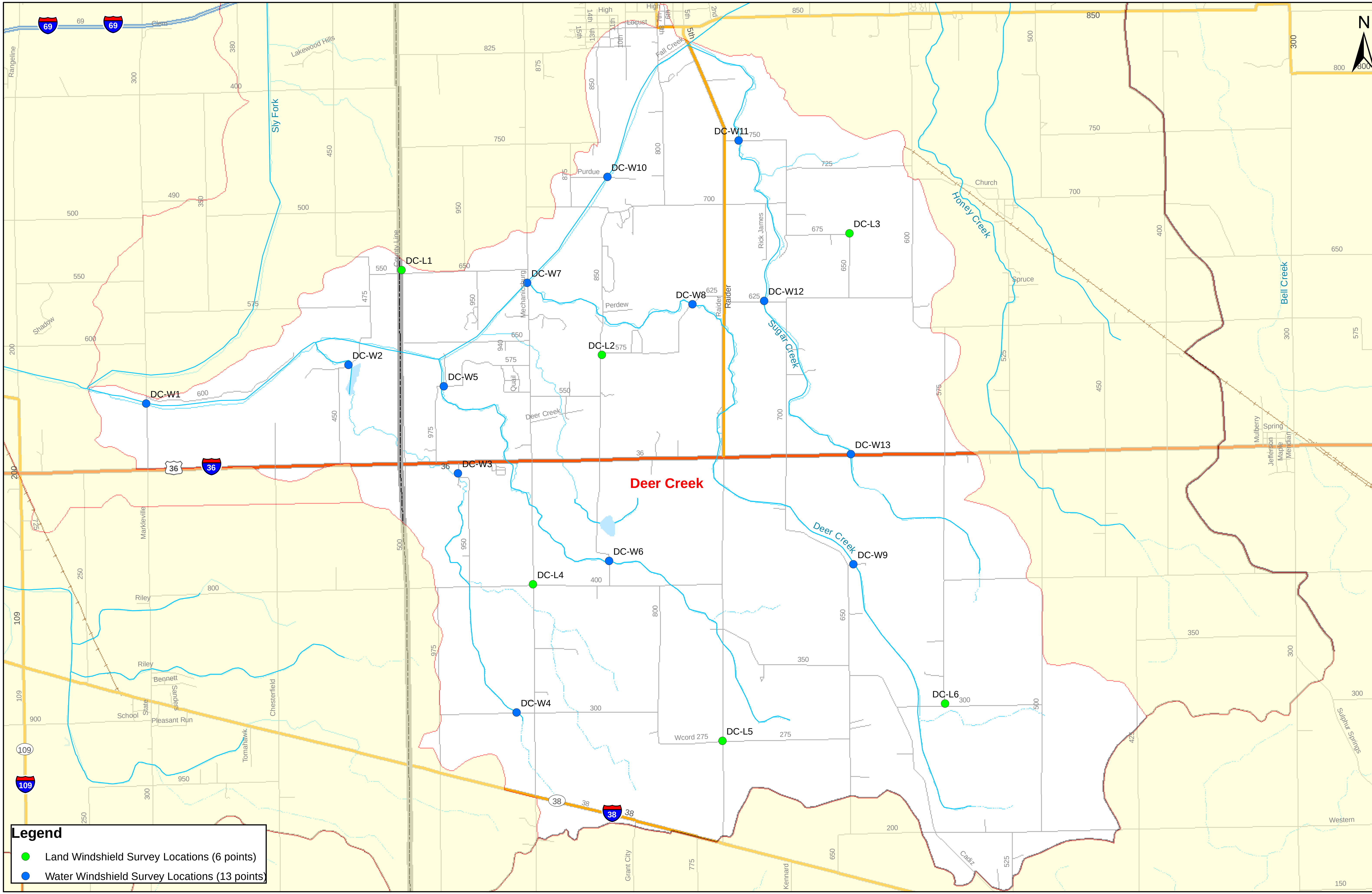
No Buffers						
Watershed	Site ID	Stream Buffer	Stream Buffer Quad 1	Stream Buffer Quad 2	Stream Buffer Quad 3	Stream Buffer Quad 4
Deer Creek	DC-W11	Absent				
Deer Creek	DC-W2	Absent				
Flatfork Creek	FC-W10	Absent				
Flatfork Creek	FC-W3	Absent				
Honey Creek	HC-W7	Absent	Present <50			
Honey Creek	HC-W8	Absent				
Lick Creek	LC-W2	Absent	Present >50			
Lick Creek	LC-W8	Absent				
McFadden Ditch	MD-W8	Absent				
McFadden Ditch	MD-W9A	Absent				
Prairie Creek	PC-W5	Absent				
Prairie Creek	PC-W6	Absent				
Sly Fork	SF-W5	Absent	Present <50			
Thorpe Creek/Geist Reservoir	TC-W1	Absent	Present >50			
Thorpe Creek/Geist Reservoir	TC-W11	Absent	Present >50			
Thorpe Creek/Geist Reservoir	TC-W2	Present >50	Present <5	Absent		
Thorpe Creek/Geist Reservoir	TC-W3	Present >50	Present <5	Absent		
Thorpe Creek/Geist Reservoir	TC-W4	Absent	Present <50			
Thorpe Creek/Geist Reservoir	TC-W5	Absent	Present >5	Present <50		
Thorpe Creek/Geist Reservoir	TC-W6	Absent	Present <50			

Buffers <50'						
Watershed	Site ID	Stream Buffer Quad 1	Stream Buffer Quad 2	Stream Buffer Quad 3	Stream Buffer Quad 4	
Deer Creel	DC-W7	Present <50				
Deer Creel	DC-W3	Present <51				
Deer Creel	DC-W4	Present <52				
deer Creek	DC-W13	Present <53				
Deer Creel	DC-W6	Present <54				
Deer Creel	DC-W12	Present <55				
Deer Creel	DC-W9	Present <50				
Flatfork Cr	FC-W1	Present <50				
Flatfork Cr	FC-W11	Present <50				
Flatfork Cr	FC-W12	Present <50				
Flatfork Cr	FC-W13	Present <50				
Flatfork Cr	FC-W2	Present <50				
Flatfork Cr	FC-W4	Present <50				
Flatfork Cr	FC-W5	Present <50				
Flatfork Cr	FC-W6	Present <50				
Flatfork Cr	FC-W7	Present <50				
Flatfork Cr	FC-W8	Present <50				
Flatfork Cr	FC-W9	Present <50				
Foster Bra	FB-W2	Present <50				
Foster Bra	FB-W5	Present <50				
Foster Bra	FB-W6	Present <50				
Honey Cre	HC-W1	Present <50				
Honey Cre	HC-W2	Present <50				
Honey Cre	HC-W3	Present >5	Present <50			
Honey Cre	HC-W4	Present <50				
Honey Cre	HC-W5	Present <50				
Honey Cre	HC-W6	Present <50				
Lick Creek	LC-W3	Present >5	Present <50			
Lick Creek	LC-W4	Present <50				
Lick Creek	LC-W5	Present <50				
Lick Creek	LC-W6	Present <50				
Lick Creek	LC-W7	Present <50				
Lick Creek	LC-W9	Present <50				
McFadden	MD-W1	Present <50				
McFadden	MD-W2	Present <50				

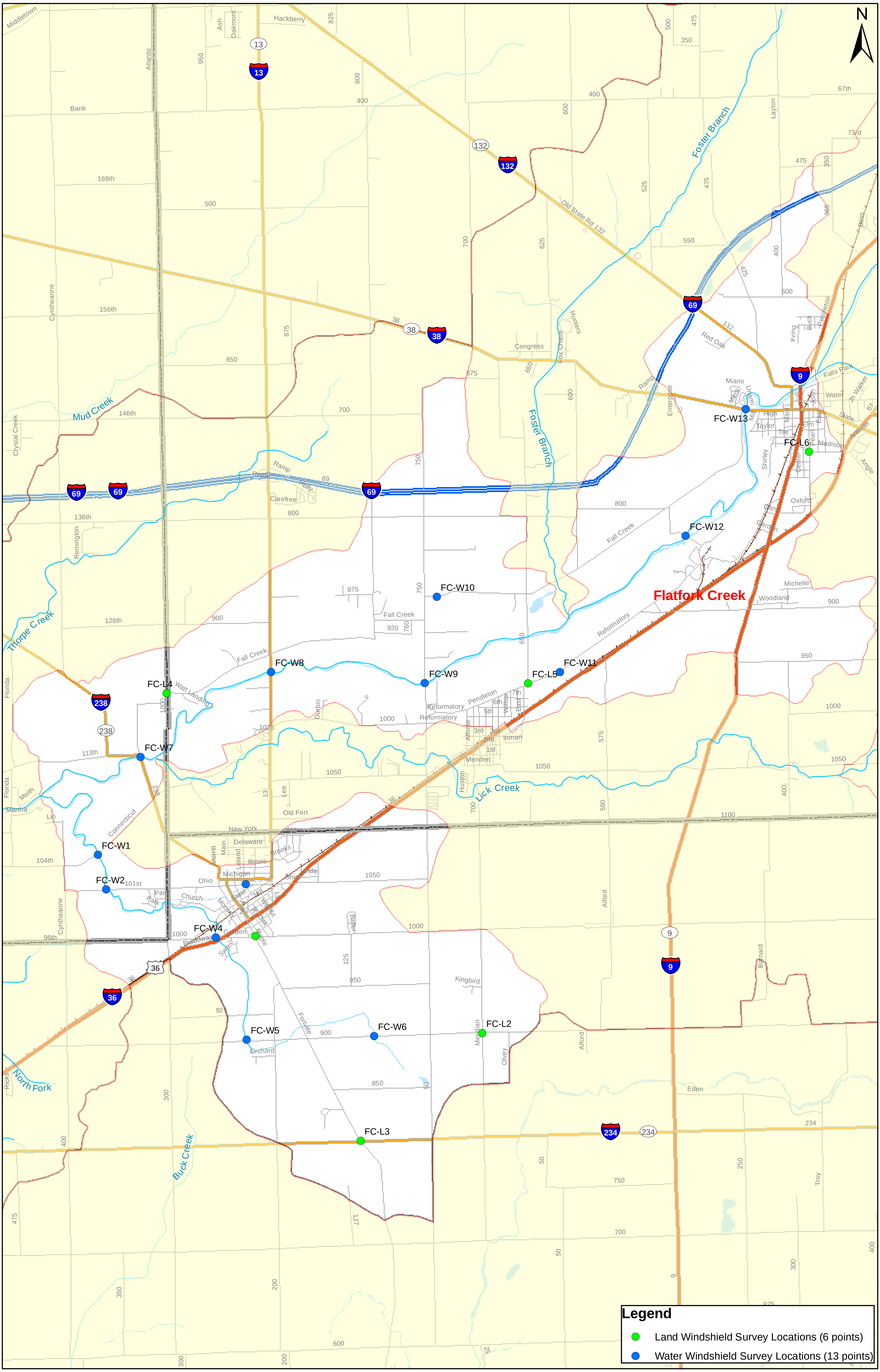
McFadden	MD-W3	Present <50			
McFadden	MD-W4	Present <50			
McFadden	MD-W5	Present <50			
McFadden	MD-W6	Present <50			
McFadden	MD-W7	Present <50			
Prairie Cre	PC-W1	Present <50			
Prairie Cre	PC-W11	Present <50			
Prairie Cre	PC-W13	Present <50			
Prairie Cre	PC-W14	Present <50			
Prairie Cre	PC-W15	Present <50			
Prairie Cre	PC-W16	Present <50			
Prairie Cre	PC-W17	Present <50			
Prairie Cre	PC-W4	Present <50			
Sly Fork	SF-W1	Present <50			
Sly Fork	SF-W2	Present <50			
Sly Fork	SF-W4	Present <50			
Sly Fork	SF-W6	Present <50			
Sly Fork	SF-W7	Present <50			
Sly Fork	SF-W8	Present <50			
Thorpe Cre	TC-W12	Present <50			
Thorpe Cre	TC-W13	Present >5	Present <50		
Thorpe Cre	TC-W15	Present <50			
Thorpe Cre	TC-W16	Present <50			
Thorpe Cre	TC-W8	Present >5	Present <50		
Thorpe Cre	TC-W9	Present <50			

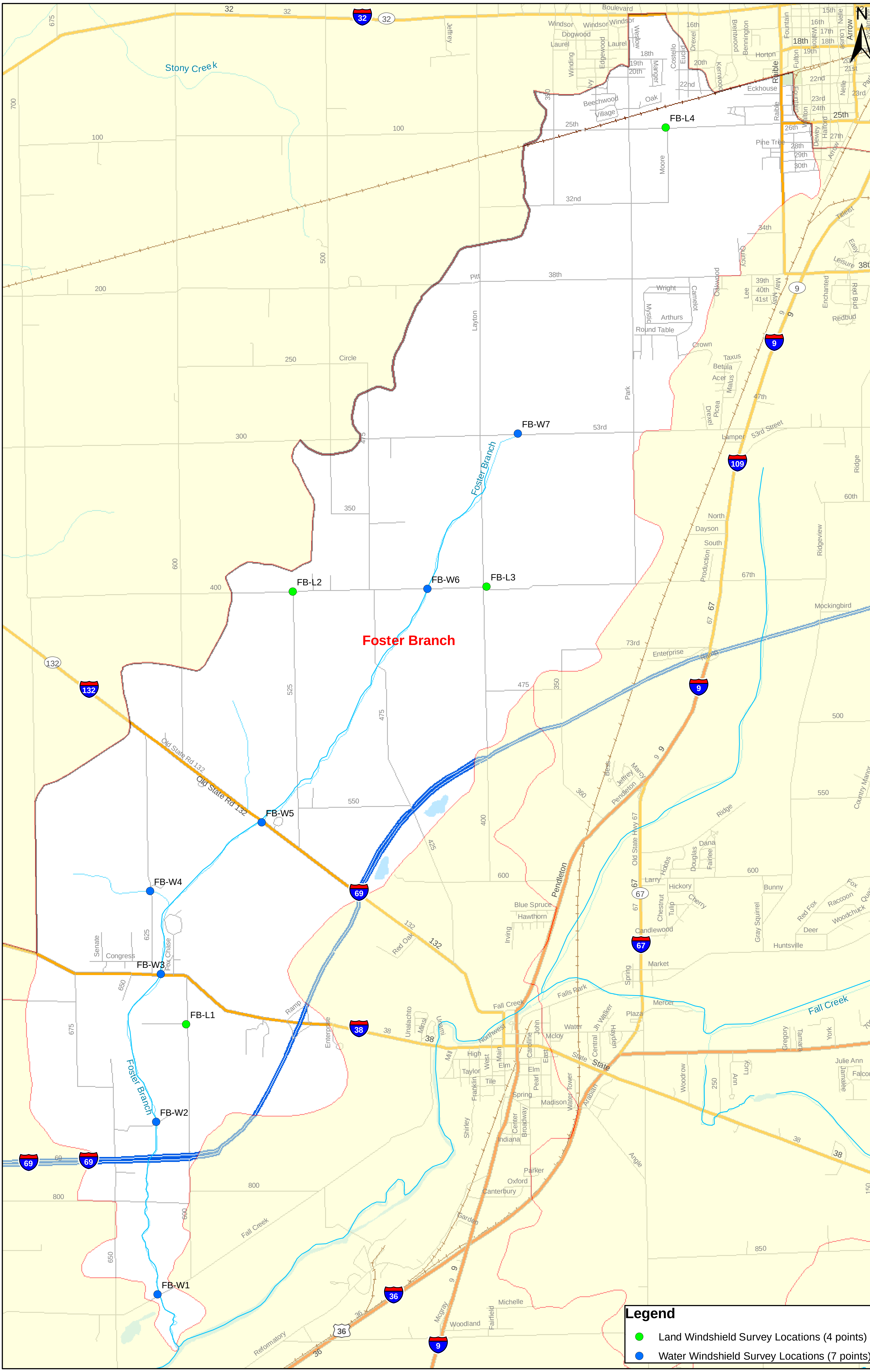
In Stream Debris						
Watershed	Site ID	In Stream Debris	In Stream I	In Stream Debris Notes		
Deer Creek	DC-W2	Trash	Deposits			
Deer Creek	DC-W5	Trash	Deposits			
Deer Creek	DC-W7	Trash	Deposits	log jam/beaver dam		
Flatfork Creek	FC-W10	Other		fence		
Foster Branch	FB-W1	Trash	Other	rocks		
Lick Creek	LC-W7	Trash				
McFadden Ditch	MD-W2	Trash	Deposits	log jam		
McFadden Ditch	MD-W6	Trash	Deposits	log jams		
McFadden Ditch	MD-W7	Trash	Deposits	log jams		
Prairie Creek	PC-W1	Trash				
Prairie Creek	PC-W14	Trash	Deposits			
Prairie Creek	PC-W2	Trash				
Prairie Creek	PC-W5	Trash				
Prairie Creek	PC-W6	Trash		leaves		
Sly Fork	SF-W1	Trash	Deposits	old bridge concrete		
Sly Fork	SF-W2	Deposits	Beaver Da	old bridge concrete		
Sly Fork	SF-W6	Deposits	Other	logs, computer monitor		
Thorpe Creek/Geist Reservoir	TC-W13	Trash				
Thorpe Creek/Geist Reservoir	TC-W7	Trash	Deposits	leaves, branches, etc		
Thorpe Creek/Geist Reservoir	TC-W9	Trash	Other	leaves, branches, etc		

Watershed	Site ID	Quad 1 Ag Tillage	Quad 2 Ag Tillage	Quad 3 Ag Tillage	Quad 4 Ag Tillage
Deer Creek	DC-L3			Reduced Till	Conventional
Deer Creek	DC-L5			Conventional	
Deer Creek	DC-W13			Reduced Till	Conventional
Deer Creek	DC-W4			Conventional	
Flatfork Creek	FC-L2	Conventional			
Flatfork Creek	FC-W6		Conventional		
Honey Creek	HC-L1		Conventional		
Honey Creek	HC-L2		Conventional		
Honey Creek	HC-L3	Conventional			
Honey Creek	HC-L4		Conventional		
Honey Creek	HC-W1			Conventional	
Honey Creek	HC-W2		Conventional		
Honey Creek	HC-W3		Conventional		
Honey Creek	HC-W6	Conventional			
Honey Creek	HC-W7		Reduced Till	Conventional	
Honey Creek	HC-W8		Conventional		
Lick Creek	LC-L4		Conventional		
Lick Creek	LC-L5		Conventional		
Lick Creek	LC-W5		Conventional		
Lick Creek	LC-W8			Conventional	
Lick Creek	LC-W9		Conventional	No-till	
Sly Fork	SF-L1		Conventional		
Sly Fork	SF-L2		Conventional		
Sly Fork	SF-W1		Conventional		
Thorpe Creek/Geist Reservoir	TC-L2	Conventional			
Thorpe Creek/Geist Reservoir	TC-L4	Conventional			
Thorpe Creek/Geist Reservoir	TC-W6	Conventional			
Thorpe Creek/Geist Reservoir	TC-W9		Conventional		

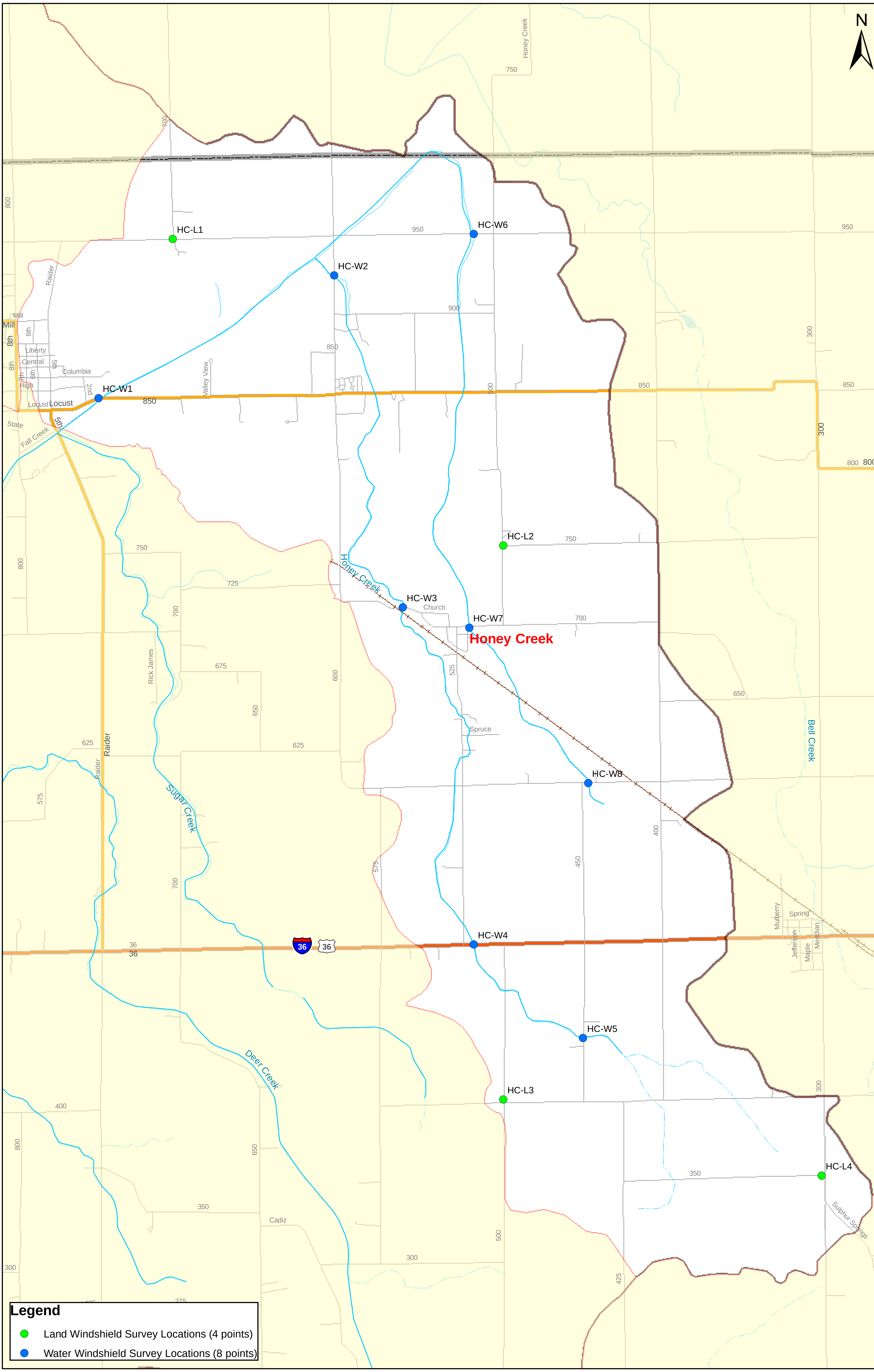


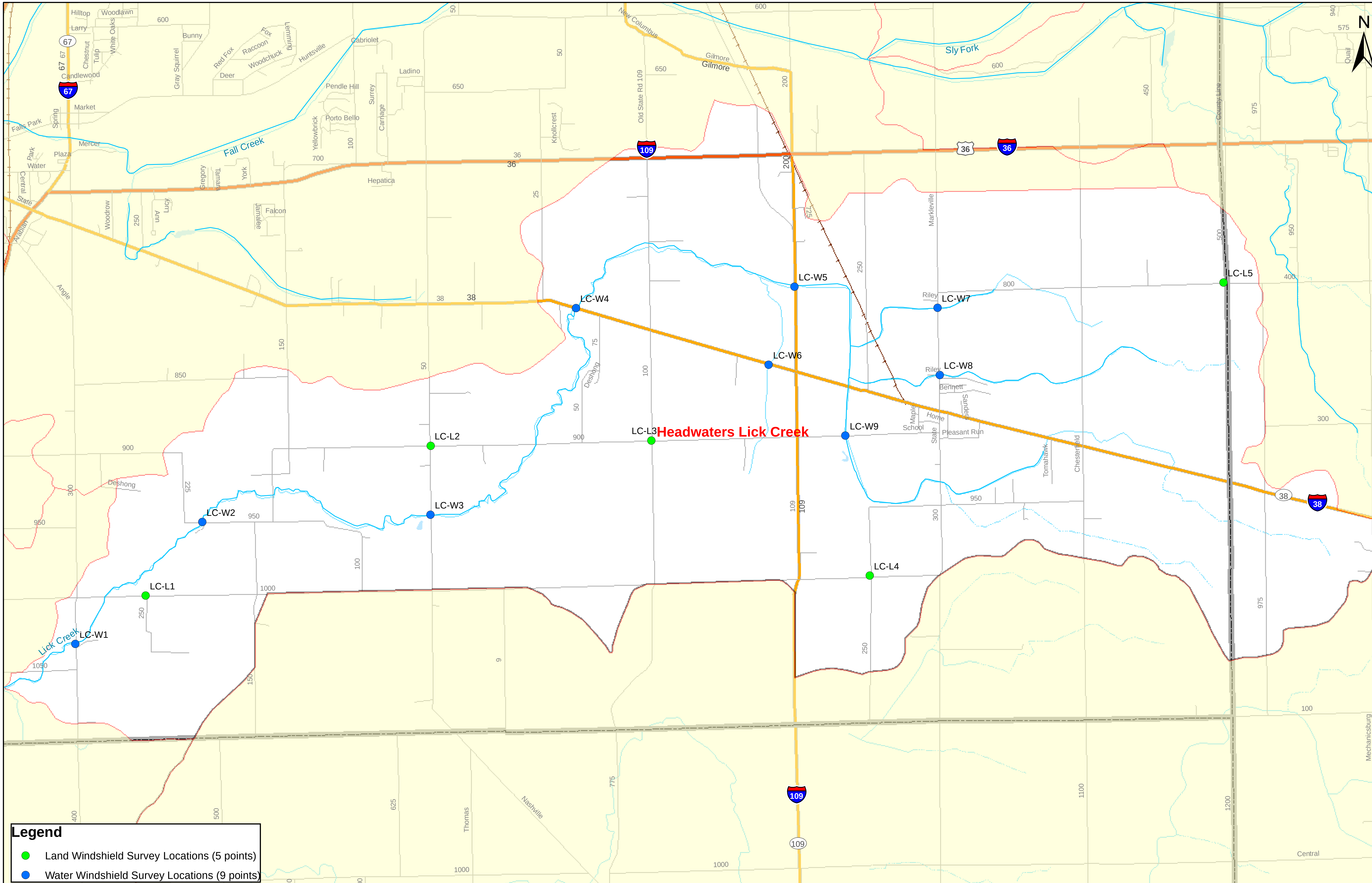
Deer Creek
N
DC-L1
DC-L2
DC-L3
DC-L4
DC-L5
DC-L6
DC-W1
DC-W2
DC-W3
DC-W4
DC-W5
DC-W6
DC-W7
DC-W8
DC-W9
DC-W10
DC-W11
DC-W12
DC-W13
Sly Fork
Sugar Creek
Honey Creek
Bell Creek
Deer Creek
Legend
Land Windshield Survey Locations (6 points)
Water Windshield Survey Locations (13 points)

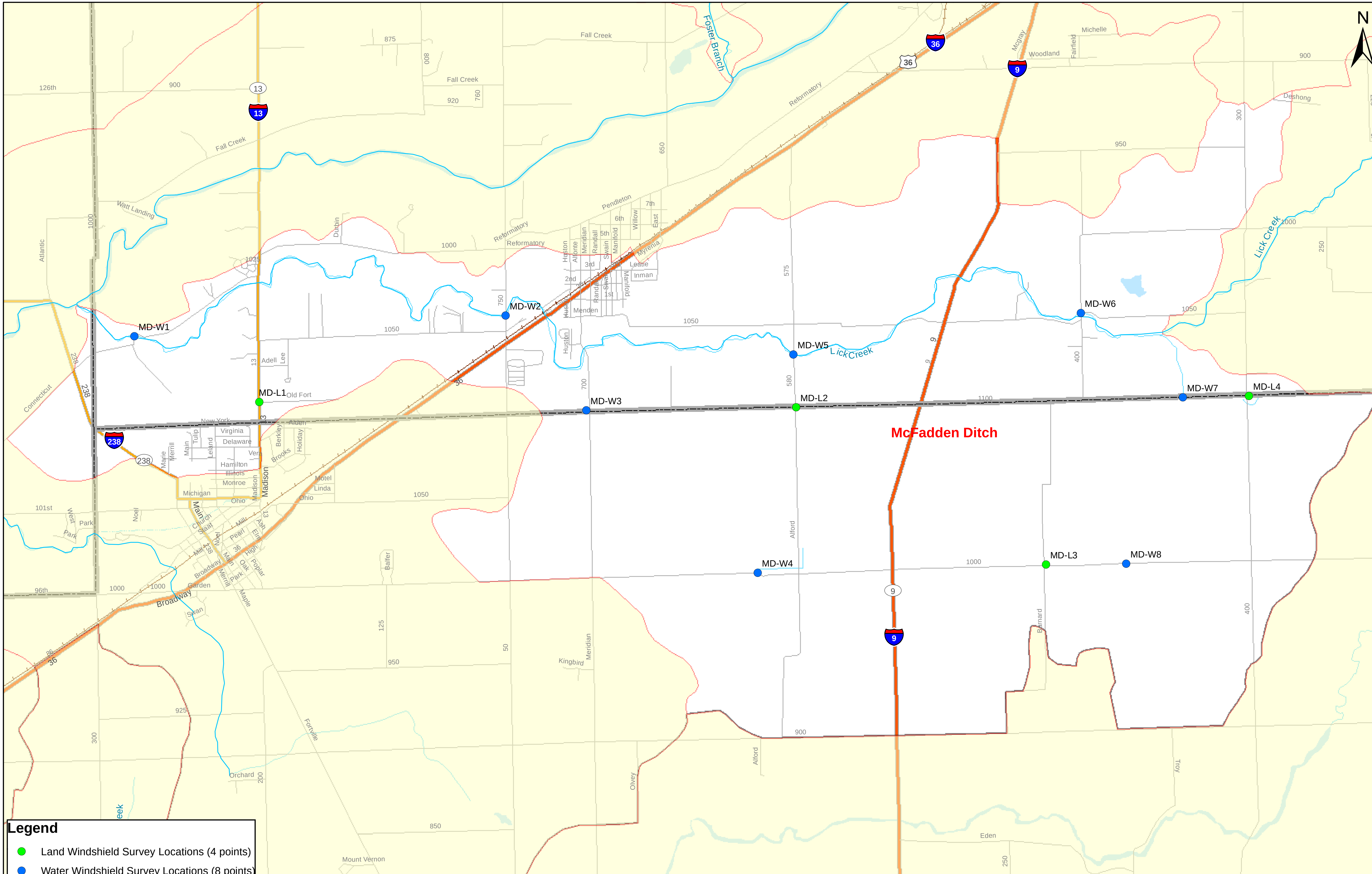

N
Flatfork Creek
FC-L2
FC-L3
FC-L4
FC-L5
FC-L6
FC-W1
FC-W2
FC-W4
FC-W5
FC-W6
FC-W7
FC-W8
FC-W9
FC-W10
FC-W11
FC-W12
FC-W13
Foster Branch
Mud Creek
Thorpe Creek
Lick Creek
Buck Creek
North Fork
Legend
Land Windshield Survey Locations (6 points)
Water Windshield Survey Locations (13 points)

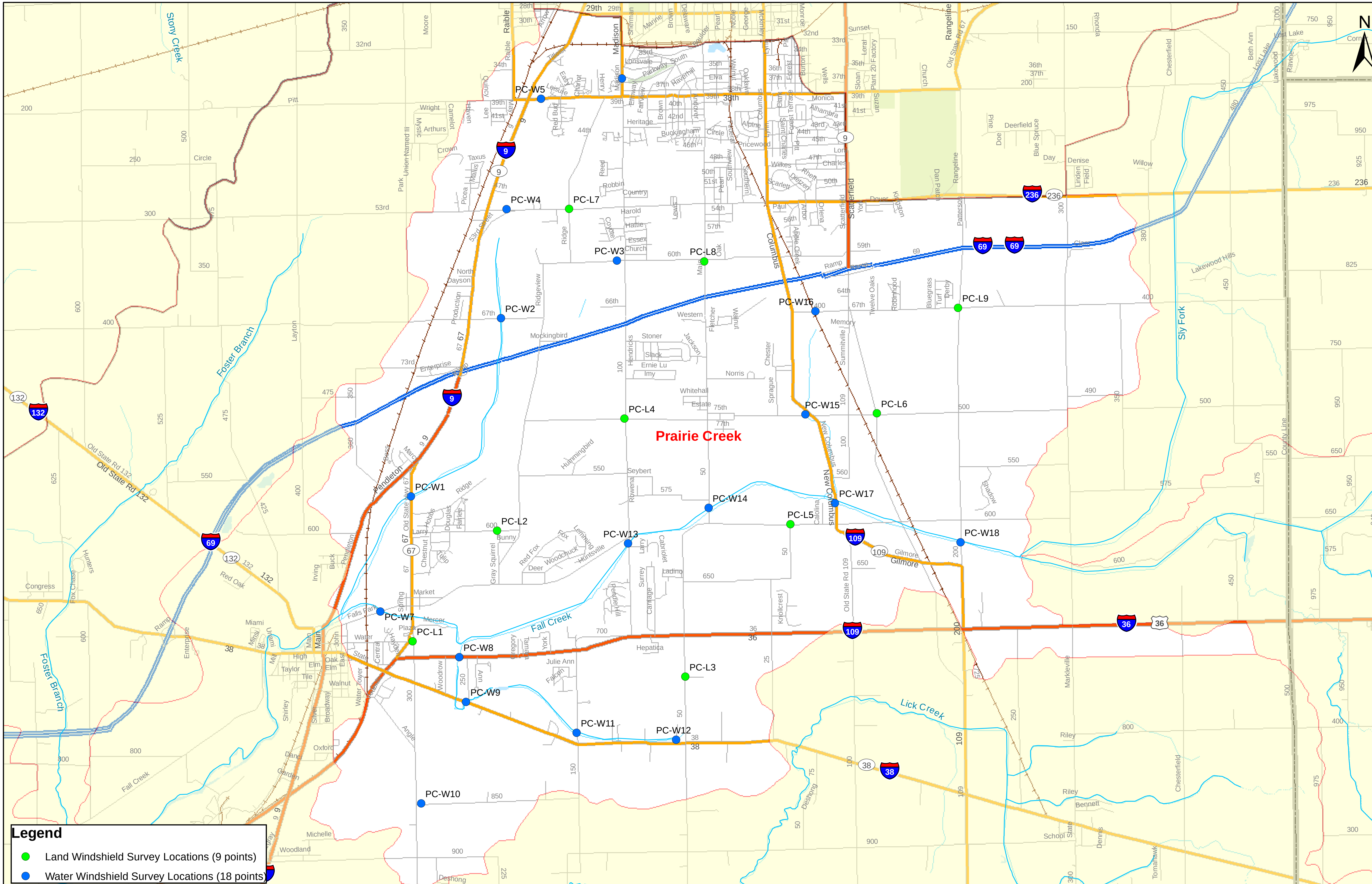


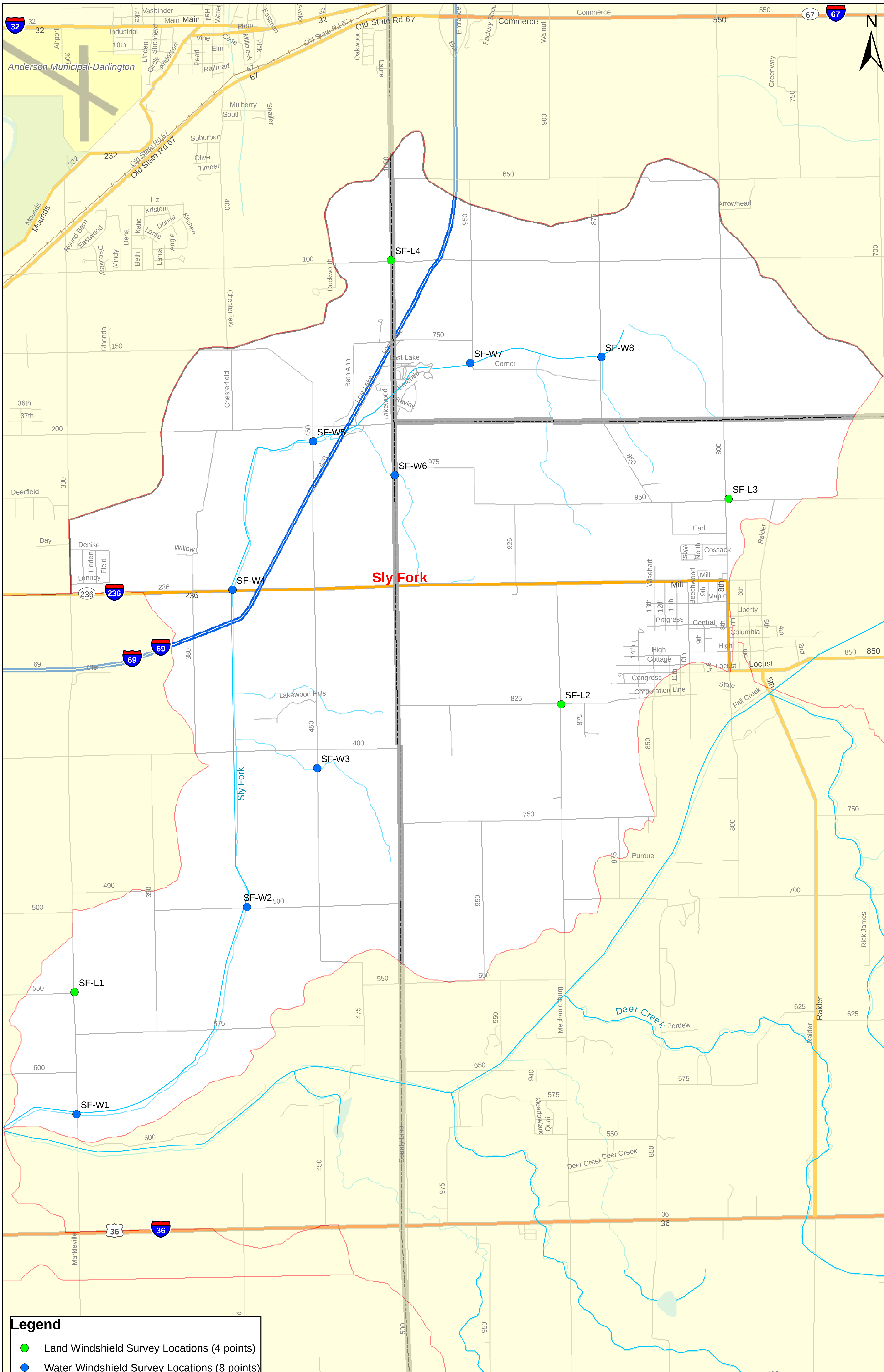
Foster Branch
FB-L1
FB-L2
FB-L3
FB-L4
FB-W1
FB-W2
FB-W3
FB-W4
FB-W5
FB-W6
FB-W7
Stony Creek
Fall Creek
Foster Branch
Old State Rd 132
Pendleton
Legend
Land Windshield Survey Locations (4 points)
Water Windshield Survey Locations (7 points)
N

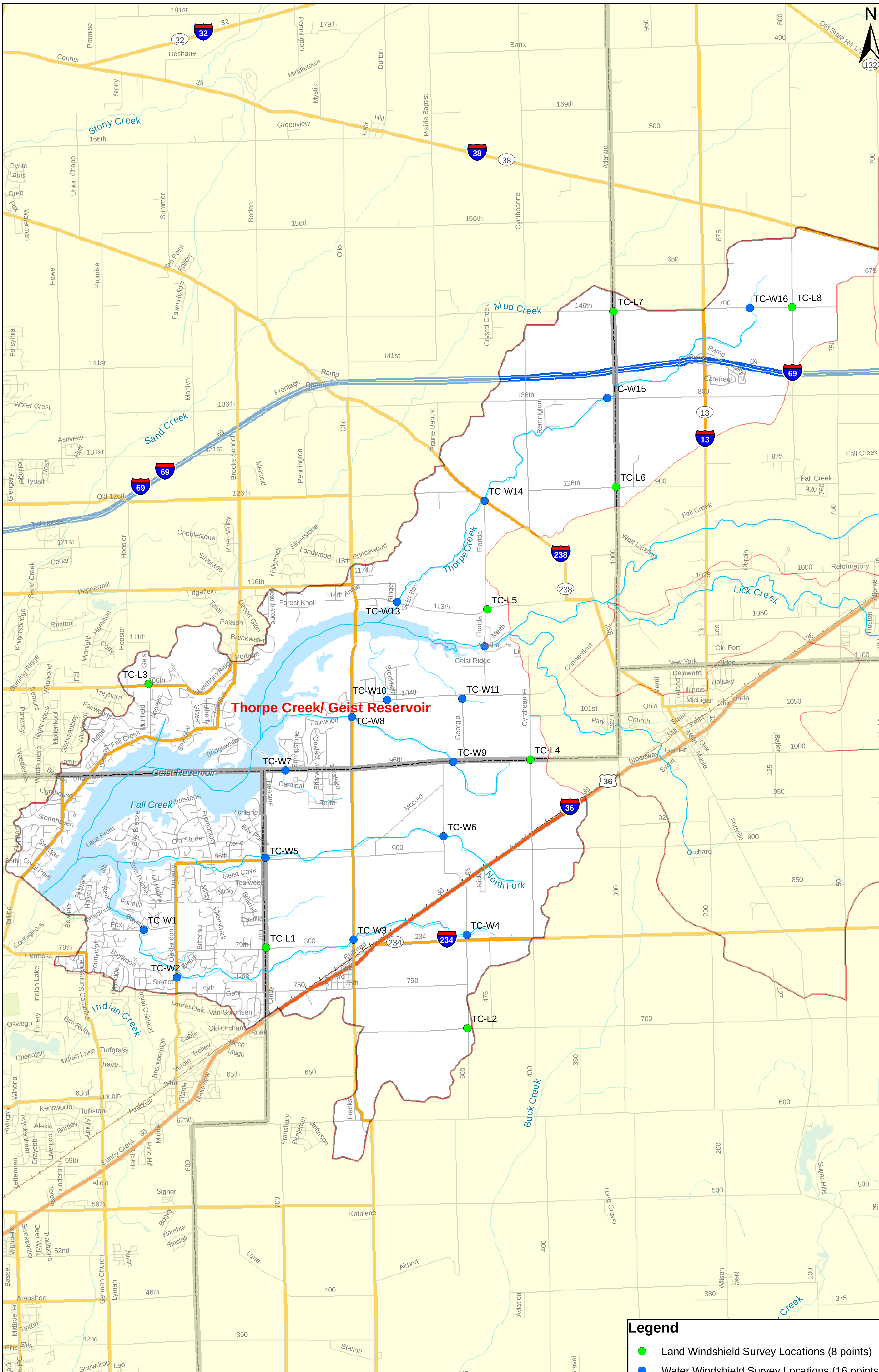

N
Honey Creek
HC-L1
HC-L2
HC-L3
HC-L4
HC-W1
HC-W2
HC-W3
HC-W4
HC-W5
HC-W6
HC-W7
HC-W8
Honey Creek
Sugar Creek
Deer Creek
Bell Creek
Fall Creek
Raider
Rick James
Valley View
Church
Spruce
Locust
Mill
8th
6th
5th
2nd
Liberty
Central
Columbia
High
State
Spring
Mulberry
Jefferson
Maple
Meridian
Sulphur Springs
Cadiz
36
950
900
850
800
750
725
700
675
650
625
600
575
525
500
450
425
400
350
300
Legend
Land Windshield Survey Locations (4 points)
Water Windshield Survey Locations (8 points)


Headwaters Lick Creek
N
LC-W1
LC-W2
LC-W3
LC-W4
LC-W5
LC-W6
LC-W7
LC-W8
LC-W9
LC-L1
LC-L2
LC-L3
LC-L4
LC-L5
Lick Creek
Fall Creek
Sly Fork
Legend
Land Windshield Survey Locations (5 points)
Water Windshield Survey Locations (9 points)


N
McFadden Ditch
MD-W1
MD-W2
MD-W3
MD-W4
MD-W5
MD-W6
MD-W7
MD-W8
MD-L1
MD-L2
MD-L3
MD-L4
Lick Creek
Foster Branch
Legend
Land Windshield Survey Locations (4 points)
Water Windshield Survey Locations (8 points)


Prairie Creek
N
Legend
Land Windshield Survey Locations (9 points)
Water Windshield Survey Locations (18 points)
PC-L1
PC-L2
PC-L3
PC-L4
PC-L5
PC-L6
PC-L7
PC-L8
PC-L9
PC-W1
PC-W2
PC-W3
PC-W4
PC-W5
PC-W7
PC-W8
PC-W9
PC-W10
PC-W11
PC-W12
PC-W13
PC-W14
PC-W15
PC-W16
PC-W17
PC-W18
Fall Creek
Lick Creek
Sly Fork
Foster Branch
Stony Creek


N
Sly Fork
SF-L1
SF-L2
SF-L3
SF-L4
SF-W1
SF-W2
SF-W3
SF-W4
SF-W5
SF-W6
SF-W7
SF-W8
Anderson Municipal-Darlington
Deer Creek
Legend
Land Windshield Survey Locations (4 points)
Water Windshield Survey Locations (8 points)


Thorpe Creek/ Geist Reservoir
Legend
Land Windshield Survey Locations (8 points)
Water Windshield Survey Locations (16 points)
N
TC-L1
TC-L2
TC-L3
TC-L4
TC-L5
TC-L6
TC-L7
TC-L8
TC-W1
TC-W2
TC-W3
TC-W4
TC-W5
TC-W6
TC-W7
TC-W8
TC-W9
TC-W10
TC-W11
TC-W13
TC-W14
TC-W15
TC-W16
Geist Reservoir
Fall Creek
Thorpe Creek
Mud Creek
Sand Creek
Stony Creek
Indian Creek
Lick Creek
Buck Creek
North Fork

Appendix I – NPDES/CFO Compliance

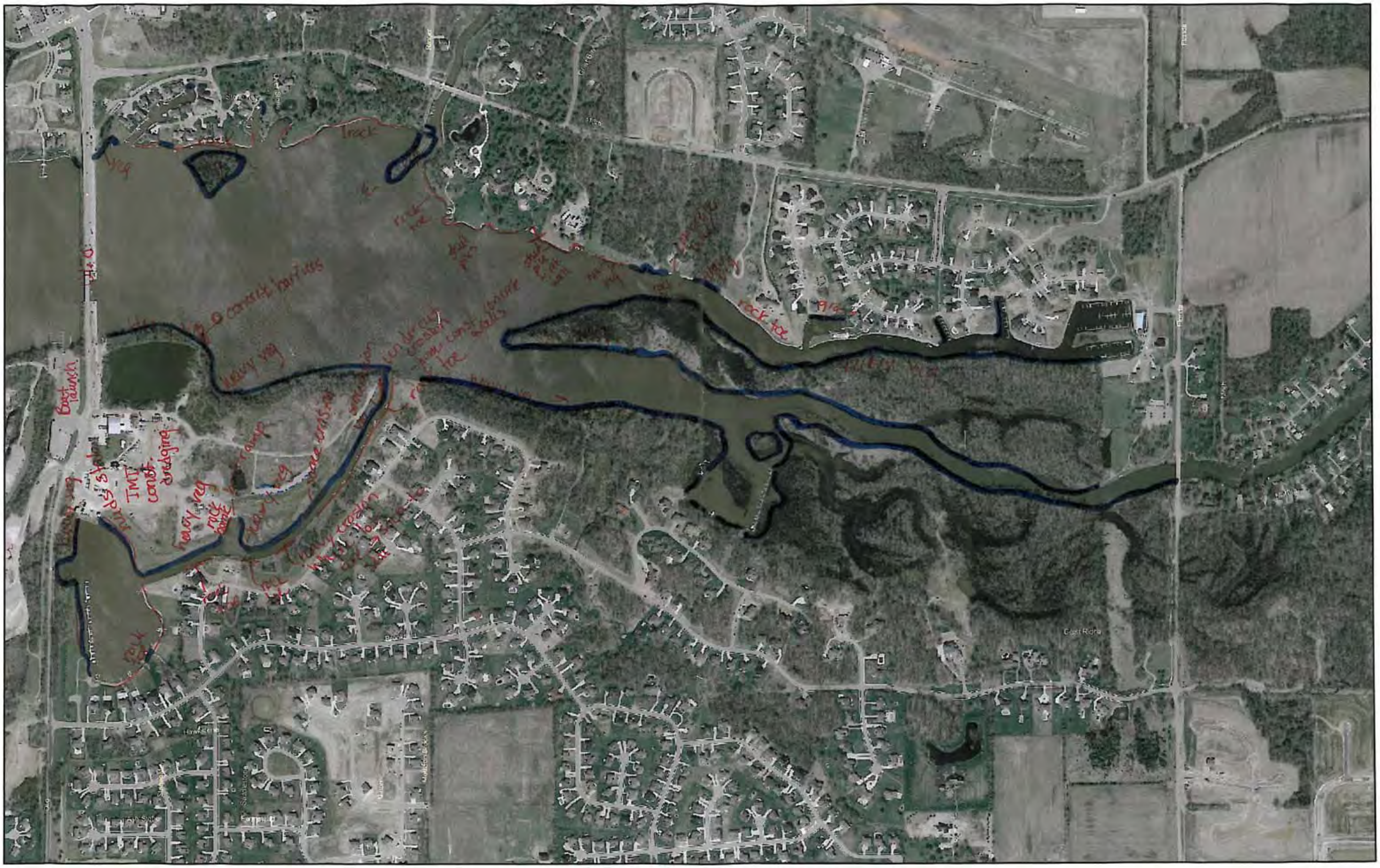
Compliance information for National Pollutant Discharge Elimination System (NPDES) permits and Confined Feeding Operations (CFO) was obtained from EPA's Enforcement and Compliance History Database and IDEM, respectively. Available information for each permit is provided on CD at the end of this report.

Appendix J – Reservoir Shoreline Investigation

V3 completed at Reservoir Shoreline Investigation of Morse Reservoir In June 2009, using both field observations and aerial photography. During the survey, areas of unprotected shoreline were identified in order to gain an understanding of where erosion may be a concern. An exhibit showing the areas of unprotected shoreline is included in this Appendix along with a copy of the field notes. Photographs taken during the field observations are provided on CD at the end of this report.

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

TITLE: **Geist Reservoir Shoreline Assesment**		PROJECT: **Geist Reservoir/Upper Fall Creek Watershed Management Plan**	
BASE LAYER: Indiana Data Spatial Portal 2006 Orthophotography	PROJECT NO.: 09006	EXHIBIT: X	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, IN 46206	QUADRANGLE: McCordsville	DATE: 6/11/09	SCALE: NTS



Geist Res.

N↑ 1" = 600'


concrete wall
condos
concrete wall
rock quarry? 80?
veg w/ concrete wall
steel piling
concrete wall
piling
heavy veg
Geist Res.
N↑
1"=600'

East Res.

N ↑ 1"=600'

Geist Res.

N↑ 1"=600'

Geist Res. N↑ 1"=600'

Appendix K – Nonpoint Source Modeling

The Spreadsheet Tool for Estimating Pollutant Load (STEPL) model was used to assess the nonpoint source pollution of three main pollutant parameters (Total Nitrogen, Total Phosphorus and Total Sediment) within the Geist Reservoir/Upper Fall Creek watershed. The model was executed for each HUC 12 subwatershed and a summary of the results is provided in this Appendix. The complete model and input information is provided on CD at the end of this report.

Input Data Collection and Assumptions
STEPL allows detailed input for land use, hydrologic soil groups, agricultural animals, septic systems and agricultural irrigation. Available data and the assumptions made for each input category are described below.

Subwatersheds
The subwatersheds were defined using the HUC12 (hydrologic unit code) watershed boundaries within the Upper Fall Creek Watershed.

Land Use
The National Land Cover Database (NLCD 2001) and 2008 aerial photography were used for land use information.

The NLCD 2001 for Indiana was obtained from the Indiana Geological Survey as raster data and converted into a shapefile for subwatershed analysis. The NLCD 2001 includes nineteen land classifications ranging from cultivated crops to high intensity developed land and forests to open water. STEPL allows input for six categories including one user defined option. Listed below are the available STEPL categories with the land classification distribution that was used for the preliminary modeling.

Urban: Developed, Open Space; Developed, Low Intensity; Developed, Medium Intensity; Developed, High Intensity
Cropland: Cultivated Crops
Pastureland: Grassland/Herbaceous; Pasture Hay
Forest: Deciduous Forest; Evergreen Forest; Shrub/Scrub
User Defined: Open Water; Woody Wetlands; Emergent Herbaceous Wetlands
Feedlots: N/A

In order to utilize the most current available data, the 2008 National Agricultural Imagery Program orthophotography was obtained for each county. These aerial images were compared to the NLCD 2001 in order to determine where changes in land use had occurred. Any changes were then incorporated into the STEPL model.

Hydrologic Soil Groups

The U.S. Department of Agriculture, Natural Resources Conservation Service Soil Survey database for was utilized to obtain hydrologic soil group information.

The hydrologic soil group for each soil classification within each subwatershed was determined. A value of one to four was assigned to each hydrologic group classification and a weighted average for the subwatershed was calculated. A value of one represents a soil group that is pervious and a value of four represents a soil group that is impervious.

Septic Systems

No information on the number of septic systems in the watershed was readily available. In order to include an estimate of the impact of failing septic systems on the nonpoint source pollution, population density information was obtained.

The U.S. Department of Commerce, U.S. Census Bureau Population Density 2000 database (as a shapefile) was obtained. The population density for each subwatershed was then used to obtain an estimate of the population within the subwatershed. STEPL assumes 2.43 people per septic system, using this assumption an estimate of the number of septic systems can be obtained. It was assumed that in the highest population density areas (greater than 500 persons per square kilometer), a sanitary sewer system was in place and no septic systems were included. A septic failure rate of 2% was assumed.

Agricultural Irrigation

No information for agricultural irrigation was readily available, so for the purposes of preliminary modeling, this optional STEPL input was not utilized.

STEPL Input Sheet: Values in RED are required input. Change worksheets by clicking on tabs at the bottom. You entered 9 subwatershed(s).

This sheet is composed of eight input tables. The first four tables require users to change initial values. The next four tables (initially hidden) contain default values users may choose to change.

Step 1: Select the state and county where your watersheds are located. Select a nearby weather station. This will automatically specify values for rainfall parameters in Table 1 and USLE parameters in Table 4.

Step 2: (a) Enter land use areas in acres in Table 1; (b) enter total number of agricultural animals by type and number of months per year that manure is applied to croplands in Table 2;
(c) enter values for septic system parameters in Table 3; and (d) if desired, modify USLE parameters associated with the selected county in Table 4.

Step 3: You may stop here and proceed to the BMPs sheet. If you have more detailed information on your watersheds, click the Yes button in row 10 to display optional input tables.

Step 4: (a) Specify the representative Soil Hydrologic Group (SHG) and soil nutrient concentrations in Table 5; (b) modify the curve number table by landuse and SHG in Table 6;
(c) modify the nutrient concentrations (mg/L) in runoff in Table 7; and (d) specify the detailed land use distribution in the urban area in Table 8.

Step 5: Select BMPs in BMPs sheet. **Step 6**: View the estimates of loads and load reductions in Total Load and Graphs sheets.

Show optional input tables? Yes No ☑ **Treat all the subwatersheds as parts of a single watershed** ☐ **Groundwater load calculation**

State: Indiana **County**: Madison **Weather Station (for rain correction factors)**: IN INDIANAPOLIS WSFO AP

1. Input watershed land use area (ac) and precipitation (in)

									Rain correction factors		
									0.870	0.417	
Watershed	Urban	Cropland	Pastureland	Forest	User Defined	Feedlots	Feedlot Percent Paved	Total	Annual Rainfall	Rain Days	Avg. Rain/Event
W1	946	8936	362	608	3	0	0-24%	10855	35.01	112.2	0.651
W2	1234	8343	882	821	56	0	0-24%	11336	35.01	112.2	0.651
W3	1361	13553	1451	1614	49	0	0-24%	18028	35.01	112.2	0.651
W4	6968	15051	1900	1206	244	0	0-24%	25369	35.01	112.2	0.651
W5	1015	11216	736	732	48	0	0-24%	13747	35.01	112.2	0.651
W6	1079	8095	575	303	45	0	0-24%	10097	35.01	112.2	0.651
W7	1006	8045	650	921	39	0	0-24%	10661	35.01	112.2	0.651
W8	3088	11976	1100	1450	244	0	0-24%	17858	35.01	112.2	0.651
W9	6393	11876	532	1362	1968	0	0-24%	22131	35.01	112.2	0.651

2. Input agricultural animals

Watershed	Beef Cattle	Dairy Cattle	Swine (Hog)	Sheep	Horse	Chicken	Turkey	Duck	# of months manure applied
W1	0	0	0	0	0	0	0	0	0
W2	0	0	0	0	0	0	0	0	0
W3	0	0	0	0	0	0	0	0	0
W4	0	0	0	0	0	0	0	0	0
W5	0	0	0	0	0	0	0	0	0
W6	0	0	0	0	0	0	0	0	0
W7	0	0	0	0	0	0	0	0	0
W8	0	0	0	0	0	0	0	0	0
W9	0	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0	

3. Input septic system and illegal direct wastewater discharge data

Watershed	No. of Septic Systems	Population per Septic System	Septic Failure Rate, %	Wastewater Direct Discharge, # of People	Direct Discharge Reduction, %
W1	0	2.43	2	0	0
W2	0	2.43	2	0	0
W3	0	2.43	2	0	0
W4	0	2.43	2	0	0
W5	0	2.43	2	0	0
W6	0	2.43	2	0	0
W7	0	2.43	2	0	0
W8	0	2.43	2	0	0
W9	0	2.43	2	0	0

4. Modify the Universal Soil Loss Equation (USLE) parameters

Watershed	Cropland					Pastureland					Forest					User Defined			
	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C	P	R	K	LS	C
W1	160.000	0.348	0.233	0.250	1.000	160.000	0.348	0.233	0.040	1.000	160.000	0.348	0.233	0.003	1.000	160.000	0.348	0.233	0.250
W2	160.000	0.348	0.233	0.250	1.000	160.000	0.348	0.233	0.040	1.000	160.000	0.348	0.233	0.003	1.000	160.000	0.348	0.233	0.250
W3	160.000	0.348	0.233	0.250	1.000	160.000	0.348	0.233	0.040	1.000	160.000	0.348	0.233	0.003	1.000	160.000	0.348	0.233	0.250
W4	160.000	0.348	0.233	0.250	1.000	160.000	0.348	0.233	0.040	1.000	160.000	0.348	0.233	0.003	1.000	160.000	0.348	0.233	0.250
W5	160.000	0.348	0.233	0.250	1.000	160.000	0.348	0.233	0.040	1.000	160.000	0.348	0.233	0.003	1.000	160.000	0.348	0.233	0.250
W6	160.000	0.348	0.233	0.250	1.000	160.000	0.348	0.233	0.040	1.000	160.000	0.348	0.233	0.003	1.000	160.000	0.348	0.233	0.250
W7	160.000	0.348	0.233	0.250	1.000	160.000	0.348	0.233	0.040	1.000	160.000	0.348	0.233	0.003	1.000	160.000	0.348	0.233	0.250
W8	160.000	0.348	0.233	0.250	1.000	160.000	0.348	0.233	0.040	1.000	160.000	0.348	0.233	0.003	1.000	160.000	0.348	0.233	0.250
W9	160.000	0.348	0.233	0.250	1.000	160.000	0.348	0.233	0.040	1.000	160.000	0.348	0.233	0.003	1.000	160.000	0.348	0.233	0.250

Optional Data Input:

5. Select average soil hydrologic group (SHG), SHG A = highest infiltration and SHG D = lowest infiltration

Watershed	SHG A	SHG B	SHG C	SHG D	SHG Selected	Soil N conc.%	Soil P conc.%	Soil BOD conc.%
W1					C	0.080	0.031	0.160
W2					C	0.080	0.031	0.160
W3					C	0.080	0.031	0.160

W4					C	0.080	0.031	0.160
W5					C	0.080	0.031	0.160
W6					C	0.080	0.031	0.160
W7					C	0.080	0.031	0.160
W8					C	0.080	0.031	0.160
W9					C	0.080	0.031	0.160

6. Reference runoff curve number (may be modified)

SHG	A	B	C	D
Urban	83	89	92	93
Cropland	67	78	85	89
Pastureland	49	69	79	84
Forest	39	60	73	79
User Defined	90	90	90	90

6a. Detailed urban reference runoff curve number (may be modified)

Urban\SHG	A	B	C	D
Commercial	89	92	94	95
Industrial	81	88	91	93
Institutional	81	88	91	93
Transportation	98	98	98	98
Multi-Family	77	85	90	92
Single-Family	57	72	81	86
Urban-Cultivate	67	78	85	89
Vacant-Develo	77	85	90	92
Open Space	49	69	79	84

7. Nutrient concentration in runoff (mg/l)

Land use	N	P	BOD
1. L-Cropland	**1.9**	**0.3**	**4**
1a. w/ manure	8.1	2	12.3
2. M-Cropland	**2.9**	**0.4**	**6.1**
2a. w/ manure	12.2	3	18.5
3. H-Cropland	**4.4**	**0.5**	**9.2**
3a. w/ manure	18.3	4	24.6
4. Pastureland	**4**	**0.3**	**13**
5. Forest	**0.2**	**0.1**	**0.5**
6. User Define	**0**	**0**	**0**

7a. Nutrient concentration in shallow groundwater (mg/l) (may be modified)

Landuse	N	P	BOD
Urban	1.5	0.063	0
Cropland	1.44	0.063	0
Pastureland	1.44	0.063	0
Forest	0.11	0.009	0
Feedlot	6	0.07	0
User-Defined	0	0	0

8. Input or modify urban land use distribution

Watershed	Urban Area (ac.)	Commercial %	Industrial %	Institutional %	Transportation %	Multi-Family %	Single-Family %	Urban-Cultivated %	Vacant (developed)	Open Space %	Total % Area
W1	946	15	10	10	10	10	30	5	5	5	100
W2	1234	15	10	10	10	10	30	5	5	5	100
W3	1361	15	10	10	10	10	30	5	5	5	100
W4	6968	15	10	10	10	10	30	5	5	5	100
W5	1015	15	10	10	10	10	30	5	5	5	100
W6	1079	15	10	10	10	10	30	5	5	5	100
W7	1006	15	10	10	10	10	30	5	5	5	100
W8	3088	15	10	10	10	10	30	5	5	5	100
W9	6393	15	10	10	10	10	30	5	5	5	100

9. Input irrigation area (ac) and irrigation amount (in)

Watershed	Total Cropland (ac)	Cropland: Acres Irrigated	Water Depth (in) per Irrigation - Before BMP	Water Depth (in) per Irrigation - After BMP	Irrigation Frequency (#/Year)
W1	8936	0	0	0	0
W2	8343	0	0	0	0
W3	13553	0	0	0	0
W4	15051	0	0	0	0
W5	11216	0	0	0	0
W6	8095	0	0	0	0
W7	8045	0	0	0	0
W8	11976	0	0	0	0
W9	11876	0	0	0	0

Input Ends Here.

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduction	%P Reduction	%BOD Reduction	%Sed Reduction
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
W1	52605.5	9732.2	123749.0	2328.6	0.0	0.0	0.0	0.0	52605.5	9732.2	123749.0	2328.6	0.0	0.0	0.0	0.0
W2	55091.1	9777.5	136237.0	2261.3	0.0	0.0	0.0	0.0	55091.1	9777.5	136237.0	2261.3	0.0	0.0	0.0	0.0
W3	85461.8	15268.7	205507.0	3568.6	0.0	0.0	0.0	0.0	85461.8	15268.7	205507.0	3568.6	0.0	0.0	0.0	0.0
W4	132347.6	22581.7	372541.3	4834.5	0.0	0.0	0.0	0.0	132347.6	22581.7	372541.3	4834.5	0.0	0.0	0.0	0.0
W5	66787.2	12201.2	156992.5	2918.5	0.0	0.0	0.0	0.0	66787.2	12201.2	156992.5	2918.5	0.0	0.0	0.0	0.0
W6	50697.9	9152.2	122888.7	2161.8	0.0	0.0	0.0	0.0	50697.9	9152.2	122888.7	2161.8	0.0	0.0	0.0	0.0
W7	50625.8	9148.4	122507.1	2142.0	0.0	0.0	0.0	0.0	50625.8	9148.4	122507.1	2142.0	0.0	0.0	0.0	0.0
W8	86759.8	15355.0	225822.0	3477.0	0.0	0.0	0.0	0.0	86759.8	15355.0	225822.0	3477.0	0.0	0.0	0.0	0.0
W9	105370.2	18787.0	299088.5	4343.3	0.0	0.0	0.0	0.0	105370.2	18787.0	299088.5	4343.3	0.0	0.0	0.0	0.0
Total	685747.0	122003.8	1765333.0	28035.6	0.0	0.0	0.0	0.0	685747.0	122003.8	1765333.0	28035.6	0.0	0.0	0.0	0.0

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	150398.57	23230.99	585077.79	3452.80
Cropland	476967.68	92449.42	996198.68	23583.14
Pastureland	53958.16	4362.81	174090.02	318.50
Forest	2327.03	1153.84	5775.49	26.31
Feedlots	0.00	0.00	0.00	0.00
User Defined	2095.52	806.78	4191.05	654.85
Septic	0.00	0.00	0.00	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	685746.95	122003.84	1765333.03	28035.60

Appendix L – Education and Outreach Menu

Electronic Communication & Technology

- Watershed Project Website
- Web-based Resources Center (target audience focus)
- Email distribution lists
- Facebook, Twitter & blogs
- Interactive "Ask the Expert" Q&A web-posts

Mass Media

- Media advertisements (TV and radio spots)
- Newspaper releases
- Public service announcements (PSAs)

Events

- Local festival participation (fall festivals, parades, run/walks, etc.)
- Rotational speaking engagements (Rotary, Chamber, etc.)
- Host Water Quality Awareness Days/Make a Splash (school or community oriented)
- Host workshops for citizens, other target audiences
  - Partner with other organizations (i.e. UWRWA, Green Indy, Indiana Living Green, Indiana Lakes Management Society, Hoosier Riverwatch, etc.)
  - Partner with Project WET, Project WILD, Go Fishin, and Project Learning Tree to reach teachers
- Host field days
  - Agricultural
  - Stormwater
  - Residential ('Extreme Home Makeovers')
  - Septic maintenance
- Storm Drain Stenciling
  - Partner with MS4, schools, Boy Scouts, Girl Scouts…etc.
  - Create/distribute door hanger for houses in area of stenciling
- Reservoir/creek side clean-up days
- Educational float trips
- Promote Waste Collection Day
  - Partner with Solid Waste Mgmt Districts (SWMD) for Household Hazardous Waste Days
- Partner with Health Department or SWMD to conduct prescription drug drop offs
- Public Meeting (topical guest speakers)
- Engage active Riverwatch and Clean Lakes Program volunteers in regular monitoring

Material Development/Distribution

- Brochures and fact sheets (make available to Steering Committee and partners)
  - Watershed specific stats/info
  - Septic Care and Maintenance

- Interpretive signs at BMP sites
- Utility bill inserts (coordinate with MS4)
- Educational Displays (use at festivals, fairs, empty store fronts, libraries, municipalities, etc.)
- Newsletter articles (submit to SWCD's, Business, HOAs, At Geist, etc.)
- Watershed project specific newsletter
- Technical graphics for lay public for use in presentation, newsletter, etc.
- Standardized presentation for anyone to deliver
- Residential "How To" manuals for BMPs (filter strips, rain gardens, etc.)
- Press kits (including background info, digital pictures, contact info, additional resource references, etc.)
- Kids Activity Books (Project Wet or similar programs)

Outreach Staff/Technical Resources

- Use of local agricultural liaison, one on one with farmers selling practices
- Full-time watershed coordinator speaking to community and media
- Engaging Veolia media resources (or others such as IUPUI, local canoe liveries, Kroger, etc.)
- Utilize Mayor's Neighborhood Liaisons
- Utilizing SWCD staff and their events

HIGHLY ERODIBLE LAND of Hamilton COUNTY, INDIANA

- HIGHLY ERODIBLE LAND CLASSES -
1 = HIGHLY ERODIBLE LAND
2 = POTENTIALLY HIGHLY ERODIBLE
3 = NOT HIGHLY ERODIBLE

HIGHLY ERODIBLE AND POTENTIALLY HIGHLY ERODIBLE LAND CACULATOR VER 1.1

MUID	MAP SYMBOL	SOIL NAME		%	WIND EROSION: C VALUE	WIND EROSION: I VALUE	WIND EROSION: HEL CLASS	WATER EROSION: R VALUE	K VALUE	T VALUE	SLOPE-PERCEN MIN.	SLOPE-PERCEN MAX.	SLOPE--LENGTH MIN.	SLOPE--LENGTH MAX.	LS-VALUE MIN.	LS-VALUE MAX.	8T/RK	HEL CLASS
********	******	*****************	*	***	*****	******	*****	******	******	*****	******	*****	******	******	*****	*****	*****	****
057BR	BR	BROOKSTON	1	100		38	ERROR	180	0.28	5	0	2	0	400	0.000	0.304	0.794	3
057CRA	CRA	CROSBY	1	100		56	ERROR	180	0.43	3	0	3	0	375	0.000	0.426	0.310	2
057FNA	FNA	FOX	1	100		56	ERROR	180	0.37	4	0	2	0	300	0.000	0.279	0.480	3
057FNB2	FNB2	FOX	1	100		56	ERROR	180	0.37	4	2	6	60	250	0.172	1.063	0.480	2
057FXC3	FXC3	FOX	1	100		48	ERROR	180	0.32	3	8	18	30	100	0.543	3.434	0.417	1
057GE	GE	GENESEE	1	100		56	ERROR	180	0.37	5	0	2	0	400	0.000	0.304	0.601	3
057HEF	HEF	HENNEPIN	1	100		56	ERROR	180	0.32	3	18	50	50	150	2.428	21.829	0.417	1
057HO	HO	HOUGHTON	1	100		134	ERROR	180	0.10	5	0	2	50	150	0.060	0.227	2.222	3
057MMA	MMA	MIAMI	1	100		56	ERROR	180	0.37	4	0	2	0	300	0.000	0.279	0.480	3
057MMB2	MMB2	MIAMI	1	100		56	ERROR	180	0.37	4	2	6	40	275	0.152	1.115	0.480	2
057MMC2	MMC2	MIAMI	1	100		56	ERROR	180	0.37	4	6	12	30	150	0.368	2.209	0.480	2
0'	MMD2	MIAMI	1	100		56	ERROR	180	0.37	4	12	18	30	150	0.988	4.205	0.480	1
0.	MOC3	MIAMI	1	100		48	ERROR	180	0.37	3	6	12	40	200	0.425	2.551	0.360	1
057MOD3	MOD3	MIAMI	1	100		48	ERROR	180	0.37	3	12	18	30	150	0.988	4.205	0.360	1
057MXA	MXA	MILTON VARIANT	1	100		48	ERROR	180	0.37	5	0	2	0	250	0.000	0.264	0.601	3
057NNA	NNA	NINEVEH	1	100		56	ERROR	180	0.28	4	0	2	0	250	0.000	0.264	0.635	3
057OCA	OCA	OCKLEY	1	100		56	ERROR	180	0.37	5	0	2	0	300	0.000	0.279	0.601	3
057OCB2	OCB2	OCKLEY	1	100		56	ERROR	180	0.37	5	2	6	30	250	0.140	1.063	0.601	2
057PA	PA	PALMS	1	100		86	ERROR	180	0.10	5	0	2	50	150	0.060	0.227	2.222	3
057PN	PN	PATTON	1	100		38	ERROR	180	0.28	5	0	2	0	400	0.000	0.304	0.794	3
057PS	PS	PATTON	1	100		38	ERROR	180	0.28	5	0	2	0	400	0.000	0.304	0.794	3
057PT	PT	PITS	1	100			ERROR	180	0.17	5	0	45	50	150	0.060	18.616	1.307	2
057RA	RA	RANDOLPH VARIANT	1	100		56	ERROR	180	0.43	5	0	3	0	375	0.000	0.426	0.517	3
057RO	RO	ROSS	1	100		56	ERROR	180	0.32	5	0	2	0	300	0.000	0.279	0.694	3
057SH	SH	SHOALS	1	100		56	ERROR	180	0.37	5	0	2	0	275	0.000	0.272	0.601	3
057ST	ST	SLEETH	1	100		56	ERROR	180	0.32	5	0	2	0	250	0.000	0.264	0.694	3
057SX	SX	SLOAN	1	100			ERROR	180	0.28	5	0	2	0	200	0.000	0.247	0.794	3
057WE	WE	WESTLAND	1	100			ERROR	180	0.28	5	0	2	0	275	0.000	0.272	0.794	3
057WH	WH	WHITAKER	1	100			ERROR	180	0.37	5	0	2	0	200	0.000	0.247	0.601	3

035MWC3	MWC3	MORLEY	1	100	ERROR	160	0.37	3	6	12	50	250	0.475	2.852	0.405	1
[illegible]A	OCA	OCKLEY	1	100	ERROR	160	0.37	5	0	2	100	400	0.069	0.304	0.676	3
[illegible]B	OCB	OCKLEY	1	100	ERROR	160	0.37	5	2	6	100	350	0.261	1.258	0.676	2
[illegible]SPE	PE	PEWAWO	1	100	ERROR	160	0.28	5	0	2	100	400	0.069	0.304	0.893	3
035PF	PF	PEWAWO	1	100	ERROR	160	0.28	5	0	2	100	400	0.069	0.304	0.893	3
035PK	PK	PEWAWO	1	60	ERROR	160	0.24	5	0	2	100	300	0.069	0.279	1.042	3
035PK	PK	BROOKSTON	2	35	ERROR	160	0.28	5	0	2	100	300	0.069	0.279	0.893	3
035RC	RC	RENSSELAER	1	100	ERROR	160	0.32	5	0	2	100	400	0.069	0.304	0.781	3
035RO	RO	ROSS	1	100	ERROR	160	0.32	5	0	2	100	350	0.069	0.292	0.781	3
035SE	SE	SEBEWA	1	100	ERROR	160	0.26	4	0	2	100	400	0.069	0.304	0.714	3
035SH	SH	SHOALS	1	100	ERROR	160	0.37	5	0	2	100	400	0.069	0.304	0.676	3
035SN	SN	SLOAN	1	100	ERROR	160	0.28	5	0	2	100	400	0.069	0.304	0.893	3
035WA	WA	WALLKILL	1	100	ERROR	160	0.37	5	0	2	100	250	0.069	0.264	0.676	3

Bes Put in tech guide addition Hancock CO

7-90 From FSA Review - Bjm

HIGHLY ERODIBLE LAND of Hancock COUNTY, INDIANA

- HIGHLY ERODIBLE LAND CLASSES -
1 = HIGHLY ERODIBLE LAND
2 = POTENTIALLY HIGHLY ERODIBLE
3 = NOT HIGHLY ERODIBLE

HIGHLY ERODIBLE AND POTENTIALLY HIGHLY ERODIBLE LAND CACULATOR VER 1.1

					WIND EROSIION			WATER EROSION											
MUID	MAP SYMBOL	SOIL NAME	A	%	C VALUE	I VALUE	HEL CLASS	R VALUE	K VALUE	T VALUE	SLOPE- MIN.	PERCEN MAX.	SLOPE--LENGTH MIN.	MAX.	LS- MIN.	VALUE MAX.	8T/RK	HEL CLASS
05900020	20	GRAVEL PITS	1	100			ERROR	180	0.24	3	0	– 25	10	— 100	0.044	5.890	0.556	2
059BR	BR	BROOKSTON	1	100		38	ERROR	180	0.28	5	0	.5 2	0	200 200	0.000	0.247	0.794	3
059CRA	CRA	CROSBY	1	100		56	ERROR	180	0.43	3	0	2 3	0	150 200	0.000	0.353	0.310	2 3
059EE	EE	EEL	1	100		56	ERROR	130	0.37	5	0	.5 2	0	200 150	0.000	0.227	0.601	3
059GE	GE	GENESEE	1	100		56	ERROR	180	0.37	5	0	.5 2	0	250 175	0.000	0.237	0.601	3
059KO	KO	KOKOMO	1	100		86	ERROR	180	0.32	5	0	.2 2	0	250 200	0.000	0.247	0.694	3
059MAA	MAA	MARTINSVILLE	1	100		56	ERROR	180	0.37	5	0	1 2	0	150 200	0.000	0.247	0.601	3
059MAB2	MAB2	*MARTINSVILLE	1	100		56	ERROR	180	0.37	5	2	4 6	100	130 200	0.201	0.951	0.601	2 3
059MMA	MMA	MIAMI	1	100		56	ERROR	180	0.37	4	0	1 2	0	150 200	0.000	0.247	0.480	3
059MMB2	MMB2	MIAMI	1	100		56	ERROR	180	0.37	4	2	5 6	100	100 200	0.201	0.951	0.480	2 1
059MMC2	MMC2	MIAMI	1	100		56	ERROR	180	0.37	4	6	8 12	50	100 175	0.475	2.386	0.480	2 1
059MMD2	MMD2	MIAMI	1	100		56	ERROR	180	0.37	4	12	14 18	75	75 175	1.562	4.542	0.480	1
059MPC3	MPC3	MIAMI	1	55		48	ERROR	180	0.37	3	6	8 12	75	100 250	0.582	2.852	0.360	1
[illegible]3	MPD3	MIAMI	1	40		48	ERROR	180	0.37	3	12	14 18	100	75 200	1.804	4.856	0.360	1
05[illegible]	MR	MILFORD	1	100		86	ERROR	180	0.28	5	0	.5 2	0	200 100	0.000	0.201	0.794	3
059OCA	OCA	OCKLEY	1	100		56	ERROR	180	0.37	5	0	1 2	0	200 200	0.000	0.247	0.601	3
059OCB2	OCB2	OCKLEY	1	100		56	ERROR	180	0.37	5	2	4 6	50	150 150	0.163	0.823	0.601	2
059OKC2	OKC2	OCKLEY	1	45		56	ERROR	180	0.37	5	6	8 12	50	160 150	0.475	2.209	0.601	2 1
059PA	PA	PALMS	1	100		86	ERROR	180	0.10	5	0	.2 2	200 50	150	0.060	0.227	2.222	3
059RE	RE	RENSSELAER	1	100		48	ERROR	180	0.32	5	0	.5 2	0	250 125	0.000	0.215	0.694	3
059SH	SH	SHOALS	1	100		56	ERROR	180	0.37	5	0	.5 2	0	150 150	0.000	0.227	0.601	3
059SO	SO	SLOAN	1	100		48	ERROR	180	0.28	5	0	.5 2	0	150 150	0.000	0.227	0.794	3
059WE	WE	WESTLAND	1	100			ERROR	180	0.28	5	0	.5 2	0	250 150	0.000	0.227	0.794	3
059WH	WH	WHITAKER	1	100			ERROR	180	0.37	5	0	1 2	0	200 125	0.000	0.215	0.601	3

* Highlighted soils are HEL

New List

10-14-88

095MNA	MNA	MIAMI	1	100	56ERROR	160	0.37	4	0	2	100	400	0.069	0.304	0.541	3
095MNB2	MNB2	MIAMI	1	100	56ERROR	160	0.37	4	2	6	75	350	0.184	1.256	0.541	[illegible] 3
[illegible]C2	MNC2	MIAMI	1	100	56ERROR	160	0.37	4	6	12	50	300	0.475	3.124	0.541	[illegible] /
[illegible]ND2	MND2	MIAMI	1	100	56ERROR	160	0.37	4	12	18	50	250	1.275	5.429	0.541	1
095MNE2	MNE2	MIAMI	1	100	56ERROR	160	0.37	4	18	25	50	200	2.428	8.330	0.541	1
095MPB3	MPB3	MIAMI	1	100	48ERROR	160	0.37	3	2	6	50	300	0.163	1.164	0.405	[illegible] /
095MPC3	MPC3	MIAMI	1	100	48ERROR	160	0.37	3	6	12	50	250	0.475	2.652	0.405	1
095MPD3	MPD3	MIAMI	1	100	48ERROR	160	0.37	3	12	18	50	200	1.275	4.656	0.405	1
095MPE3	MPE3	MIAMI	1	100	48ERROR	160	0.37	3	18	25	50	150	2.428	7.214	0.405	1
095MRB2	MRB2	MORLEY	1	100	48ERROR	160	0.37	4	2	6	50	300	0.163	1.164	0.541	[illegible] /
095MRC2	MRC2	MORLEY	1	100	48ERROR	160	0.37	4	6	12	50	250	0.475	2.852	0.541	[illegible] /
095MRD	MRD	MORLEY	1	100	48ERROR	160	0.43	4	12	18	50	250	1.275	5.429	0.465	1
095MSB3	MSB3	MORLEY	1	100	38ERROR	160	0.37	3	2	6	50	350	0.163	1.258	0.405	[illegible] /
095MSC3	MSC3	MORLEY	1	100	38ERROR	160	0.37	3	6	12	50	200	0.475	2.551	0.405	1
095MSD3	MSD3	MORLEY	1	100	ERROR	160	0.37	3	12	18	50	250	1.275	5.429	0.405	1
095OCA	OCA	OCKLEY	1	100	56ERROR	160	0.37	5	0	2	100	400	0.069	0.304	0.676	3
095OCB	OCB	OCKLEY	1	100	56ERROR	160	0.37	5	2	6	75	325	0.184	1.212	0.676	[illegible] 3
095PC	PC	PEWAMO	1	100	48ERROR	160	0.28	5	0	2	100	400	0.069	0.304	0.893	3
095RDE2	RDE2	RODMAN	1	100	0ERROR	160	0.20	3	12	50	50	150	1.275	21.829	0.750	1
095RO	RO	ROSS	1	100	56ERROR	160	0.32	5	0	2	100	350	0.069	0.292	0.781	3
095RS	RS	ROSS	1	100	56ERROR	160	0.32	5	0	2	100	350	0.069	0.292	0.781	3
095SH	SH	SHOALS	1	100	56ERROR	160	0.37	5	0	2	100	350	0.069	0.292	0.676	3
095SL	SL	SLEETH	1	100	56ERROR	160	0.32	5	0	2	100	400	0.069	0.304	0.781	3
095SM	SM	SLEETH	1	100	56ERROR	160	0.32	5	0	2	100	400	0.069	0.304	0.791	3
095SO	SO	SLOAN	1	100	48ERROR	160	0.80	5	0	2	100	350	0.069	0.292	0.313	3
095WA	WA	WALLKILL	1	100	ERROR	160	0.37	5	0	2	75	250	0.065	0.264	0.676	3
095WC	WC	WASHTENAW	1	100	56ERROR	160	0.37	5	0	2	75	250	0.065	0.264	0.676	3
095WD	WD	WESTLAND	1	100	38ERROR	160	0.28	5	0	2	125	400	0.072	0.304	0.893	3
[illegible]	WS	WESTLAND	1	100	38ERROR	160	0.28	5	0	2	125	400	0.072	0.304	0.893	3

Henry

- HIGHLY ERODIBLE LAND CLASSES -
1 = HIGHLY ERODIBLE LAND
2 = POTENTIALLY HIGHLY ERODIBLE
3 = NOT HIGHLY ERODIBLE ! WIND EROSION !

HIGHLY ERODIBLE AND
POTENTIALLY HIGHLY ERODIBLE
LAND CACULATOR VER 1.1
WATER EROSION

MUID	MAP SYMBOL	SOIL NAME		%	C VALUE	I VALUE	HEL CLASS	R VALUE	K VALUE	T VALUE	SLOPE-PERCEN MIN.	SLOPE-PERCEN MAX.	SLOPE—LENGTH MIN.	SLOPE—LENGTH MAX.	LS-VALUE MIN.	LS-VALUE MAX.	ST/RK	HEL CLASS
********	******	****************	*	***	*****	******	*****	******	******	*****	******	*****	******	******	*****	*****	*****	****
065CEB2	CEB2	CELINA	1	100		48	ERROR	160	0.37	5	1	6	50	250	0.105	1.063	0.676	2
065CFB2	CFB2	CELINA	1	100		48	ERROR	160	0.37	5	1	6	50	250	0.105	1.063	0.676	2
065CRA	CRA	CROSBY	1	100		56	ERROR	160	0.43	3	0	3	25	360	0.053	0.421	0.349	2
065CSA	CSA	CROSBY	1	100		56	ERROR	160	0.37	3	0	3	25	360	0.053	0.421	0.405	2
065CY	CY	CYCLONE	1	100		38	ERROR	160	0.28	5	0	1	0	360	0.000	0.189	0.893	3
065EDA	EDA	ELDEAN	1	100		56	ERROR	160	0.37	4	0	2	0	400	0.000	0.221	0.541	3
065EDB2	EDB2	ELDEAN	1	100		56	ERROR	160	0.37	4	2	6	50	350	0.163	1.258	0.541	2
065EDC2	EDC2	ELDEAN	1	100		56	ERROR	160	0.37	4	6	12	35	300	0.398	3.124	0.541	2
065EDD2	EDD2	ELDEAN	1	100		56	ERROR	160	0.37	4	12	18	30	180	0.988	4.607	0.541	1
0[illegible]E2	EDE2	ELDEAN	1	100		56	ERROR	160	0.37	4	18	35	30	180	1.881	13.714	0.541	1
0[illegible]C3	EXC3	ELDEAN	1	100		48	ERROR	160	0.32	3	6	12	35	300	0.398	3.124	0.405	2
[illegible]XD3	EXD3	ELDEAN	1	100		48	ERROR	160	0.32	3	12	18	30	220	0.988	5.093	0.405	1
[illegible]GE	GE	GENESEE	1	100		56	ERROR	160	0.37	5	0	1	0	400	0.000	0.195	0.676	3
065LA	LA	LANDES	1	100		56	ERROR	160	0.32	4	0	1	0	400	0.000	0.195	0.625	3
065LEB2	LEB2	LOSANTVILLE	1	100		48	ERROR	160	0.37	3	2	6	50	350	0.163	1.258	0.405	2
065LEC2	LEC2	LOSANTVILLE	1	100		48	ERROR	160	0.37	3	6	12	35	280	0.398	3.018	0.405	2
065LED2	LED2	LOSANTVILLE	1	100		48	ERROR	160	0.37	3	12	18	30	200	0.988	4.856	0.405	1
065LEE2	LEE2	LOSANTVILLE	1	100		48	ERROR	160	0.37	3	18	30	30	160	1.881	10.670	0.405	1
065LHC3	LHC3	LOSANTVILLE	1	100		48	ERROR	160	0.37	2	6	12	35	250	0.398	2.852	0.270	1
065LHD3	LHD3	LOSANTVILLE	1	100		48	ERROR	160	0.37	2	12	18	30	200	0.988	4.856	0.270	1
065LSB2	LSB2	LOSANTVILLE	1	100		48	ERROR	160	0.37	3	2	6	50	300	0.163	1.164	0.405	2
065LSC2	LSC2	LOSANTVILLE	1	100		48	ERROR	160	0.37	3	6	12	35	250	0.398	2.852	0.405	2
065LSD2	LSD2	LOSANTVILLE	1	100		48	ERROR	160	0.37	3	12	18	30	180	0.988	4.607	0.405	1
065LSE2	LSE2	LOSANTVILLE	1	100		48	ERROR	160	0.37	3	18	30	30	120	1.881	8.712	0.405	1
065LXC3	LXC3	LOSANTVILLE	1	100		48	ERROR	160	0.37	2	6	12	35	280	0.398	3.018	0.270	1
065LXD3	LXD3	LOSANTVILLE	1	100		48	ERROR	160	0.37	2	12	18	30	200	0.988	4.856	0.270	1
065MA	MA	MARTISCO	1	100		134	ERROR	160	0.01	3	0	1	25	125	0.053	0.138	15.000	3
065MLA	MLA	MIAMI	1	100		48	ERROR	160	0.37	5	0	2	50	400	0.060	0.304	0.676	3
065MLB2	MLB2	MIAMI	1	100		48	ERROR	160	0.37	5	1	6	50	300	0.105	1.164	0.676	2
065MMB2	MMB2	MIAMIAN	1	100		48	ERROR	160	0.37	5	2	6	50	300	0.163	1.164	0.676	2
065MOB2	MOB2	MIAMIAN	1	100		48	ERROR	160	0.37	5	2	6	50	325	0.163	1.212	0.676	2
065MX	MX	MILLGROVE	1	100		48	ERROR	160	0.24	4	0	2	0	150	0.000	0.227	0.833	3
065OT	OT	ORTHENTS	1	50			ERROR	160	0.37	2	0	40	25	200	0.053	17.893	0.270	2
065OT	OT	AQUENTS	2	50			ERROR	160	0.28	5	0	2	50	400	0.060	0.304	0.893	3
065PT	PT	PITS	1	160			ERROR	160	0.37	2	0	50	25	250	0.053	28.181	0.270	2
065SG	SG	SHOALS	1	100		56	ERROR	160	0.37	5	0	3	0	180	0.000	0.342	0.676	3
[illegible]	SK	SLEETH	1	100		56	ERROR	160	0.32	5	0	2	0	150	0.000	0.227	0.781	3
[illegible]SN	SN	SLOAN	1	100		48	ERROR	160	0.28	5	0	3	0	180	0.000	0.342	0.893	3
[illegible]65TS	TS	TREATY	1	100		48	ERROR	160	0.32	5	0	1	0	125	0.000	0.138	0.781	3
065WB	WB	WASHTENAW	1	100		56	ERROR	160	0.37	5	0	3	0	180	0.000	0.342	0.676	3
065WE	WE	WESTLAND	1	100		48	ERROR	160	0.28	5	0	3	0	180	0.000	0.342	0.893	3

[illegible] Page 1

Delaware

Only List they have

- HIGHLY ERODIBLE LAND CLASSES -
1 = HIGHLY ERODIBLE LAND
2 = POTENTIALLY HIGHLY ERODIBLE
3 = NOT HIGHLY ERODIBLE

HIGHLY ERODIBLE AND
POTENTIALLY HIGHLY ERODIBLE
LAND CACULATOR VER 1.1

MUID	MAP SYMBOL	SOIL NAME	#	%	WIND EROSION C VALUE	I VALUE	HEL CLASS	WATER EROSION R VALUE	K VALUE	T VALUE	SLOPE-PERCENT MIN.	MAX.	SLOPE--LENGTH MIN.	MAX.	LS-VALUE MIN.	MAX	ST/RK	HEL CLASS
035BLA	BLA	BLOUNT	1	100			ERROR	160	0.43	3	0	2	100	350	0.065	0.292	0.349	3
035BLB	BLB	BLOUNT	1	100			ERROR	160	0.43	3	2	4	100	350	0.201	0.633	0.349	2
035BLB2	BLB2	BLOUNT	1	100			ERROR	160	0.43	3	2	4	50	250	0.163	0.577	0.349	2
035BP	BP	BORROW PITS	1	100			ERROR	160	0.37	3	5	80	50	200	0.375	47.293	0.465	2
035BR	BR	BROOKSTON	1	100			ERROR	160	0.28	5	0	2	100	400	0.069	0.304	0.893	3
035BS	BS	BROOKSTON	1	100			ERROR	160	0.28	5	0	2	100	400	0.069	0.304	0.893	3
035CA	CA	CARLISLE	1	100			ERROR	160	0.01	5	0	1	100	400	0.069	0.199	25.000	3
035CRA	CRA	CROSBY	1	100			ERROR	160	0.43	3	0	2	100	400	0.069	0.304	0.349	3
035CSA	CSA	CROSBY	1	100			ERROR	160	0.37	3	0	2	100	300	0.069	0.279	0.465	3
035FOC2	FOC2	FOX	1	100			ERROR	160	0.37	4	6	12	50	200	0.475	2.551	0.541	2
035FOD2	FOD2	FOX	1	100			ERROR	160	0.37	4	12	18	50	150	1.275	4.265	0.541	1
035FSA	FSA	FOX	1	100			ERROR	160	0.37	4	0	2	100	400	0.069	0.304	0.541	3
035FSB	FSB	FOX	1	100			ERROR	160	0.37	4	2	6	100	400	0.201	1.344	0.541	2
035FXB3	FXB3	FOX	1	100			ERROR	160	0.24	3	2	6	50	300	0.163	1.164	0.625	2
035FXC3	FXC3	FOX	1	100			ERROR	160	0.24	3	6	12	50	2000	0.475	5.566	0.625	2
035GE	GE	GENESEE	1	100			ERROR	160	0.37	5	2	2	100	400	0.261	0.314	0.676	3
035GP	GP	GRAVEL PITS	1	50			ERROR	160	0.24	2	5	100	50	100	0.375	42.144	0.417	2
035GP	GP	STONE QUARRIES	2	50			ERROR	160	0.01	1	5	100	50	100	0.375	42.144	5.000	2
[illegible]	HEE	HENNEPIN	1	100			ERROR	160	0.32	3	18	50	50	150	2.428	23.039	0.469	1
	KM	KOKOMO	1	100			ERROR	160	0.32	3	0	2	150	400	0.075	0.304	0.469	3
[illegible]	KO	KOKOMO	1	100			ERROR	160	0.32	3	0	2	150	400	0.075	0.304	0.469	3
035LM	LM	LINWOOD	1	100			ERROR	160	0.01	4	0	2	100	400	0.069	0.304	20.000	3
035MA	MA	MADE LAND	1	100			ERROR	160	0.37	3	0	25	50	250	0.069	9.313	0.405	2
035MDC2	MDC2	MARTINSVILLE	1	100			ERROR	160	0.24	5	6	12	50	250	0.475	2.852	1.042	2
035MEA	MEA	MARTINSVILLE	1	100			ERROR	160	0.37	5	0	2	100	300	0.069	0.279	0.676	3
035MEB	MEB	MARTINSVILLE	1	100			ERROR	160	0.37	5	2	6	50	300	0.163	1.164	0.676	2
035MMA	MMA	MIAMI	1	100			ERROR	160	0.37	4	0	2	100	400	0.069	0.304	0.541	3
035MMB2	MMB2	MIAMI	1	100			ERROR	160	0.37	4	2	6	50	350	0.163	1.258	0.541	2
035MMC2	MMC2	MIAMI	1	100			ERROR	160	0.37	4	6	12	50	300	0.475	3.124	0.541	2
035MMD	MMD	MIAMI	1	100			ERROR	160	0.37	4	12	18	50	250	1.275	5.429	0.541	1
035MNA	MNA	MIAMI	1	100			ERROR	160	0.37	5	0	2	100	400	0.069	0.304	0.676	3
035MNB	MNB	MIAMI	1	100			ERROR	160	0.37	5	2	6	50	300	0.163	1.164	0.676	2
035MNC2	MNC2	MIAMI	1	100			ERROR	160	0.37	5	6	12	50	250	0.475	2.852	0.676	2
035MOA	MOA	MIAMI	1	100			ERROR	160	0.37	5	0	2	100	400	0.069	0.304	0.676	3
035MOB	MOB	MIAMI	1	100			ERROR	160	0.37	5	2	6	50	350	0.163	1.258	0.676	2
035MRB2	MRB2 3	MIAMI 6H 8/92	1	100			ERROR	160	0.37	3	2	6	50	250	0.163	1.063	0.405	2
035MRC3	MRC3	MIAMI	1	100			ERROR	160	0.37	3	6	12	50	250	0.475	2.852	0.405	1
035MUB	MUB	MORLEY	1	100			ERROR	160	0.43	4	2	6	50	300	0.163	1.164	0.465	2
035MUB2	MUB2	MORLEY	1	100			ERROR	160	0.43	4	2	6	50	300	0.163	1.164	0.465	2
035MUD2	MUD2	MORLEY	1	100			ERROR	160	0.43	4	6	18	50	250	0.475	5.429	0.465	1
035MVB2	MVB2	MORLEY	1	100			ERROR	160	0.43	5	2	6	50	300	0.163	1.164	0.581	2
035MVC2	MVC2	MORLEY	1	100			ERROR	160	0.43	5	6	12	50	250	0.475	2.852	0.581	2
035MWB3	MWB3	MORLEY	1	100			ERROR	160	0.37	3	2	6	50	300	0.163	1.164	0.465	2

HIGHLY ERODIBLE LAND of Madison COUNTY, INDIANA

- HIGHLY ERODIBLE LAND CLASSES -
1 = HIGHLY ERODIBLE LAND
2 = POTENTIALLY HIGHLY ERODIBLE
3 = NOT HIGHLY ERODIBLE

HIGHLY ERODIBLE AND POTENTIALLY HIGHLY ERODIBLE LAND CACULATOR VER 1.1

MUID	MAP SYMBOL	SOIL NAME	#	%	C VALUE (WIND EROSION)	I VALUE (WIND EROSION)	HEL CLASS (WIND EROSION)	R VALUE	K VALUE	T VALUE	SLOPE- MIN.	PERCEN MAX.	SLOPE--LENGTH MIN.	MAX.	LS- MIN.	VALUE MAX.	8T/RK	HEL CLASS
********	******	****************	*	***	*****	******	*****	******	******	*****	******	*****	******	******	*****	*****	*****	****
095BOA	BOA	BLOUNT	1	100		48	ERROR	160	0.43	3	0	2	100	350	0.069	0.292	0.349	3
095BOB2	BOB2	BLOUNT	1	100		48	ERROR	160	0.43	3	2	6	100	250	0.201	1.063	0.349	2 /
095BR	BR	BROOKSTON	1	100		48	ERROR	160	0.28	5	0	2	100	400	0.069	0.304	0.893	3
095BS	BS	BROOKSTON	1	100		38	ERROR	160	0.28	5	0	2	100	400	0.069	0.304	0.893	3
095CAA	CAA	CAMDEN	1	100		48	ERROR	160	0.37	5	0	2	100	300	0.069	0.279	0.676	3
095CAB2	CAB2	CAMDEN	1	100		48	ERROR	160	0.37	5	2	6	50	300	0.163	1.164	0.676	2 3
095CM	CM	CARLISLE	1	100		86	ERROR	160	0.01	5	0	2	100	400	0.069	0.304	25.000	3
095CNA	CNA	CELINA	1	100		48	ERROR	160	0.37	5	0	2	100	400	0.069	0.304	0.676	3
095CNB2	CNB2	CELINA	1	100		48	ERROR	160	0.37	5	2	6	100	300	0.201	1.164	0.676	2 3
095CP	CP	CLAY PITS	1	100			ERROR	160	0.43	1	0	2	50	300	0.060	0.279	0.116	2 /
095CRA	CRA	CROSBY	1	100		56	ERROR	160	0.43	3	0	2	100	400	0.069	0.304	0.349	3
095CRB2	CRB2	CROSBY	1	100		56	ERROR	160	0.43	3	2	6	50	350	0.163	1.258	0.349	2 /
095ED	ED	EDWARDS	1	100		134	ERROR	160	0.01	4	0	2	100	400	0.069	0.304	20.000	3
095ES	ES	EEL	1	100		56	ERROR	160	0.37	5	0	2	100	400	0.069	0.304	0.676	3
095FAA	FAA	FOX	1	100		86	ERROR	160	0.24	4	0	2	100	400	0.069	0.304	0.833	3
095FAB	FAB	FOX	1	100		86	ERROR	160	0.24	4	2	6	100	350	0.201	1.258	0.833	2 3
095FOA	FOA	FOX	1	100		56	ERROR	160	0.37	4	0	2	150	400	0.075	0.304	0.541	3
095FOB2	FOB2	FOX	1	100		56	ERROR	160	0.37	4	2	6	75	400	0.184	1.344	0.541	2 3
095FOC2	FOC2	FOX	1	100		56	ERROR	160	0.37	4	6	12	50	250	0.475	2.852	0.541	2 /
095FOD2	FOD2	FOX	1	100		56	ERROR	160	0.37	4	12	18	50	150	1.275	4.205	0.541	1
A	FRA	FOX	1	100		56	ERROR	160	0.37	4	0	2	100	400	0.069	0.304	0.541	3
[illegible]A	FSA	FOX	1	100			ERROR	160	0.37	4	0	2	100	400	0.069	0.304	0.541	3
095FSB	FSB	FOX	1	100			ERROR	160	0.37	4	2	6	75	300	0.184	1.164	0.541	2 3
095FSB2	FSB2	FOX	1	100			ERROR	160	0.37	4	2	6	75	300	0.184	1.164	0.541	2 3
095FSC	FSC	FOX	1	100			ERROR	160	0.37	4	6	12	50	250	0.475	2.852	0.541	2 /
095FSC2	FSC2	FOX	1	100			ERROR	160	0.37	4	6	12	50	250	0.475	2.852	0.541	2 /
095FTC3	FTC3	FOX	1	100		48	ERROR	160	0.32	3	6	12	50	250	0.475	2.852	0.469	1
095FXB3	FXB3	FOX	1	100			ERROR	160	0.37	2	2	6	75	300	0.184	1.164	0.270	2 /
095GN	GN	GENESEE	1	100		56	ERROR	160	0.37	5	0	2	100	400	0.069	0.304	0.676	3
095GR	GR	GRAVEL PITS	1	100			ERROR	160	0.10	2	5	80	50	250	0.378	52.774	1.000	2 /
095HEF2	HEF2	HENNEPIN	1	100		56	ERROR	160	0.32	3	18	35	50	150	2.428	12.519	0.469	1
095HM	HM	HOMER	1	100		56	ERROR	160	0.37	4	0	2	100	400	0.069	0.304	0.541	3
095HN	HN	HOMER	1	100		48	ERROR	160	0.37	4	0	2	100	400	0.069	0.304	0.541	3
095KC	KC	KOKOMO	1	100		86	ERROR	160	0.32	5	0	2	150	400	0.075	0.304	0.781	3
095KG	KG	KOKOMO	1	100		86	ERROR	160	0.32	3	0	2	150	400	0.075	0.304	0.469	3
095KM	KM	KOKOMO	1	100		86	ERROR	160	0.32	3	0	2	150	400	0.075	0.304	0.469	3
095KS	KS	KOKOMO	1	100		86	ERROR	160	0.32	3	0	2	150	400	0.075	0.304	0.469	3
095KT	KT	KOKOMO	1	100		66	ERROR	160	0.32	3	0	2	150	400	0.075	0.304	0.469	3
095LM	LM	LINWOOD	1	100		134	ERROR	160	0.01	4	0	2	100	400	0.069	0.304	20.000	3
095MA	MA	MADE LAND	1	100			ERROR	160	0.24	3	0	25	50	250	0.060	9.313	0.625	2 /
095MH	MH	MAHALASVILLE	1	100		48	ERROR	160	0.28	5	0	2	100	400	0.069	0.304	0.893	3
095ML	ML	MAHALASVILLE	1	100		38	ERROR	160	0.28	5	0	2	100	400	0.069	0.304	0.893	3
095MM	MM	MAHALASVILLE	1	100		38	ERROR	160	0.28	4	0	2	100	400	0.069	0.304	0.714	3

MARION

- HIGHLY ERODIBLE LAND CLASSES -
1 = HIGHLY ERODIBLE LAND
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HIGHLY ERODIBLE AND
POTENTIALLY HIGHLY ERODIBLE
LAND CACULATOR VER 1.1

					WIND EROSION			WATER EROSION										
MUID	MAP SYMBOL	SOIL NAME		%	C VALUE	I VALUE	HEL CLASS	R VALUE	K VALUE	T VALUE	SLOPE- MIN.	PERCEN MAX.	SLOPE--LENGTH MIN.	MAX.	LS- VALUE MIN.	MAX.	8T/RK	HEL CLASS
********	******	*****************	*	***	*****	******	*****	******	******	*****	******	*****	******	******	*****	*****	*****	****
09700004	4	CUT AND FILL LAND	1	100			ERROR	180	0.37	5	10	30	25	200	0.684	11.247	0.601	1
09700005	5	GRAVEL PITS	1	100			ERROR	180	0.10	2	2	20	25	200	0.132	5.768	0.889	2
097BR	BR	BROOKSTON	1	100		38	ERROR	180	0.28	5	0	2	0	400	0.000	0.304	0.794	3
097CRA	CRA	CROSBY	1	100		56	ERROR	180	0.43	3	0	2	0	400	0.000	0.304	0.310	3
097CSB2	CSB2	CROSBY	1	60		56	ERROR	180	0.43	3	2	4	50	250	0.163	0.577	0.310	2
097CSB2	CSB2	MIAMI	2	30		56	ERROR	180	0.37	4	2	4	50	250	0.163	0.577	0.480	2
097EE	EE	EEL	1	100		48	ERROR	180	0.37	5	0	2	0	200	0.000	0.247	0.601	3
097FOA	FOA	FOX	1	100		56	ERROR	180	0.37	4	0	2	0	300	0.000	0.279	0.480	3
097FOB2	FOB2	FOX	1	100		56	ERROR	180	0.37	4	2	6	50	250	0.163	1.063	0.480	2
097FXC2	FXC2	FOX	1	40		56	ERROR	180	0.37	4	6	15	50	150	0.475	3.135	0.480	2
097GE	GE	GENESEE	1	100		56	ERROR	180	0.37	5	0	2	0	200	0.000	0.247	0.601	3
097HEF	HEF	HENNEPIN	1	100		48	ERROR	180	0.32	3	25	50	50	300	4.165	30.871	0.417	1
097MGA	MGA	MARTINSVILLE	1	100		56	ERROR	180	0.37	5	0	2	0	300	0.000	0.279	0.601	3
097MGB2	MGB2	MARTINSVILLE	1	100		56	ERROR	180	0.37	5	2	6	50	300	0.163	1.164	0.601	2
097MMA	MMA	MIAMI	1	100		48	ERROR	180	0.37	5	0	2	0	300	0.000	0.279	0.601	3
097MMB2	MMB2	MIAMI	1	100		56	ERROR	180	0.37	4	2	6	50	300	0.163	1.164	0.480	2
097MMC2	MMC2	MIAMI	1	100		56	ERROR	180	0.37	4	6	12	50	150	0.475	2.209	0.480	2
097MXD2	MXD2	MIAMI	1	70		56	ERROR	180	0.37	4	12	18	50	150	1.275	4.205	0.480	1
097MXE2	MXE2	MIAMI	1	50		56	ERROR	180	0.37	4	18	24	50	150	2.428	6.744	0.480	1
097OCA	OCA	OCKLEY	1	100		56	ERROR	180	0.37	5	0	2	0	300	0.000	0.279	0.601	3
CB2	OCB2	OCKLEY	1	100		56	ERROR	180	0.37	5	2	6	50	250	0.163	1.063	0.601	2
E	RE	RENSSELAER	1	100		48	ERROR	180	0.32	5	0	2	0	400	0.000	0.304	0.694	3
SH	SH	SHOALS	1	100		56	ERROR	180	0.37	5	0	2	0	200	0.000	0.247	0.601	3
097SK	SK	SLEETH	1	100		56	ERROR	180	0.32	5	0	2	0	200	0.000	0.247	0.694	3
097SN	SN	SLOAN	1	100		48	ERROR	180	0.28	5	0	2	0	200	0.000	0.247	0.794	3
097UB	UB	URBAN LAND	1	50			ERROR	180	0.37	5	0	2	50	400	0.060	0.304	0.601	3
097UB	UB	BROOKSTON	2	30		38	ERROR	180	0.28	5	0	2	50	400	0.060	0.304	0.794	3
097UC	UC	URBAN LAND	1	50			ERROR	180	0.37	5	0	4	50	400	0.060	0.696	0.601	2
097UC	UC	CROSBY	2	30		56	ERROR	180	0.43	3	0	4	50	400	0.060	0.696	0.310	2
097UFA	UFA	URBAN LAND	1	50			ERROR	180	0.37	5	0	3	50	300	0.060	0.399	0.601	3
097UFA	UFA	FOX	2	35		56	ERROR	180	0.37	4	0	3	50	300	0.060	0.399	0.480	3
097UFC	UFC	URBAN LAND	1	50			ERROR	180	0.37	5	6	12	50	250	0.475	2.852	0.601	2
097UFC	UFC	FOX	2	35		56	ERROR	180	0.37	4	6	12	50	250	0.475	2.852	0.480	2
097UG	UG	URBAN LAND	1	40			ERROR	180	0.37	5	0	2	50	200	0.060	0.247	0.601	3
097UG	UG	GENESEE	2	40		56	ERROR	180	0.37	5	0	2	50	200	0.060	0.247	0.601	3
097UMB	UMB	URBAN LAND	1	50			ERROR	180	0.37	5	0	6	50	300	0.060	1.164	0.601	2
097UMB	UMB	MIAMI	2	30		56	ERROR	180	0.37	4	0	6	50	300	0.060	1.164	0.480	2
097UMC	UMC	URBAN LAND	1	50			ERROR	180	0.37	5	6	12	50	150	0.475	2.209	0.601	2
097UMC	UMC	MIAMI	2	30			ERROR	180	0.37	4	6	12	50	150	0.475	2.209	0.480	2
097UW	UW	URBAN LAND	1	50			ERROR	180	0.37	5	0	2	50	400	0.060	0.304	0.601	3
097UW	UW	WESTLAND	2	50			ERROR	180	0.28	5	0	2	50	400	0.060	0.304	0.794	3
097WE	WE	WESTLAND	1	100			ERROR	180	0.28	5	0	2	50	400	0.060	0.304	0.794	3
097WH	WH	WHITAKER	1	100			ERROR	180	0.37	5	0	2	50	400	0.060	0.304	0.601	3