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

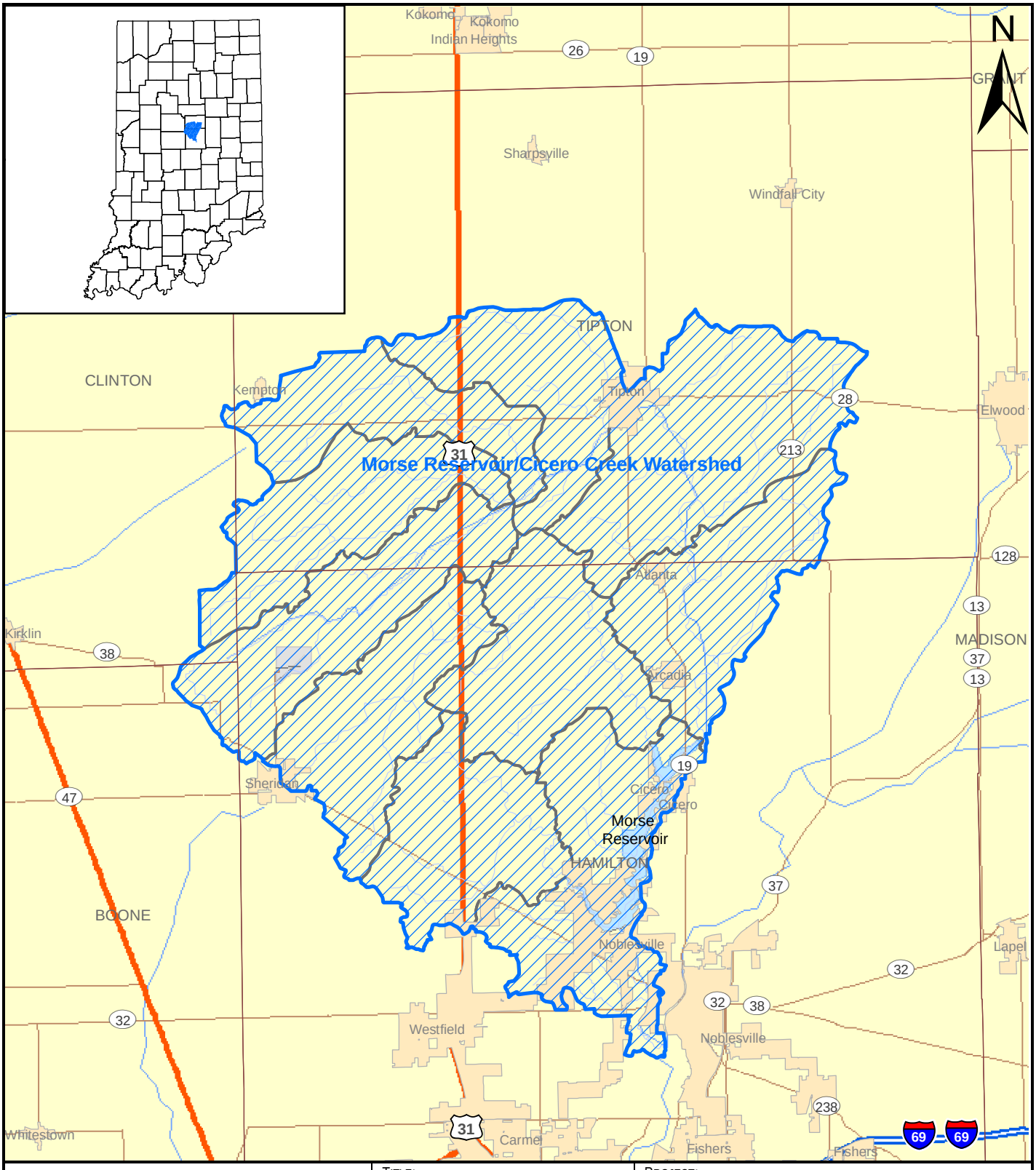
A healthy watershed is essential for a healthy environment and economy. The watersheds we live in provide us with drinking water, jobs, recreation, food and shelter. Watersheds are a unique, dynamic complex combination of natural resources; air, water, soil, plants and animals. Each characteristic of a watershed (e.g. topography, soils, land use, wetlands, etc.) 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. Sandy soils tend to erode easily when not covered with dense vegetation. Clayey 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. The following sections of this WMP further explain the characteristics found in the Morse Reservoir/Cicero Creek Watershed.

Location, Characteristics and Size

Cicero Creek has its origins in southeast Clinton County and flows northeast through Tipton County before turning south and flowing through central Hamilton County (Exhibit 1). The watershed also encompasses portions of Boone County. The Morse Reservoir/Cicero Creek Watershed consists of approximately 144,343 acres of mixed land use of which approximately 1,500 acres is Morse Reservoir.

The distribution of watershed area within each county is shown in Table 1.



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TITLE: **Location Exhibit**	PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**		
BASE LAYER: StreetMap USA	PROJECT NO. 09005	EXHIBIT: 1	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 20000'

Table 1: Counties Within the Watershed		
County	**Acres**	**Percentage**
Boone	1,674	1.2%
Clinton	1,646	1.1%
Hamilton	77,606	53.8%
Tipton	63,417	43.9%

Approximately 197.7 linear miles of cumulative waterways are contained in the Morse Reservoir/Cicero Creek Watershed. Some of the cities and towns located in the watershed include: Arcadia, Atlanta, Cicero, Noblesville, Sheridan, Tipton, and Westfield.

Geology/Topography

The bedrock geology of Indiana formed primarily during the Paleozoic Era. The principal bedrock formations in the Morse Reservoir/Cicero 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 Cicero 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 approximately 965 feet at the western edge of the watershed in Boone County to an elevation of approximately 740 feet at the confluence of Cicero Creek with the White River in Hamilton County, or a change of 225 feet.

Hydrology

Climate

The Morse Reservoir/Cicero 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, only one falls within the Morse Reservoir/Cicero Creek Watershed. Table 2 summarizes the temperature and precipitation data for the Tipton 5 SW station.

Table 2: NOAA Monthly Normals for Tipton 5 SW, 1971- 2000		
Month	Average Temperature (^{o}F)	Average Precipitation (in.)
January	23.5	1.91
February	27.7	1.67
March	37.6	3.02
April	48.1	3.62
May	59.1	3.96
June	68.7	4.24
July	72.1	4.20
August	69.9	3.03
September	63.4	2.89
October	51.7	2.47
November	40.2	3.24
December	28.9	2.94

USGS gage 03349510 Cicero Creek at Arcadia has information on stream discharge and gage height dating back to 2004. This information is valuable to understand the characteristics of the stream and when the flows are the highest and lowest.

Morse Reservoir

Construction of Morse Reservoir was completed in 1956. The primary purpose of the reservoir was to provide a consistent source of water supply to the Indianapolis Water Company's White River Water Treatment Facility. In the early 1970's real estate development began around the reservoir, resulting in development along most of its 32.5 miles of shoreline. The reservoir has a maximum depth of approximately 42 feet, a storage capacity of 8.3 billion gallons, and a surface area of approximately 1500 acres. In addition to water supply, Morse Reservoir is currently widely used for recreation purposes including swimming, boating, and fishing (see Exhibit 1).

Based on information provided in previous studies (IDEM and Little Cicero Creek WMP) for Morse Reservoir, the volume within the reservoir is completely replaced by the input volume (surface water, groundwater, direct precipitation, etc.) every 56 days. Therefore, meaning the hydraulic retention time for the approximate 135,680 acre tributary area to the watershed is 56 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. The three wetland classifications within the Morse Reservoir/Cicero Creek Watershed include lacustrine, palustrine, and riverine. There are 5,611 acres (3.9% of the watershed) of wetlands scattered throughout

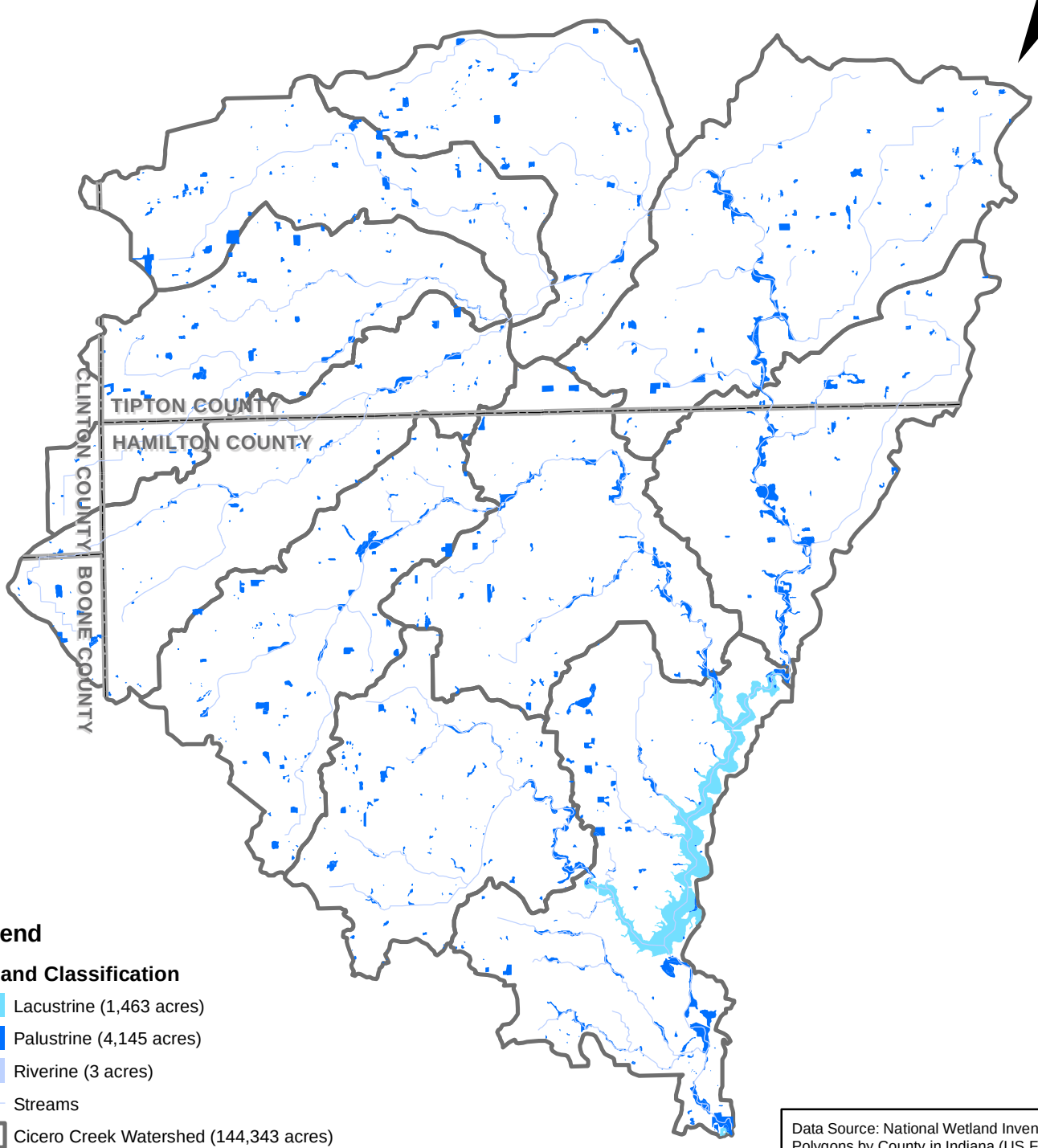
the watershed. Among the three wetland classification 1,463 acres are considered lacustrine, 4,145 acres are palustrine, and 3 acres are riverine (Exhibit 2). The shapefiles used to create this exhibit were obtained directly from the National Wetland Inventory Polygons by County in Indiana (US Fish and Wildlife Service, publication date 20030128). The Weasel Creek, Little Cicero Creek and Cox Ditch subwatersheds all have approximately 1 acre of riverine wetland.

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.

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.



Legend

Wetland Classification

- Lacustrine (1,463 acres)
- Palustrine (4,145 acres)
- Riverine (3 acres)
- Streams
- Cicero Creek Watershed (144,343 acres)
- County Boundary

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**	PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**		
BASE LAYER: National Wetland Inventory	PROJECT NO. 09005	EXHIBIT: 2	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 15000'

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 Morse Reservoir/Cicero 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 of properties, 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. The Indiana Department of Transportation (INDOT) requires impacts to wetlands associated with roadway improvements to be mitigated for in the same watershed. Stream enhancement and stream mitigation are some of the options that INDOT offers to offset wetland/stream impacts.

Threatened or Endangered Species

The Indiana Department of Natural Resources Division of Nature Preserves was contacted to provide any Indiana Natural Heritage Data or related records for all listed threatened, endangered or rare species documented within the Morse Reservoir/Cicero Creek Watershed. Their response indicated that the watershed is home to one State Rare Species, seven Species of Special Concern to Indiana, six State Endangered Species, one State Threatened Species, two Federally Endangered Species, and one Federal Candidate Species (Table 3).

Table 3: Threatened or Endangered Species			
Type	**Common Name**	**State Status**	**Federal Status**
Amphibian	Common mudpuppy	Species of Special Concern	
Bird	Black-crowned Night Heron	Endangered	
	Upland Sandpiper	Endangered	
Mammal	American Badger	Species of Special Concern	
Mollusk	Little Spectaclecase	Species of Special Concern	
	Clubshell	Endangered	Endangered
	Kidneyshell	Species of Special Concern	
	Rayed Bean	Species of Special Concern	Candidate Species
	Rabbitsfoot	Endangered	
	Round Hickorynut	Species of Special Concern	
	Wavyrayed	Species of Special Concern	
	Northern Riffleshell	Endangered	Endangered
Vascular Plant	Leiberg's Witchgrass	Threatened	
	Awned Sedge	Endangered	
	Spoon-leaved Sundew	Rare	

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. Specific information for the analysis of aquatic vegetation/exotic species within Morse Reservoir was not included in the scope of this plan, however, based on other studies, Blue-Green Algae, Eurasian Watermilfoil, and Zebra Mussels have been reported in the watershed.

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.

Specific locations and magnitudes of nuisance wildlife and exotic invasive species were not determined. However, general locations can be inferred from the information provided in the WMP.

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 Morse Reservoir/Cicero Creek Watershed are shown on Exhibit 3.

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 elevations (BFEs) have been established comprises 4,975 acres (3.4% 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 BFEs have been determined, comprises 3,265 acres (2.3% 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

Legend

- Streams
- County Boundary
- Zone A Floodplain (4,975 acres)
- Zone AE Floodplain (3,265 acres)
- Zone X Floodplain (46 acres)
- Cicero Creek Watershed (144,343 acres)

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: **Morse Reservoir/Cicero Creek Watershed Management Plan**		
BASE LAYER: FEMA Floodplain	PROJECT NO. 09005	EXHIBIT: 3	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 15000'

depths are less then 1 foot, comprises only 46 acres (0.3% 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.

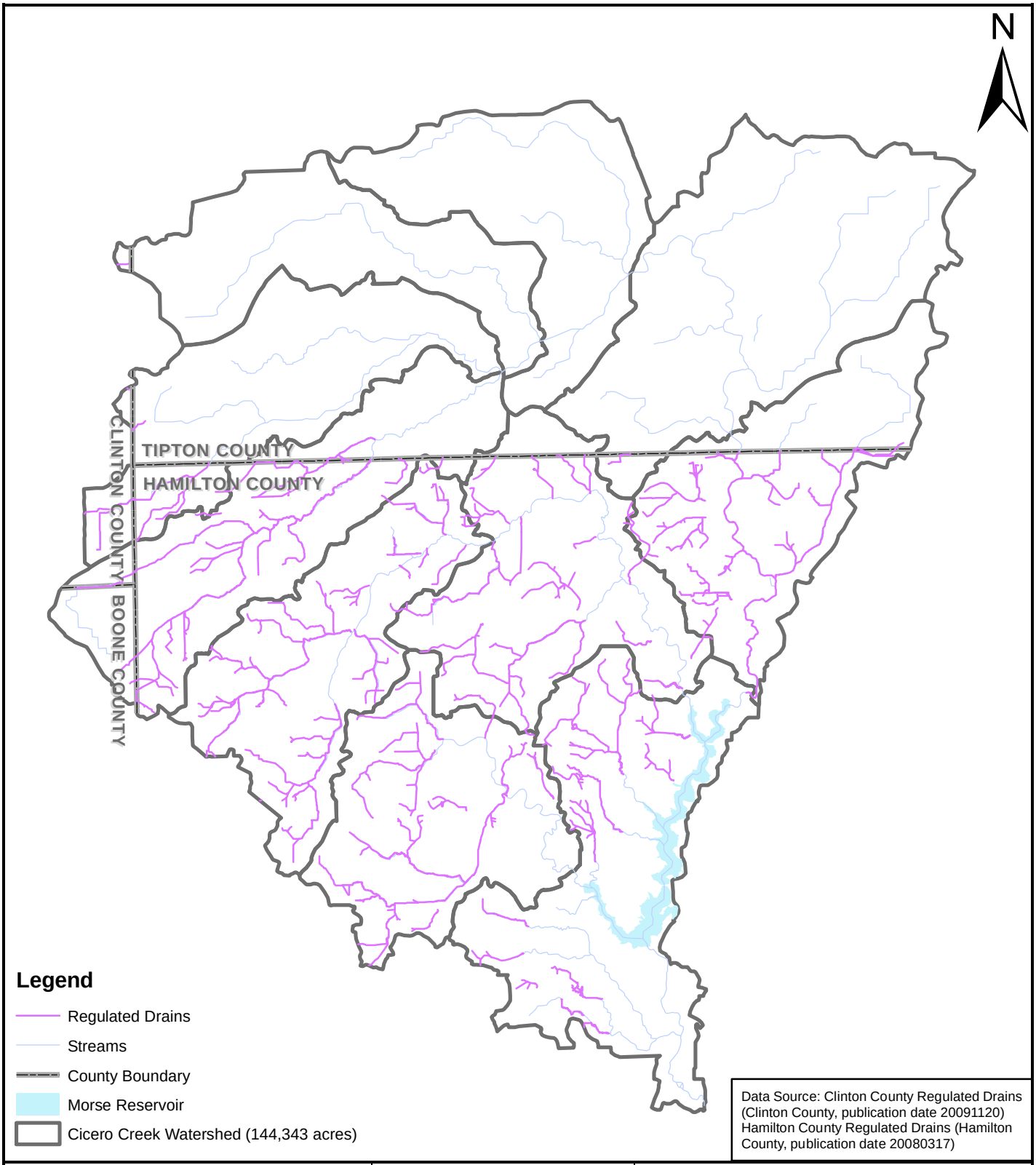
Teams of USGS hydrographers have traveled to 40 streamflow-gaging stations to keep station instruments operating and to verify streamflow data needed for National Weather Service (NWS) flood forecasts. USGS personnel have worked closely with Federal, state, and local agencies during the flood to provide flood information for emergency managers, the media, and the public.

Identifying the location of floodplain areas within the Morse Reservoir/Cicero 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. 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 or the County Surveyor's office. Regulated drains are common throughout the watershed and are mainly tiles and open ditches. It should be noted that regulated drain locations were requested from all four counties within the watershed but only Hamilton and Clinton County provided data which is shown on Exhibit 4. Information on the regulated drains in Boone and Tipton Counties was not provided and therefore is not included on the exhibit.

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 Morse Reservoir/Cicero 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.



Data Source: Clinton County Regulated Drains (Clinton County, publication date 20091120) Hamilton County Regulated Drains (Hamilton County, publication date 20080317)

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TITLE: **Regulated Drain Map**	PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**		
BASE LAYER: Regulated Drains	PROJECT NO. 09005	EXHIBIT: 4	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 15000'

Future potential BMPs within regulated drains in the watershed should be evaluated prior to implementation. If regulated drains are considered for BMP measures, the steering committee should contact the local County Surveyors offices of Boone, Clinton, Hamilton, and Tipton Counties to confirm the location of the regulated drain.

Wellhead Protection Areas

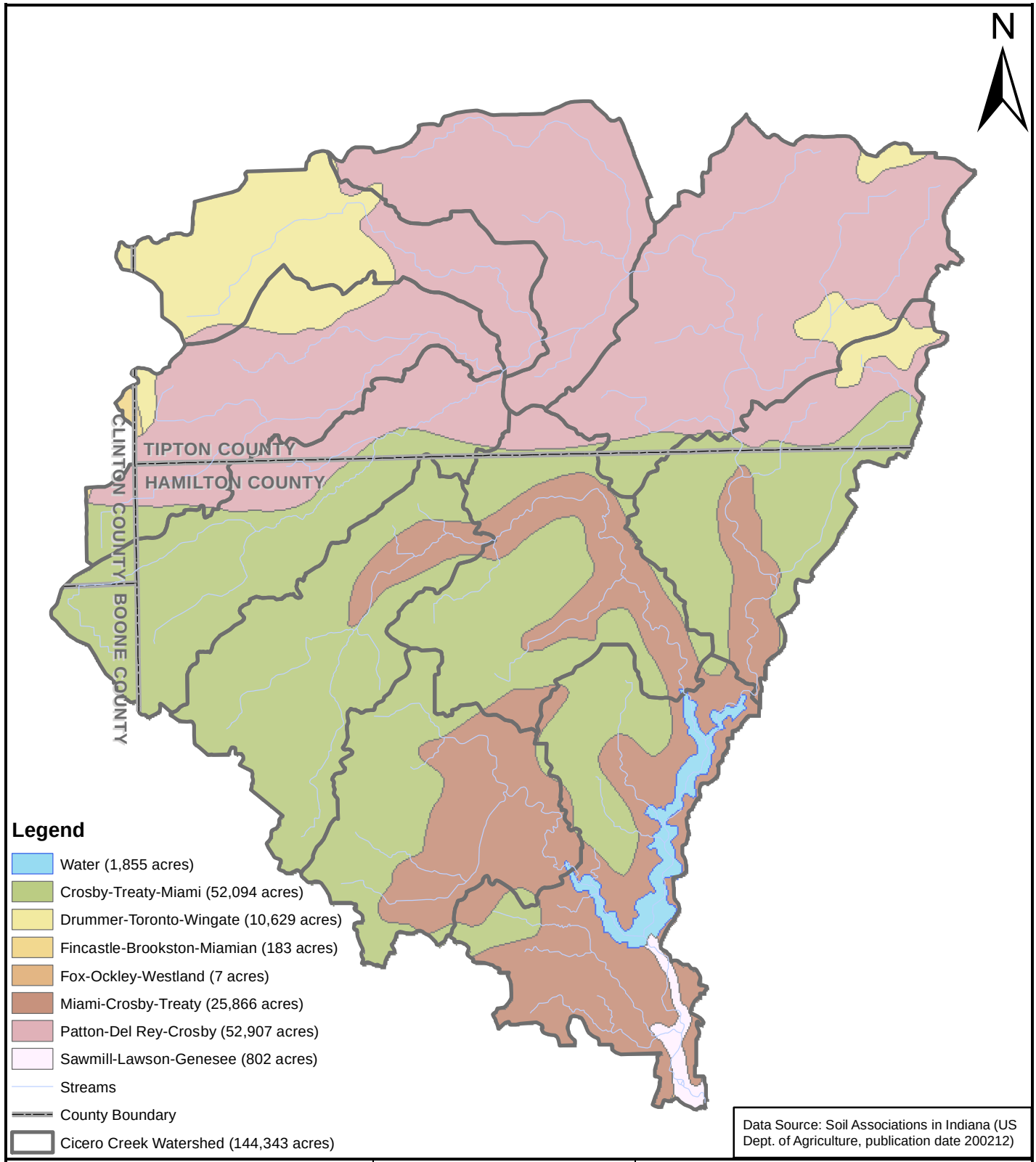
The IDEM Ground Water Section administers the Wellhead Protection Program, which is a strategy to protect ground water drinking supplies from pollution. The Safe Drinking Water Act and the Indiana Wellhead Protection Rule mandates a wellhead program for all Community Public Water Systems. The Wellhead 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.

In late 1995 the Hamilton County Drainage Board requested the Surveyors Office to form a Task Force to study the County's needs in the area of Wellhead Protection. A fifteen member task force was created which represented all cities and towns and water suppliers, both public and private, within Hamilton County. The group met for the first time in December 1995 and met six times in 1996. The result of the efforts in 1996 was an inter-local agreement between Hamilton County and seven other public and private entities for the delineation of Wellhead Protection Areas in order to comply with the Indiana Wellhead Protection Rule. Cicero, Atlanta, Westfield, Arcadia and Indianapolis Water Company entered into a contract through the original inter-local agreement for the delineation phase of the project. All the communities have since completed wellhead delineations and have completed Phase I Wellhead Protection Plans or are awaiting approval.
Since then, Cicero, Atlanta, Carmel, Arcadia and Hamilton County have enacted Wellhead Ordinances and the other communities are working towards adopting their own. This information will be important during the implementation phases of the plan.

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 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 should be performed in the areas where implementation projects are recommended for more project specific detailed information. The major soil associations in the Morse Reservoir/Cicero Creek Watershed are shown in Exhibit 5.

Table 4 includes the major characteristics of the four soil associations that make up the majority (98%) of the watershed.



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

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TITLE: **Soil Associations Map**	PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**			
BASE LAYER: State Soil Geographic Data Base	PROJECT NO. 09005	EXHIBIT: 5	SHEET: 1 OF: 1	
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 15000'	

Table 4: Soil Associations		
Name	**Characteristics**	**Acres**
Patton-DelRey-Crosby	Deep, somewhat poorly to poorly drained, nearly level soils	52,907
Crosby-Treaty-Miami	Deep, somewhat poorly drained, nearly level soils	52,094
Miami-Crosby-Treaty	Deep, well drained to somewhat poorly drained, nearly level to strongly sloping soils	25,866
Drummer-Toronto-Wingate	Deep, somewhat poorly drained nearly level soil	10,629

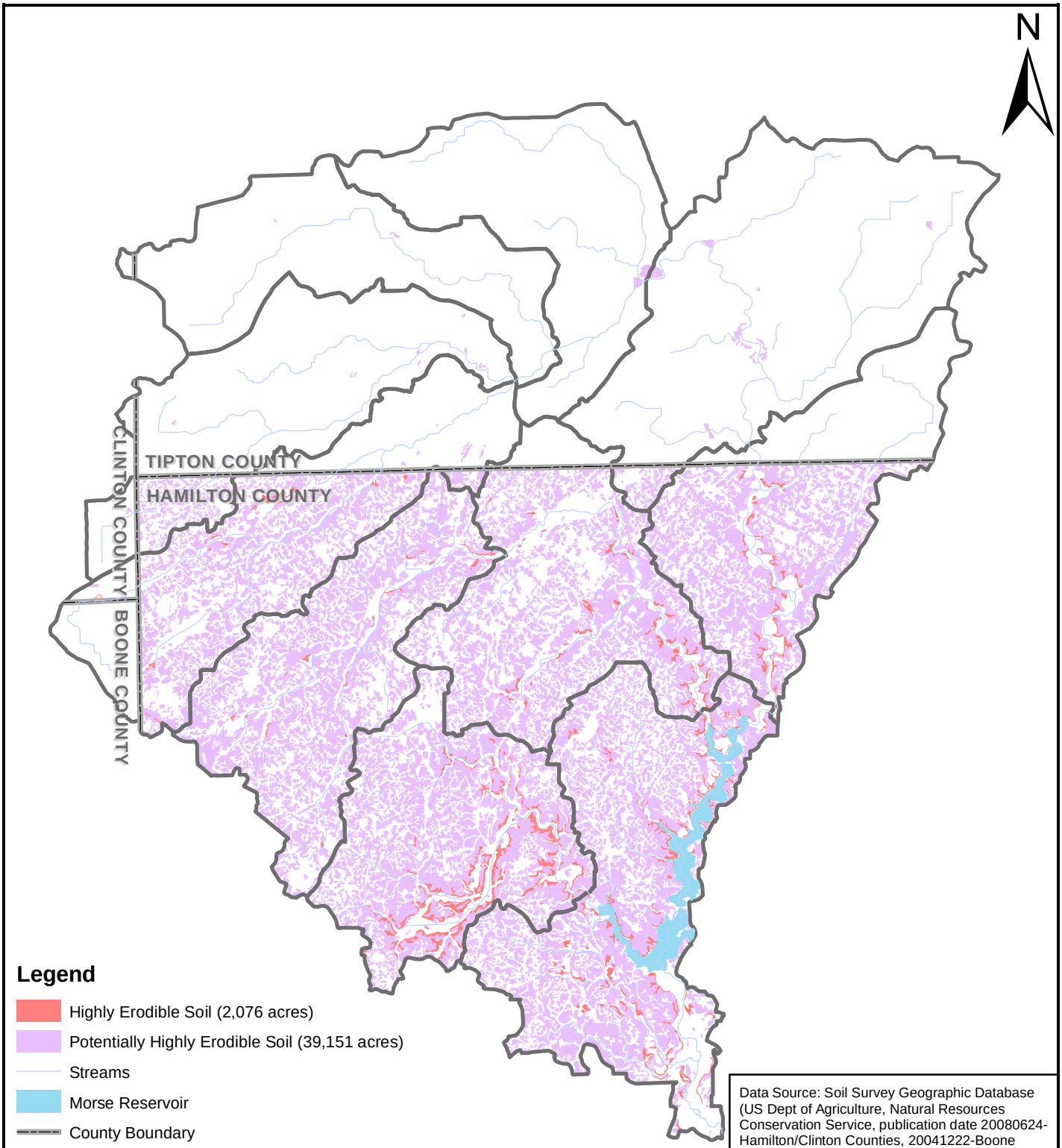
The data source for the Soil Association Map is from the Department of Agriculture Soil Associations in Indiana GIS shapefile with a published date of December 2002. Based on this data and the time it was obtained, the water area is a total of 1,855 acres. This not only includes the reservoir, but some areas outside of the reservoir that were inundated at the time of the data collection.

Highly Erodible Land (HEL)

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. Erosion also impacts water quality as it increases nutrients and decreases water clarity. As water flows over land and enters the stream as runoff 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 soils and potentially highly erodible soils in the Morse Reservoir/Cicero 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 offices of Boone, Clinton, Hamilton, and Tipton Counties. A total of approximately 2,076 acres or 1.4% of the watershed is considered highly erodible, while approximately 39,151 acres or 27.1% 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 County when compared to Tipton, Boone, and Clinton Counties. This discrepancy can be attributed to the difference in the classification of soils between the counties. For example, Crosby soil (CRA) in Hamilton County is considered potentially highly erodible however the same soil in Boone County is considered not highly erodible. Appendix O 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.

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.



Data Source: Soil Survey Geographic Database (US Dept of Agriculture, Natural Resources Conservation Service, publication date 20080624-Hamilton/Clinton Counties, 20041222-Boone County, 20080625-Tipton County) USDA-SCS Indiana Technical Guide Section II-11/87

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TITLE: **Highly Erodible Lands Map**	PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**			
BASE LAYER: NRCS Soil Survey	PROJECT NO. 09005	EXHIBIT: 6	SHEET: 1 OF: 1	
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206	QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 15000'	

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 68,748 acres or 47.6% of the soils in the Morse Reservoir/Cicero Creek Watershed are considered hydric (Exhibit 7). All of the mapped soils that are in the portion of Boone County that is located within the watershed are considered hydric based on the soil survey information obtained from the Soil Survey Geographic Database.

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

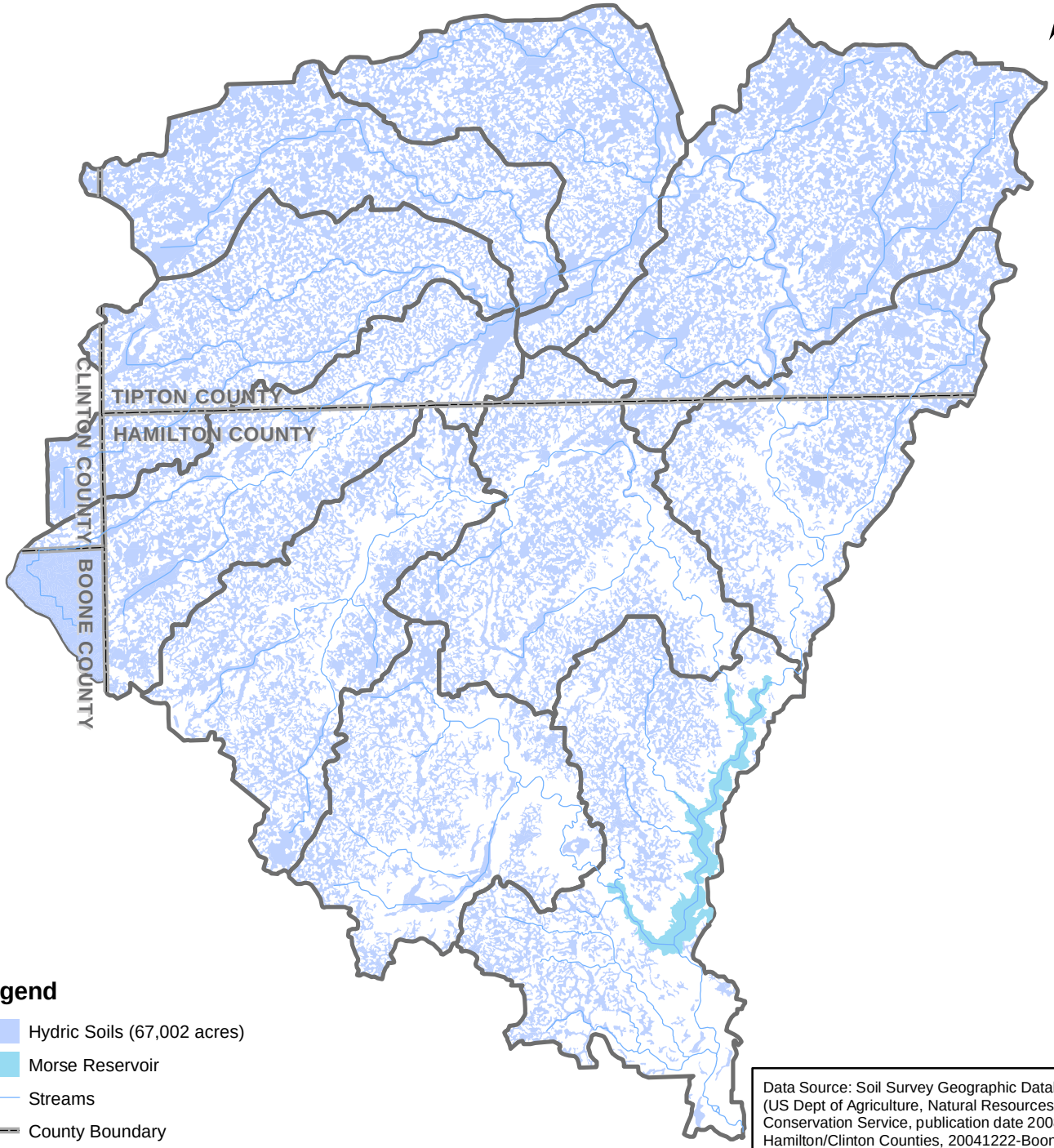
In rural areas, households often depend on septic tank absorption fields. These waste treatment systems require soil characteristics and geology that allow gradual seepage of wastewater into the surrounding soils. Seasonal high water tables, shallow compact till and coarse soils present limitations for septic systems. While system design (e.g. 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 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 based on industry standards) has been an impediment to modernization.



Legend

- Hydric Soils (67,002 acres)
- Morse Reservoir
- Streams
- County Boundary
- Cicero Creek Watershed (144,343 acres)

Data Source: Soil Survey Geographic Database (US Dept of Agriculture, Natural Resources Conservation Service, publication date 20080624-Hamilton/Clinton Counties, 20041222-Boone County, 20080625-Tipton County) National Hydric Soils List by State February 2010

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TITLE: **Hydric Soils Map**		PROJECT: **Morse Reservoir/Cicero Creek Watershed Management Plan**		
BASE LAYER: NRCS Soil Survey		PROJECT NO. 09005	EXHIBIT: 7	SHEET: 1 OF: 1
CLIENT: Upper White River Watershed Alliance P.O. Box 2065 Indianapolis, Indiana 46206		QUADRANGLE: N/A	DATE: 09/27/10	SCALE: 1" = 15000'