1.0 INTRODUCTION & WATERSHED CHARACTERISTICS

Each of us lives in a watershed or area of land drained by a river or stream system (Figure 1). Despite this relatively simple definition, a watershed is actually a complex interaction between ground, water, vegetation, climate, people, and animals. Other elements such as nutrient rich agricultural and urban stormwater runoff, impervious surfaces, altered stormwater flows, and erosion are all detrimental to the health of watersheds with increasing human development. Depending on size, watersheds are also called basins, sub-basins, subwatersheds, or Subwatershed Management Units (SMUs), also known as catchments.

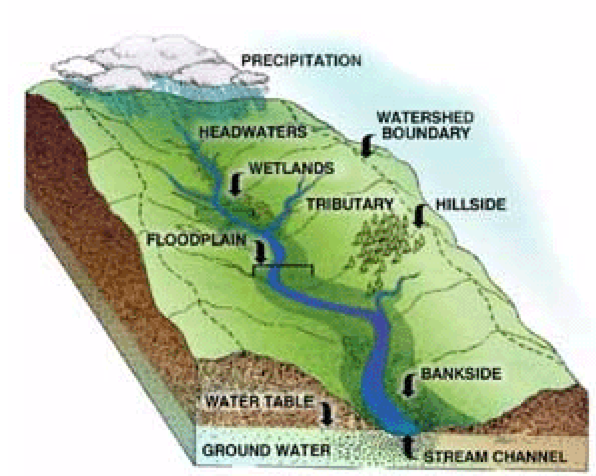


Figure 1. Conceptual watershed cross-section.

1.1 Pike River Watershed Setting

The Pike River Watershed is located in southeast Wisconsin in portions of Racine and Kenosha Counties (Figure 2). Pike River and its numerous small tributaries drain approximately 50.78 square miles (32,498 acres) of land surface. The watershed drains area of southeast Racine County and northeast Kenosha County. This includes portions of the Cities of Kenosha and Racine, the town of Somers, and the Villages of Pleasant Prairie, Mt. Pleasant, Sturtevant and Elmwood Park. The Pike River discharges directly into Lake Michigan in the City of Kenosha.

Another area that is addressed in this watershed plan is adjacent to the Pike River Watershed to the north but drains directly into Lake Michigan. This is an area of approximately 6.82 square miles (4,367 acres). Much of this area is in Racine, the eastern portions of Mount Pleasant, Elmwood Park, and Somers. Some of this area has large ravines which could be considered smaller sub-basin

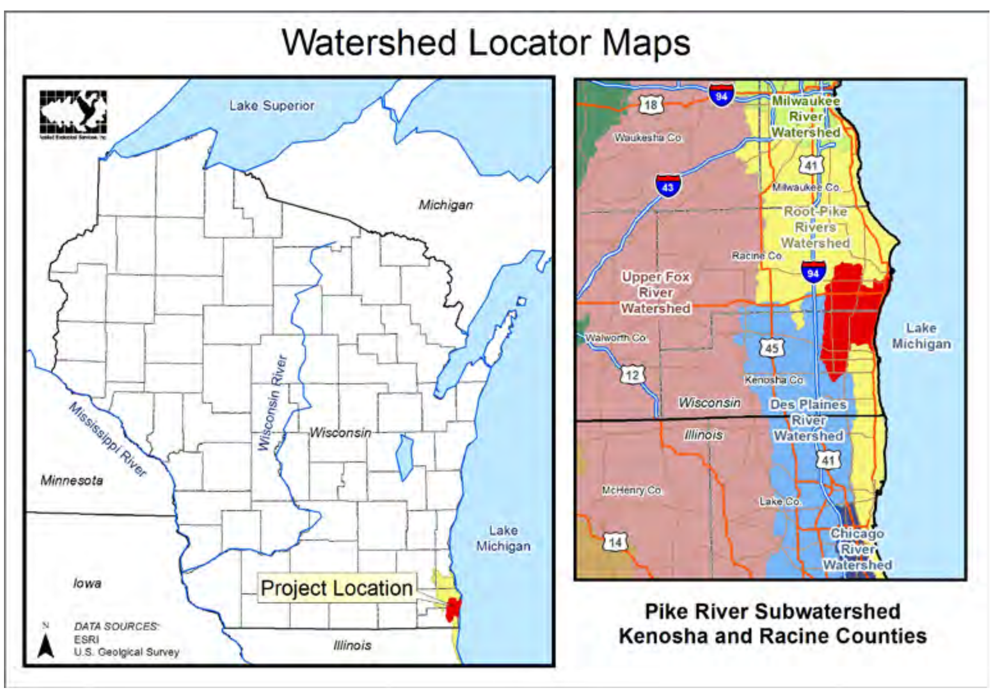


Figure 2. Watershed Locator Maps.

drainages while a large portion of the urban area has storm sewers that feed directly into Lake Michigan. Throughout this plan, this area will be referred to as the Direct Drainage area. Combined, the Pike River and Direct Drainage Area drain a total of 57.6 square miles.

The Pike River watershed is east of the Highway 94 and a commuter rail line runs through the eastern portion of the watershed. The Pike River watershed has experienced rapid development in the past 30 years because of the close proximity to Milwaukee and Chicago, affordable land costs and existing transportation infrastructure. During the current economic recession, the housing boom has slowed and the ecological impacts of development can be evaluated within the watershed context.

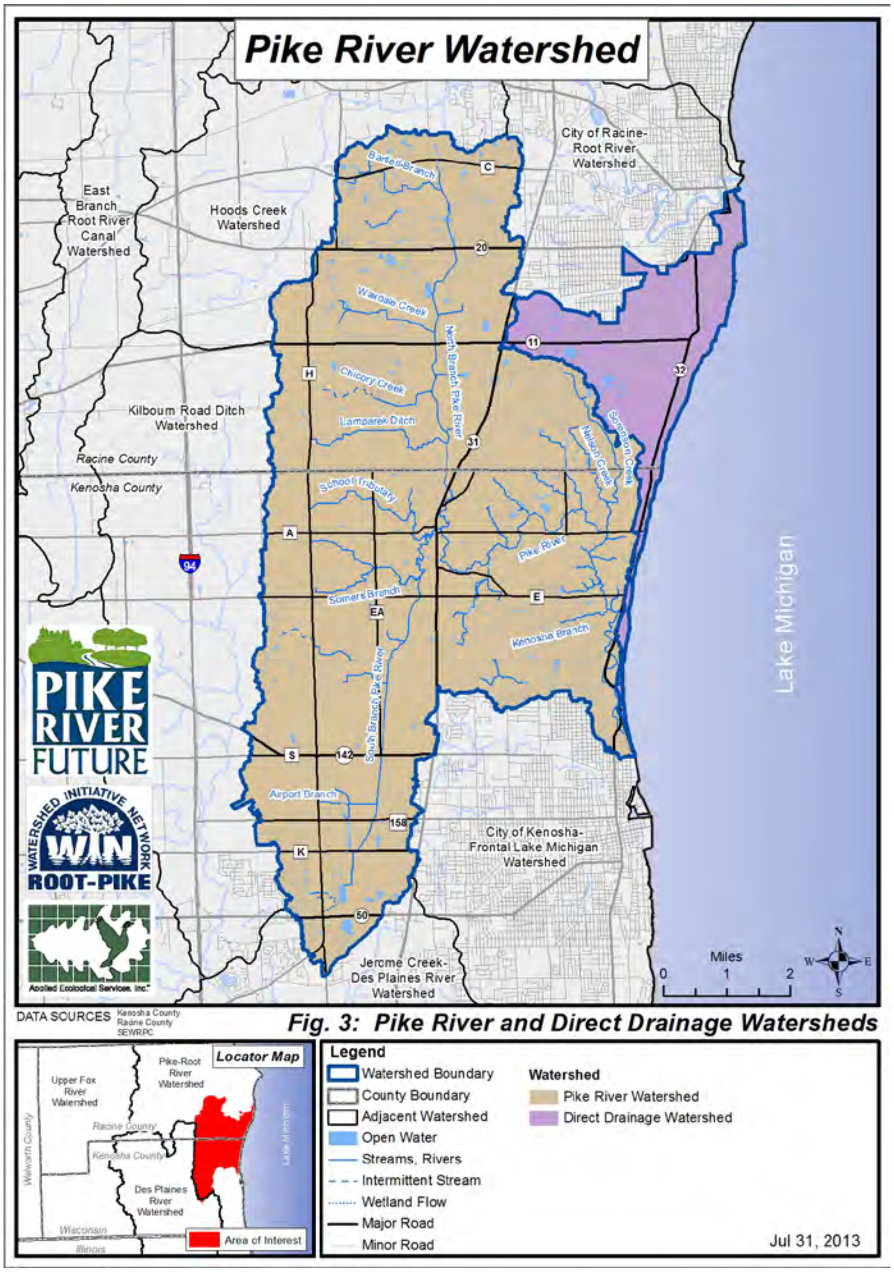


Fig. 3: Pike River and Direct Drainage Watersheds

Ecological conditions changed drastically and quickly following European settlement in the mid 1800's. Large scale fires no longer occurred and bison and elk were extirpated. The majority of prairie and forest was removed and drain tiles were installed throughout wet areas as farming became the primary land use in the early 1900's. Residential and commercial development followed which led to additional alteration and fragmentation of the natural landscape as landowners converted property to meet individual needs and roads were constructed across the watershed creating impervious surfaces that no longer allow precipitation to infiltrate into the ground.

As humans alter the landscape, streams suffer from compounding and interconnected side effects caused by urban development such as channelization, streambank erosion, invasive species establishment, degraded in-stream habitat, nutrient inputs from improper land management, and sediment deposition. Many of these side effects lead to poor water quality.

The Pike River watershed currently maintains large expanses of both private and public open space. Much of this open space is agricultural land in the western portions of the watershed, where cash grain agriculture and vegetable crops dominate. There are a few larger parks and nature centers of note in the watershed including Petrifying Springs Park, Hawthorn Hollow Nature Sanctuary and Arboretum, Sanders Park and Kenosha Country Club. There are two universities in the watershed: University of Wisconsin, Parkside and Carthage College. Gateway Technical College abuts the lakefront and is located in the direct drainage area. There is a large percentage of open space on these campuses. Development pressure is most abundant in the western portion of the watershed where recent residential and commercial development has occurred in Mount Pleasant, Somers and Pleasant Prairie. Older developments with extensive stormwater infrastructure are located in Racine and Kenosha.

The Pike River is proposed to be listed by the EPA as impaired in the most recent 2012 Water Quality Report and Section 303d List for Total Phosphorus indicated by a degraded biological community. The North Branch Pike River is listed as impaired for fish and aquatic life due to chronic aquatic toxicity and degraded habitat caused by stream channelization, debrushing of streambanks, draining of wetlands, sedimentation from runoff and increased stormwater drainage due to urban development within the watershed. Waxdale Creek, one of the northern tributaries is listed as an impaired stream suffering from high amounts of sedimentation and degraded habitat. This reach was previously listed for an unknown pollutant causing chronic aquatic toxicity, but the pollutant has since been removed. Additionally, both Alford Park Beach and Pennoyer Park Beach along Lake Michigan are listed as impaired for Recreational Uses due to elevated E. coli levels (WDNR, 2011).

1.2 Scope, Purpose, and Project Approach

In November of 2011, The Root-Pike Watershed Initiative Network hired Applied Ecological Service, Inc. to produce a comprehensive "Watershed-Based Plan" for the Pike River watershed that meets requirements as defined by the United States Environmental Protection Agency (USEPA). The primary scope of this project is the development of an ecologically-based watershed restoration and management plan for the Pike River watershed that focuses on increasing public education through the creation of a Pike River Education Public Outreach Committee, managing future growth by utilizing a more sustainable development pattern, protecting and restoring the river corridor, increasing and improving recreational access, and increasing protected open space within the watershed. Ultimately, the intent of this project is to develop and implement a Watershed-Based Plan designed to achieve applicable water quality standards.

The primary purpose of this plan is to spark interest and give stakeholders a better understanding of the Pike River watershed to promote and initiate plan recommendations that will accomplish the goals and objectives of the plan. This report was produced by implementing a comprehensive watershed planning approach with input from stakeholders and analysis of complex watershed issues by Ecologists, Planners, GIS Specialists, and Environmental Engineers.

The Pike River Watershed Restoration Planning project utilized a unique approach that was designed in two phases. Phase I, began during the summer of 2011 and concluded in the spring of 2012, was focused on building early stakeholder engagement in support of the planning process; educating stakeholders on watershed assets, challenges and threats; and determining stakeholder visions and goals for the watershed. Phase II of the planning process consisted of the development of the watershed-based plan, including addressing all of the nine Elements required by the USEPA. Information gathered during Phase I of the planning process and interests, issues, and opportunities identified by the Root-Pike Watershed Initiative Network (Root-Pike WIN) were addressed and incorporated into the watershed plan. The plan incorporates scientific, economic and practical rational for maintaining and improving open space to meet the majority of the goals and objectives in the plan. It emphasizes entering into relationships with public, private, and non-profit entities to manage these properties to maximize watershed benefits. In addition, ideas and recommendations in this plan are designed to be updated through adaptive management that will strengthen the plan over time as additional information becomes available.

1.3 USEPA Watershed-Based Plan Requirements

In October 2003, USEPA released watershed protection guidance entitled "Nonpoint Source Program and Grant Guidelines for States and Territories." (USEPA 2008) The document was created to ensure that Section 319 funded projects make progress towards restoring waters impaired by nonpoint source pollution. AES consulted this document to create this Watershed-Based Plan. Having a Watershed-Based Plan will allow Pike River watershed stakeholders to access 319 Grant funding for management measures recommended in the plan. Under the USEPA guidance, nine "Elements" are required in order for a plan to be considered a Watershed-Based Plan. The nine Elements are as follows:

Element A: Identification of the causes and sources or groups of similar sources of pollution that will need to be controlled to achieve the pollutant load reductions estimated in the watershed-based plan;
Element B: Estimate of the pollutant load reductions expected following implementation of the management measures described under Element C below;
Element C: Description of the non-point source management measures that will need to be implemented to achieve the load reductions estimated under Element B above and an identification of the critical areas in which those measures will be needed to implement the plan;
Element D: Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement the plan;
Element E: Public information/education component that is designed to change social behavior;
Element F: Plan implementation schedule;
Element G: Description of interim, measurable milestones;
Element H: Set of criteria that can be used to determine whether pollutant loading reductions are being achieved over time;
Element I: Monitoring component to evaluate the effectiveness of the implementation efforts over time.

1.4 Planning Process

The Root-Pike Watershed Initiative Network (Root-Pike WIN) initiated the planning process for the Pike River Watershed-Based Plan with assistance from Hawthorn Hollow Nature Sanctuary and Arboretum and University of Wisconsin – Extension. The process was divided into three phases: Phase I focused on building stakeholder engagement and education, Phase II was dedicated to the development of the Pike River Watershed-Based Plan and addressing the USEPA's nine Elements, and Phase III will be centered around on-the-ground implementation and restoration projects as identified in the plan.

The stakeholder group met 13 times during the planning process (seven times during Phase I and six during Phase II). The committee generally consisted of representatives from municipalities, townships, state and federal agencies, nonprofit organizations, and watershed residents.

Root-Pike WIN played an important role in the early identification of watershed issues, stakeholder goals, and an overall vision for the watershed restoration. Meetings were initiated by the Watershed Coordinator, Susan Greenfield, and covered a wide range of topics specific to the Pike River Watershed. Meeting schedules for both Phases I and II, including the topics of those meetings, are included in Tables 1 and 2. Meeting minutes are included in Appendix A.

Pike River Summit Meeting

Table 1: Phase I meeting schedule

Meeting Date	Agenda	Location
Thursday, September 29, 2011	Overview of the Pike River Watershed	Hawthorn Hollow
Thursday, October 27, 2011	Upper Pike River Restoration Project	Village of Mt. Pleasant – Village Hall
Thursday, December 1, 2011	Racine and Kenosha County Comprehensive Plans	Kenosha Country Club
Thursday, January 26, 2012	Managing Agricultural Runoff	UW-Parkside
Thursday, February 23, 2012	The Pike River Fishery	Town of Somers – Town Hall
Thursday, March 22, 2012	Environmental Corridors	Petrifying Springs Park
Thursday, May 12, 2012	Pike River Summit – Community Visioning	City of Kenosha

Table 2: Phase II meeting schedule

Meeting Date	Agenda	Location
Thursday, August 23, 2012	• Results of Survey • EPA 9 Elements Review • Overview of Watershed Management Measures	Town of Somers – Town Hall
Thursday, September 20, 2012	• Review Climate, Topography, Geology, Soils • Review Jurisdiction, Demographics, Transportation • Open Space and Natural Areas Inventory	Town of Somers – Town Hall
Thursday, November 29, 2012	• Review Existing/Future Land Use Summary • Review, Streams, Lakes, Wetland Inventory • Water Quality Inventory	Town of Somers – Town Hall
Thursday, January24, 2013	• Pollutant Loading Model • Pollutant Reduction Needs/Targets • Selection of BMP's to Reduce Pollutant Loading	Village of Mt. Pleasant – Village Hall
Thursday, March 21, 2013	• Prioritize: Programmatic Action Plan • Prioritize: Site Specific Action Plan • Green Infrastructure Plan/Recommendations	Village of Mt. Pleasant – Village Hall
Thursday May 23rd, 2013	• Watershed Education and Outreach • Plan Performance: Implementation, Schedule and Milestones	Village of Mt. Pleasant - Village Hall

In addition to meetings, Phase I included a web-based Issue Identification Survey and culminated in the Pike River Summit - Community Visioning meeting which identified stakeholder priorities (see Appendix A). Those priorities included increasing public education through the creation of a Pike River Education Public Outreach Committee, managing future growth by utilizing a more sustainable development pattern, protecting and restoring the river corridor, increasing and improving recreational access, and increasing protected open space within the watershed.

Community visioning during the Summit meeting

1.5 Mission, Goals, and Objectives

Mission Statement
Pike River Future is comprised of watershed stakeholders dedicated to the preservation, protection, and improvement of the Pike River watershed.

Pike River Future's mission is to realize a long-term vision for a healthy watershed, provide stewardship, and educate citizens. The group's primary goal is to educate while building partnerships for projects to improve water quality, reduce flooding, and enhancing ecosystem benefits by preserving and restoring wetlands, prairies, and other natural features for future generations.

Development of Goals and Objectives
Draft goals were established for the Pike River watershed to address the issues and opportunities raised during the issue identification survey, watershed summit visioning, and public meeting questions and "Places of the Heart" exercises. The goals and objectives were then revised in a stakeholder meeting in January 2013 in order to adjust for changes and new information added during the planning process. Objectives assigned to each goal are intended to be measurable where appropriate so that future progress can be assessed. Note: goals and objectives are not listed by order of importance.

- **Goal A:** Foster engagement and provide opportunities for stewardship of our watershed.

  Objectives:
  1) Create Pike River Education Public Outreach Committee to engage County, City and Town boards, schools, and foster partnerships
  2) Educate the public about invasives, native plants, balanced ecosystems, restoration, pollutants and their relation to the health of the Pike River. Encourage public involvement and inform the public of their role in the stewardship of the Pike River.
  3) Provide watershed stakeholders with an education plan that promotes the knowledge, skills, and motivation needed to take action on implementing the watershed plan.
  4) Inform the public and public officials on the benefits of sustainable development practices and support changes to ordinance language that promotes sustainable development.
  5) Create targeted educational information for land owners adjacent to the river, tributaries and floodplain.
  6) Install environmental interpretation signage at access points throughout public open space.
  7) Develop recommendations for education and alternatives for fertilizer and pesticide use.
  8) Develop recommendations for education and alternatives to road & other pavement salt use.

- **Goal B:** Improve surface water quality and groundwater resources to achieve WDNR/EPA water quality standards.

  Objectives:
  1) Identify, implement, and monitor management measures (Best Management Practices (BMPs)) that address "Critical" and high priority pollutant loading areas.
  2) Retrofit existing stormwater management systems and design new systems within developed areas to specifically improve water quality and create wildlife habitat.
  3) Retrofit systems in intensely developed areas, specifically those in the Direct Drainage area.

4) Protect and restore the river corridor by reducing blockages, stream bank erosion, and impacts of stormwater systems.
5) Encourage use of alternatives to road salt and best application practices of deicers.
6) Maintain setbacks and buffers in streams, tributaries, and wetlands. Decrease invasive species in these zones.
7) Identify opportunities for drain tile modification to improve water quality.
8) Continue water quality monitoring programs, specifically including Nitrogen, Phosphorus and Total Suspended Solids.

- **Goal C:** Identify, enhance and protect important natural areas and provide open space for appropriate recreational benefits.

  Objectives:
  1) Increase appropriate water and land based recreational opportunities to the Pike River.
  2) Permanently protect all sites with high quality natural areas or threatened and endangered species, as identified by primary and secondary environmental corridors by SEWRPC.
  3) Identify and protect open space that provides important green infrastructure, preserves corridor connections, and can provide appropriate recreational opportunities.
  4) Develop recommendations for adoption of conservation and/or low impact design standards for all new development or redevelopment.
  5) Increase environmental and recreational stewardship with volunteers and docents.
  6) Create environmental interpretive signage on trails explaining watersheds and water quality.

- **Goal D:** Reduce existing structural flood damage and ameliorate potential flooding where flooding threatens structures and infrastructure.

  Objectives:
  1) Protect undeveloped non-protected floodplain as open space.
  2) Reconnect channelized stream reaches to historic floodplain where feasible.
  3) Implement multi-objective stormwater management measures (BMPs) within important open space and new developments that help reduce runoff and flashy stream flows through infiltration of rainwater.
  4) Maintain or improve existing constructed storm water management systems.
  5) Manage and maintain existing natural depressional storage, wetlands, streams, and riparian areas.

- **Goal E:** Improve aquatic and terrestrial habitat to encourage diverse, resilient ecosystems.

  Objectives:
  1) Improve habitat in channelized stream reaches using natural design approaches, with special focus on water temperature and fish habitat.
  2) Restore native riparian buffers along stream reaches identified as having poor buffer quality, especially in agricultural areas.
  3) Restore areas identified with excessive bank erosion.
  4) Improve habitat in degraded upland (terrestrial) communities by removing non-native plants, replacing with native plant species, and reintroducing fire via controlled burns.
  5) Encourage development and implementation of management plans for natural areas.

6) Require future developers to protect sensitive natural areas both during and after construction, restore degraded natural areas, then donate natural areas and naturalized stormwater management systems to a public agency or conservation organization for long term management with dedicated funding.

- **Goal F:** Increase communication and coordination among municipal decision-makers, business and agricultural communities and other stakeholders within the watershed.

  Objectives:
  1) Encourage governing bodies to adopt the Pike River Watershed-Based Plan.
  2) Encourage amendments of municipal comprehensive plans, codes and ordinances to include watershed plan goals and objectives.
  3) Encourage and support business and agricultural communities and other stakeholder efforts to implement recommended actions within the watershed plan.

1.6 Using the Watershed-Based Plan

The information provided in this document is prepared so that it can be easily used as a tool by elected officials, federal/state/county/municipal staff, and the general public to identify and take actions related to water quality, natural resource, and flood risk issues. This section of the report summarizes what the user can expect to find in each major section of the report.

Section 1.0 Introduction, Climate, Topography and Geology
Section 1.0 of the report contains the Pike River Future mission and goals/objectives identified by watershed stakeholders. Goal topics generally include fostering engagement and education, improving water quality, protecting natural areas, improving habitat, reducing flood problem areas, and increasing engagement of decision makers in the watershed. In addition, "measurable objectives" were developed for each goal so that the progress toward meeting each goal can be measured in the future by evaluating information included in Section 11.0: Measuring Plan Progress & Success.

Section 2.0 Jurisdiction, Demographics, and Transportation Summary
This section outlines jurisdictional boundaries and roles as well as some basic demographics of its population, including projected changes. Additionally, various transportation routes are summarized within the watershed.

Section 3.0 Open Space and Natural Areas Summary
Section 3.0 includes the open space inventory, prioritization, and assessment; outlines the development of the Green Infrastructure Network; and provides a summary of the existing ecologically significant and natural areas.

Section 4.0 Existing and Future Land Use and Impervious Cover Impacts
Highly accurate land use/land cover data was produced for Pike River watershed in Section 4.0 using several processes. Future land use predictions took into account SEWRPC's 2035 Land Use Plan as well as updates from the comprehensive plans of several municipalities. Impervious cover impacts and vulnerability are also discussed in this section.

Section 5.0 Streams, Wetlands, Ravine, & Brownfield Inventory
An inventory of the characteristics, problems, and opportunities in Pike River watershed is examined in Section 5.0. Resulting analysis of the inventory data led to recommended watershed actions that are included in Section 8.0: Management Measures Action Plan. Inventory results also helped identify causes and sources of watershed impairment as required under USEPA's *Element A*.

Section 6.0 Water Quality Inventory
Section 6.0 summarizes existing water quality data for the Pike River and its tributaries. The Pike River from the mouth at Lake Michigan to the junction of Pike River and the South Branch is proposed to be newly 303(d) listed because of excessive amounts of phosphorus resulting in a degraded biological community. North Branch Pike River from the junction of South Branch to the headwaters of Pike River is 303(d) listed for an unknown pollutant and for sediment/total suspended solids resulting in chronic aquatic toxicity and degraded habitat. Waxdale Creek is 303(d) listed for an unknown pollutant that has since been removed as well as sediment/total suspended solids resulting in chronic aquatic toxicity and degraded habitat. Alford Park Beach and Pennoyer Park Beach, both on Lake Michigan, are 303(d) listed and under recreational restrictions due to elevated E. coli levels.

Section 7.0 Pollutant Loading Model and Reduction Needs/Targets
This section of the plan includes a list of causes and sources of watershed impairment as identified in Sections 5.0 and 6.0 and by watershed stakeholders that affect WDNR "Designated Uses". As required by USEPA, Section 7.0 also addresses all or portions of *Elements A, B, & C* including an identification of the "Critical Areas", pollutant load reduction targets, and estimate of pollutant load reductions following implementation of recommended Management Measures identified in Section 8.0.

Section 8.0 Management Measures Action Plan and Green Infrastructure Recommendations
The Management Measures Action Plan is divided into a Programmatic Action Plan and a Site Specific Action Plan. Action recommendations are presented in table format with references to regulatory authorities that would provide consulting, permitting, or other services needed to implement specific BMPs and complete larger restoration projects. The Programmatic Action Plan recommends action items with general applicability throughout the watershed. The Site Specific Action Plan identifies specific sites where water quality can be improved, natural resources/open space protected, and flood risks minimized. A priority ranking is assigned to both programmatic action recommendations and site-specific action recommendations. In addition, the Action Plan section contains Green Infrastructure Recommendations.

Section 9.0 Information and Education Plan
Section 9.0 recommends campaigns that are designed to enhance understanding of the issues, problems, and opportunities within the Pike River Watershed. The intention is to promote general acceptance and stakeholder participation in selecting, designing, and implementing recommended Management Measures to improve watershed conditions.

Section 10.0 Plan Implementation
The Plan Implementation section serves as a guide to implementing the plan over time. This includes responsible entities/stakeholders, an implementation schedule and a discussion of funding mechanisms.

Section 11.0 Measuring Plan Progress and Success
Section 11.0 includes the Water Quality Monitoring Plan and recommendations as well as Progress Evaluation "Report Cards" that should be used to determine whether Management Measures are being implemented over a given time period and how effective those measures are.

Section 12.0 Literature Cited and Section 13.0 Glossary of Terms
Section 12.0 includes a list of literature that is cited throughout the report. The Glossary of Terms (Section 13.0) includes definitions or descriptions for many of the technical words or agencies that the user may find useful when reading or using the document.

Appendix
The Appendix to this report is included on the attached CD. It contains Pike River watershed meeting minutes (Appendix A), results of the watershed inventory (Appendix B), raw data used to develop the pollutant loading and reduction models (Appendix C), a list of Pike River stakeholders & partners (Appendix D), and a list of potential funding opportunities (Appendix E).

1.7 Prior Studies and Work

Various studies have been completed describing and analyzing conditions within the Pike River watershed. This Watershed-Based Plan uses existing data to analyze and summarize work that has been completed by others and integrates new data and information. A list of known studies is summarized below. A complete list of reference documents is located in Section 12.0.

1. In 1983 the Southeastern Wisconsin Regional Planning Commission (SEWRPC) developed "A Comprehensive Plan for the Pike River Watershed". This plan reports on flooding, water pollution and other land use issues occurring in the watershed.
2. The Lake Michigan Lakewide Management Plan (LaMP) was first written in 2000 by the Lake Michigan Technical Committee with assistance from the Lake Michigan Forum and Tetra Tech, Inc. Subsequent updates were written in 2002, 2004, 2006, and 2008. The plans and updates take an ecosystem approach to addressing issues within the Lake Michigan basin and take a broad, systemic view of the interaction among physical, chemical, and biological components in the basin.
3. In 2002 the Wisconsin Department of Natural Resources and the Root-Pike WIN researched the current conditions of the Root-Pike River Basin and created a report entitled "The State of the Root-Pike River Basin." This report provides an overview of the land and water resource quality and identifies challenges within this basin.
4. In 2003/2004, the Bay-Lake Regional Planning Commission produced "A Guide to Planning for Coastal Communities in Wisconsin." Identifies and provides guidance on issues facing coastal communities in comprehensive planning efforts.
5. In 2004, The Department of Ecology of the University of Wisconsin Milwaukee (Ehlinger and DeThorne) produced "Interim Monitoring Report: Stream Habitat and Aquatic Biotic Integrity, Pike River North and South Branches, Racine and Kenosha Counties, Wisconsin." This report summarized fish, stream invertebrates, riparian habitat and water quality monitoring results from 2003 and compared them to prior monitoring in the North Branch and other reference reaches.

6. In 2005 the Fish Ecology Laboratory of the University of Wisconsin in Milwaukee (Hoverman, Ehlinger) produced Technical Report No. 6, "Using Simulation Models for Predicting the Quality and Quantity of Fish Habitat in Relationship to Flow Variation in Urban Streams." This study examines whether hydraulic models can contribute to a better understanding for how to incorporate habitat features into stream restoration designs.
7. In 2009, The Department of Ecology of the University of Wisconsin Milwaukee (Ehlinger, Ortenblad, Schmitz) produced "Interim Monitoring Report: Stream Habitat and Aquatic Biotic Integrity, Pike River North and South Branches, Racine and Kenosha Counties, Wisconsin." This report summarized fish, stream invertebrates, riparian habitat and water quality monitoring results from 2008 and put them in the context of prior research.
8. In 2010 the Wisconsin Department of Natural Resources produced a document entitled "2010 Water Quality Management Plan Update" for the Pike River Watershed. This document provides an update on conditions and efforts within the watershed since the completion of the 1983 plan.
9. In 2010, the Department of Chemistry at Carthage College in Kenosha produced a study entitled "Monitoring Chloride Concentrations for the Pike River in Southeastern Wisconsin" which studied chloride concentrations along the Pike River.
10. In 2012, The Department of Ecology of the University of Wisconsin Milwaukee (Timothy Ehlinger) produced "Monitoring of Stream Habitat & Aquatic Biotic Integrity, Pike River - North Branch, Racine County, Wisconsin." This report summarizes the findings from the monitoring work conducted by UWM during the Pike River Restoration Project for fish abundance and species composition, aquatic invertebrates, habitat, water quality, and hydrology from 2000 through 2012.

1.8 Geologic History

The terrain of the Midwestern United States was created over thousands of years as glaciers advanced and retreated during the Pleistocene Era or "Ice Age". Some of these glaciers were a mile or more thick. The area of southeastern Wisconsin where the Pike River Watershed now lies was covered by the most recent glacial event known as the Late Wisconsin Glaciation that began approximately 30,000 years ago and ended around 9,500 years ago (Figure 4). During this period the earth's temperature warmed and the ice slowly retreated leaving behind moraines and glacial ridges where it stood for long periods of time (Hansel 2005). As the glaciers from this period receded, they scoured out what has become the Great Lakes and left behind a nearby terminal moraine known as the Kettle Moraine.

The composition of the soil in the Pike River Watershed is also a remnant of the ancient ice movement. Above the bedrock lies a layer of deposits left behind from the glaciers, consisting of clay, silt, sand, and limestone cobble.

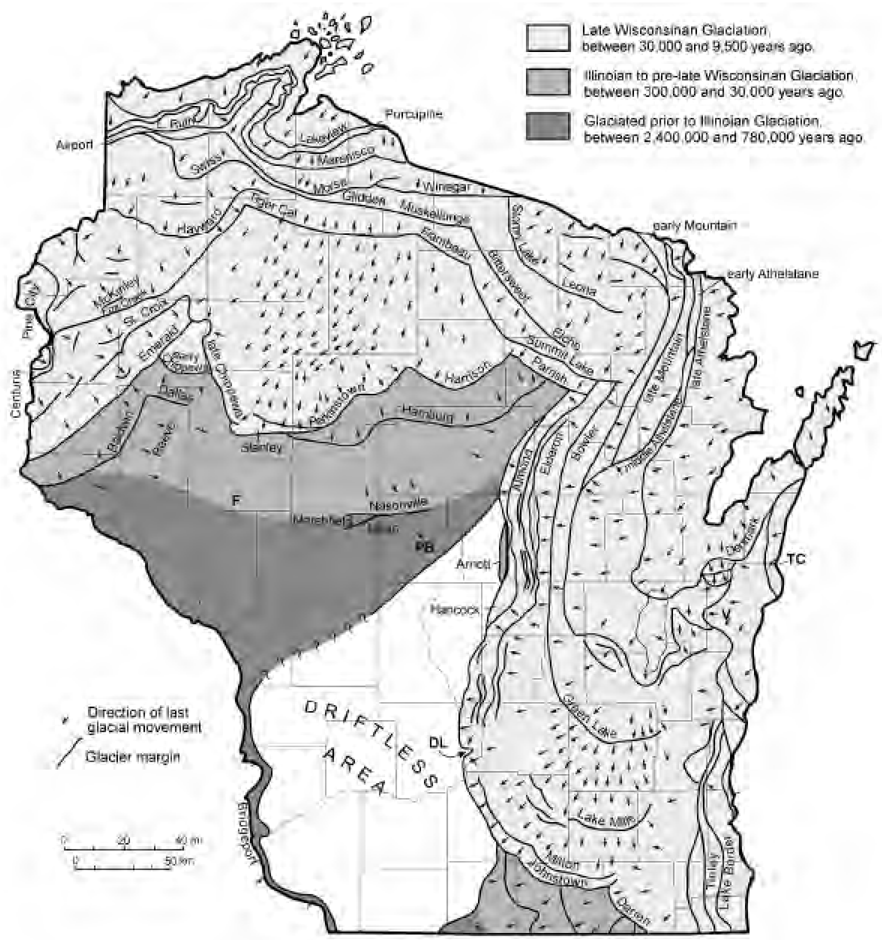


Figure 4. Phases of glaciations in Wisconsin.
Source: Syverson & Colgan.

A tundra-like environment covered by spruce forest was the first ecological community to colonize after glaciers retreated. As temperatures continued to rise, tundra was replaced by cool moist deciduous forests and eventually by maple-basswood-beech forests, oak forests, oak savannas, and prairies, as well as black ash, relict cedar, and tamarack swamps.

1.9 Climate and Wisconsin Ecoregions

The climate of southeastern Wisconsin and the Pike River watershed consists of a fairly typical continental type climate. As such, it follows a continuous progression of four distinct seasons and a large range of annual temperatures. Average annual temperatures range from the lower tens in January, dominated by prevailing northwesterly winds, to upper 70's in July driven by warm southwesterly winds. The Pike River watershed receives an average of 35 inches of precipitation a year (city-data.com).

The climate of the watershed is heavily influenced by its location at the convergence of two competing, migratory air mass patterns: cyclonic storm tracks for low pressure centers moving from the west and southwest as well as the path of high pressure centers moving generally toward the southeast. This results in frequent and relatively abrupt changes in weather patterns particularly in winter and spring, including variations in temperature, amount and type of precipitation, relative humidity, cloud cover, and wind speed and direction. The climate along the eastern edge of the Pike River watershed is also tempered by its proximity to Lake Michigan due to differences in the temperatures of those land air masses and the lake water. This moderating influence is specifically applicable to the area that falls within a few miles of the shoreline and most pronounced in spring, summer, and fall (SEWRPC, 1983).

The Western Ecology Division of the Environmental Protection Agency relies on a system of defining ecoregions within the state of Wisconsin for research and management purposes. Ecoregions consist of geographical areas within which the biotic, abiotic, terrestrial and aquatic characteristics are all similar. These ecoregions were defined according to factors such as soils, vegetation, climate, geology, and physiography and are critical for structuring and implementing integrated management strategies such as a watershed plan.

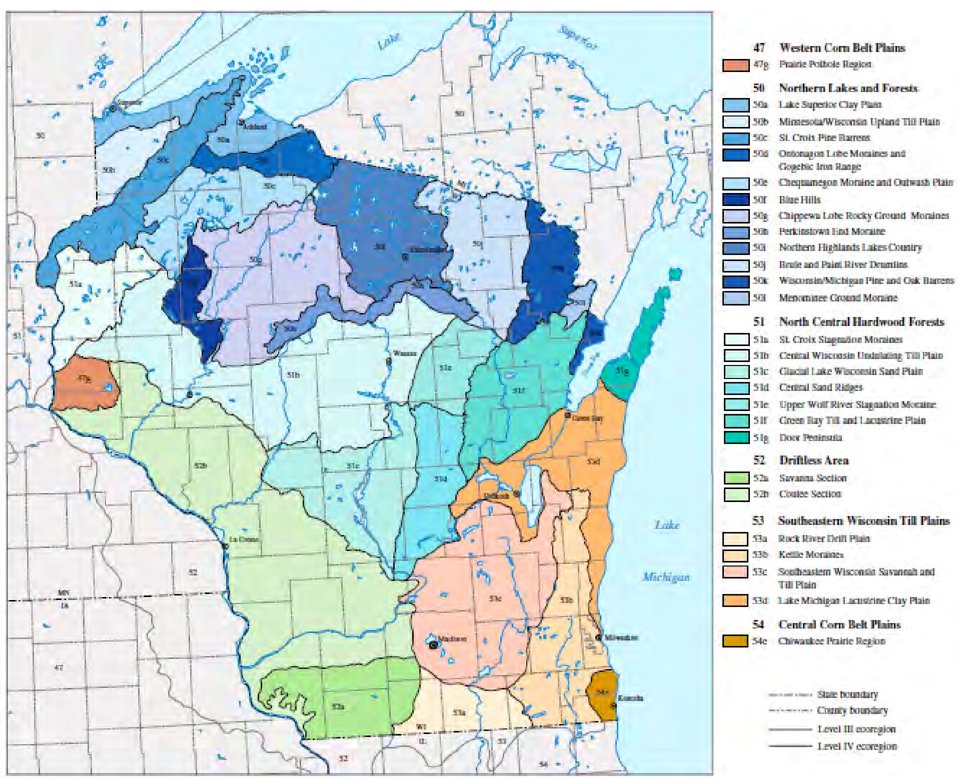


Figure 5. Level III and IV Wisconsin Ecoregions. Source: Omernik, et. al.

The Pike River watershed falls within the Central Corn Belt Plains ecoregion and, more specifically, within the Chiwaukee Prairie Region. The Central Corn Belt Plains consist predominantly of prairie communities native to the glaciated plains in contrast to the southern mesic forest and oak savanna of the adjacent region to the north and west. The natural vegetation was gradually replaced by agriculture starting in the nineteenth century and farms now cover much of the soils within the region. The Chiwaukee Prairie Region consists of intensive agriculture, prairie soils, loess capped loamy till, and lacustrine deposits. The extent of agriculture in the area affected stream chemistry, turbidity, and habitat. Today, "land use of the ecoregion continues to change, from exclusively agriculture to a pattern with an increasing amount of urban and industrial land. (Omernik, 2000)"

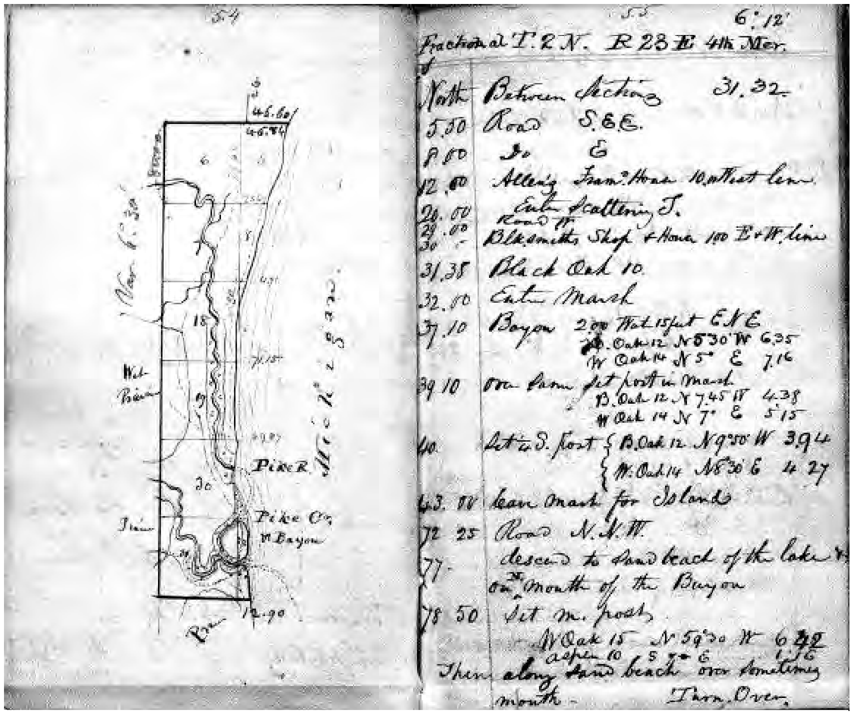
1.10 Pre-European Settlement Ecological Communities & Changes

An ecological community is made up of all living things in a particular ecosystem and is usually named by its dominant vegetation type. The original public land surveyors that worked for the office of U.S. Surveyor General in the early and mid 1800's mapped and described natural and man-made features and vegetation while creating the township, range and section grid for mapping and sale of western public lands of the United States (Wisconsin Board of Commissioners of Public Lands, 1848). We know by interpreting survey notes and the hand drawn Federal Township Plats of Wisconsin (1833-1866) and from documents written by the earliest settlers in the area that a complex interaction existed between several ecological communities including prairie, southern oak forest, southern mesic forest, oak openings, and marshland. Figure 6 shows a compilation of the survey maps of Pike River made in 1836.

Noteworthy : Accounts of pre-European Settlement conditions

One of the earliest residents of the Pike River watershed was a gentleman by the name of Ben Bones of Mt. Pleasant, Wisconsin. He was born there in 1842 and wrote an article published in April of 1904 in the *Racine Journal Times* entitled "In Memory of the Once Big Trees of Pike Woods." In it, he describes the nature of the forest and trees that once covered the area:

> *"A half a mile southeast of Petrified Springs, there was a timber hewed from a swamp burr oak 2 ft. square and 64 ft. long. I think this is the largest stick ever taken out of Pike Woods. A white oak, three-quarters of a mile west of my farm, was cut down. I made a butcher block, 42 posts, and 17-1/2 cords of wood. A hickory felled on the Jackson farm made 7-1/2 cords of wood. One half mile west of Berryville, and exactly where John Gehring's house now stands, was a fallen black walnut tree, 7-1/3 ft. in diameter. Black walnut trees 4 ft. in diameter were plenty, also butternut trees on the flats; also elms of that caliber and now and then a basswood tree, white and black ash 3-1/2 ft. were not scarce. There was probably no forest more beautiful on earth fifty years ago.*
>
> *The monarch of the woods blew down in 1876. It was 9 ft. at the base and 124 ft. long. I bought the tree and put ten feet of the hollow base in my front yard making a wigwam for the children. I paid for the cutting of this. There were two horse blocks and 22 cords of stove wood before getting to the first branch. This tree was a cotton wood about 135 years old and I think the largest tree in the state. There is just one of the large trees left, a cottonwood, 125 feet high, 5-1/2 feet at the base and it is sixty feet to the first limb. The body is a symmetrical shaft worth going miles to see. I feel it a duty to these old trees of long ago, to write that they once lived. Alas! Those who will remember them are about as scarce as the old trees."*



Field notes from the survey of the mouth of the Pike River, February 1836.

Another documentation of pre-settlement conditions comes from a book called *Pioneer Life in Kenosha County*, written in 1876 by H.M. Simmons. In it he describes the existing prairies as they were being cleared: "The upland prairies are bright with flowers; and the lowlands wave with grass so tall that the legends say the mower sometimes worked in its shade half the day, and even a horse and rider were sometimes concealed in it."

Pre-European settlement ecological communities in the Pike River watershed were balanced ecosystems exhibiting a diversity of plants and wildlife. The mosaic of maple – basswood forests, oak savanna, prairie, and wetlands were largely maintained and shaped by frequent fires ignited by both lightning and the Native Americans that inhabited the area. Herds of bison and elk also helped maintain the landscape by grazing. Fires ultimately removed dead plant material, exposing the soils to early spring sun, and returning nutrients to the soil. During these times most of the water that fell as precipitation was absorbed in upland prairie and forest communities or within the extensive wetlands that existed along stream corridors; any additional water slowly seeped into the Pike River and its tributaries. Infiltration and absorption of water was so great that many of the defined stream channels seen today were likely sedge and grass-dominated swales exhibiting excellent water quality.

Pre-European settlement prairie-savanna landscape

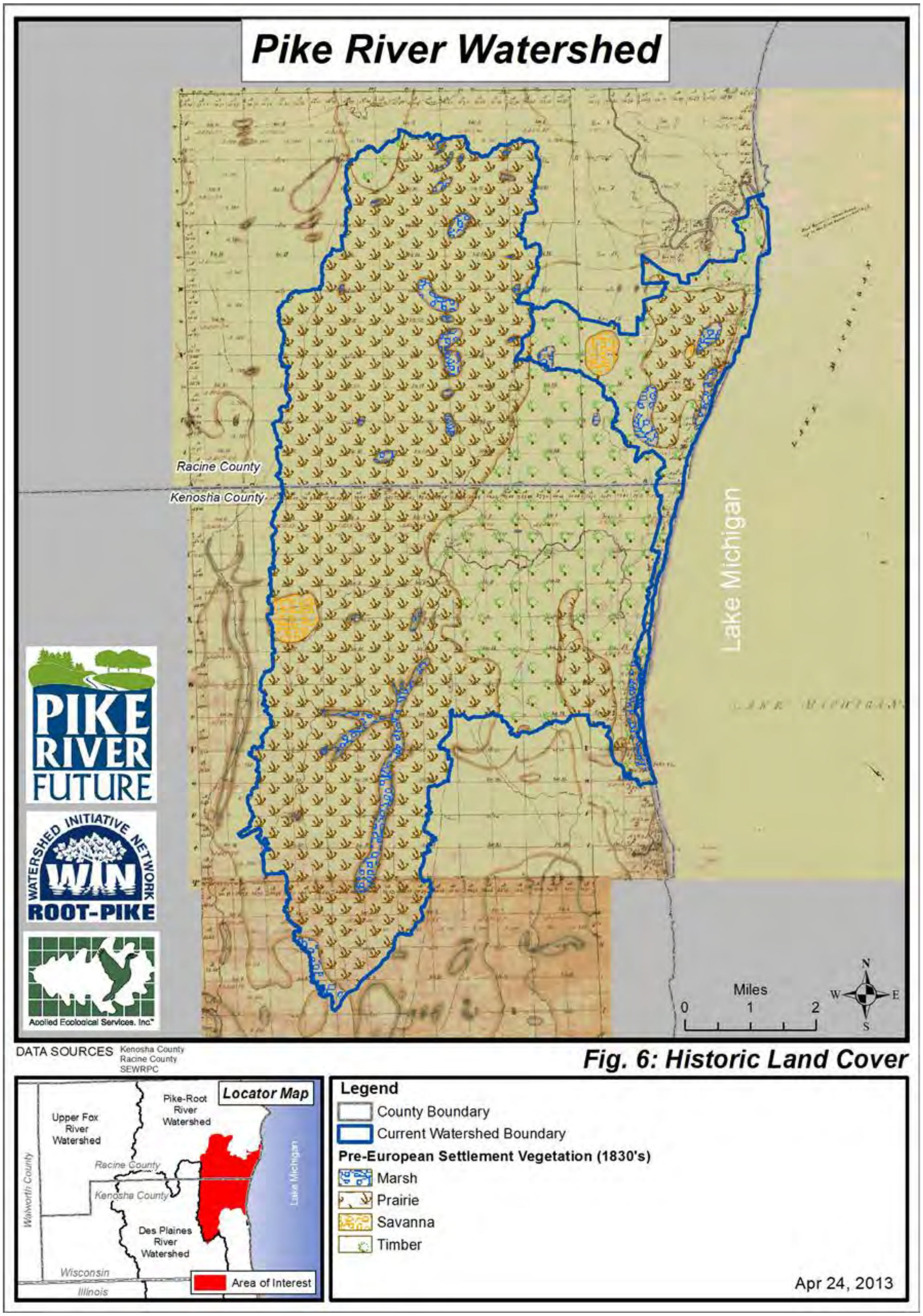
European settlement began in 1835 and resulted in drastic changes to the fragile ecological communities. The old growth forests, once known as Pike Woods, were cleared by settlers who used the wood for fuel, to build their homes, sold it to sawmills, and farmed what land was left between the stumps. Fires rarely occurred; prairies were tilled for farmland, cut for hay, or developed; and wetlands were drained. The majority of streams were dammed, channelized, and ditched and in most cases the land was cleared right up to the streambank, leaving little to no natural riparian cover. Today, isolated remnants of once healthy ecological communities exist in the Pike River watershed but many are degraded or retain an oak canopy component but have been cleared in the understory and planted to manicured turf grass in residential areas.

Rare plants communities that still exist within the watershed today include mesic, wet mesic, and wet prairie. Additionally, rare plants can also still be found including state-designated species of special concern goldenseal (*Hydrastis canadensis*); uncommon ferns such as ostrich (*Matteuccia struthiopteris*), rattlesnake (Botrypus virginianus), rusty woodsia (*Woodsia ilvensis*), and ebony spleenwort (*Asplenium platyneuron*); as well as showy orchis (*Galearis spectabilis*), yellow lady's-slipper (*Cypripedium parviflorum*), false mermaid (*Floerkea proserpinacoides*), false Solomon's seal (*Maianthemum racemosum*), Trillium (*Trillium recurvatum*), sharp-lobed hepatica (*Hepatica nobilis acuta*), spring-beauty (*Claytonia virginica*), wild geranium (*Geranium maculatum*), and blue cohosh(*Caulophyllum thalictroides*).

The earliest aerial photographs of this area were taken in 1937 (Figure 7) and depict the Pike River watershed when early farming was the primary land use but before the majority of the residential and commercial development seen today. The 1937 aerial depicts the majority of the watershed transformed into farmland, the cities of Racine and Kenosha already urbanizing, and a few pockets that more closely resemble the pre-European settlement forested and prairie landscape. Most notably, the area surrounding Petrifying Springs Park is largely unchanged. The park was established in 1928 to preserve what was left of the forests that had once covered the landscape. A narrow corridor along the main branch of the Pike River remains open and untouched as well.

Figure 8 shows a 2010 aerial image of the Pike River Watershed. The cities of Racine and Kenosha and their residential sprawl have covered the majority of the watershed, squeezing out much of the farmland. Petrifying Springs Park remains as well as some of the riparian corridor along the main branch of the Pike River, but what is left is substantially narrower.

With degraded ecological conditions comes the opportunity to implement ecological restoration to improve the condition of the Pike River watershed. Present day knowledge of how pre-European settlement ecological communities formed and evolved provides a general template for developing present day natural area restoration and management plans. One of the primary goals of this watershed plan is to identify, protect, restore, and manage natural areas. With this in mind, it is important to note that the processes that shaped the historic landscape, such as intense fire and bison grazing have largely been removed or greatly altered and the condition of most ecological communities has been degraded in some way by human activities. In most cases, pristine conditions that once existed can no longer be completely restored. Thus, we are left to manage remaining remnants and to restore and manage degraded ecosystems back to a sustainable state. The effort of restoration is compounded by urbanization and climate change which are resulting in greater stream flashiness, therefore resilient ecosystems and channel design are needed that may not resemble historical ecological communities.


Pike River Watershed
Racine County
Kenosha County
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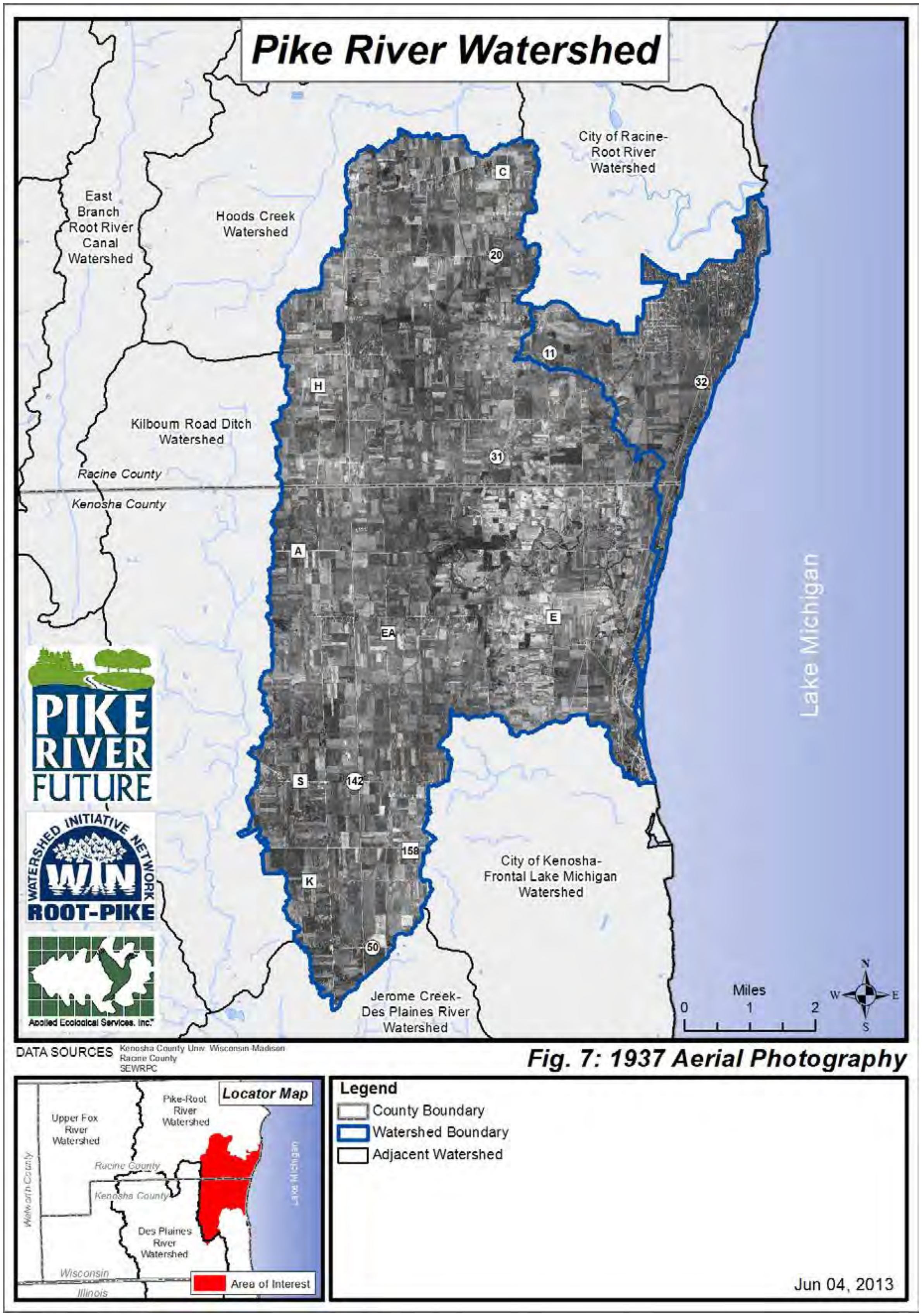
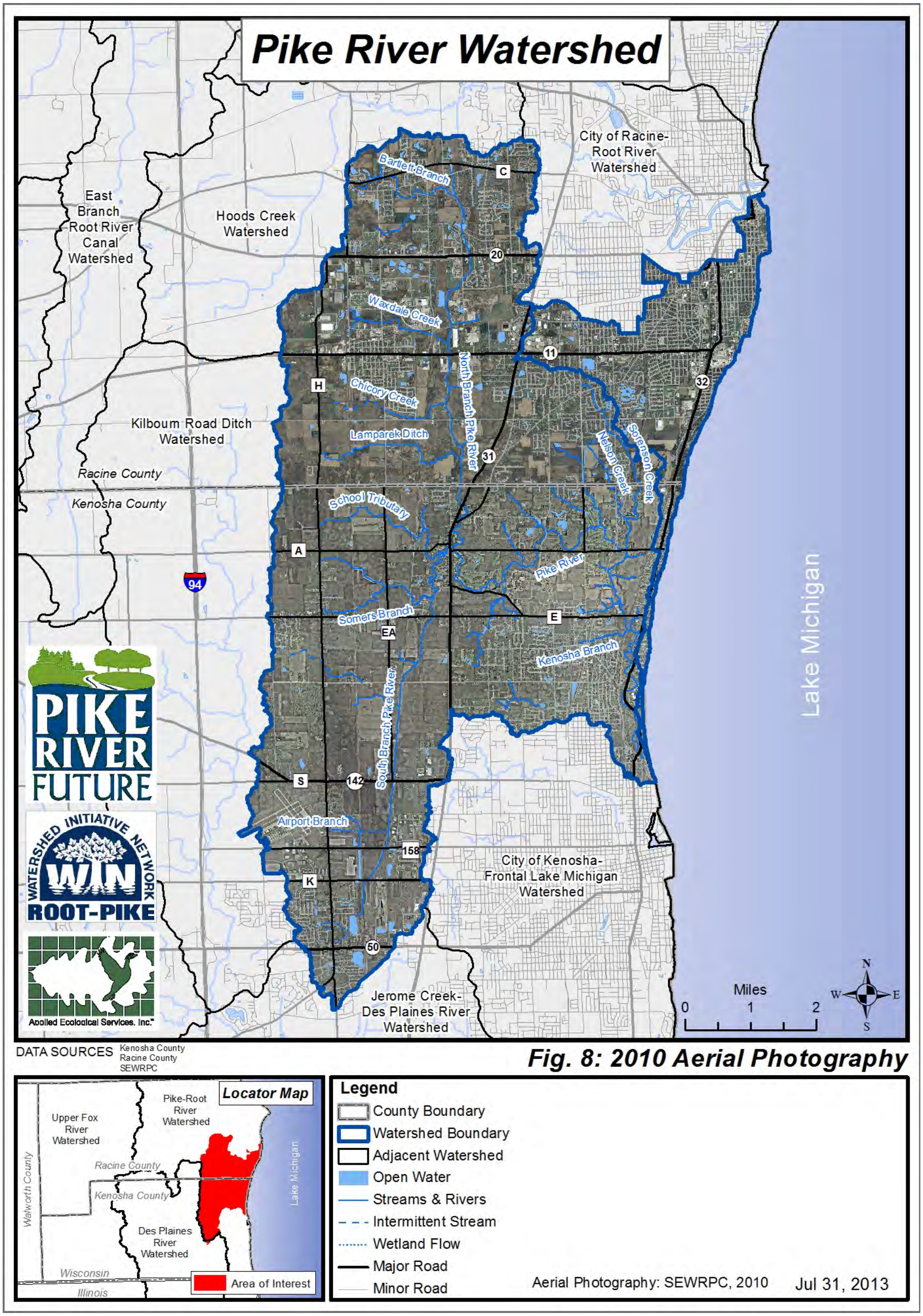
DATA SOURCES Kenosha County
Racine County
SEWRPC
Fig. 6: Historic Land Cover
Locator Map
Upper Fox River Watershed
Pike-Root River Watershed
Racine County
Kenosha County
Walworth County
Des Plaines River Watershed
Lake Michigan
Wisconsin
Illinois
Area of Interest
Legend
County Boundary
Current Watershed Boundary
Pre-European Settlement Vegetation (1830's)
Marsh
Prairie
Savanna
Timber
Apr 24, 2013


Pike River Watershed
City of Racine-Root River Watershed
East Branch Root River Canal Watershed
Hoods Creek Watershed
Kilbourn Road Ditch Watershed
Racine County
Kenosha County
City of Kenosha-Frontal Lake Michigan Watershed
Jerome Creek-Des Plaines River Watershed
Lake Michigan
PIKE RIVER FUTURE
WATERSHED INITIATIVE NETWORK
WIN
ROOT-PIKE
Applied Ecological Services, Inc.
Miles
0 1 2
DATA SOURCES Kenosha County Univ. Wisconsin-Madison Racine County SEWRPC
Fig. 7: 1937 Aerial Photography
Locator Map
Upper Fox River Watershed
Pike-Root River Watershed
Racine County
Kenosha County
Walworth County
Des Plaines River Watershed
Wisconsin
Illinois
Lake Michigan
Area of Interest
Legend
County Boundary
Watershed Boundary
Adjacent Watershed
Jun 04, 2013


Pike River Watershed
City of Racine-Root River Watershed
East Branch Root River Canal Watershed
Hoods Creek Watershed
Kilbourn Road Ditch Watershed
Racine County
Kenosha County
Bartlett Branch
Waxdale Creek
Chicory Creek
Lamparek Ditch
North Branch Pike River
School Tributary
Nelson Creek
Sorenson Creek
Pike River
Somers Branch
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City of Kenosha-Frontal Lake Michigan Watershed
Jerome Creek-Des Plaines River Watershed
PIKE RIVER FUTURE
WATERSHED INITIATIVE NETWORK
WIN
ROOT-PIKE
Applied Ecological Services, Inc.
Miles
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N S E W
DATA SOURCES Kenosha County Racine County SEWRPC
Fig. 8: 2010 Aerial Photography
Locator Map
Upper Fox River Watershed
Pike-Root River Watershed
Racine County
Kenosha County
Walworth County
Des Plaines River Watershed
Lake Michigan
Wisconsin
Illinois
Area of Interest
Legend
County Boundary
Watershed Boundary
Adjacent Watershed
Open Water
Streams & Rivers
Intermittent Stream
Wetland Flow
Major Road
Minor Road
Aerial Photography: SEWRPC, 2010
Jul 31, 2013

1.11 Topography, Watershed Boundary, & Subwatershed Management Units

Topography & Watershed Boundary

The Wisconsin glacier that retreated 9,500 years ago formed the topography and generally defined the Pike River watershed boundary. Topography refers to elevations of a landscape that describe the configuration of its surface and ultimately defines watershed boundaries. The specifics of watershed planning cannot begin until a watershed boundary is clearly defined.

Two previous watershed boundaries exist for the Pike River Watershed: the WDNR and SEWRPC. These watershed boundaries differ because of the available topography used and the scale of processing. Computing capabilities are now able to process data for this size watershed area with the 2´ topography contours and 15´ grid, a finer scale than used by either WDNR or SEWRPC. The Pike River watershed boundary used for this plan was created from a digital landform or surface in GIS using a 15´ grid and the topography contours used was 2´. In the more urban areas, boundary lines from either the WDNR or SEWRPC were used to be the most inclusive.

Headwaters of South Branch Pike River

The Pike River watershed drains from northwest to southeast along the North Branch and Pike River and from southwest to northeast along South Branch and eventually to Lake Michigan within the municipality of Kenosha. The highest point in the watershed (830 feet above sea level) is roughly in the center of the northern most end of the watershed. As expected, the lowest point (577 feet above sea level) is where the Pike River enters Lake Michigan. The difference in the highest and lowest points reflects a 253 foot change in elevation. As seen on the DEM (Figure 9) the eastern third of the watershed is relatively flat while the western two-thirds contains a variety of ridge lines along the Pike River and its various tributaries.

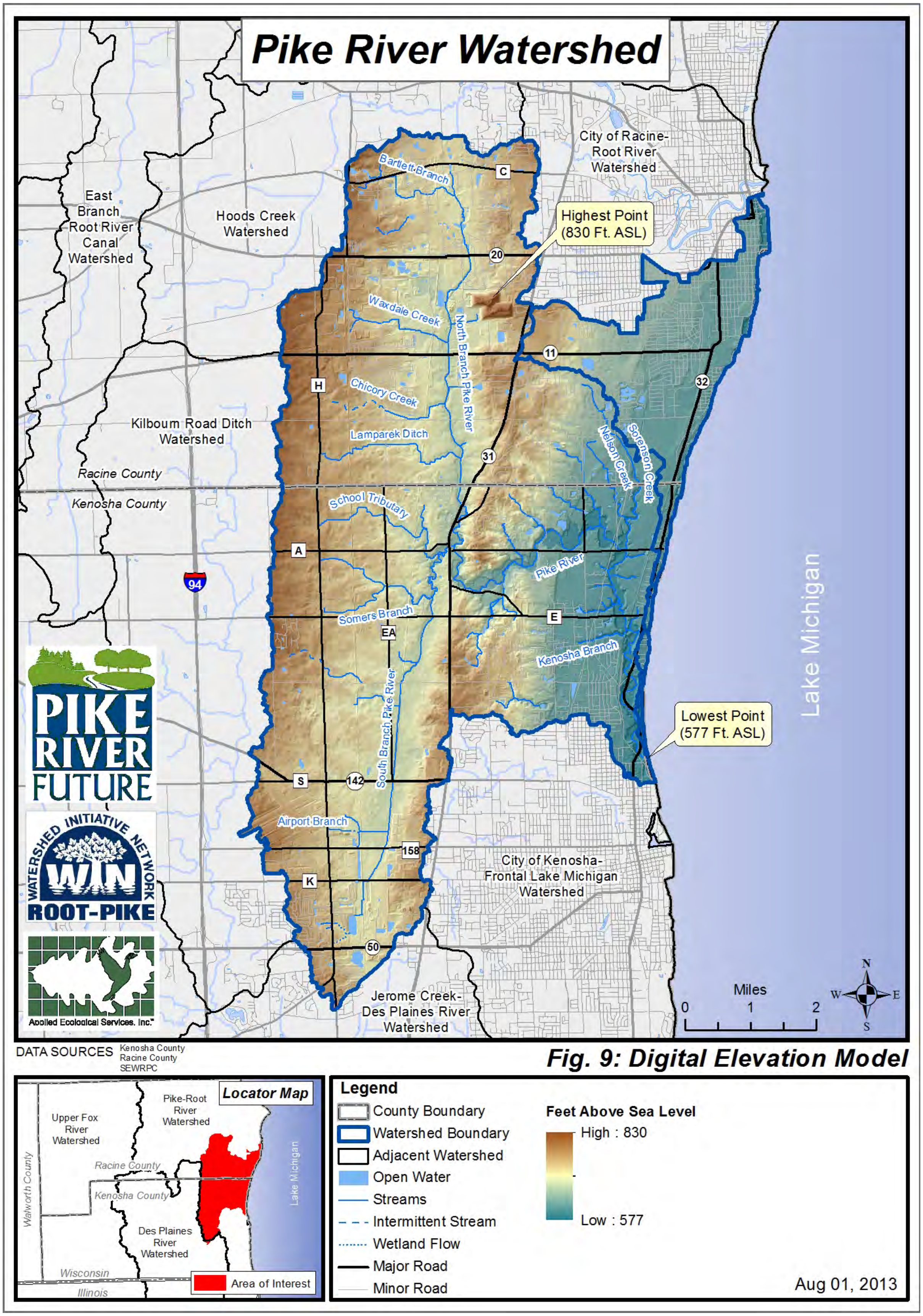


Fig. 9: Digital Elevation Model

Subwatershed Management Units (SMUs)

The Center for Watershed Protection (CWP) is a leading watershed planning agency and has defined appropriate watershed and subwatershed sizes to meet watershed management goals. In 1998, the CWP released the "Rapid Watershed Planning Handbook" (CWP, 1998) as a guide to be used by watershed planners when addressing issues within urbanizing watersheds. The CWP defines a watershed as an area of land that drains anywhere from 10 to 100 square miles. The Pike River watershed drains 57.6 square miles. Broad assessments of conditions such as soils, wetlands, and water quality are often evaluated at the watershed level and provide some information about the overall condition. However, a more detailed look at smaller drainage areas must be completed to find specific problem areas or "Critical Areas".

To address issues at a smaller scale, a watershed can be divided into smaller subwatersheds called Subwatershed Management Units (SMUs). The Pike River watershed contains 20 SMUs as delineated using the Digital Elevation Model (DEM). This size allows for detailed analysis and better recommendations for site specific Best Management Practices (BMPs). Table 3 presents each SMU and acreage within the watershed. Figure 10 depicts the location of each SMU boundary delineated within the larger Pike River watershed. SMU 20 is significantly larger than the rest of the subwatershed management units within the watershed, but this area includes all of the land that drains directly into Lake Michigan as opposed to draining into the Pike River. This area faces different challenges and generates differing recommendations from much of the rest of the watershed and its boundaries reflect that difference.

Table 3. Subwatershed Management Units and acreage.

SMU #	Total Acres	Total Square Miles
SMU 1	952.3	1.5
SMU 2	2,183.9	3.4
SMU 3	1,844.7	2.9
SMU 4	1,271.9	2.0
SMU 5	1,221.0	1.9
SMU 6	1,123.2	1.8
SMU 7	1,409.0	2.2
SMU 8	1,025.5	1.6
SMU 9	1,904.8	3.0
SMU 10	2,331.5	3.6
SMU 11	1,777.9	2.8
SMU 12	1,558.9	2.4
SMU 13	1,739.6	2.7
SMU 14	2,151.0	3.4
SMU 15	971.4	1.5
SMU 16	2,617.5	4.1
SMU 17	3,180.5	5.0
SMU 18	562.5	0.9
SMU 19	2,671.3	4.2
SMU 20	4,366.6	6.8
Totals	**36,865**	**57.6**

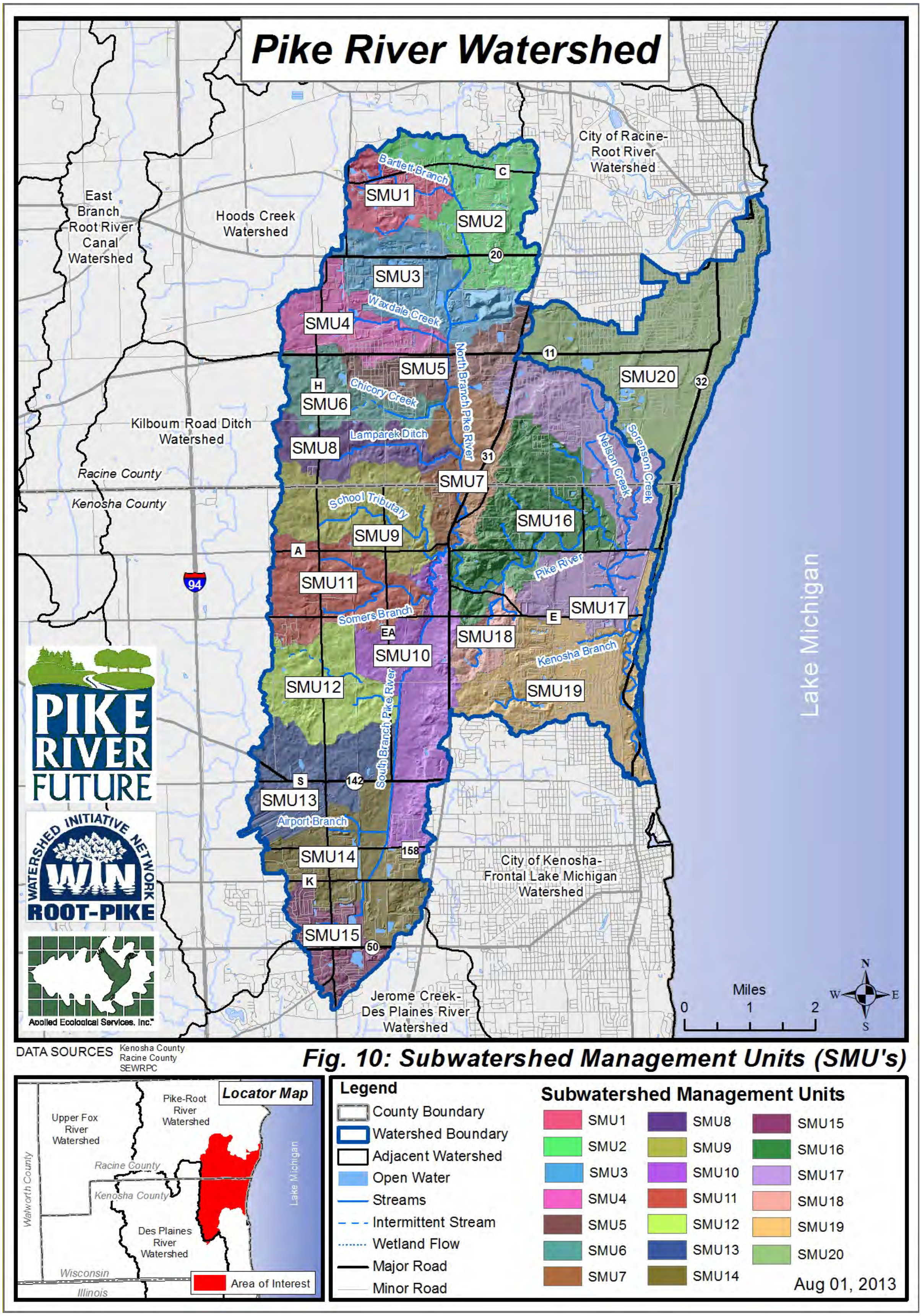


Fig. 10: Subwatershed Management Units (SMU's)

1.12 The Mouth of the Pike River and Direct Drainage Area

The Mouth of the Pike River

Left: mouth of the Dead River in Illinois. Right: mouth of the Pike River.

The mouth of the Pike River opens directly into Lake Michigan, underscoring the importance of managing water quality within the Pike River watershed. From the mouth of the river at Lake Michigan to roughly where Carthage College is located, the river and its floodplain act as an estuary for Lake Michigan and are subject to both river and lake influences. Similar in nature to the nearby Dead River in northeastern Illinois, a sand bar driven by littoral drift sometimes dams off the mouth of the river, but is broken again each time the river experiences high flows. This normal cyclical process and movement along the mouth of the Pike River is important to the health of the river and has been affected by excessive urbanization, streambank channelization, modifications, and erosion upstream. The degree of sedimentation within the Pike River as a whole is also affecting this process as sediment loads from the river itself build up in the mouth of the river in addition to the normal sedimentation it would receive from Lake Michigan. The amount of sedimentation is such that the City of Kenosha removes the sediment at the mouth as needed throughout the year. Additionally, urban development has constrained the normal movement and shifting of the mouth of the river itself.

Direct Drainage Area

The Direct Drainage area consists of the southern portions of Racine and the lakefront areas of the Villages of Mt. Pleasant, the Town of Somers and the northeastern portion of Kenosha. The watershed divide along the lakefront is Sheridan Road. The topography in the area is generally flat until the lake edge. Typically, large ravines would have provided drainage channels for smaller subwatersheds along the Lake Michigan shore. It is evident that many of these were filled to increase the amount of buildable lakeshore frontage. There are smaller ravines or drainage channels in the central areas of the Direct Drainage area, while the largest portion within Racine is primarily drained by an extensive storm sewer network whose pipes outlet directly into Lake Michigan, either at the shoreline or underwater.

The majority of the Direct Drainage area is urban and industrial, including former industrial sites. The portion of the Direct Drainage that abuts the lake along Sheridan Road is primarily single family residential. The southern sections of downtown Racine, Gateway Technical College, S.C. Johnson headquarters, waste water processing facility and the Case Industrial plant, and former industrial plant are all located in the Direct Drainage. There are many sources of pollution from this area including the street runoff from the residential areas of Racine which is untreated prior to emptying into the lake. The roadways in this area are minimally 52' in width to accommodate parking on both sides and two driving lanes. Other possible sources of pollution include slag used in the revetment rocks near Gateway Technical College and the former Case Plant in the Village of Mt. Pleasant. The former Case Plant was razed and the site is still primarily covered in concrete and weeds; the lakefront portion of the property has been filled in with unknown rock and other materials.

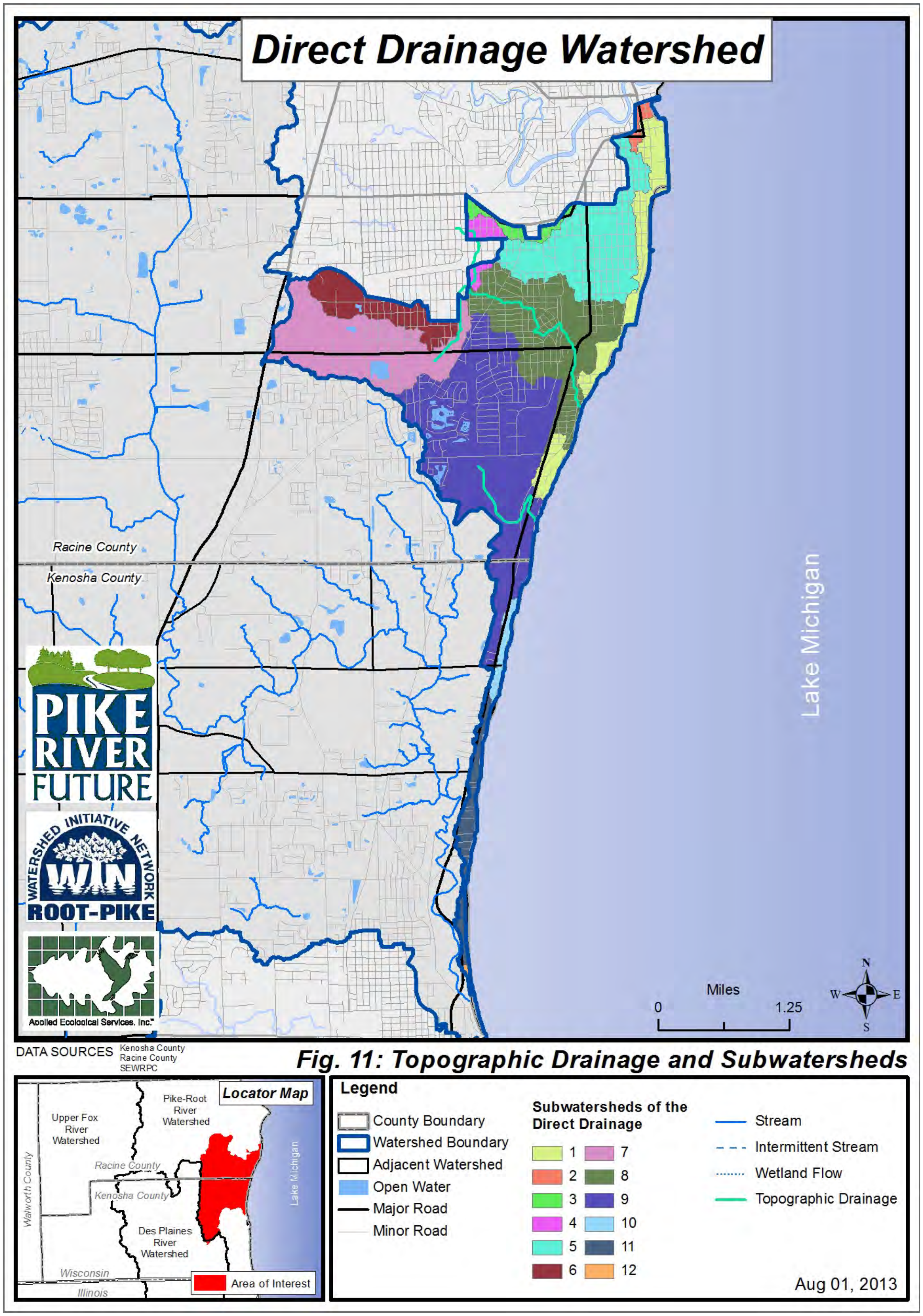


Fig. 11: Topographic Drainage and Subwatersheds

1.13 Hydric Soils, Soil Erodibility, & Hydrologic Soil Groups

Deposits left by the Wisconsin glaciation 9,500 years ago are the raw materials of present soil types. These raw materials include till (debris) and outwash. A combination of physical, biological, and chemical variables such as topography, drainage patterns, climate, and vegetation, have interacted over centuries to form the complex variety of soils found in the watershed. Most soils formed with wetland, savanna, forest, and prairie vegetation. The most up to date Natural Resources Conservation Services' (NRCS) soils information for Racine and Kenosha Counties was used to map the soil types including the extent of hydric soils, soil susceptibility to erosion, and infiltration capacity of soils in the Pike River watershed.

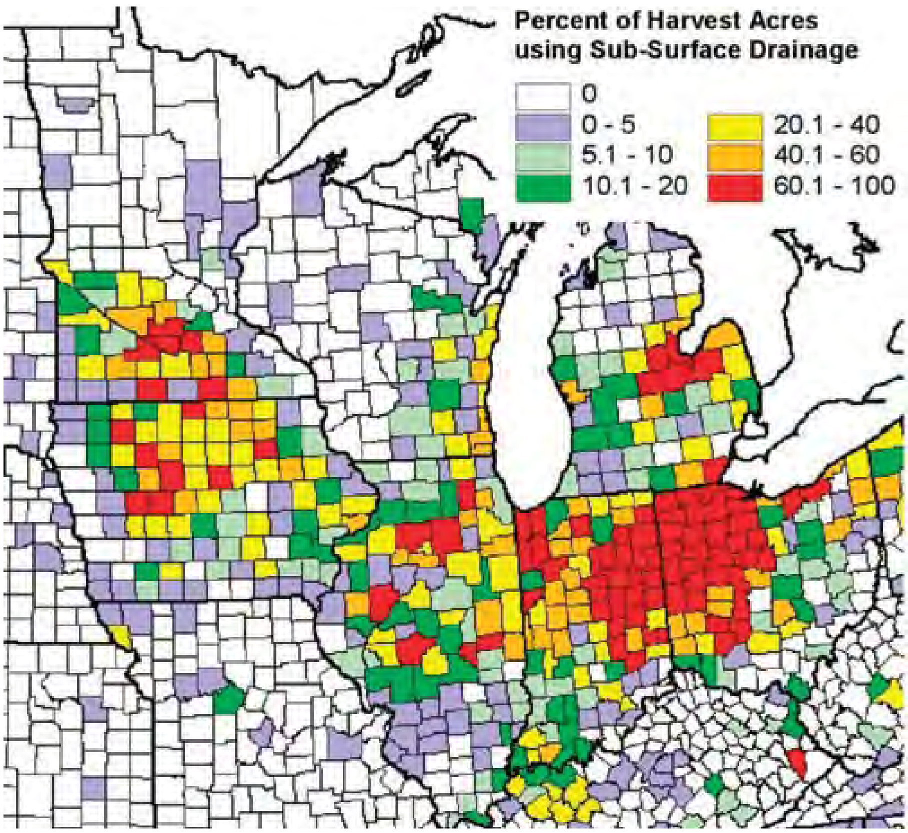


Figure 12. *Extent of Subsurface Drainage Tiles. Note: Racine and Kenosha County both fall within the 40.1 to 60 percent range, indicating that drain tiles have been used extensively within the watershed. Source: Ruark, 2009.*

Soil properties are a key component to consider when designing and implementing Best Management Practices (BMPs). Some soils that are saturated for extended periods throughout the year become what are called "Hydric Soils" because they generally hold water or infiltrate water very slowly. These soils provide the key to wetland restoration potential. Often, drain tiles (see map illustration, left) are found in areas that exhibit hydric soil but because the water is diverted, wetlands that were once present no longer exist. This is the case with many of the wetlands that once existed within Pike River watershed. By breaking these tiles, wetland hydrology can generally be restored and a wetland created. A wetland inventory and discussion of wetland restoration sites is included in Section 5.0.

Soils also exhibit differences in erodibility depending on their composition and slope. Erodibility of soils is especially important on construction sites where improper installation or maintenance of erosion control devices can lead to sediment creating turbid water within the stream.

Soils also exhibit different infiltration capabilities and have been classified to fit what are known as "Hydrologic Soil Groups". Knowing how a soil will hold water ultimately affects the type and location of infiltration BMPs such as wetland restorations and detention basins. More importantly however is the link between hydrologic soil groups and groundwater recharge areas. Groundwater Recharge is discussed in detail in Section 5.7.

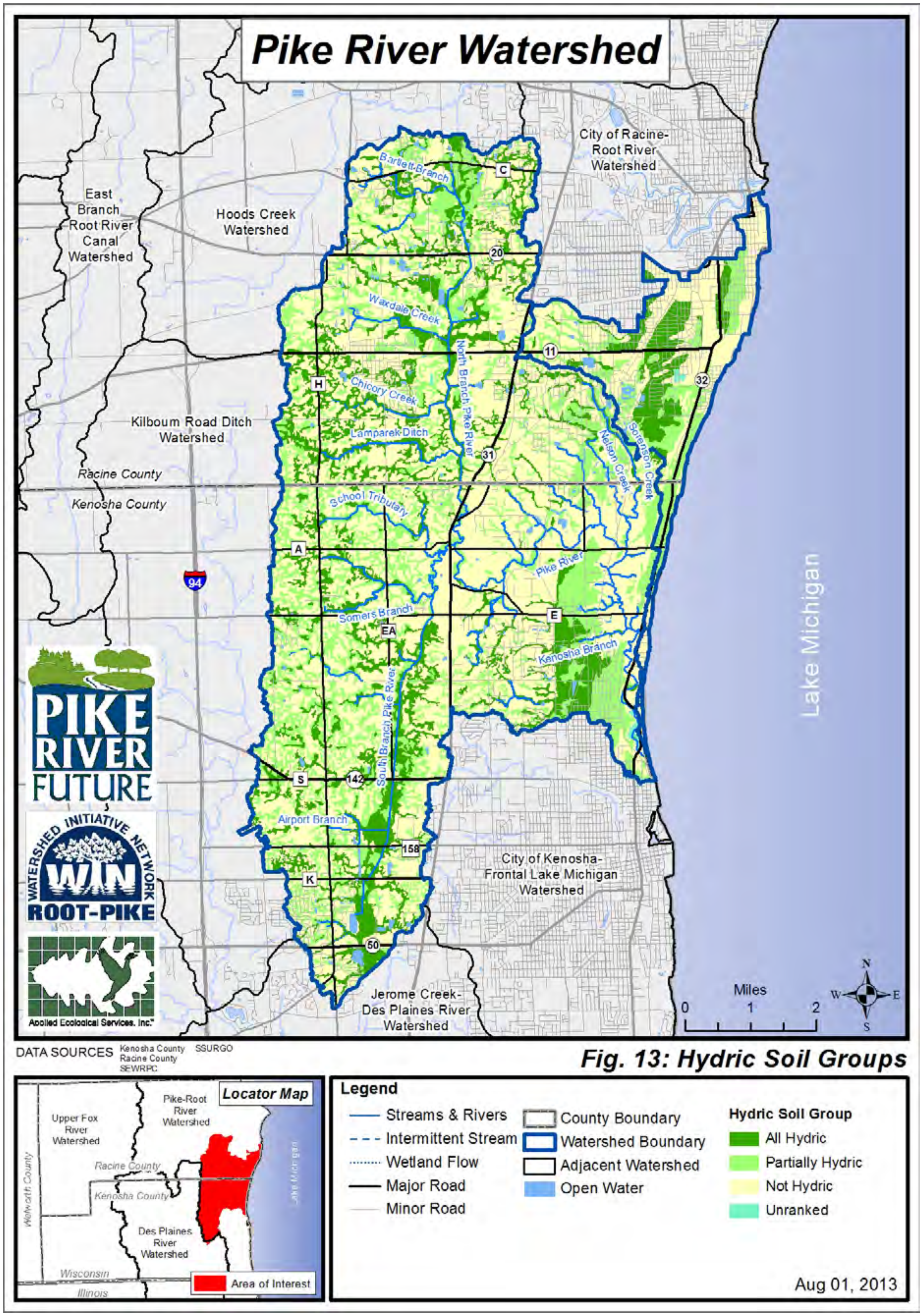
Hydric Soils
Hydric soils are important because they indicate the presence of existing wetlands or drained wetlands where restoration may be possible. Wetland restoration opportunities in the watershed are discussed in detail in Section 5.4. Historically, wetland soils formed over poorly drained clay material associated with wet prairies, marshes, and other wetlands and accumulated organic matter from decomposing surface vegetation. Table 4 and Figure 13 list acreages and map the location of hydric, partially hydric, and non-hydric soils in the watershed, respectively. Hydric soils comprise 5,409 acres or 15% of the watershed. 3,446 acres or 9% of the watershed is comprised of partially hydric soils which exhibit some, but not all, of the characteristics of hydric soils. 9,260 acres or 25% of the watershed is comprised of upland soils. The remaining 18,771 acres (51%) of the watershed is not classified because it consists of water & urban land.

Table 4. Percent coverage of hydric soils and non-hydric soils within the watershed.

Soil	Total Area (acres)	Percentage of Watershed
Hydric Soil	5,409	15%
Partially Hydric Soil	3,446	9%
Non-Hydric Soil	9,260	25%
Not Classified (Water & Urban Land)	18,771	51%
Totals	**36,849**	**100%**

Soil Erodibility
Soil erosion is the process whereby soil is removed from its original location by flowing water, wave action, wind, and other factors. Sedimentation is the process that deposits eroded soils on other ground surfaces or in bodies of water such as streams and lakes. Soil erosion and sedimentation reduces water quality by increasing total suspended solids (TSS) in the water column and by carrying attached pollutants such as phosphorus, nitrogen, and hydrocarbons. When soils settle in streams and lakes they change the course and floodplain of the stream and often blanket rock, cobble, and sandy substrates needed by fish and macroinvertebrates for habitat, food, and reproduction.

A highly erodible soils map was created by selecting soils with particular attributes such as soil type and the percent slope on which a soil is located. It is important to map highly erodible soils because they represent areas that have the highest potential to degrade water quality during farm tillage and development. Based on the mapping, 941.97 acres (2.6%) of the watershed exhibits highly erodible soils, while an additional 22,350.61 acres (60.7%) exhibits potentially highly erodible land with the difference in classification based mostly on the slope of the land. Generally, land classified as potentially highly erodible consisted of a slope of between 2 and 6% while lands with a slope above 6% were typically classified as highly erodible slopes (Figure 14). One option for farmers is to convert highly erodible areas to vegetative cover under the USDA NRCS's Conservation Reserve Program (CRP). Under this program farmers receive an annual rental payment for the term of the multi-year contract. It is also important to address highly erodible soils in relation to future areas of development, trails within preserves, overgrazed woodlands, and areas covered by invasive species.


Pike River Watershed
City of Racine-Root River Watershed
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Kilbourn Road Ditch Watershed
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Bartlett Branch
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South Branch Pike River
Airport Branch
City of Kenosha-Frontal Lake Michigan Watershed
Jerome Creek-Des Plaines River Watershed
Lake Michigan
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Applied Ecological Services, Inc.
DATA SOURCES Kenosha County Racine County SEWRPC SSURGO
Fig. 13: Hydric Soil Groups
Locator Map
Upper Fox River Watershed
Pike-Root River Watershed
Racine County
Kenosha County
Walworth County
Des Plaines River Watershed
Wisconsin
Illinois
Lake Michigan
Area of Interest
Legend
Streams & Rivers
Intermittent Stream
Wetland Flow
Major Road
Minor Road
County Boundary
Watershed Boundary
Adjacent Watershed
Open Water
Hydric Soil Group
All Hydric
Partially Hydric
Not Hydric
Unranked
Aug 01, 2013

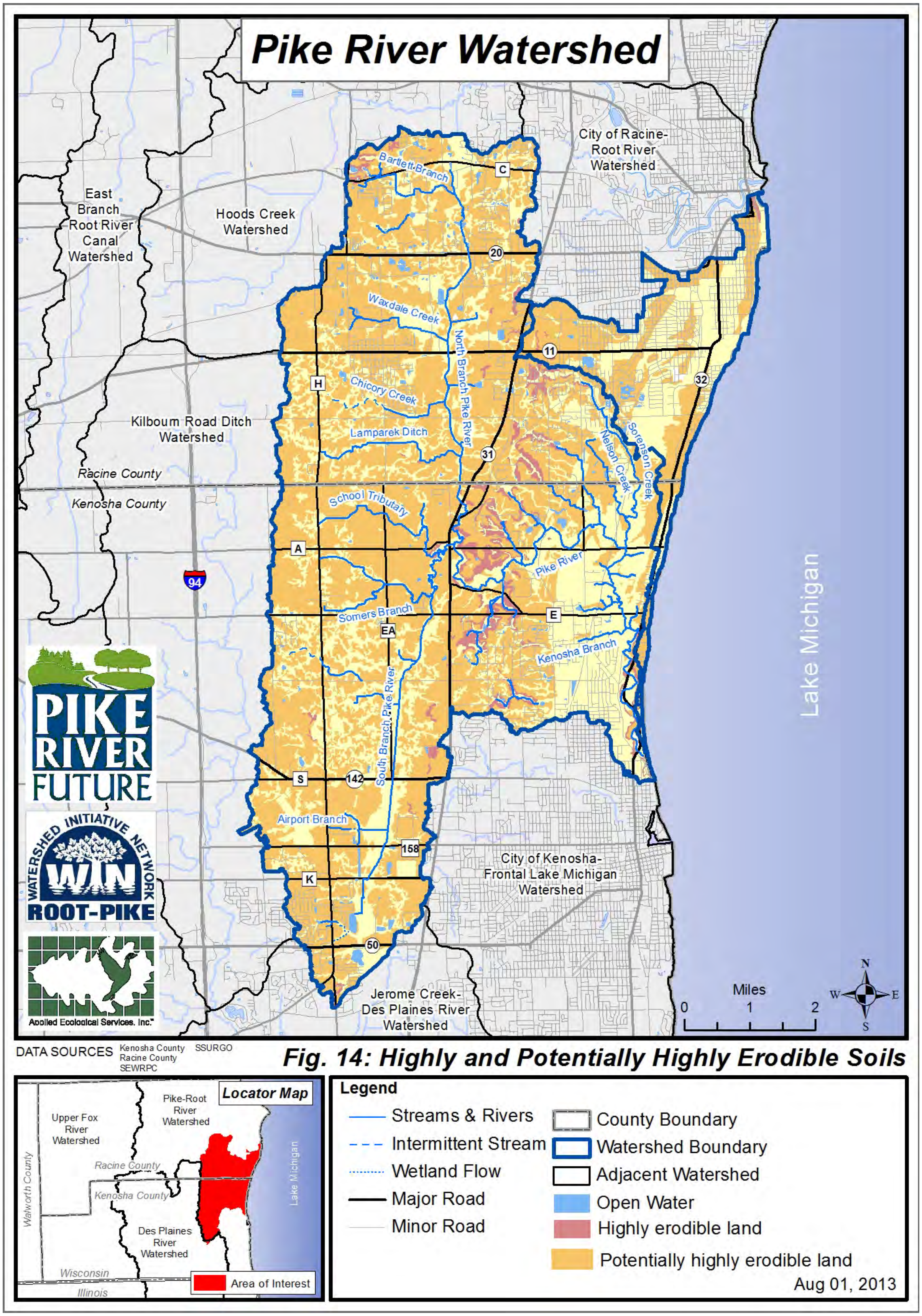

Fig. 14: Highly and Potentially Highly Erodible Soils

Hydrologic Soil Groups
Hydrologic Soil Groups (HSGs) are based on a soil's infiltration and transmission (permeability) rates and are used primarily by engineers to estimate runoff potential related to how development sites should be designed and constructed to control stormwater runoff. HSG's are classified into four primary categories; A, B, C, and D, and three dual classes, A/D, B/D, and C/D. The characteristics of these groups are included in Table 5. Note: dual hydrologic groups (A/D, B/D, or C/D) are classified differently. The first letter is for artificially drained areas and the second is for undrained areas. Only soils that are rated D in their natural condition are assigned to dual classes.

Table 5. Hydrologic Soil Groups and their corresponding attributes.

HSG	Soil Texture	Drainage Description	Runoff Potential	Infiltration Rate	Transmission Rate
A	Sand, Loamy Sand, or Sandy Loam	Well to Excessively Drained	Low	High	High
B	Silt Loam or Loam	Moderately Well to Well Drained	Moderate	Moderate	Moderate
C	Sandy Clay Loam	Somewhat Poorly Drained	High	Low	Low
D	Clay Loam, Silty Clay Loam, Sandy Clay Loam, Silty Clay, or Clay	Poorly Drained	High	Very Low	Very Low

Management Measures are often recommended based on infiltration and permeability rates of a particular HSG. The HSG categories and their corresponding soil texture, drainage description, runoff potential, infiltration rate, and transmission rate are shown in Table 4. Figure 15 depicts the location of each HSG found in the watershed while Table 6 summarizes the acreage and percent of watershed for each HSG. Poorly drained areas (Groups C, C/D and D) account for about 66% of the watershed. These soils are dispersed throughout the watershed, but generally cluster toward the western two-thirds of the area. Excessively and moderately drained (Group A, A/D, B, and B/D) areas make up an additional 33% of the watershed. The majority of these soils are found in the eastern third of the watershed. Landfill, borrow pit, and open water comprise the remaining 1% of the watershed.

Table 6. Hydrologic Soil Groups including acreage and percent of watershed.

Hydrologic Soil Group	Total Acreage	Percent of Watershed
A	179	0.5%
A/D	78	0.2%
B	6,382	17.3%
B/D	5,506	14.9%
C	23,038	62.5%
C/D	20	0.1%
D	1,360	3.7%
Open Water, Landfill, & Borrow Pit	286	0.8%
Totals	36,849	100%

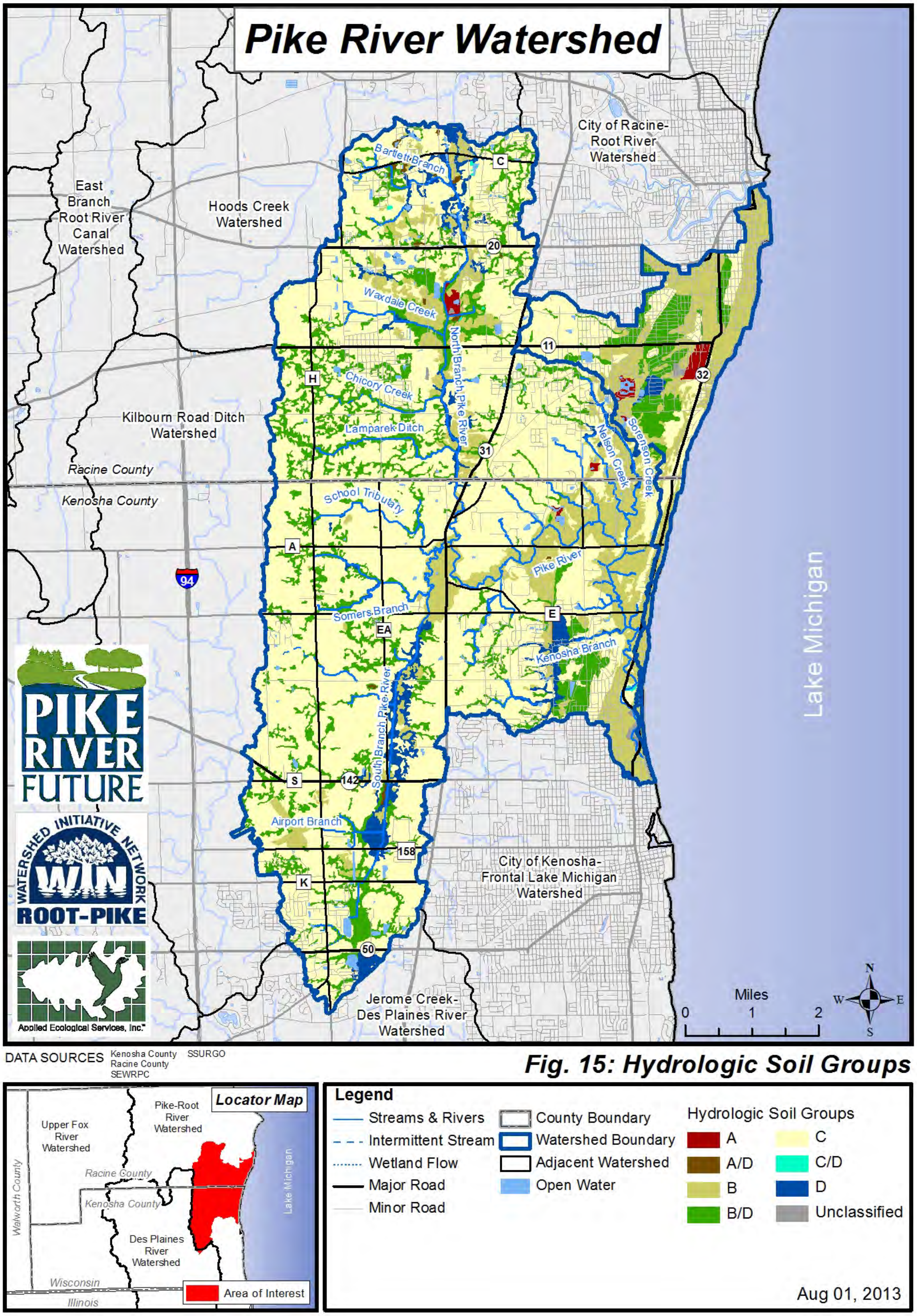

Fig. 15: Hydrologic Soil Groups

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